

# Management Information Systems

## Text and Cases

*A Global Digital Enterprise Perspective*

Fifth Edition



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*A Global Digital Enterprise Perspective*

Fifth Edition

**Waman S Jawadekar**

*Management and IT Consultant  
Pune, India*



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To  
*Shwetal*



# Preface to the Fifth Edition

The fourth edition of Management Information Systems authored by me was focusing on digital perspective of the organisation. The MIS design and architecture was required to change from traditional, post event report based system to a system generating actionable information, knowledge development and its sharing with users for strategic decision making and maintaining competitive advantage. The organisation's processes are ICT driven, some crossing across the boundaries of the organisation. The organisation's technology resource includes now mobile computing, cloud computing, extensive use of portals and social networking. The HR of the organisation has to be smart user of technology. The definition and scope of organisation therefore is now much wider making it an enterprise management. The fifth Edition perspective due to globalization of business, focuses on global digital enterprise information management.

Due to extensive use of technology and the globalisation of business, the digital organisation of business has undergone a structural change in its operations due to following changes:

- Globalisation of business, opening bigger markets to all
- Liberalization of trade barriers
- Customer has wider choices
- The bargaining power of the customer as well as that of suppliers and business partners is dictating terms of business
- Business organisation is now an enterprise, managing customers and Partners located outside the country requiring skills of enterprise management
- Business risk is global and therefore management needs to have global perspective of business to manage digital enterprise spread beyond the national boundary

This called upon MIS designer to shift decision making focus from operations management to performance management shifting information processing focus, 'JIT actionable information to JIT actionable information', for performance management. The actions expected were in the strategic zone of business management to keep organisation's leadership, competitive advantage and key areas of differentiation not challenged.

The management of global enterprise requires skills of managing diversity of culture, technology mismatch and country specific laws and regulations, politics and economics of the country and so on.

The traditional SWOT analysis needs to be supplemented by PESTEL analysis when a major strategic decision is required to meet the emerging challenging scenario.

Enterprise management needs new skills of managing strategy, operations and performance for achieving enterprise vision.

The 5<sup>th</sup> edition of MIS therefore moves further from 'Digital Firm Perspective' of fourth edition to 'Global Digital Enterprise Perspective' and introduces appropriate changes in the entire process of MIS development, its structure and design.

The 5<sup>th</sup> edition introduces you the following:

- Organisation model for business excellence
- Business performance management
- Information security engineering
- Security Risk Management
- Strategic management of business for performance achievement
- Knowledge management for strategic management of business
- Business Intelligence (BI), Tools & Technology
- Intelligent DSSs through application of Knowledge and BI
- Managing global enterprise going beyond e-business

It also adds additional topics such as Service Oriented Architecture (SOA), Cyber security and WEB2.0

The book puts forward a MIS model which has a super structure of Knowledge management systems, BI based scenario building systems for decision making and Strategic performance measuring systems for performance control.

I hope this edition will meet the expectations of students, professionals and faculty of management and information technology.

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## **Reviewers**

The Publishers gratefully acknowledge the below mentioned reviewers for their valuable comments and feedback:

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# Preface to the First Edition

*An information bomb is exploding in our midst, showering us with shrapnel of images and drastically changing the way each of us perceives and acts upon our private world. In shifting from a second wave to third wave info-sphere, we are transforming our own psyches.*

*In altering the info-sphere so profoundly, we are destined to transform our own minds as well, the way we think about our problems, the way we synthesize information, the way we anticipate the consequences of our own actions. We are likely to change the role of literacy in our lives. We may even alter our own brain chemistry.*

**Alvin Toffler**  
The Third Wave

## THEME

In the last two decades, information technology has emerged in the world affecting our personal, social and public life and has made a significant impact on the quality of life. It handles data and information represented in digital, text, image, graphics or voice media and deals with communication, storage, processing and printing or exhibition in the manner and kind as desired by the users. It is an outcome of the advances in telecommunication and computer technology.

Information technology (IT) helps to optimize the use of scarce resource through intelligent information support for decision making, and helps further in its implementation by supporting coordination effort without wasteful delays. Decision making has become a very complex process due to competitive environment, scarce resources, time pressures and unavoidable compulsions to achieve goals.

Information technology has made decisive inroads in all walks of life; in offices, factories, railways stations, airports, communications, entertainment, education, banking, hotels, hospitals, transportation and shopping. It is being used extensively for decision making, ease of operations, communication, record keeping and for obtaining higher productivity from the system in which it is put to use.

It replaces old, outdated slow methods by fast ones. It allows you to handle big and complex data and its structure with ease which has never been possible earlier. It helps you test the solutions without implementing them. The distance and access are no longer technical or opera-

tional problems, as information stored anywhere can be used without its personal possession. It has affected the work culture in organizations and life style of each individual. Information, therefore, is considered as the fifth, productive resource along with men, machines, material, and money. It can be developed only by designing proper INFORMATION SYSTEMS for the management of the organisation.

## OBJECTIVE OF THIS BOOK

The objective of this book is to bring home a systematic knowledge of the management information technology so that it can be appreciated and understood for application in business and industry. As a practicing experienced manager and also a teacher, I have observed that most of the problems in business and industry are due to lack of awareness, appreciation and knowledge of the information technology and its application to business management problems.

This book explains in brief the principles and practices of management which is the basis for conducting any business. It further explains all concepts which are used in information systems to make them more effective. It then deals with technology—Hardware, Software, Database and so on. It emphasizes the role of decision support systems in MIS and explains the factors behind successful implementation of MIS within the organisation. The text is further enriched with glossary, review questions and the list of selected readings.

The book is architected in five parts, management, conceptual foundation of MIS, application to business and industry, technology in MIS, and Cases, taking the reader from basics to real world application of information technology. Throughout the book, emphasis is laid to application of information to business management. The book covers all topics of current interest preparing the reader for absorbing the new wave of technology.

The book attempts to simplify the subject as much as possible to enable the reader grasp the concepts easily and equip himself to face this new technology wave. The book in its initial stages has been extensively reviewed both the teachers and managers, and their valuable suggestions have been duly incorporated.

This book is targeted at practicing managers, system designers and its users in business, industry and public institutions. Postgraduate students taking degree and diploma courses in business administration, computer applications and computer science will also find this book very useful.

My attempt to publish this book has been encouraged by Late Shri S K Padhye of Venus Prakashan, Pune, India. This has immensely helped in taking my ideas to the readers in an improvised manner.

I welcome suggestions and comments for further improvement of the book.

**WAMAN S JAWADEKAR**

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# PART I

## Strategic View of MIS

### CHAPTERS

- 1. Introduction to Management Information Systems
- 2. E-business Enterprise
- 3. Strategic Management of Business
- 4. Information Security Challenges in E-enterprise
- 5. Information Technology: Impact on Society
  - Exercises and Cases

In today's competitive world of business and information systems, Management Information systems have strategic purpose in business management. The role of MIS is now not limited to business operations management. The new role of MIS is to support business manage in strategic analysis, strategy formulation, and strategy implementation to achieve short-term and long-term business goals. Design, and architecture of MIS is to run customer centric customer driven business with efficient use of e-business technologies.

Computer, network, communication, internet and web technologies together have radically changed the business management process and have an impact on the role of the manager.

Objectives of this part is to understand the cultural and operational changes in business management due to the application of various technologies. Further, understand the need of taking a strategic view of business to design MISs for strategic management with due regard to security and ethical issues surrounding MISs.

# Management Information Systems in a Digital Firm

## LEARNING OBJECTIVES

- Concept of Strategic MIS
- Conceptual Model and Physical Model of MIS
- MISs, a Superset Over other Information Systems
- Views of MIS
- Role and Impact on Management and Organisation of MIS
- Management as a Control System and Role of MIS
- Impact of MIS on Business Performance
- User's Influence on MIS
- MIS Model of a Digital Firm

### 1.1 MANAGEMENT INFORMATION SYSTEM (MIS): CONCEPT

The concept of the MIS has evolved over a period of time comprising many different facets of the organisational functions. MIS is a necessity of all the organisations.

The initial concept of MIS was to process data from the organisation and present it in the form of reports at regular intervals. The system was largely capable of handling the data from collection to processing. It was more impersonal, requiring each individual to pick and choose the processed data and use it for his requirements. This concept was further modified when a distinction was made between data and information. The information is a product of an analysis of data. This concept is similar to a raw material and the finished product. What is needed is an information and not a mass of data. However, the data can be analysed in a number of ways, producing different shades and specifications of the information as a product. It was, therefore, demanded that the system concept should be an individual-oriented, as each individual may have a different orientation towards the information. This concept was further modified, that the system should present information in such a form and format that it creates an impact on its user, provoking a decision, an action or an investigation. It was later realised that even though such an impact was a welcome modification, some sort of selective approach was necessary in the analysis and reporting. Hence, the concept of exception reporting was imbibed in MIS. The norm for an exception was necessary to evolve in the

organisation. The concept remained valid till and to the extent that the norm for an exception remained true and effective. Since the environment turns competitive and is ever changing, fixation of the norm for an exception becomes a futile exercise at least for the people in the higher echelons of the organisation. The concept was then evolved that the system should be capable of handling a needbased exception reporting. This need may be either of an individual or a group of people. This called for keeping all data together in such a form that it can be accessed by anybody and can be processed to suit his needs. The concept is that the data is one but it can be viewed by different individuals in different ways. This gave rise to the concept of DATABASE, and the MIS based on the DATABASE proved much more effective.

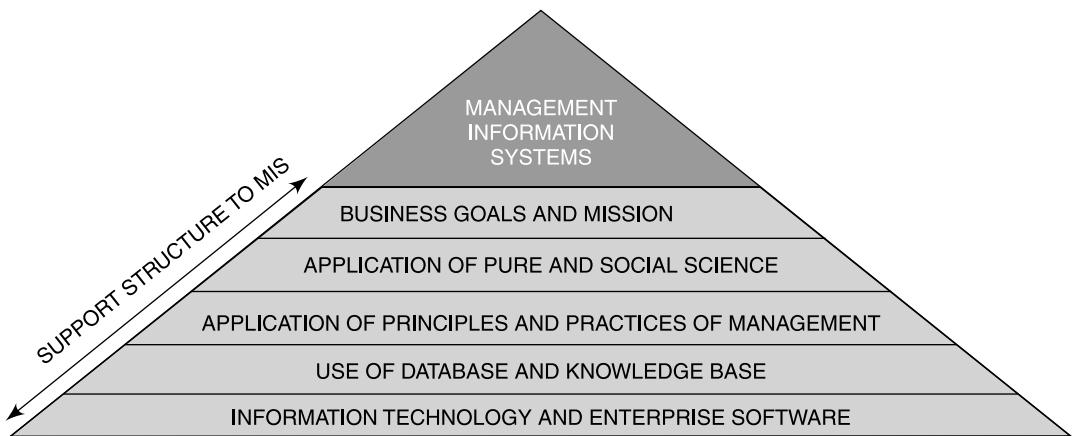
Over a period of time, when these conceptual developments were taking place, the concept of the end user computing using multiple databases emerged. This concept brought a fundamental change in MIS. The change was, decentralisation of the system and the user of the information becoming independent of computer professionals. When this became a reality, the concept of MIS changed to a decision-making system. The job in a computer department is to manage the information resource and leave the task of information processing to the user. The concept of MIS in today's world is a system which handles the databases, provides computing facilities to the end user and gives a variety of decision-making tools to the user of the system.

The concept of MIS gives high regard to the individual and his ability to use the information. MIS gives information through data analysis. While analysing the data, it relies on many academic disciplines. These include the theories, principles and concepts from the Management Science, Management Accounting, Operation Research, Organisational Behaviour, Engineering, Computer Science, Psychology and Human Behaviour, making the MIS more effective and useful. These academic disciplines are used in designing the MIS, evolving the decision support tools for modeling and decision-making.

The foundation of MIS is the principles of management and its practices. MIS uses the concept of management control in its design and relies heavily on the fact that the decision maker or the manager is a human being and is a human processor of information.

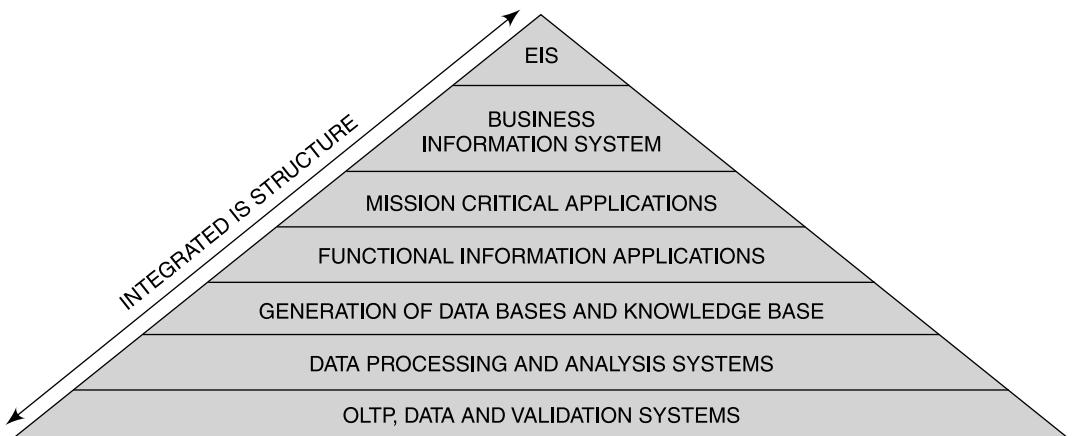
A Management Information System can be evolved for a specific objective if it is evolved after systematic planning and design. It calls for an analysis of a business, management views and policies, organisation culture and the management style. The information should be generated in this setting and must be useful in managing the business. This is possible only when it is conceptualised as a system with an appropriate design. The MIS, therefore, relies heavily on the systems theory. The systems theory offers solutions to handle the complex situations of the input and the output flows. It uses theories of communication which helps to evolve a system design capable of handling data inputs, process, the outputs with the least possible noise or distortion in transmitting the information from a source to a destination. It uses the principles of System Design, viz., an open system or a closed system. An open system of the MIS offers an ability of continuous adjustment or correction in the system in line with the environmental changes in which the MIS operates. Such a design helps to keep the MIS tuned with the business management needs of the organisation.

The concept, therefore, is a blend of principles, theories and practices of the Management, Information and System giving rise to single product known as Management Information System (MIS). The conceptual view of the MIS is shown as a pyramid in Fig. 1.1.



**Fig. 1.1** Conceptual View of MIS

The physical view of the MIS can be seen as an assembly of several subsystems based on the databases in the organisation. These subsystems range from data collection, transaction processing and validating, processing, analysing and storing the information in databases. The subsystems could be at a functional level or a corporate level. The information is evolved through them for a functional or a departmental management and it provides the information for the management of business at the corporate level. The physical view of the MIS is shown as in Fig. 1.2. All the systems shown here together are MISs.



**Fig. 1.2** Physical View of MIS

The MIS is a product of a multi-disciplinary approach to the business management. It is a product which needs to be kept under a constant review and modification to meet the corporate needs of the information. It is a prescribed product design for the organisation. The MIS differs in two organisations involved in the same business. The MIS is for the people in the organisation. Since the people in two different organisations are different, the design of MIS would also differ. The MIS model may be the same but it differs greatly in the contents.

The MIS, therefore, is a dynamic concept subject to change, time and again, with a change in the business management process. It continuously interacts with the internal and the external environment of the business and provides a corrective mechanism in the system so that the changed needs of information are met with effectively. The MIS, therefore, is a dynamic design, the primary objective of which is to provide the information for decision-making and it is developed considering the organisational fabric, giving due regard to the people in the organisation, the management functions and the managerial control.

The MIS model of the organisation changes over the time as the business passes through several phases of developmental growth cycle. It supports the management of the business in each phase by giving the information which is crucial in the phase. Every business has critical success factors in each phase of growth cycle and the MIS model gives more information on the critical success factors for decision-making.

## 1.2 MIS: DEFINITION

The Management Information System (MIS) is a concept of the last decade or two. It has been understood and described in a number of ways. It is also popularly known as the Information System, the Information and Decision System, the Computer-based Information System.

The MIS has more than one definition, some of which are given below.

1. The MIS is defined as a system which provides information support for decision-making in the organisation.
2. The MIS is defined as an integrated system of man and machine for providing the information to support the operations, the management and the decision-making function in the organisation.
3. The MIS is defined as a system based on the database of the organisation evolved for the purpose of providing information to the people in the organisation.
4. The MIS is defined as a Computer-based Information System.

Though there are a number of definitions, all of them converge on one single point, i.e., the MIS is a system to support the decision-making function in the organisation. The difference lies in defining the elements of the MIS. However, in today's world, the MIS is a computerised business processing system generating information for the people in the organisation to meet the information needs for decision-making to achieve the corporate objectives of the organisation.

In any organisation, small or big, a major portion of the time goes in data collection, processing, documenting and communicating it to the people. Hence, a major portion of the overheads goes into this kind of unproductive work in the organisation. Every individual in an organisation is continuously looking for some information which is needed to perform his/her task. Hence, the information is people-oriented and it varies with the nature of the people in the organisation.

The difficulty in handling this multiple requirement of the people is due to a couple of reasons. The information is a processed product to fulfill an imprecise need of the people. It takes time to search the data and may require a difficult processing path. It has a time value and unless processed on time and communicated, it has no value. The scope and the quantum of information is individual-dependent and it is difficult to conceive the information as

a well-defined product for the entire organisation. Since the people are instrumental in any business transaction, a human error is possible in conducting the same. Since a human error is difficult to control, the difficulty arises in ensuring a hundred percent quality assurance of information in terms of completeness, accuracy, validity, timeliness and meeting the decision-making needs.

In order to get a better grip on the activity of information processing, it is necessary to have a formal system which should take care of the following points:

1. Handling of a voluminous data.
2. Confirmation of the validity of data and transaction.
3. Complex processing of data and multidimensional analysis.
4. Quick search and retrieval.
5. Mass storage.
6. Communication of the information system to the user on time.
7. Fulfilling the changing needs of the information.

The management information system uses computers and communication technology to deal with these points of supreme importance.

### **1.3 ROLE OF THE MANAGEMENT INFORMATION SYSTEM**

The role of the MIS in an organisation can be compared to the role of heart in the body. The information is the blood and MIS is the heart. In the body the heart plays the role of supplying pure blood to all the elements of the body including the brain. The heart works faster and supplies more blood when needed. It regulates and controls the incoming impure blood, processes it and sends it to the destination in the quantity needed. It fulfills the needs of blood supply to human body in normal course and also in crisis.

The MIS plays exactly the same role in the organisation. The system ensures that an appropriate data is collected from the various sources, processed, and sent further to all the needy destinations. The system is expected to fulfill the information needs of an individual, a group of individuals, the management functionaries: the managers and the top management.

The MIS satisfies the diverse needs through a variety of systems such as Query Systems, Analysis Systems, Modelling Systems and Decision Support Systems. The MIS helps in Strategic Planning, Management Control, Operational Control and Transaction Processing.

The MIS helps the clerical personnel in the transaction processing and answers their queries on the data pertaining to the transaction, the status of a particular record and reference on a variety of documents. The MIS helps the junior management personnel by providing the operational data for planning, scheduling and control, and helps them further in decision-making at the operations level to correct an out of control situation. The MIS helps the middle management in short term planning, target setting and controlling the business functions. It is supported by the use of the management tools of planning and control. The MIS helps the top management in goal setting, strategic planning and evolving the business plans and their implementation.

The MIS plays the role of information generation, communication, problem identification and helps in the process of decision-making. The MIS, therefore, plays a vital role in the management, administration and operations of an organisation.

## 1.4 IMPACT OF THE MANAGEMENT INFORMATION SYSTEM

Since the MIS plays a very important role in the organisation, it creates an impact on the organisation's functions, performance and productivity.

The impact of MIS on the functions is in its management. With a good MIS support, the management of marketing, finance, production and personnel becomes more efficient. The tracking and monitoring of the functional targets becomes easy. The functional managers are informed about the progress, achievements and shortfalls in the activity and the targets. The manager is kept alert by providing certain information indicating and probable trends in the various aspects of business. This helps in forecasting and long-term perspective planning. The manager's attention is brought to a situation which is exceptional in nature, inducing him to take an action or a decision in the matter. A disciplined information reporting system creates a structured database and a knowledge base for all the people in the organisation. The information is available in such a form that it can be used straight away or by blending and analysis, saving the manager's valuable time.

The MIS creates another impact in the organisation which relates to the understanding of the business itself. The MIS begins with the definition of a data entity and its attributes. It uses a dictionary of data, entity and attributes, respectively, designed for information generation in the organisation. Since all the information systems use the dictionary, there is common understanding of terms and terminology in the organisation bringing clarity in the communication and a similar understanding of an event in the organisation.

The MIS calls for a systemisation of the business operations for an effective system design. This leads to streamlining of the operations which complicates the system design. It improves the administration of the business by bringing a discipline in its operations as everybody is required to follow and use systems and procedures. This process brings a high degree of professionalism in the business operations.

Since the goals and objectives of the MIS are the products of business goals and objectives, it helps indirectly to pull the entire organisation in one direction towards the corporate goals and objectives by providing the relevant information to the people in the organisation.

A well designed system with a focus on the manager makes an impact on the managerial efficiency. The fund of information motivates an enlightened manager to use a variety of tools of the management. It helps him to resort to such exercises as experimentation and modeling. The use of computers enables him to use the tools and techniques which are impossible to use manually. The ready-made packages make this task simpler. The impact is on the managerial ability to perform. It improves the decision-making ability considerably.

Since the MIS works on the basic systems such as transaction processing and databases, the drudgery of the clerical work is transferred to the computerised system, relieving the human mind for better work. It will be observed that a lot of manpower is engaged in this activity in the organisation. If you study the individual's time utilisation and its application, you will find that seventy per cent of the time is spent in recording, searching, processing and communicating. This is very large overhead in the organisation. The MIS has a direct impact on this overhead. It creates an information-based work culture in the organisation.

## 1.5 MIS AND THE USER

Every person in the organisation is a user of the MIS. The people in the organisation operate at all levels in the hierarchy. A typical user is a clerk, an assistant, an officer, an executive or a manager. Each of them has a specific task and a role to play in the management of business. The MIS caters to the needs of all persons.

The main task of a clerk is to search the data, make a statement and submit it to the higher level. A clerk can use the MIS for a quick search and reporting the same to higher level. An assistant has the task of collecting and organising the data, and conducting a rudimentary analysis of it. The MIS offers the user tools to perform these tasks. An officer has a role of integrating the data from different systems and disciplines to analyse it and make a critical comment if anything adverse is found.

The MIS offers the methods and facilities to integrate the data and report the same in a proper format. An executive plays the role of a decision maker. He is in a position of responsibility and accountability; a position of a planner and a decision-maker. He is responsible for achieving the targets and goals of the organisation. The MIS provides facilities to analyse the data and offers the decision support systems to perform the task of execution. The MIS provides an action-oriented information.

The manager has a position of responsibility and accountability for the business results. His management role expands beyond his management function. He is a strategist and a long-term planner. He is a person with a foresight, an analytical ability and is expected to use these abilities in the functions of top management. The MIS provides information in a structured or unstructured format for him to react. The MIS caters to his constant changing needs of information. The user of the MIS is expected to be a rational person and the design of the MIS is based on this assumption.

However, in reality the impact created on individuals by MIS is difficult to explain. The nature of the impact in a few cases is negative. However, this negative impact can be handled with proper training and counselling.

It is observed that at lower level, there is a sense of insecurity. As the MIS takes away the drudgery of search, collection, writing and reporting the data, the work vacuum, so created, is not easily filled, thus creating a sense of insecurity. To some extent the importance of the person is also lost, giving rise to a fear of non-recognition in the organisation.

At the level of an officer and an executive, the MIS does the job of data manipulation and integration. It analyses the data in a predetermined manner. This means that the knowledge of business is transferred from an individual to the MIS and is made available to all in the organisation. This change arising out of the MIS creates a sense of being neglected for knowledge, information and advice. The psychological impact is larger if the person is not able to cope up with this change by expanding or enriching the job and the position held by him.

The manager, holding a position in the top or middle management, suffers from fear of challenge and exposure. The MIS makes his competitors more effective as they have access to the information and have an ability to interpret. This leads to a situation where he is afraid that his position, decision and defence will be challenged and may be proved wrong sometimes. The risk of adverse exposure to the higher management also increases. The effects so far pointed out are all negative and they are seen only in a few cases.

The positive effects of the individuals at all levels are that they have become more effective operators. The time and energy which was spent earlier in unproductive work is now applied for a productive work. Some are able to use their analytical skills and knowledge with the information support for improving their position in the organisation. Managers, having improved their decision-making ability, are able to handle the complex situations with relative ease. Some are benefited by improving their performance and being held in high esteem by the higher management.

The enterprising managers are able to use the systems and the models for trying out a number of alternatives in a given problem situation. The impact of the MIS on people of the organisation is phenomenal as it has made the same body of people collectively more effective and productive.

The recent major technological advances in communication such as Multimedia, Imaging, Graphical User Interfaces (GUI), Internet, Web etc., and the ability to access the data stored at different locations on the variety hardware of platforms would make MIS more attractive and efficient proposition. An intelligent user of information can demonstrate the ability of decision making, since his manipulative capability is considerably increased, with the information now being available on his desktop.

Through the MIS, the information can be used as a strategic weapon to counter the threats to business, make businesses more competitive, bring about the organisational transformation through integration. A good MIS also makes an organisation seamless by removing all the communication barriers.

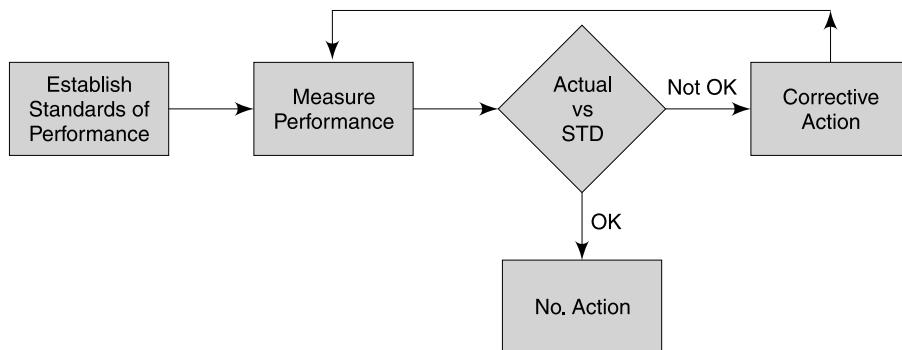
## 1.6 MANAGEMENT AS A CONTROL SYSTEM

Planning, organising, staffing, coordinating, directing and controlling are the various steps in a management process. All the steps prior to a control are necessary but are not necessarily self-assuring the results unless it is followed by a strong control mechanism. The management experts have viewed these steps as 'Management Control System.' They postulate the hypothesis that unless a control is exercised on the process, the goals will not be achieved. They advocate a system of effective control to ensure the achievement of the business objective.

A definition of control is the process through which managers assure that actual activities conform to the planned activities, leading to the achievement of the stated common goals. The control process measures a progress towards those goals, and enables the manager to detect the deviations from the original plan in time to take corrective actions before it is too late. Robert J Mockler defines and points out the essential elements of the control process. The basic steps of the control process are given in Fig. 1.3

The management is a systematic effort to set the performance standards in line with the performance objectives, to design the information feedback systems, to compare the actual performance with these predetermined standards, to identify the deviations from the standards, to measure its significance and to take corrective actions in case of significant deviations. This systematic effort is undertaken through the management control system.

The control system is essential to meet the environmental changes discussed earlier, to meet the complexity of today's business, to correct the mistakes made by the people, and to



**Fig. 1.3 Process Flow of Control System**

effectively monitor the delegation process. A reliable and effective control system has the following features.

#### ***Early Warning Mechanism***

This is a mechanism of predicting the possibility of achieving the goals and the standards before it is too late and allowing the manager to take corrective actions.

#### ***Performance Standard***

The performance standard must be measurable and acceptable to all the organisation. The system should have meaningful standards relating to the work areas, responsibility, managerial functions and so on. For example, the top management would have standards relating to the business performance, such as production, sales, inventory, quality, etc. The operational management would have standards relating to the shift production, rejections, down time, utilisation of resources, sale in a typical market segment and so on. The chain of standards, when achieved, will ensure an achievement of the goals of the organisation.

#### ***Strategic Controls***

In every business there are strategic areas of control known as the critical success factors. The system should recognise them and have controls instituted on them.

#### ***Feedback***

The control system would be effective, if it continuously monitors the performance and sends the information to the control center for action. It should not only highlight the progress but also the deviations. The feedback should be accurate in terms of results and should be communicated on time for corrective action.

#### ***Realistic***

The system should be realistic so that the cost of control is far less than the benefits. The standards are realistic and are believed as achievable. Sufficient incentive and rewards are to be provided to motivate the people.

### ***The Information Flow***

The system should have the information flow aligned with the organisation structure and the decision-makers should ensure that the right people get the right information for action and decision-making.

### ***Exception Principle***

The system should selectively approve some significant deviations from the performance standards on the principle of management by exception.

A standard is meaningful when it is achievable and provides a challenge to the achiever.

A management control system has a set of objectives, standards to measure, a feedback mechanism and an action centre as elements of the system. They need to be properly evolved and instituted in the organisation with due recognition to the internal and the external environment. The system as a whole should be flexible to be changed with ease so that the impact of changed environment is handled effectively.

### ***Management by Exception***

Pareto's principle of 80:20 is applicable to the management of enterprise. Several terms have been coined on this principle such as management by objectives, management by results, management of strategic areas. At the root of the management methodology is the **management by exception**. When the management operates under time constraint, each manager has to allocate specific time for the several demands made on his time. It is, therefore, necessary for him to attend to the situation where his attention is necessary. Such attention would lead to an action, a decision or a wait-and-see approach.

If all the situations are considered in a routine manner, it consumes time and tends to be neglected over a period of time. An efficient manager tries for selective attention to manage within the available time resource. The principle evolved, therefore, is of the management by exception. The exception is decided on the impact a situation would make on the performance, the process and the standards set in the management control system.

The exception is defined as a significant deviation from the performance, or the process and the standard. The deviation could be abnormal on a positive or on a negative side of the standard. The deviation could be predictive or could be arising out of random causes in the business operations. It is, therefore, necessary to access whether the deviation is sporadic or consistently coming in, calling for managerial attention. The manager is interested in knowing the significant deviation by the yardsticks of consistency and not out of random causes. The significant deviations are exceptional in nature and require to be attended to immediately. A manager is further interested in knowing the reasons behind the exceptional nature of the situation. It is possible to trace the reasons of deviation, and it is possible to take a corrective action.

The significant deviation can occur on account of wrong performance standards and wrong management process. Many a times the standards are set very low and they need to be looked into to avoid the misuse of resources. If the standards are set too high, then the people fail to achieve them on account of demotivating factor of the high standards.

A wrong management process refers to a variety of decisions a manager has taken in the planning, organising, staffing, directing and controlling a given management task. These

decisions relate to the choice and the allocation of resources, the methods of using resources, the application of the tools and the techniques, the use of manpower by way of staffing and the manner in which the efforts are coordinated in the organisation. For an efficient and an effective management, without loss of time, it is, therefore, necessary to report the significant deviations to the right persons in the organisation. In this regard a manager himself has to provide the conditions of exceptions in the control system so that they are highlighted and informed. The management by exception commands grip on the management process. The managerial effort gets directed towards the goal with the purpose of achievement.

## 1.7 MIS: A SUPPORT TO THE MANAGEMENT

The management process is executed through a variety of decisions taken at each step of planning, organising, staffing, directing, coordinating and control. As discussed earlier, the MIS aids decision-making. If the management is able to spell out the decisions required to be taken, the MIS can be designed suitably. The decisions required to be taken in these steps are tabulated in Table 1.1.

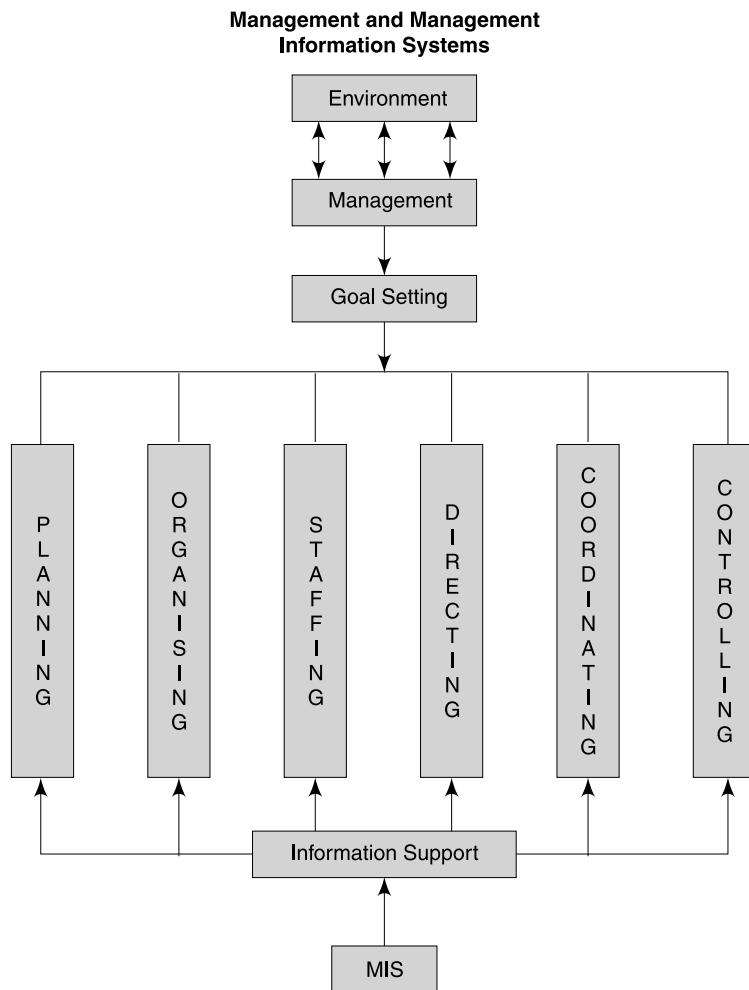
**Table 1.1** Decisions in Management

<i>Steps in management</i>	<i>Decision</i>
Planning	A selection from various alternatives—strategies, resources, methods, etc.
Organisation	A selection of a combination out of several combinations of the goals, people, resources, method, and authority.
Staffing	Providing a proper manpower complement.
Directing	Choosing a method from the various methods of directing the efforts in the organisation.
Coordinating	Choice of the tools and the techniques for coordinating the efforts for optimum results.
Controlling	A selection of the exceptional conditions and providing the decision guidance to deal with them.

The objective of the MIS is to provide information for a decision support in the process of management. It should help in such a way that the business goals are achieved in the most efficient manner. Since the decision-making is not restricted to a particular level, the MIS is expected to support all the levels of the management in conducting the business operations. Unless the MIS becomes a management aid, it is not useful to the organisation. Figure 1.4 illustrates the process discussed here.

## 1.8 MANAGEMENT EFFECTIVENESS AND MIS

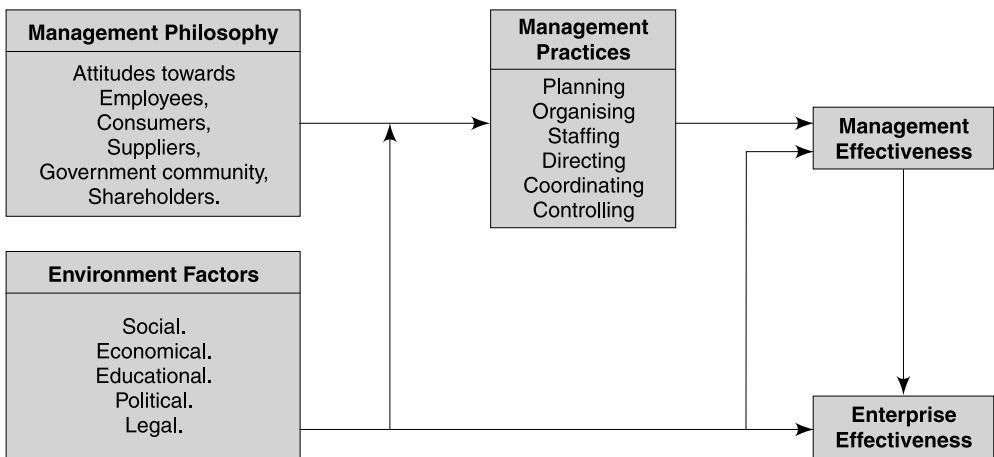
'Negandhi Estafen' provides a good model (Fig. 1.5) for the analysis of management effectiveness, which generates an enterprise effectiveness in achieving the goals and objectives. The model puts a lot of emphasis on the management philosophy and the environment factors on which the effectiveness is dependent. The environment factors provide the opportunities to survive and grow with certain constraints, while the management philosophy sets the guidelines for deciding the management practices of running the enterprise.



**Fig. 1.4 MIS Support to Management Process**

While the environment factors are difficult to control, it is left for the management to change its philosophy towards the various players in the business, viz., the employees, the consumers, the suppliers, the government, the community and the shareholders. Basically, it is a change in attitude towards these players. For example, how to look at the employees? If the attitude is to treat them as business partners, you will empower them and create a sense of belonging to the organisation. Such an attitude will have an impact on the management practices, where the employee will play a decisive critical role. It will affect the organisation structure by reducing its size and the reporting levels.

If the attitude towards the consumer is changed to fulfill the expectations giving rise to a higher satisfaction, then the management practices in the product design, manufacturing and marketing will undergo a significant change. The product life cycle will then be short, and more features and functions will be added to the product fulfilling not only the functional needs but also the service needs of the consumer.



**Fig. 1.5** Negandhi Estafen Model for Analysis of Management Effectiveness

The management practices, therefore, emerge out of the managements philosophy and the environment, in which it operates. The management effectiveness, would largely depend on both these factors. The MIS design would, therefore, be different depending upon the management practices followed by several organisations in the same industry. Such design improves the management effectiveness leading to an improvement in the enterprise effectiveness.

### Goals, Objectives and Targets

The process of management begins with setting of goals, objectives and targets. The goals are long-term aims to be achieved by the organisation; objectives are relatively short-term milestones to be accomplished, while the targets generally refer to physical achievements in the organisation's business. The goals, objectives and targets are so set that they are consistent with each other and help to achieve each other. These are to be achieved within a stipulated time and failing to achieve the same, means loss of business profit and image. The difference between these entities can be best understood by examples in the three type of organisations given in Table 1.2.

**Table 1.2**

	<i>Manufacturing organisation</i>	<i>Hospital</i>	<i>State transport organisation</i>
GOALS	Be a leader in the household consumer goods industry, with modern amenities.	Be a hospital providing total service to the patients.	Connect all villages of population 5000 and above by S.T. service.
OBJECTIVES	Provide complete product range in Processing.	Establish 300-bed hospital in five years.	Manage state transport expense in three years at the rate of ₹ 5 per kilometre travel.
TARGETS	20 per cent growth per annum in turnover.	Achieve ₹ 800 per bed per day earnings.	Achieve 90 per cent average seat occupancy every day.

The setting of goals, objectives and targets is a top management function. It has its implications on the business operations and profits. These are set considering the environment and changes expected in it. It considers social, technological, political, educational and economical changes expected to occur in about five to six years. The organisation is expected to consider and cater for these changes and, translate them into business operations. The setting of goals, objectives and targets helps to pull the resources of the organisation in one direction and solve. It helps to build the strategies, frame the policies and set the rules of conducting the business. It provides an efficient measure to monitor the managerial process. The people in the organisation can have common understanding of the purpose of the managerial process. the People in the organisation can have common understanding of the purpose of the business operations.

In an organisation, as time progresses, business goals, departmental goals functional goals and personal goals emerge, which create conflicting environment in the organisation. The goals, objectives and targets form a network. Achievement of targets helps in accomplishing objectives, and accomplishment of objectives leads to the attainment of goals. Careful determination of these entities is, therefore, essential for a successful management process. The goals, objectives and targets become reference points for strategic planning, resource planning, and operations planning.

It further helps the management to identify key areas of business and key areas of management attention. It helps appropriate and consistent business review. The performance appraisal of the manager becomes impersonal and unbiased as it is done with reference to achievement of goals, objectives and targets. McGregor saw appraisal against the goals and objectives as a better means of performance evaluation and more meaningful because it emphasised on results and not only personality. Its advantage is that it stimulates the development of people and provides motivation. According to Peter Druker, "goals and objectives are necessary in every area where performance and results directly and vitally affect the survival, growth and prosperity of business."

The last but the most important step in the process of management is controlling, the successful execution of management plan. Without control, the process becomes unproductive. The purpose of control is to regulate the process in such a way that the management process continuously strives for the achievement of the goals, objectives and targets.

The control is exercised through a system. The system measures the performance of the management in terms of some predefined measures of output. It compares the output with the standard, identifies the deviations from the standard, corrects the management process to ensure that the plan continues to be effective in terms of achieving goals, objectives and targets.

The control system works on the principle of feedback. The feedback on the performance should be quick without any loss of time, so that corrective action can be taken immediately. The process of correction involves changes in the plan, reallocation of resources, application on new systems, procedures and rules. The best control is the one which brings the process back into operation on the main track without outside intervention. The control system must get into action automatically to correct the midstream adverse development.

Time is the essence of control. If the corrective action is taken late on account of delayed feedback, it is ineffective and may result in heavy losses. Most of the managers look for real

of the managers. It should highlight on the critical success factors and support key areas of management. MIS should have, wherever possible, decision support systems to help the manager in decision-making.

Modern management systems rely on MIS. The complexity of business management and competitive nature of business requires handling of business operations with skill and foresight to avert the crisis. Modern business management requires shift from the traditional controls to managerial control. The shift requires the manager to become more efficient in handling the tasks he is entrusted with. The manager becomes more efficient if he is well informed, made richer in knowledge, experience and analytical skills and is able to face the uncertainties and the risks of business. This is possible only if he is supported by MIS, in his specific task of management of business.

Modern business has become more technology-oriented wherein the manager is required to be up-to-date on technological advancement, not only in his field of operations but also in the other technologies. The emerging new technologies are posing threats to current business and are opening new opportunities for new business ventures. The manager has to keep himself abreast on the information of how these technologies affect his business prospects. A good MIS designed for such a support is absolutely essential. MIS, therefore, is a tool for effective execution of the management process.

### **MIS: A Tool for Implementation of Management Process**

The process of management requires a lot of data and information for execution of the plan. This requirement arises on account of the fact that in each step of management, a variety of decisions are taken to correct the course of development. The decisions or actions are promoted due to the feedback given by the control system incorporated in the management system. The control of overall performance is made possible by way of budget summaries and reports. The summary showing sales, costs, profit and return on investment throws light on the direction the organisation is moving to. The exception reports identify the weaknesses in the system of management.

If effective management system is to be assured, it has to rest on business information. The management performance improves if the business risk and uncertainties are handled effectively. If the information provided is adequate, one can deal with these factors squarely. The information support improves the lack of knowledge, enriches experience and improves analytical abilities leading to better business judgement. So, if efficient information support is to be provided, it calls for a system with the goals of generating management information. A good MIS must furnish information to the managers to expand their knowledge base. He must know the adverse trends in business, the shortfalls and failures in the management process.

The MIS should provide the support to act and to act decisively. It should support management in terms of basic business information at the corporate level and meet the specific needs of information.

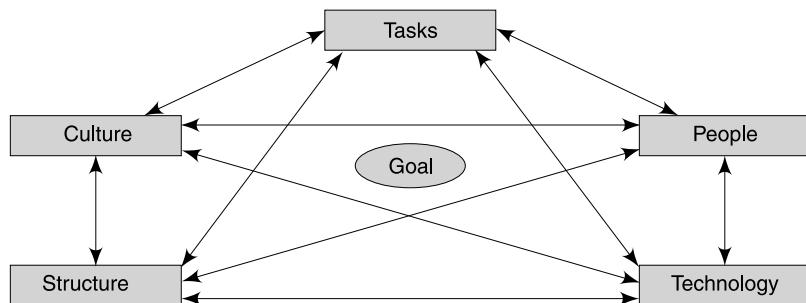
## **1.9 ORGANISATION AS A SYSTEM**

A system is an assembly of elements arranged in a logical order to achieve certain objectives. The organisation is also a system of people. The individuals in the organisation are selected in

terms of number, quality and ability and are placed in hierarchical order to plan and execute the business activities to achieve certain goals and objectives. This is the simplest justification for calling the organisation a system.

The management theorists, however, have seen organisation in different views and perspectives. They have identified more elements in the system besides the people. H. J. Leavitt identified task, technology and structure as additional three elements of the organisation system. He says that the task, technology and people structure are dependent on each other and their significance cannot be ignored as elements of the system.

The arrangement of task in terms of process and work design is dependent on the people. The choice of technology of handling the task is dependent on the people. You may choose the best technology and well designed tasks, but they have to be suited for the people. Over and above, these are to be arranged improper structure. Further, a fourth element has been added as culture. According to Leavitt an organisation should be viewed as a socio-technical system consisting of people, tasks, technology, culture and structure. The modified Leavitt's model is shown in Fig. 1.6.



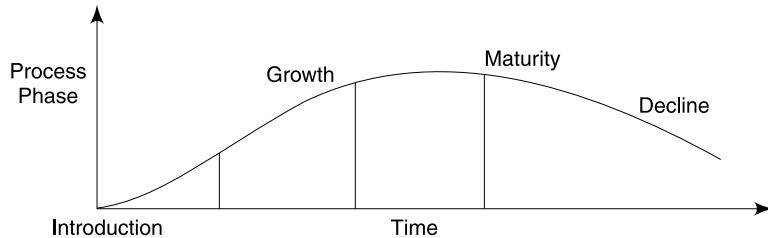
**Fig. 1.6** Modified Model of the Organisation System

In view of the nature of the task, the organisation is supposed to carry out, it has to be designed as an open system capable of adjusting itself to the changing environment. The organisation continuously exchanges the information with the environment and is influenced by the changes in it. The organisation, therefore, has to be built in such a fashion that it adjusts with the changes in the environment and that the goals and objectives are achieved.

Hence, the organisation is a socio-technical system whose sub-systems are tasks, people, technology, culture and structure, each having its own input and output satisfying at first its own objectives and eventually the corporate organisation's goals and objectives. If the sub-system's goals and objectives are not congruent with the goals and objectives of the corporate organisation, poor performance, resistance to change and non-attainment of corporate goals will be the consequences.

The system and their goals are not stable. The goals change in response to the changes in the business focus, the environment and in the people in the organisation. A significant change calls for change in the organisation structure. A goal displacement is said to have occurred when the system goals replace the organisation system goals. When a goal displacement occurs, it affects the organisation's goals significantly. Another reason for goals change

is due to the natural process of growth and decline. This phenomenon is best described by a sigmoid or S curve (Fig. 1.7)



**Fig. 1.7 Sigmoid or S-curve**

All organisations and their business go through the different phases of growth cycle in stages as, introduction, growth, maturity and decline. Each phase generates new goals to be served. If the changed or displaced goals are not reflected in the organisation as a system, the organisation is bound to suffer from decay.

## 1.10 MIS: ORGANISATION EFFECTIVENESS

Management Information System (MIS) should be designed viewing the organisation as discussed earlier. MIS design should give due weightage to the human side of the organisation and its culture. The task and technology are the physical aspects of the organisation which can be ascertained very easily. But culture and people are very difficult to assess from the design point of view. The structure of the five subsystem should be considered while designing the MIS. MIS design should give reports in line with the organisation structure. This means that the main decision-makers and the power centers must be recognised in the MIS. Let us discuss these aspects of the organisation structure and their implications.

In a tall hierarchy with a high degree of centralisation, the MIS should give control information to the higher management where decision-making is concentrated. If the system is structured on the functional basis where the functional head is a key decision-maker and all the functions have equally important role to play, then the MIS will have a functional design with the information support to the functional head. Further, in such a set-up, an integrated MIS would be necessary, reporting the corporate status of the business to the top management.

If the organisation works on a standardised system where rules, policies, systems and procedures have been laid down, then these become part of the MIS. The processing routines in the MIS incorporate these features as an integral part. This is safe as it has already been approved by the management of the organisation. Along with the information, if the decision-making responsibilities are also clearly defined and allocated, then the MIS can produce information reports by processing the data and summarising the results in line with the decision-makers' position in the structure.

If the basic model of the organisation is modified as a product or a project organisation system, then the MIS should focus on the management of product or project where the concerned manager has a composite responsibility of planning and control of the multiple functions.

Besides these functions, he has to know the status of the other support functions. The information should be such that it highlights the trouble spots and shows the interconnection with the other functions. It must summarise all information relating to the span of control of product or project manager. The MIS should be able to cater to the view of the product or the project manager and also of the top management.

If the organisation culture provides sufficient incentive for efficiency and results, the MIS should support this culture by providing such information which will aid the promotion of efficiency. If the culture encourages delegation of power and authority, then the MIS should incorporate the decision-making rules in the system.

The organisation system is an open system and MIS should be so designed that it highlights the critical business, operational, technological and environmental changes to the concerned level in the organisation, so that the action can be taken to correct the situation. The principle of the feed forward control should be extensively used as a design feature to provide a prior warning to the decision maker.

Since the organisation system has a dynamic role to play to meet the changing needs of a business, the MIS becomes a common support system for playing the dynamic role. When an organisation is moving through the business phases of introduction, growth, maturity and decline, MIS should provide an information support, relevant to that phase of the business cycle. This means the designer of MIS should foresee such requirements and make the design flexible enough to support such requirements.

The organisational learning helps to tone up the behaviour of the organisation. The MIS should support the learning mechanism by identifying the cause and effect in a given situation. It should keep the records of action and provide help to analyse the best action in a given situation. It should help to build various decision-models for use by the managers. The information support should be such that the group of enterprising managers should be able to improve their capabilities to perform better.

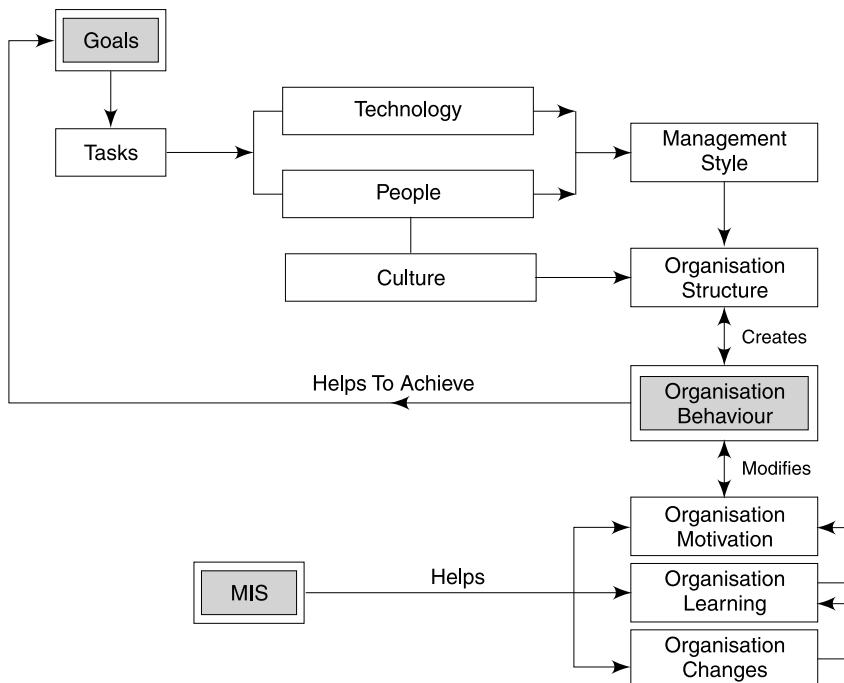
The design of the MIS, in isolation from organisational factors, is destined to fail as it just does not fit into the structure. Since organisation system in the same business differ for various reasons such as the leadership style, the management style, culture and group of people as a body and so on, it is difficult to evolve a standard model of the MIS for a business and/or an industry.

MIS plays a very important role in creating organisation behaviour which in turn sets the goals for achievement. Technology and people decide the organisation structure and style of the management. Fig. 1.8 explains the impact and relationship of MIS on the organisation behaviour.

## 1.11 MIS FOR A DIGITAL FIRM

Twenty first century organisations are E-Enterprises, that run their major operations on Internet/WEB and WAN, spread over large area.

The term 'E- Business enterprise' was coined to convey the use of Internet and IT in key resource management processes and to transact the business with customers, suppliers and business partners. ERP, SCM, CRM, PLM and home grown legacy systems are the main applications in the business. The application of Internet and information technology is in key



**Fig. 1.8** Organisational Behaviour and Management Information System

core areas of business. These technologies are used for computing, collaboration, communication, storage information in all kinds of format. These applications however did not integrate entire cycle of business starting '*from Customer to finishing at Customer: Customer Ordering to Delivery to Customer Service*'.

With the advancement of Internet, Web communication, network and Information technology, business process management crossed the boundaries of the organisation and embraced every aspect of the business making all its operations 'Digital'. That is capturing the data or event, validating, processing, decision making, storing, and delivering. The extent of use of these technologies is so much across the boundaries of the organisation that E- Business enterprise has become completely digitalised all its operations, and hence is now called as a "Digital Firm".

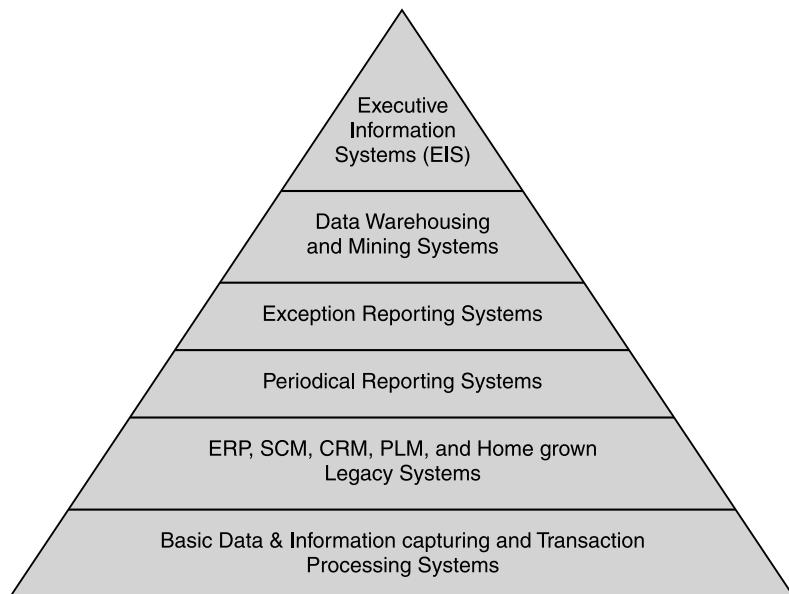
Digital describes electronic technology that generates, captures, validates and stores, and processes data in terms of two states: positive and non-positive. Positive is expressed or represented by the number 1 and non-positive by the number 0. Digital firms use extensively computing, convergence, and content management technologies on internet platform for all E-business processes, transactional and relational. Digital firms rely heavily on Internet and Information technology to conduct the E- business operations. The complete change over to digital platform makes organisation and its activities more flexible, profitable, competitive, and efficient than traditional people, paper and process driven organisation.

Going digital has a clear strategic advantage to the firm and its stake holders. Supply chain management systems, customer relationship management systems, enterprise management

systems (ERPs), and knowledge management systems, content management systems are the main systems which drive the function of a digital firm. In a digital firm, relationships with customers, suppliers, and employees are digital, meaning all transactions, communications, pictures, images, drawings, data, and information are exchanged through digital medium. Customer orders, delivery, billing and payment, purchases and so on are through web and internet using enterprise software. Information like product details is communicated through web to the customer. Using organisation's Web portal customer can build the order to the self requirement accessing this information and post it to the organisation's order book, and keep its track till it is delivered. Figure 1.9 is a Model of MIS for a digital firm focusing on business strategy.

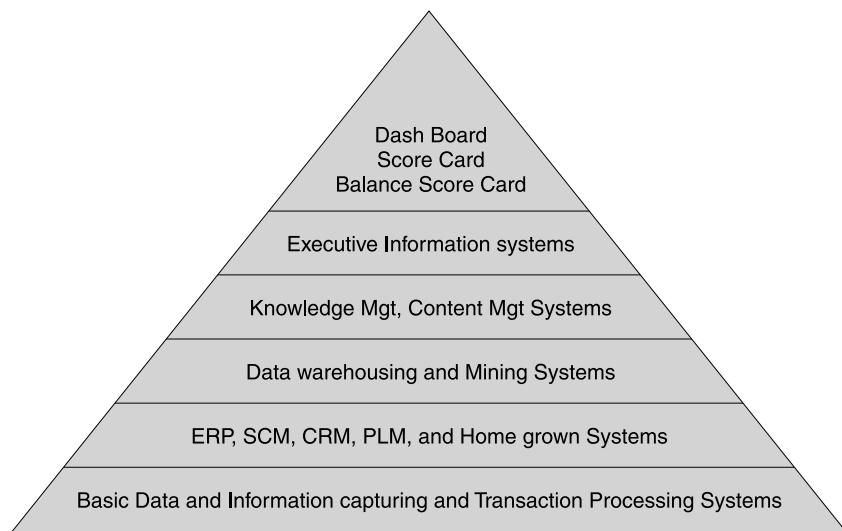
One of the characteristics of a digital firm is it functions in critical areas in real time. In real time mode, decision makers' responses have to be faster and correct. In a digital firm, there is an automation of data or event capturing, assessing, analysing, inferring and decision making. Fairly large amount of decision making responsibility is embedded into information driven decision making systems.

This calls upon MIS to provide just in time information on the specific emerged situation and display, simultaneously, the support information to make appropriate decisions. Conventional design of MIS designed to throw information on 'Where, What, When' in standard report format is totally ineffective and useless. Figure 1.9 is the IS structure of conventional MIS.



**Fig. 1.9** IS Structure of Conventional Design of MIS

The MIS design for a digital firm has to focus on business strategy, key result areas, critical success factors, monitoring key performance indicators (KPIs) & key business measures. Fig 1.10 is the IS structure of the MIS.



**Fig. 1.10 MIS Model of a Digital Firm Focusing on Strategy**

The focus of MIS in a digital firm needs to shift from just in time information to just in time actionable information. The just in time actionable information is a result of analytical processing of the business results and the strategy behind it. This is best handled by introducing an information systems designed to produce Balance Score Card, Score card and Dash Board. The MIS in a digital firm is a Strategic Design of the MIS.

## KEY TERMS

- |  |   |
|--|---|
| Management Information                         | Seamless Integration of Business Process      |
| Management Control System                      | Strategic Control of Critical Success Factors |
| Organisation as System                         | Sigmoid/S-curve of Growth                     |
| Organisation Behaviour and MIS                 | E-business Organisation: Digital Firm         |
| Strategic Design of MIS Score card, Dash board |   |

## REVIEW QUESTIONS

1. Identify the nature of impact of MIS on people, organisation and the management style.
2. Why is MIS looked upon as a strategic need of management today?
3. MIS supports a manager in his functional responsibilities. Explain.
4. List the external environment in which a manager operates. How many of them have a direct impact on the management process and hence should be considered in the MIS design?

5. Explain the importance of management by exception. Can it be the only approach in managing the business?
6. Explain the role of performance standard and “feedback” on it in effective management of business.
7. Show the relationship of organisation effectiveness and management effectiveness to MIS.
8. Can you state goal, objectives and targets which you have set for career management? What is the qualitative difference between them?
9. The manager has a leadership role to play. How can MIS support this role?
10. What is a goal displacement? Why does it occur? How does the organisation handle goal displacement? What would happen to MIS as goals are displaced?
11. Why does the organisation structure and MIS differ from company to company even though they are in same business and industry?

## CONFIRM YOUR UNDERSTANDING

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1. MIS is a product, which needs constant review, and modification to meet \_\_\_\_\_ needs of \_\_\_\_\_ business support information.
2. MIs include \_\_\_\_\_ systems, \_\_\_\_\_ systems, \_\_\_\_\_ systems modeling systems \_\_\_\_\_ systems, EIS system.
3. A good MIS improves business management \_\_\_\_\_ through planning, tracking, \_\_\_\_\_ monitoring targets, objectives and business goals.
4. MIS users include in-house personnel of the organisation as well as \_\_\_\_\_ and stakeholders.
5. Early warning mechanism in MIS helps decision-maker to take early \_\_\_\_\_ to control critical \_\_\_\_\_.
6. Exception is a \_\_\_\_\_ from the target performance which is handled by management seeking MIs support.
7. Modern business is termed as \_\_\_\_\_ because it uses extensively Internet/web/mobile computing and \_\_\_\_\_ software for \_\_\_\_\_ business.
8. MIS is a tool for achieving business goals by linking business \_\_\_\_\_ to MIS \_\_\_\_\_.
9. MIS should dynamically change as business and organisation moves on s-curve of \_\_\_\_\_.
10. MIS improves business performance and organisation effectiveness through improving \_\_\_\_\_ of decision-makers, making a \_\_\_\_\_ organisation, and helping in \_\_\_\_\_ of business.



## CASE STUDY

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### 1. PRECISION WATCHES LTD. (PWL)

'Precision' is an established brand in wristwatches and claims that PWL could achieve this status due to various management initiatives undertaken to make it an IT-enabled Internet driven E-enterprise. PWL has become more customer centric. In E-environment we come to know what customer wants and what changes are taking place in the market. This is possible as we get online information in real time mode about choice of product made or expressed by the customer, rate of sale of products by location, segment and market, and unsuccessful sale events by reason and so on. With established communication network, PWL, knows customer preferences, product movements, modifications and is able to respond faster to customer requirements and expectations. PWL has four factories at Bangalore, Jammu, Gurgaon, and Mumbai.

Due to networking of all work centres, sales points, dealers, distributors and use of enterprise business process application suite, PWL has management information daily on

**Product Inventory:** Brand, Model, Price, and Location

**Product Sale:** Fast Moving and Slow Moving

**Market:** Segment, Areas, and Locations

**Customer:** Preferences, Profile, and Lost Customers

PWL claims that all this is possible due to implementation of ERP package SAP. The implementation goal of SAP ERP was to

- Make information access available to all concerned.
- Provide information integrity for all users.
- Integration of complete supply chain.
- Reduce inventory of watches, and know at all sales point 'Where is what?'

With ERP implementation, IT is an integral part of the enterprise making it E-business enterprise. Management of PWL is able to handle efficiently dispersed, disparate and heterogeneous customer preferences. Management is able to compete in a dynamic wrist watch market where competition from gray market and international brands is very strong.

Using IT-enabled applications Internet technologies integration of supply chain is a challenge. To boost these strategic initiatives PWL implemented B2B solutions to leverage Internet for order handling, configuring, tracking, and delivering. PWL is also thinking of implementation of Radio Frequency Identification Device (RFID) technology, as it believes RFID is the technology of the future and is more efficient for handling variety of watches and high value of inventory.

PWL is convinced that strategic use of IT and Internet has made PWL an E-business enterprise where IT and Internet are business drivers and enablers as well. Management claims that success of enterprise is due to user and customer participation in E-Enterprise solution.

PWL now has online Management Information systems support when weekly meetings are held for business review, operation review, and customer issues.

#### Questions

1. Explain the motivation of PWL for implementing SAP-ERP and what benefits are achieved?

2. What new initiatives are now possible for PWL due to E-Enterprise business structure?
3. Explain how PWL has become more efficient after SAP-ERP implementation.
4. Explain how IT-enabled E-Enterprise solution has given competitive advantage to PWL.
5. Define the role of MIS for PWL. Identify different information systems at each level, which PWL may be using.
6. Who are the users of MIS in E-business environment? Identify key information needs of each user.
7. Explain how MIS using SAP-ERP will support business goals achievement? Which management functions at higher & strategic level would be benefited?
8. What structural & cultural changes you see in PWL organization due to IT-enabled Internet driven initiative?
9. Explain what is the nature of impact of SAP – ERP and MIS on the following?
  - People organisation
  - Inventory
  - Business processes
  - Customer relations
  - Customer service level
  - Business goals
10. Identify MIS, which would be needed over and above SAP-ERP implementation.
11. Explain how SAP-ERP and MISs, together helps PWL to handle dynamic nature of the business.

# E-Business Enterprise: A Digital Firm

## LEARNING OBJECTIVES

- Understanding paradigm shift to E-enterprise
- Conventional organisation vs E-enterprise Organisation
- Drivers of E-business Enterprise
- E-business Models
- Customer Centric E-business System
- E-business Organisation Structure
- Use of Workflow and Workgroup Application Model
- Role of Enterprise Software: ERP/SCM/CRM
- E-business Models and Applications
- Components of E-business Models
- Digital Firm
- Real Time Enterprise

### 2.1 INTRODUCTION TO ‘E-BUSINESS ENTERPRISE: A DIGITAL FIRM’

With the emergence of Internet, business organisation of 20th century has undergone structural, cultural and qualitative change, the way business is done and a new organisation structure has emerged known as E-business enterprise. E-business enterprise enables employees, professionals, teams, groups, vendors, customers to perform business operations through electronic exchange of data and information anywhere at any time. The business operations are performed through E-communication and E-collaboration initiatives. Therefore, E-business enterprise has a global market, reach, source and global competition. Due to extensive use of technology, the enterprise is now called a Digital Firm.

Due to Internet capabilities and web technology, traditional business organisation definition has undergone a change where scope of the enterprise now includes other company locations, business partners, customers and vendors. It has no geographic boundaries as it can extend its operations where Internet works. All this is possible due to Internet and web moving traditional paper driven organisation to information driven Internet enabled Digital

Firm. Digital Firm is open twenty-four hours, and being independent managers, vendors, customers transact business any time from anywhere.

Internet capabilities have given Digital Firm a cutting edge capability advantage to increase the business value. It has opened new channels of business as buying and selling can be done on Internet. It enables to reach new markets across the world anywhere due to communication capabilities. It has empowered customers and vendors/suppliers through secured access to information to act, wherever necessary. The cost of business operations has come down significantly due to the elimination of paper driven processes, faster communication and effective collaborative working. The effect of these radical changes is the reduction in administrative and management overheads, reduction in inventory, faster delivery of goods and services to the customers.

In Digital Firm traditional people organisation based on 'Command Control' principle is absent. It is replaced by people organisation who are empowered by information and knowledge to perform their role. They are supported by information systems, application packages, decision supported systems. It is no longer functional, product, and project or matrix organisation of people but E-organisation where people work in network environment as a team or work group in virtual mode.

Digital Firm is more a process driven, technology enabled, and uses its own information and knowledge to perform. It is lean in size, flat in structure, broad in scope and a learning organisation. In Digital Firm most of the things are electronic, use digital technologies and work on databases, knowledge bases, directories and document repositories. The business processes are conducted through enterprise software like ERP, SCM, and CRM supported by data warehouse, decision support, knowledge management and content management systems.

The term 'E- Business enterprise' was coined to convey the use of Internet and IT in key resource management processes and to transact the business with customers, suppliers and business partners. ERP, SCM, CRM were the main applications in the business. The application of Internet and information technology was in key core areas of business. These applications, however did not integrate the entire cycle of business, starting 'from Customer to finishing at Customer: Customer Ordering to Delivery to Customer Service'. With the advancement of Internet, Web, communication, network and information technology the business process management scope not only crossed the boundaries of the organisation but embraced every aspect of the business, making all its operations 'Digital'. That is capturing, validating, processing, decision making, storing, and delivering. The extent of use of these technologies is so much across the boundaries of the organisation that E- Business enterprise is now called a "Digital Firm".

Digital describes electronic technology that generates, captures, validates, and stores, and processes data in terms of two states: positive and non-positive. Positive is expressed or represented by the number 1 and non-positive by the number 0. The alphabets of this language are 'Zero and One' and hence digital.

Prior to digital technology, electronic transmission was limited to analog technology, which conveys data as electronic signals of varying frequency or amplitude that are added to carrier waves of a given frequency. Broadcast and phone transmission has conventionally used analog technology.

Digital firms extensively use computing, convergence, and content management technologies on internet platform for all E-business processes, transactional and relational. Digital firms rely heavily on Internet and information technology to conduct the E-business operations. The complete change over to digital platform makes organisation and its activities more flexible, profitable, competitive and efficient than traditional people and process driven organisation.

In today's new world of business, organisations face multiple challenges—globalisation, maintaining a connected mobile workforce, and increased competition. To maintain their competitive advantage, organisations must adapt and get better through process innovation, capturing strategic insights, and delivering customised services.

Unified communications technologies improve efficiency and effectiveness of supply chains by enabling stakeholders to collaborate, located anywhere in different time zones. Different functional teams and experts along with external supply chain and logistics partners can share data and information to act fast. With integrated UC capabilities into business processes, employees can quickly and easily find the right person and communicate from within the software applications and business processes currently in use.

Enterprise software makes business processes digital, unified communications makes collaboration digital.

Going digital has a clear strategic advantage to the firm and its stakeholders. Supply chain management systems, Customer Relationship management Systems, Enterprise Management Systems (ERPs), and Knowledge management Systems are the main systems which drive the function of a digital firm. The key feature of a digital firm is its ability to transact business efficiently across the traditional boundaries of the business organisation. In a digital firm seamless integration of systems and processes operating on different platforms at customers, suppliers and business partners is easily possible.

In digital firm relationships with customers, suppliers, and employees are digital, meaning all transactions, communications, pictures, images, drawings, data, and information are exchanged through digital medium. Customer orders, delivery, billing and payment, purchases and so on are through web and internet using enterprise software. Information like product details is communicated through web to the customer. Using organisation's Web portal customer can build the order to the self requirement accessing this information and post it to the organisation's order book, keep its track and so on.

#### Managing The E-enterprise: Digital Firm

Today most of the business organisations are using Internet technology, network, and wireless technology for improving the business performance measured in terms of cost, efficiency, competitiveness and profitability. They are using E-business, E-commerce solutions to reach faraway locations to deliver product and services. The enterprise solutions like ERP, SCM, and CRM run on Internet (Internet/Extranet) & Wide Area Network (WAN). The business processes across the organisation and outside run on E-technology platform using digital technology. Hence today's business firm is also called E-enterprise or Digital firm.

The paradigm shift to Digital Firm has brought four transformations, namely

- Domestic business to global business.
- Industrial manufacturing economy to knowledge based service economy.

- Enterprise Resource Management to Enterprise Network Management.
- Manual document driven business process to paperless automated electronically transacted business process.

This paradigm shift has added new challenges for management to tackle. It has opened larger market but not without severe competition from more competitors. Market and business risks have increased. Then differentiating factors in manufacturing process and products are no longer competitive advantage. What is critically important is service to the customer and customer satisfaction. Customer satisfaction and high level customer service is possible using knowledge based proactive management systems.

These transformations have made conventional organisation design obsolete. The basis of conventional organisation design is command and control which is now collaborate and control. This change has affected the organisation structure, scope of operations, reporting mechanisms, work practices, workflows, and business processes at large. The comparison between conventional organisation design and Digital Firm is summarised in Table 2.1.

**Table 2.1** Comparison Between Conventional Design Vs. Digital Firm

Conventional Organisation Design	Digital Firm
<ul style="list-style-type: none"> <li>• Top heavy organisation structure</li> <li>• Work and work place location at one place</li> <li>• Manual and document based work flows</li> <li>• High administrative and management overheads</li> <li>• Inflexible, rigid and longer business process cycles</li> <li>• Private business process systems for self-use. They are barred for usage to customer, vendors, and business partners</li> <li>• Low and selective usage of technology</li> </ul>	<ul style="list-style-type: none"> <li>• Flat organisation structure</li> <li>• Separation of work from workplace location.</li> <li>• Paperless work flows</li> <li>• Low overheads due to lean organisation</li> <li>• Flexible, agile and responsive process cycles</li> <li>• Public business processes and systems for use by customers, vendors and business partners</li> <li>• Use Internet, wireless and network technologies at all work centres</li> </ul>

In E-enterprise, business is conducted electronically. Buyers and sellers through Internet drive the market and Internet based web systems. Buying and selling is possible on Internet. Books, CDs, computer, white goods and many such goods are bought and sold on Internet. The new channel of business is well known as E-commerce. On the same lines, banking, insurance, healthcare are being managed through Internet. E-banking, E-billing, E-audit, & use of Credit cards, Smart card, ATM, E-money are the examples of the E-commerce application.

Managers in Digital Firm must be highly IS and IT literate to meet their own information and knowledge needs. Major management challenge to build and use MIS is developing competitive information systems, understanding the character of global business heterogeneity, variability & risk, creation of IS and IT platform for achieving MIS goals.

Having discussed so much good about Digital Firm, its management has some challenges to meet.

To achieve the said benefits of Digital Firm it is necessary to redesign the organisation to realize the benefits of digital firm. The organisation structure lean and flat. Get rid of rigid

established infrastructure such as branch office, zonal office. Allow people to work from anywhere. Automate processes after reengineering to cut down process cycle time.

Another challenge is to convert domestic process design to work for international process, where integration of multinational information systems using different communication standards, country specific accounting practices, and laws of security are to be adhered strictly.

Internet and networking technology has thrown another challenge to enlarge the scope of organisation where customers and vendors become part of the organisation. This technology offers a solution to communicate, coordinate, and collaborate with customers, vendors and business partners. This is just not a technical change in business operations but a cultural change in the mindset of managers and workers to look beyond the conventional organisation. It means changing the organisation behaviour to take competitive advantage of the Digital technology.

The last but not least important, is the challenge to organise and implement information architecture and information technology platforms, considering multiple locations and multiple information needs arising due to global operations of the business into a comprehensive MIS.

## 2.2 ORGANISATION OF BUSINESS IN DIGITAL FIRM

Internet technology is creating a universal bench or platform for buying and selling of goods, commodities and services.

Essentially Internet and networks enable integration of information, facilitate communication, and provide access to everybody from anywhere. And software solutions make them faster and self-reliant as they can analyse data information, interpret and use rules and guidelines for decision-making. These enabling capabilities of technology have given rise to four business models that together work in an E-enterprise organisation. They are

- E-business
- E-commerce
- E-communication
- E-collaboration

These models work successfully because Internet technology provides the infrastructure for running the entire business process of any length. It also provides e-mail and other communication capabilities to plan, track, monitor and control the business operations through the workers located anywhere. It is capable of linking to disparate systems such as logistics, data acquisition, radio frequency used systems and so on. Low cost connectivity physical & virtual, and universal standards of Internet technology make it a driving force to change conventional business model to Digital model.

Internet has enabled organisations to change their business process and practices. It has dramatically reduced cost of data and information processing, its sending and storing. Information and information products are available in electronic media, and are a resident on the network. Once everyone is connected electronically, information can flow seamlessly from any location to any other location. For example, product information is available on an organisation website which also has a feature of order placement. An order placed is processed at the backend and status of acceptance, rejection is communicated instantaneously to the customer. Such order is then placed directly on the order board for scheduling and execution. These basic capabilities of Internet have given rise to number of business models. Some of them are given in Table 2.2.

**Table 2.2** Business Models of Digital Firm

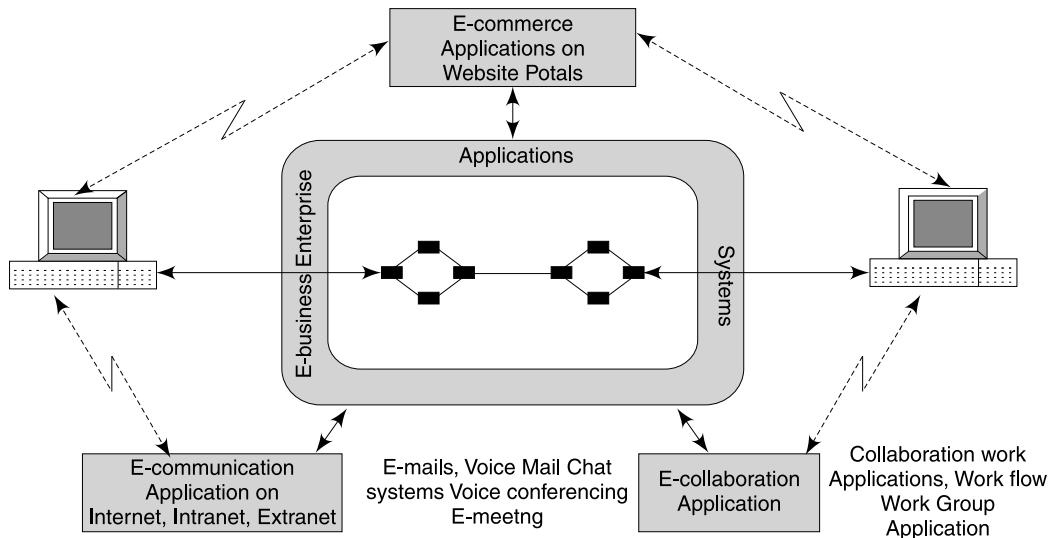
<i>Business Model</i>	<i>Description</i>	<i>Example</i>
Virtual Store	Provides information about product, and sells and delivers directly to customer or business organisation.	amazon.com, rediff.com, ebay.com.
Information Store	Provides information of interest and earns revenue from sharing and advertising.	yahoo.com, msn.com rediff.com, google, satyaminfoway.com.
Transaction Process	Processes bills for payment: telephone, electricity, money transfer & banking transactions, membership for club registration.	icici.com billjunction.com seekandsource.com
Online Marketing	Provides a marketing platform where buyers and sellers can meet to exchange information, negotiate and place order for delivery. Examples are shoes, commodities.	eauction.com seekandsource.com
Content Selling	News, music, photos, articles, pictures, greetings are stored and sold at a price.	timesofindia.com gartner.com aberdeen.com
Online Service	Offers services to individuals and business at large and generates revenue. Examples: Tours and travels, manpower recruiting and maintenance services.	Railway, restaurant, airlines booking. Online maintenance service. Online examination.
Virtual Communities	Provides platform to meet people of common interests. Software user groups, professional groups like doctors, managers, user groups.	Linux Group New Groups Application Package User Groups Community Groups
E-Learning	Provides contents, E-books, CDs, lessons, conducts test and offers certification.	sifylearning.com

We now discuss in detail how E-business enterprise model, and E-business process adds value in management process. Such E-business enterprise model is shown in Fig. 2.1. Source Adapted and Modified from Ravi Kalakota and Marcia Robinson. MIS, Fifth edition, James A'. O' Brien, TMH.

The Internet and networks provide platform and various capabilities whereby communication, collaboration, and conversion has become significantly faster, transparent and cheaper. These technologies help to save time, resource and enable faster decision-making. The technology adds speed and intelligence in the business process improving quality of service to the customer.

The business process of serving the customer to offer goods, products or services is made of following components.

- Enquiry Processing
- Order Preparation
- Order Manufacturing
- Order Status Monitoring



**Fig. 2.1** Digital Firm Model

- Order Placement
- Order Confirmation
- Order Planning
- Order Scheduling
- Order Dispatching
- Order Billing
- Order Receivable Accounting
- Order Payment Processing

The entire process in parts or full can be handled through these technologies and software solutions. It provides important strategic, competitive advantage. Further the technology is flexible and capable of handling any business models such as

- Retailing, Trading, Auctioning
- Manufacturing, Distribution & Selling
- Outsourcing, Subcontracting
- Servicing, Training, Learning, Consulting

The resultant effect is the reduction in cost of business operations, improved customer loyalty and retention and better quality offer to the customer.

Four major applications mentioned earlier make this achievement possible. We go into details of each one of them.

### 2.3 E-BUSINESS

The scope of E-business is limited to executing core business process of the organisation. These processes would have external interface like suppliers, customers, contractors, consultants and so on. The core business processes of the organisation are procurement, manufacturing, selling, distribution, delivery and accounting. These core processes are best run by application packages like Enterprise Resource Planning (ERP). If enterprise definition is made wider including customer, suppliers and distributors, application package like Supply Chain Management (SCM) is best suited for planning and execution of entire business process.

In addition to these core processes, organisations use Internet enabled systems and other technologies to handle these processes more effectively. Table 2.3 illustrates such Internet enabled systems.

**Tabel 2.3** Internet Enabled Technology Applications

Application	Illustration	Technology
Transaction Processing	Order booking from remote location	Wireless, PDAs
	Receipt processing at warehouse	Bar code reading, RFID
Workflow	Insurance claim	Data Processing
	Leave application	LAN, WAN, Database
Work Group	Travel advance payment	Intranet, Client/Server
	Engineering design	Use of stored procedures and intelligent trigger.
Process Control	Employee database for pay roll, tax applications	DBMS capabilities of Data and Information sharing through Internet/Intranet
	Shop floor applications to run machines	Embedded technology
	To control process based output	Use of intelligent chips and sensors
	Automated Go/No Go	Use of programmable logic controllers
	Quality/Checking applications	

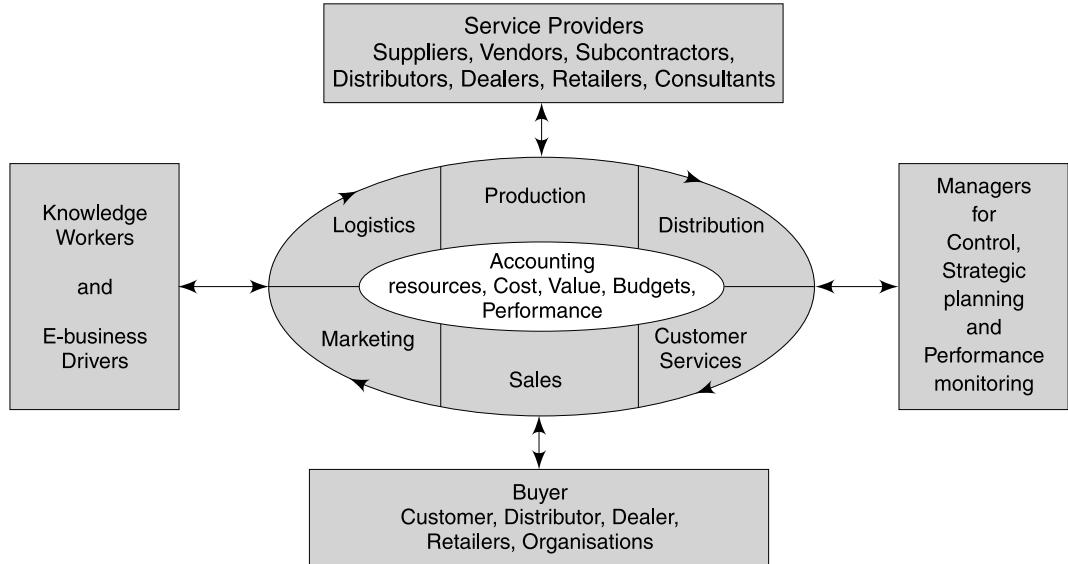
Transaction processing, workflow, work group and process control applications are the backend support systems to main ERP/SCM enterprise management systems.

For example, when a supplier sends goods, it is received in the warehouse. This event is processed E-way using E-business systems suite. The receipt, documents and packages are read by bar coding system or RFID. Then receipt processing is done to confirm the validity of dispatch by the supplier, confirmation of quality, acknowledging the receipt, updating the inventory, communication of receipt to manufacturing, updating the purchase order, effecting material accounts and supplier accounts, creating a liability in payables and posting it into cash flow projections. You will observe that receipt processing is first done at locations like warehouse, and 'Procurement' module of ERP takes over to effect seamlessly all updates and changes.

In this event processing, workflow system is used where quality of goods is checked, confirmed and certified in stages by three agencies in the organisation. This event is processed by a work group, which includes receiver at the warehouse, QA inspector, and warehouse manager playing their respective role in the receipt processing as specified in the workgroup application. Having accepted the goods, automated and process controlled goods movement, warehouse system takes over, and reads the receipt record to move the goods physically to assigned bin in a rack.

E-business systems use internet/intranet/extranet capabilities to process an event in seamless manner covering all technical, commercial, business aspects and implications of an event. They perform internal business operations and interface with external agencies. Use of

E-business systems has redefined and redesigned conventional business model to customer centric process model as shown in Fig. 2.2.



**Fig. 2.2** *Customer Centric E-business System*

E-business system scope manages cross-functional application systems as a single business process. It integrates cross functions seamlessly, automates the tasks, and updates the information in real time. The ERP/SCM and now customer relations management system (CRM) is a family of software solution packages dedicated to core management of functions of business. They are supported by frontend and backend systems and applications designed for transaction processing, workflow management, work group processing and automated process control. E-business systems use client/server architecture and run on Internet platform. E-business systems are foundation for other Enterprise applications, namely E-commerce, E-communications, and E-collaboration.

The current E-business system scope is build through ERP dedicated to manufacturing resource management for effective use of capacity and enhancing productivity. SCM is dedicated to logistics and distribution management and CRM is dedicated to customer relations management for customer satisfaction.

E-business essentially concentrates on functional business information systems and their integration. Traditionally five business systems are recognised as Marketing, Production, Procurement, Human Resource, and Accounting & Finance. These functional systems in E-business have become more intelligent and knowledge driven as against information driven in traditional way of doing business. Let us discuss them in brief.

IT, the backbone of E-enterprise, enables more precise target marketing towards intended audience. Organisations use websites and portals to store and share information, use networks to communicate, coordinate, and collaborate amongst structured teams and virtual teams. Employees use notebook computers, Personal Digital Assistant (PDAs). Most of the

processes are automated and they use Internet, Intranet, and Extranet for communication and E-business application packages to run the functional systems in integrated manner.

In Marketing System, IT helps to reach customer directly and is in the position to understand customer behaviour, customer's demographic/psychographic profile; It then helps to segment market by customer for advertising, promotion and contact.

In Manufacturing System, IT helps to automate number of management processes relating to resource, capacity, engineering & design, maintenance, and support. The application of IT is so strong that it is termed as Computer Integrated Manufacturing (CIM) or Computer Aided Manufacturing (CAM).

CIM adds value in the manufacturing by way of simplification of processes in production and design. Automation of simplified processes using process control devices, numerically controlled machines and robots and lastly integration of all core and support processes contributes to manufacturing excellence.

In Human Resource management systems extensive use of Internet is made to automate processes of HR planning, scheduling, requirement analysis, training and development. The entire chain of HR planning, advertising, recruitment and selection is an automated one. HR administration is a huge area of application which is wholly IT enabled. It handles payroll, leave planning, movement, career planning and succession.

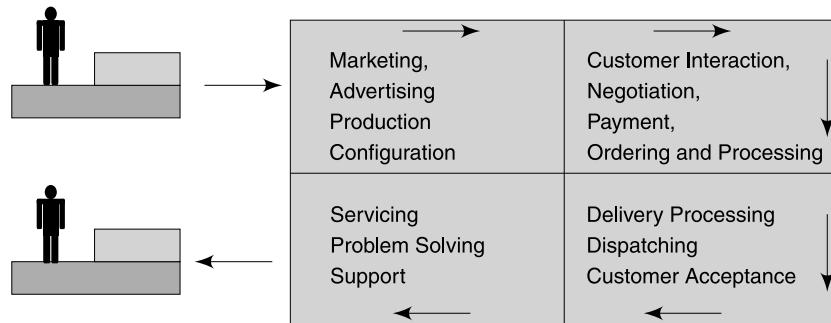
In Accounting and Finance system, IT application is very strong. E-business applications in this area are capable of accounting every business entity such as material, men, machines, cash, customer, vendor and so on. All processes, which deal with transaction, computing, accounting and analysis, are automated using system intelligence and knowledge driver intelligent systems.

The architecture of these processes enables to receive inputs from other functional systems like marketing, manufacturing, and HR, and process the same to account and analyze the impact on the business performance, be it cost, profit or productivity. An integrated E-business system is capable of forecasting resources requirement, managing resources, budgeting capital, sales, and manpower, and measuring financial performance.

## 2.4 E-COMMERCE

E-commerce is a second big application next to ERP. It essentially deals with buying and selling of goods. With the advent of internet and web technology, E-commerce today covers an entire commercial scope online including design and developing, marketing, selling, delivering, servicing, and paying for goods. Some E-commerce applications add order tracking as a feature for customer to know the delivery status of the order. Figure 2.3 shows the E-commerce process model.

The entire model successfully works on web platform and uses Internet technology. E-commerce process has two participants, namely buyer and seller, like in traditional business model. And unique and typical to E-commerce there is one more participant known as 'Merchant Server'. Merchant server role in E-commerce ensure secures payment to seller by authorisation and authentication of commercial transaction.



**Fig. 2.3** E-commerce Process Model

E-commerce process model can be viewed in four ways and categories.

- **B 2 C:** Business Organisation to Customer
- **B 2 B:** Business Organisation to Business
- **C 2 B:** Customer to Business Organisation
- **C 2 C:** Customer to Customer

In B2C model, business organisation uses websites or portals to offer information about product, through multimedia clippings, catalogs, product configuration guidelines, customer histories and so on. A new customer interacts with the site and uses interactive order processing system for order placement. On placement of order, secured payment systems comes into operation to authorise and authenticate payment to seller. The delivery system then takes over to execute the delivery to customer.

In B2B model, buyer and seller are business organisations. They exchange technical and commercial information through websites and portals. Then model works on similar line like B2C. More advanced B2B model uses Extranet and conducts business transactions based on the information status displayed on the buyers application server. Auto component industry uses this model for supplying parts and components to auto manufacturer based on the inventory levels and production programme.

In C2B model, customer initiates actions after logging on to seller's website or to server. On the server of the selling organisation, E-commerce applications are present for use of the customer. The entire Internet banking process works on C2B model where account holder of the bank transacts number of requirements such as seeking account balance, payment, money transfer and so on.

In C2C model, customer participates in the process of selling and buying through the auction website. In this model, website is used for personal advertising of products or services. E-newspaper website is an example of advertising and selling of goods to the consumer.

In all models, there are two channels: one channel deals with information delivery and sharing, and another channel deals with the commercial aspect of buying and selling. Some illustrations of the two channels are listed below for all the four models.

In B2B model, the participants in E-business are two organisations with relations as buyer-seller, distributor-dealer and so on.

### Information Delivery Application

- Issuing business circular
- Product catalogues publications
- News clippings
- Messaging

### Transaction Processing Application

- Order processing
- Order execution
- Payment processing
- Money transfer

In B2C model, the participants in E-business are an organisation, and customer as an individual. The customer is an individual consumer. The E-business applications in B2C are the following:

### Information Delivery and Sharing Application

- Organisation manual
- Database of knowledge
- Business information

### Transaction Processing Application

- Payments to employee
- Issue of shares/bonds
- Delivery through courier

In C2B, the customer/consumer deals with business organisation in individual capacity.

### Information Delivery and Sharing Application

- Downloading of information from website/portal
- Viewing the bank balance
- Seeing manuals/drawings/pictures/images, and so on

### Transaction Processing Application

- Requesting an item
- Obtaining travel advance
- Inquiry processing
- Credit card payment
- Cash withdrawal through ATM

In C2C, both the parties are individuals and play the role of buyer/seller as the case may be.

### Information Delivery and Sharing Application

- Messaging e-mail
- Reports

- News groups
- Interests groups

### **Transaction Processing Application**

- Payment approvals
- Memos
- Sanctions and confirmations
- Issues and receipts

Broadly, information delivery and sharing application is built on back-end systems, which collect data and process it to create information databases. The users of these databases could be organisations or individuals in the capacity of buyer or seller. The participants have an authorised access to information and have rights to read, write or use it in any of the application.

In transaction processing applications, participants draw the information, use the business rules and follow a process to achieve the results. Information or material is transacted using electronic process using information and business rules. There is a well-defined input to produce the predefined output based on business rules and on satisfying certain conditions.

In more specific terms, ERP/supply chain management is a typical B2B model where information is shared and business is transacted between two organisations. The organisations could be a manufacturer and a vendor, a manufacturer and a courier service partner, or a manufacturer and a bank, and is built on trust and confidence. Hence, information is shared with confidence and business is transacted on the basis of agreed rules and regulations. In B2B model, procurement, inventory, distribution and payments are managed using E-business technology.

In B2C, messaging and information downloading is a big application. Inter organisation communication applications, like news bulletin, communicating change of rules, announcements, price revisions are very common in B2C. In the case of bank, announcing new interest rates, financial products, opening of new branch, and so on is a communication application.

Crediting interest on fixed deposits, dividend on shares, refund of unused share amount are applications, that fall in the domain of B2C, where partner 'C'—an individual in B2C model—is outside the organisation.

In C2B model, a customer interacts with information databases such as product catalogues, price information, configures the product, compares the cost, places the order and have it delivered after the electronic payment process. The products like computers, books, CDs, music systems and different services are purchased through E-commerce application. Bill payments are a big application of C2B model. The electronic mail, video conferencing and news groups are other big applications where information is shared through electronic communications.

In C2C model, E-business revolves around two individuals who deal with each other in their individual capacities and play a designated role as buyer/seller, teacher/student, manager/officer, brother/sister. E-mailing, sending E-greetings, payments, ordering and sending gifts are the C2C model applications.

In all models, basic business and communication processes are executed through electronic documents. Table 2.4 shows an example of these documents.

**Table 2.4** Paper document Vs E-document

<i>Information on paper</i>	<i>Information on E-document</i>
Product information brochure	Product catalogue document database
Order on paper	Electronic order
Confirmation letter	E-mail
Payment cheque	Electronic cash, credit card, E-cheque

### Information vs E-document

All transactions are paperless hence, confirmations, approvals, signatures are electronically carried out and the participant is informed through E-communications.

The organisations, which are in E-business in a big way, are listed in Table 2.5.

**Table 2.5** Organisations in E-business

<i>Service</i>	<i>Organisation</i>	<i>E-business Model</i>
Internet banking	ICICI www.icici.com HDFC www.hdfc.com	B2C C2B
Complete business cycle	BHPVL www.bhpvl.com Dalmia Industries www.dalmiaindustries.com	B2B
Billing	Citibank	B2C
Bill payments	ICICI www.Billjunction.com	B2B
News sharing	Times of India www.timesofindia.com	B2C
Tendering	Gujrat Refineries www.gujrefin.com	B2B
Greetings/messaging	Through ISP VSNL, MTNL	C2C
Buying	Satyam Infoway www.satyaminfoway.com	C2B
Selling	Gloster Cables www.glostercables.com	B2B
Information Sharing	IT space www.itspace.com	B2B B2C
Servicing	LG Ltd. www.lgsi.com	B2C
Configuring of product and complete business cycle	IBM/Dell/LG	C2B

It should be noted that B2B business models actually run with the help of B2C, C2B and C2C models. These models work under the umbrella of B2B. The execution process using these models is assisted by portals, websites, E-mail, web directories, Internet Service Providers (ISP). Each organisation in E-business environment has its website and E-mail address and they are linked from portals, which provide basic information. The portal is a website dedicated to specified class of items where focus is on information about the items and not so much on who makes it? They essentially are information providers to users to transact through E-business models. Some portals have scope of buying and selling besides information sharing. Search engines like Yahoo, Alta Vista, and Lycos are higher-level portals, which help you find web address of buyers and sellers for you to choose your E-business partner.

In E-business models, we have considered two parties who engage in business activity. But to perform these activities certain intermediaries are required to handle the communication traffic between the two parties in B2B, B2C, C2B and C2C. The intermediaries are:

### **Hardware Suppliers: Server, clients, routers and network card providers**

- Network access providers: ISP, EDI, DoT
- Information access providers: Browsers such as Netscape, Adobe and Internet Explorer.
- Payment processors: Master Card, Visa.
- Website design providers: Consultants and web developing companies.
- Web directory providers: Yahoo, Alta Vista, and Lycos.

**Digital Firm Models are developed using these intermediaries. The components of E-business models are:**

- Internet for external communication
- Intranet/Extranet for internal communication
- Network and TCP/IP protocols and tools for delivery mechanism
- Web server and web browsers software for access, process and download and mailing.
- Back-end integrated systems for application processes

**The people involved in E-business model other than users of the models are:**

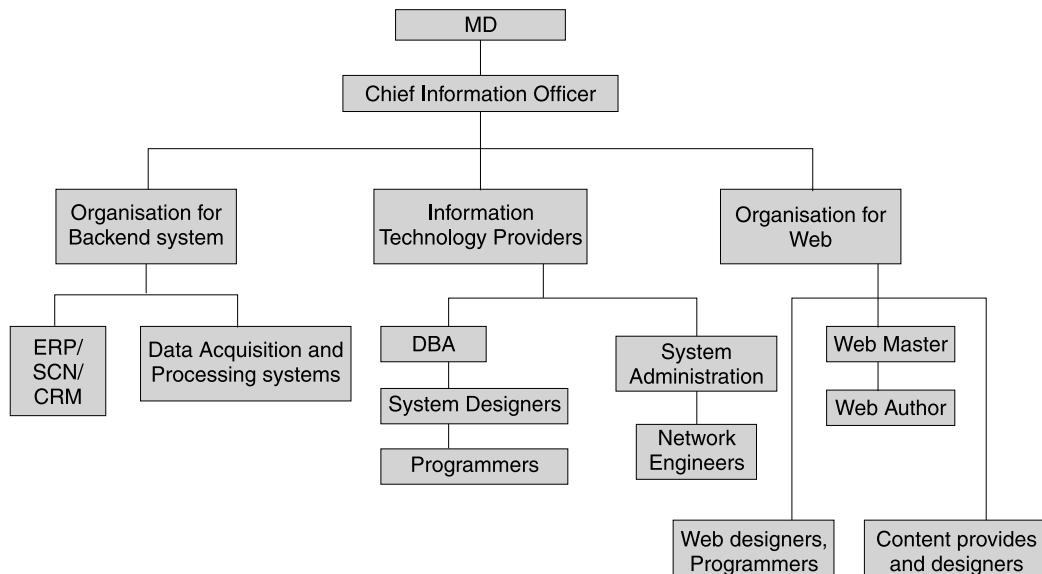
- |  |   |
|--|---|
| <ul style="list-style-type: none"><li>• Web master</li><li>• Web designer</li><li>• Web developer/programmer</li></ul> | <ul style="list-style-type: none"><li>• Content provider</li><li>• Content designer</li><li>• Web administrator</li></ul> |
|--|---|

Web master controls the website inflow/outflow, content management and regulation of the traffic. The role is similar to DBA in RDBMS environment. Web designer conceptualises and visualises the requirement of the parties and creates a web design, which is attractive, useful and easy to handle. He plays a role of an architect and an interior designer of the website. Web developer/programmer writes web pages using HTML, DHTML, XML, CGI script and other tools. They are also involved in programme writing for transaction processing, information processing, providing links to other sites, writing interfaces for connectivity to other databases and to back-end ERP or legacy system. Content providers are responsible

to create text, images and a multimedia input to the site. These people are subject experts and are key people in making a website a grand success. They have to write contents of the website looking into the needs of the target website visitors. The contents should address the needs of the users of the website. The content designers give website layout, icons, positioning and display ideas to deliver the contents to the viewers immediately. They provide input in terms of aesthetics, colours, navigating through different information layers, and so on.

Web administrator maintains the website. He is a troubleshooter. In case of any problem, web administrator is the first contact point of users/viewers to solve their difficulties. The job is to keep the website very responsive and keep contents latest and up-to-date. Web administrator is responsible to make viewer analysis in terms of visits to website, areas visited and business generated.

A Digital Firm structure model is given in Fig. 2.4.



**Fig. 2.4** Digital Firm Organisation Structure

All buying and selling does not succeed through E-commerce. The products and services, which are standard in nature, and customer does not have a great need of interaction with seller, are best suited for E-commerce. E-commerce culture is mostly virtual and impersonal. E-commerce site must create confidence in the buyer showing competitive prices, performance assurance and post sale support. Faster processing in every step and covering entire buying and selling cycle is very much essential. The look and feel of E-commerce website should be customer friendly and attractive. Finally, security and reliability of information, transactions, and order fulfillment is an absolute necessity.

## 2.5 E-COMMUNICATION

In E-business world, E-communication system is a backbone of all processes whose role is to share information by messages or store information to download on access by the customer. This is done through many applications and systems. Most popular and widely used

messaging system is e-mail & voice-mail. Through these systems both parties communicate on ongoing basis. It provides facilities to store, delete and search mails supporting the reference need of the user. This system is popular when one to one communication is needed.

When there is a need of communication in real time, systems available are voice conferencing, Video conferencing and electronic meeting systems. Voice conferencing is conducted on telephone network using speaker phones or networked PCs with Internet telephone connectivity. Video conferencing provides capabilities of video and audio for participants situated at different locations. Video conferencing also becomes an interacting and effective communication system when it has a feature of white boarding and document sharing. In electronic meeting system, participants sit in a meeting room with networked PCs and online screen projector to discuss the meeting agenda. PC network is chosen for communication, and access databases and processing and projecting on the screen for common viewing. This system is useful to solve some problems, and communication within small groups.

Another E-communication system which is a kind of offline is known as web publishing. Web publishing uses websites and portals for storing documents, catalogues, drawings, pictures and so on for sharing. Such information is stored on documents. In this system, a user searches, navigates, selects and downloads document for self-use. Web publishing is popular amongst research organisations, educational bodies, government organisations, and large business and commercial bodies. These organisations have large information set and document to share with the community.

E-communication systems are capable of sending messages, documents, and files in any format over Internet. The communication could be online in offline mode and online in real time mode. All E-communication systems have sufficient safeguards, which make them secured for use. Internet and web technologies are used for forming different interest groups to communicate and share the information. These groups are popularly known as 'user groups' who have common interest in subject, technology or tool, and come together with the objective of improving the quality of subject of interest by sharing the experience.

Enterprise information portal is another tool used for information posting and communication to users or customers. Portal is a web-based interface on an integrated internet/intranet/extranet platform allowing customers to use application and other services. It provides secured access to all users/consumers to search information, analyse the situation and communicate. The difference between a website and a portal is that the latter is a comprehensive multipurpose repository of information, applications, tools to serve the consumers. Most of the information needs are met at one place like portal eliminating excessive surfing, quick access to various resources and application. Relatively, website is a very focussed platform with limited objective of sharing and communicating the information.

## 2.6 E-COLLABORATION

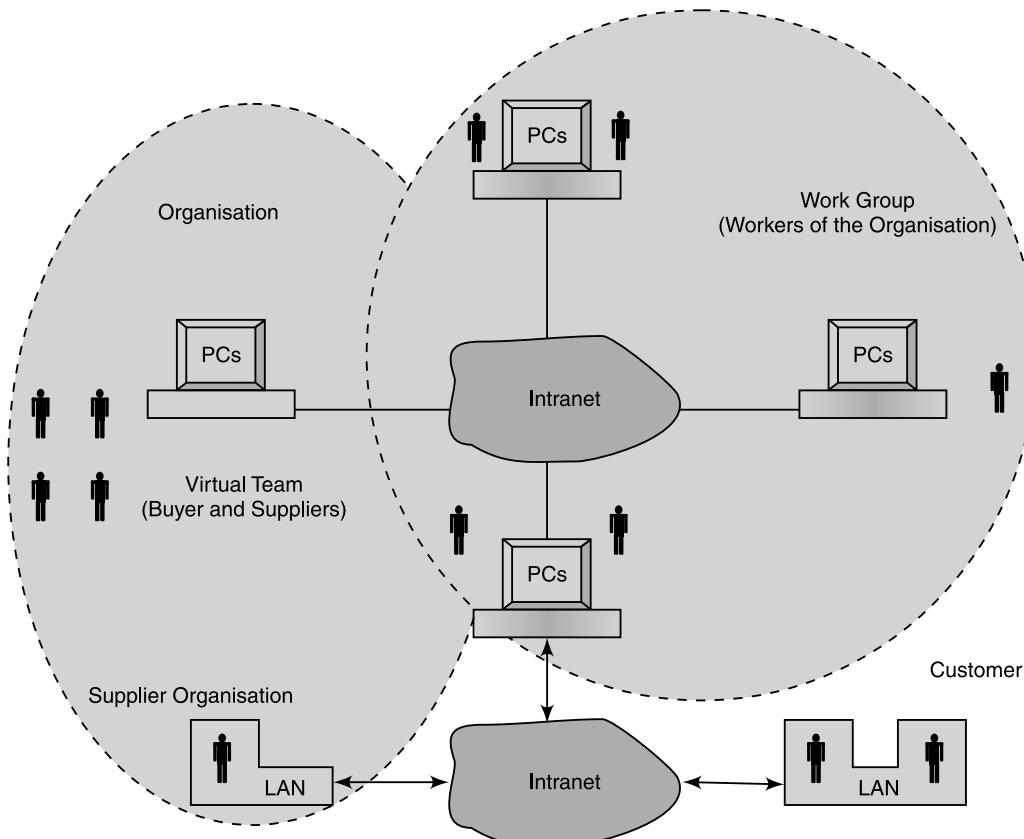
Every business has number of work scenarios where group of people work together to complete the tasks and to achieve a common objective. The groups could be teams or virtual teams with different member strength. They come together to perform a task to achieve some results. The process is called collaboration. The collaboration now is possible with e-technologies, which put these teams in network with Internet support for communication, access to different databases and servers. These capabilities help to create collaborative work systems and allow members to work together cooperatively on projects and assignments. The biggest

advantage of E-collaboration is that it taps the collective wisdom, knowledge and experience of the members. The collaboration team or group could be within the organisation and between the organisations as well.

Since, E-collaboration works on an Internet platform and uses web technology, work group/team need not be at one physical location. They can be at different locations and form a virtual team to work on project or assignment.

E-collaboration uses E-communication capabilities to perform collaborative tasks, or project assignment. Its effectiveness is increased by a software 'GroupWare' that enables the members of the group to share information, invoke an application and work together to create documents and share them and so on. GroupWare is a collaboration software. For example, Lotus Notes, Novell GroupWare, Microsoft exchange and Netscape communicator are GroupWare tools. These tools are designed to make communication and coordination between members of the group more easily, disregarding their physical location.

E-collaboration helps work effectively on applications like calendering and scheduling tasks, event, project management, workflow applications, work group applications, document creation and sharing, and knowledge management. Figure 2.5 shows an E-collaboration system Model.



**Fig. 2.5** E-Collaboration System Model

E-collaboration system components are Internet, Intranet, Extranet and LAN, WAN networks for communication through GroupWare tools, browsers. Application packages are software suit, which help process customer requirements. It is supported by databases present on various servers like mail server, material database, knowledge server, document server and so on.

Having understood the E-collaboration system let us know where it is successfully applied in business. There are five main applications, which are very popular amongst E-business community. They are:

### **Preparation of Calendars and Schedules**

Organisation plans a number of meetings, appointments, schedules where number of people are involved and they need to be informed about their participation in a number of events. GroupWare tools help in automatic scheduling, notification and reminding to the participants. GroupWare tools help in time management, arranging the meetings without conflict in availability of the persons.

### **Project Management**

Teams manage projects, and a high-level collaboration among team members, and within teams is absolutely necessary for expeditious project process execution towards completion. GroupWare tools provide capabilities by scheduling, tracking and charting the group status on various aspects of project.

### **Work Flow Management**

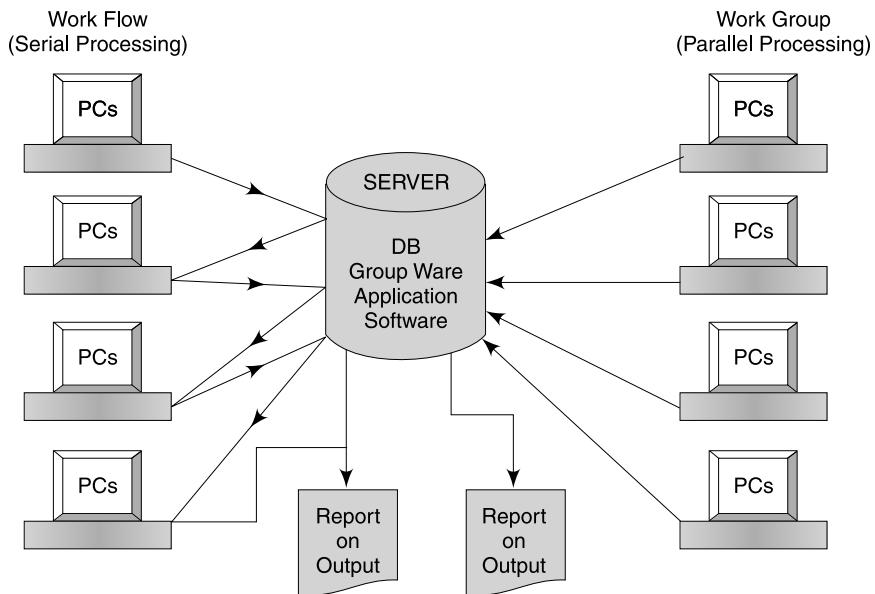
There are many tasks in an organisation, which require progressive incremental working as the flow moves forward. The entire process has steps, that contribute to incremental value of task. The workflow is managed by a group of personnel, each having a specific role and responsibility in the task.

The GroupWare tools handle communication between stages, trigger process of that stage, support member to perform, and secure the completed task and hands it over to the next stage. GroupWare tools work best where work is to be performed step by step. Another popular application is electronic document processing. For example, in project management, contracts are created and finalised between a customer or a vendor and the organisation. Such contract has a number of sections like technical, commercial, legal, performance and obligation and so on. These documents are prepared step by step by different experts in the organisation. In other words, contract document preparation work flows from stage to stage in segment towards the goal of publication.

### **Work Group Application**

Work Group Application differs from workflow to the extent that in workflow a process or transaction is handled while in workgroup the members of the group share a common database and perform their respective roles to achieve some common goals. The concept of a work group is that a set of information has a multiple use and the concerned users draw this information to perform their role.

Members of the work group are in a network and use GroupWare tools to communicate coordinate, and collaborate by sharing knowledge, software and databases to complete a group assignment. Fig. 2.6 shows the workflow and workgroup model.



**Fig. 2.6** Workflow and Workgroup Application Model

Let us illustrate these two models using an event in the business such as receipt of material for a job to be processed on the shop floor. In this event there is a transaction receipt of material, which needs to be processed, and then a workgroup will use this information of material receipt. Each member of this workgroup has a different goal.

In workflow application different members with a single goal of processing receipt of material for inventory, process transaction in its logical serial order. While in work group application, three members have different assignments, in a sense independent of each other but they share information of receipt of material to complete their assignment.

All four applications: E-business, E-commerce, E-communication and E-collaboration run on Internet, Intranet, Extranet and other networks and use web technology extensively. In the execution of these applications, E-organisation uses GroupWare software and tools. GroupWare is capable of handling core processes like communication, integration, collaboration and delivery, and expedites processing of transaction, application and system. The GroupWare thus becomes an integral part of the enterprise E-solution, designed to manage the enterprise business.

For all four applications, packaged software solutions are available broadly called as Enterprise Resource Planning (ERP), Customer Relation Management (CRM), and Supply Chain Management (SCM). All three packages are then integrated in one customise suit known as Enterprise Application Integration (EAi). EAi supports E-organisation functioning through MIS.

**Table 2.6** Shows Workflow and Work Group Application in Material Receipt Event.

Work Flow			Work Group		
Step	Member	Member Role	Step	Member	Member Role
1. Check at the gate	Security Guard consignment	Enter receipt record of the	Schedules the job	Production Planner	Issues job work order
2. Open consignment & scrutinise documents	Store Supervisor	Enter receipt record of items in the consignment	Process for issue of material requisition	Shop Engineer	Checks inventory reserves material, triggers material requisition process
3. Inspect the items	Inspector	Enter inspection record, acceptance and rejections	Prepare a pick list for issue	Stores Incharge	Trigger a process of pick list for issue
4. Accept in stores	Stores Incharge	Up			

MIS in E-organisation deviates from traditional report formats to automated intelligent knowledge driven system. It enforces manager to act quickly to response displayed on the screen. Most of the decisions of middle and operational management are delegated to IT-enabled information and knowledge driven systems. They are supported by the rule based transaction processing system, decision support systems, expert systems, artificial intelligence (AI) systems, and data warehouse and mining systems. MIS in E-organisation deviates from the conventional model of 'Capture - Compute - Process - Analyse - Report - Think and Act' to 'Point - Click - Respond - Act'.

## 2.7 REAL TIME ENTERPRISE

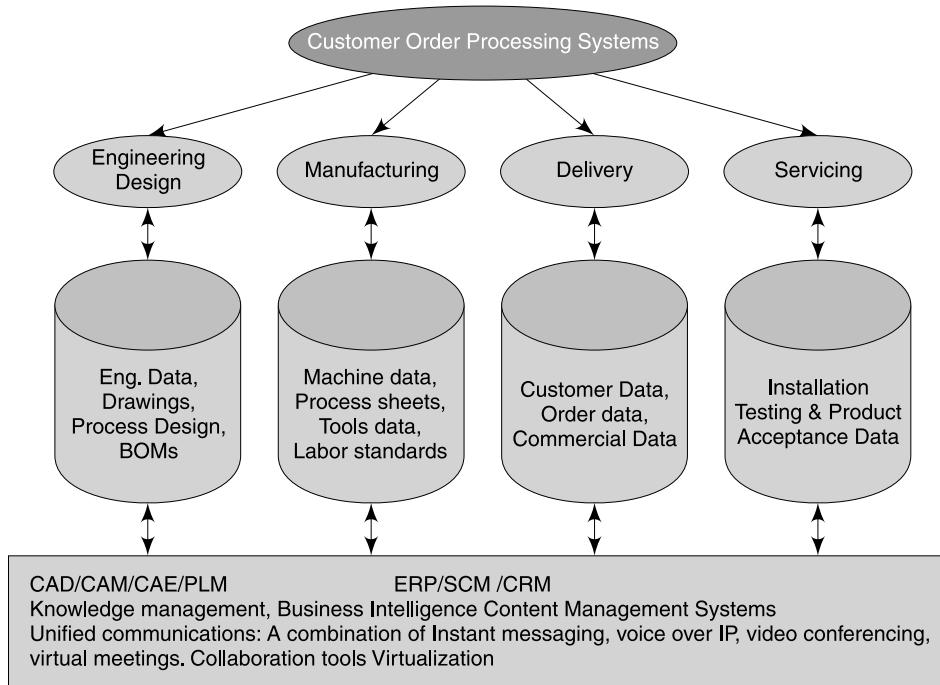
Real Time Enterprise (RTE) is a special case of a digital firm. In RTE the business needs are to be executed in real time mode. That is any request needs to be serviced or responded instantaneously in real time. This means capturing the input, data/information/event in real time and processing it immediately through real time information collaboration. In RTE the information is not scattered but it is available immediately and accessible instantaneously in real time. It is extracted from transaction paper documents, databases and E mails, and processed and stored for ready use on demand in real time. It is also being updated continuously in real time making it current for just in time use when called for.

The goal of RTE is to provide accurate and timely information to decision makers within and outside the organisation. The other goal of RTE is to connect all operations and enable all information to be shared in real time. RTE operates on a platform built out of Strategy, Technology and People. RTE are benefited in shortening the 'Order to Cash', 'Issue to Resolution' and 'Lead to Order' cycle times. In RTE the collaboration between people and processes is through automated business processes.

In RTE customers build and enter their orders, check inventory, track shipments make secured payments and seek real time support to enquiries. Suppliers assess and monitor

customer demand, check inventory, build delivery details, deliver and bill the customer. Business partners work in collaboration to obtain business leads, conduct joint campaigns and promotions, and convert a prospect into a customer.

In RTE, Internet and other complementary technologies are used for real time automation and integration of Enterprise resource planning, marketing and sales, sales force management, accounting, customer servicing, billing and payment, and e-mails carrying actionable information. In RTE the information, resident and inaccessible in spreadsheets, ERP, CRM, SCM etc, is extracted and stored in central repository giving a single real time view of the data. RTE is a model of demand driven enterprise working on integrated platform of Back office and Front office systems. Figure 2.7 is a digital model of an engineering firm producing engineering products. The processing of data, information, transactions, applications in large enterprise systems run on digital platform. In E-enterprise/digital firm: All data and information is in digital format available from any storage location to all authorised persons.



**Fig. 2.7** Model of a Digital Firm for an Engineering Product Company

An efficiently working RTE would have the following characteristics.

- Business process automation bridging the gap between organisations, systems and processes across the organisation.
- Real time creation and storage of information ready for exchange to customers, vendors and business partners.
- Processes to ensure currency and consistency of information across the global network.

- Event driven processes with automated sense and respond trigger eliminating human intervention.

## 2.8 WHAT ARE THE TECHNOLOGY OPTIONS FOR BECOMING A REAL TIME ENTERPRISE?

RTE is not a revolution. It is an innovation of doing existing processes better from all angles using wide range of technologies namely Internet, Web, Wireless, IT, Communication and RFID and more. To become a RTE, it requires changes in the process through Business Process Reengineering, followed by evaluation of various technologies for adoption and adaptation to produce desired results. The choice of technology or its mix largely depends on the business processes chosen to go real time. The next requirement is to see that such choice integrates well on the existing platform and correlated applications already in place in the organisation. The primary goal of RT approach is to ensure collaboration throughout and beyond the enterprise. The vision of RTE is about conducting the business without any human or technological bottlenecks. This is very challenging and difficult, but feasible, if technology is handled with care and caution.

### RTE functions with the help of four technology components:

- *Internet/Intranet & Web Technology:* While ability of this technology to assist real time processing by sourcing data/information from all resources is undoubtedly high, its success depends upon widespread acceptance on the security, design and development complexity and its integration in existing IS and IT platform.  
Great care should be taken about Web—Services and industry standards while selecting the technology and the service provider.  
There are over 20 different Web- Services standards and protocols.
- *Enterprise Software:* Organisations planning to move over RT processing mostly would have an enterprise software like ERP, SCM or CRM. The leading enterprise software solutions offer integration capability. This however needs to be examined from the view point of its suitability and the degree of collaboration it offers.
- *Infrastructure supporting RTE:* Organisations contemplating to go over as RTE have basic network (LAN/WAN & Internet/Extranet) infrastructure within and across the organisations. Most of them would have data warehousing systems which is the soft infrastructure, offering a single source of data for the organisation to access. What is then needed in the event of going over to RT processing is making data warehousing system real time as well. This is a very challenging and complex task to achieve.
- *Solution providers for Information sharing:* Hosted solution providers offer application suite to maximise real time information sharing. This suite offers capability to build an integrated application around business process workflows and common data repository, like Data Warehouse. The cost of information sharing across the organization, then, is lower because of using a hosted solution.

## Why Organizations are Moving Towards Real Time Management of Business?

There are five forces which are driving this movement.

1. The differentiation between competition and the organisation is zeroing down to the quality of delivery in terms of cost, time and speed. RTE approach ensures such delivery.
2. The demand for operational excellence through value based management supported by information through score card and dash board.
3. The competition is now on how you integrate SCM and CRM on the platform of ERP and leverage the integration to mutual advantage.
4. The rapid development and convergence of emerging technologies such as RFID, Ubiquitous Computing, Neural Network, Pattern recognition, and Mobile computing into Internet, web, IT , Network, Communication , Wireless technology. These technologies enable automation of processes with least human intervention.
5. It offers competitive advantage due to
  - Availability of superior competitive intelligence.
  - Reduced response time to customer call.
  - Transparency and visibility to entire value chain.
  - Significant reduction in cost of serving customer needs.

To build sustainable competitive advantage an organisation needs a real time response to all the events in the organisation. Transforming to RTE is the solution. There are many ways to achieve this, but the best long term strategy is to invest first in systems that are built to support RTE.

## BPO a 'Digital Firm'

The internet supports collaborative processes on a global scale. Business Process Outsourcing (BPO) enables new forms of cooperation amongst organisations. With the help of internet, organisations can be established without the use of 'brick and mortar' buildings and business functions could be carried out by outsourcing them to internet connected organisations. This form of an organisation is called a digital firm or RTE, where most of the business functions have been digitized. Even though the business is going on, still there is no existence of a corporate office, branch offices and factories in the vicinity to keep rolling in the work. The internet can link thousands of organisations into a single network, creating the foundation for a vast digital market place. In a digital market, many buyers and sellers exchange information, products, services and payments. Through computers and networks these systems function like electronic intermediaries in integrated manner as a single process. Buyers and sellers can complete purchase and sale transactions digitally, regardless of their location. All information driven functions are outsourced to the other companies while only the core competencies remain with the original enterprise. For example all cell phone companies have outsourced all customer related functions like billing, recovery and queries. These companies then concentrate on business expansion, marketing and improving cell phone device with features and facilities.

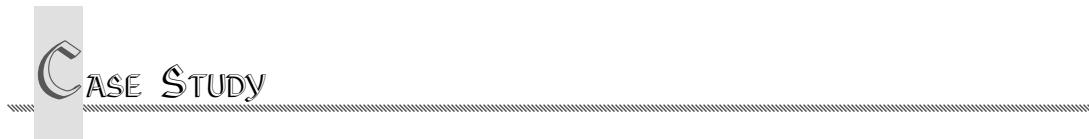
The impact of going digital is on the way the business **is conducted by the organisation in the internet world.**

## **50**    *Management Information Systems*

- The organisations have become flat as they focus on processes driven by their core competency. And other processes are outsourced to other organisation who are in the network.
- Decision making is decentralised and delegated to people who are empowered by the knowledge.
- Organisations have become flexible in meeting customer expectations due to digital culture of conducting the business. The product or service can be easily redesigned to fulfill specific need of the customer. The organisations have become more agile.
- Information being available from any location, the work and the person need not be at fixed location. The location independence adds further flexibility into the organisations operations.
- Low transaction and coordination costs is a reality due reduced overhead, cycle times and ease in coordinating various agencies for achieving a common goal.
- Empowerment of people by knowledge has made people more productive and efficient.
- Collaborative work and teamwork has become a dire necessity because of distributed and flexible nature of work.



3. E-business systems use \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ and \_\_\_\_\_ technologies for \_\_\_\_\_ integration of business processes.
4. Internet banking uses \_\_\_\_\_, \_\_\_\_\_ E-business models for non-corporate customers.
5. E-collaboration uses E-communication capabilities and uses \_\_\_\_\_ software on \_\_\_\_\_ and web \_\_\_\_\_.
6. In workflow process people work for \_\_\_\_\_, \_\_\_\_\_ and in workgroup people work for different \_\_\_\_\_, but use same \_\_\_\_\_ base.
7. E-business enterprise is \_\_\_\_\_ driven and E-technology enabled.
8. E-business enterprise is \_\_\_\_\_, in number, \_\_\_\_\_ in structure and is a \_\_\_\_\_ organisation.
9. MIS in E-business enterprise \_\_\_\_\_ from report generating system to automated \_\_\_\_\_ and \_\_\_\_\_ generating system for quick response.
10. MIS is a \_\_\_\_\_ of systems and applications on the top of enterprise software.



## 1. LOGITECH LTD.

The PC is becoming the centre of the digital world. It helps educate and entertain. Education CDs and the sheer wealth of information on the web are helping children prepare better for a very competitive world. Web cameras are helping people stay connected. And, of course, in a film and music crazy country, DVD drives and speakers make the PC a complete entertainment device. Logitech dreams big and wants to become bigger.

### Logitech and the Big Bang

Our partners and we at Logitech are uniquely poised to take maximum advantage of this Tipping Point. With our wide range of peripherals, we are not only in the new PC opportunity but also the Huge Upgrade Opportunity brought by the dramatic shift in mouse technology. Also the upgrade to cordless opportunity in both mouse and keyboards is huge.

However to convert these into actual sales require a slight shift in the strategy. For too long we in the PC industry have been concerned with getting the customer to buy by lowering prices rather than giving him a great value proposition. The old approach may have worked so far. But, as observed earlier, the consumer is evolving. He is more aware, more informed, more equipped to make appropriate decisions. And is looking for great value.

The natural corollary of this is that we need to get closer to the customer and develop a relation of trust and delight. It's simple; a home user is also a customer for speakers, web cams, PC headset and gaming devices. Our partners need to leverage their existing installed base to help maximise the PC peripheral expense of these existing customers. The starting point for this would be building databases of customers. Some partners may have 10 customers, some over a 1,000. Partners who have invested in retaining post sale contact stand the best chance of flourishing. So, in case one already hasn't done so, start now. Know your customer's demographic and psychological profile. It helps maintain written documentation. Analyse the same—his love for entertainment, the equipment of gaming and the use of Internet chat. All these are great pointers to what is most likely to be an "easily sale." Also, the type of mouse and keyboard currently used, and the age of the same are also great pointers on "when will he upgrade." The best way to notch up easy sales is to do "studied sales."

### Dream Big, Get Bigger

This is the mantra that we would follow. A close look at the customer outlook will help achieve sales, which so far looked out of reach. Target 100 per cent growth and work backwards to arrive at actions that will help realise dreams of getting bigger.

### Questions

1. Identify different opportunities Logitech has identified for future growth.
2. What is driving Logitech to shift the strategy from lower price to higher value ?
3. What IT initiatives Logitech is planning to make this shift possible.
4. Explain how Logitech can use IT for converting existing 'Partner' into a value adding 'Business Partner.'

5. Which E-enterprise business model is more suited for Logitech?

(Source acknowledgment: Adapted from article, *get closer to customers, dream big & get success by Monidar Jain, Country Manager, Logitech, 360 Magazine, Volume 4, No. 23, Nov. 2004.*)

## 2. LG ELECTRONICS

The world LG spells television sets, computers, laptop, CD drives, DVD players, microwaves, refrigerators and the very recent - cosmetics. But very few people know that we actually started off as a chemical company manufacturing unbreakable caps for cosmetics way back in the early 1950's. The year that changed our status in the market was 1958—a company by the name GoldStar was established in Korea, which went on to manufacture Korea's first radio in 1959. After this achievement, there was no stopping us from turning into a consumer electronics major.

### Our India Roots

In India we started in 1997 as LG Electronics India. Today we have our presence in various domains. In the computers and peripherals arena, we are present in as many categories as you can think - Home PCs (MyPC), notebook PCs (XNote), CD drives, LCD monitors, CRT monitors and much more. We have our presence in the cellphone industry by launching our GSM mobile phones and we have forayed into the CDMA industry through Reliance India Mobile. In fact, we are today the world's largest CDMA handset manufacturer.

### A Steady Today

For the year 2004, we have had a fairly good progress in the IT segment. We recently inaugurated our second manufacturing unit in Pune at the investment of ₹ 150 crores. The major success has been in our PC venture, wherein we grew from a practically zero base to a run-rate business of 10,000 PCs per month. We have posted a 63 per cent jump in sales revenue for the first half ended June'04 as far as IT sales is concerned. The sales turnover for the IT division touched ₹ 325 crores against ₹ 199 crores last year. We are also considered a leader in the optical storage devices arena and have aggressive plans of taking the leadership position in the monitor and PC segments too.

With a strong focus on R & D, we at LG India intend to become a \$10 billion company by 2010 of which 30 per cent will be from exports. With our firm resolution to realise our objectives, we will further consolidate our leadership position in the consumer electronics, home appliances, IT and GSM markets. Additionally we will be launching a range of new products in the year 2005 to materialise our vision. We will also be introducing servers. LCD monitors with F-engine technology, world's only DVD writer with all formats compatible, and so on. We currently have more than 900 regional distributors across India and plans are afoot to increase this number substantially in the coming years. There will be a whole lot of exciting opportunities from new products, new markets and increased channel profitability. High-end products and up-selling will be the key objective for the year 2005.

### Focusing on the Future

For the year 2005, we will be focusing mainly on the market in B and C class cities by appointing new distributors in these areas. We will also increase the number of service centres across the country. Currently, we have about 238 service centres and 30 exclusive IT service centres across India. In the year 2004, most companies into the consumer electronic and IT space have opened their own showrooms across India. We too will follow suit by expanding our network of cyber shoppee providing customers with world-class services.

## Questions

1. Identify the decision and action LG is taking to remain a leader in Consumer Electronics.

Suggest ways and means to make LG an E-enterprise where distributors, service centres and cyber shoppees integrate into LG Electronics.

(Source acknowledgement: Adapted from article, 360 Magazine, Volume 4, No. 23, Nov. 2004.)

## 3. SUNDARAM CLAYTON LTD. (SCL)

The process is more important than the software. Sundaram Clayton, a brakes and aluminium castings manufacturer, seems to have realised this. The core business processes management is supported by information drawn from SAP, an Enterprise Resource Management Software package. SCL MIS largely depends on SAP ERP system.

One of the most difficult things about implementing a software system is to overcome resistance by the workforce that is used to the earlier way of doing things. SCL did this by getting information from users such as senior manager, urged them to voice their grievances with the existing methods, and then proposed changes. This helped create ownership of the project. Says Dhandapani, "We also asked them what they would give the company in return of those changes for the better were brought in. The requirements were thus focussed and weren't made because of top-of-mind recall. For instance, a plant manager promised a one per cent increase in profit from his corner, if a new system brought in the change that he wanted."

Another interesting promise that technology has, for long, been marketing is the instant connectivity for the company with its business partners. SCL has achieved this. When its customers release a daily requirement plan and resources are consumed, there is an electronic trigger sent to SCL's production units. When the components procured from vendors are consumed during production, an automatic electronic alert is sent to the supplier, quoting the quantity and date of delivery through the World Wide Web. Say Dhandapani, "Suppliers respond to this alert."

This is an example of the juncture at which Dhandapani's team, pulled in from across the functions such as planning, marketing and vendor management, comes in useful. Asked if it was too much to ask suppliers to wire up so that they can be adequately connected to receive triggers from SCL for replenishing stocks, Dhandapani says, "That cost is minimal. They only need a PC with a connection to the Internet required at the maximum. No supplier would be unwilling to invest in such equipment."

Dhandapani also stresses the reduced waiting time between the breakdowns of a piece of machinery and setting it right. The company uses the short messaging system (SMS) to alert engineers when a breakdown is reported. Once the problem is addressed, the engineers enter the details of the breakdown, reason (code wise), and the details of corrective actions into the system. This collation of information, over time, helps in analysis and countermeasures to prevent further trouble in cases of repeated component failures. The system also triggers a purchase command for a mandatory spare when the relevant date for the replacement comes about. Says Dhandapani, "Having engineers on call has a tremendous effect. Otherwise, there used to be a delay in the paper work required and all that."

Material transactions use a bar code system. Asked if the time was ripe to move to an RFID (Radio Frequency Identification) system, Dhandapani feels, "Barcodes are still much cheaper to use than RFID tags."

## Genesis/Breakeven

It was easy for SCL to decide on SAP rather than another software system. Many of its customers, such as Tata Motors, Eicher and the like, were already using SAP. Its sister concern and customer, TVS Motors, was also into SAP. Dhandapani had, in fact, overseen the SAP implementation at TVS Motors, which made him a valuable hand here.

Others using the system weren't alone the motive to decide on SAP, though. Says Dhandapani, "SAP addressed the issue of applying web technology using the ERP system elegantly." As SCL's export business and customer base increased over time, SCL had to exchange information with clients in real-time. This was made possible by integrating SAP and the Internet application system with the business systems.

The project cost is about Rs. 4 crore. It was started in the last financial year and the implementation period was about eight months, involving 150 users. Dhandapani says breakeven is estimated in 18 to 24 months.

### **Reduced Time Wastage**

Suppliers not only use the web application to ensure prompt deliveries of raw material or components but also to check their own payment schedules. Dhandapani says that all their payment schedules are on the web. And payment is sent according to the schedule. Suppliers visit the accounts department only in the case of a discrepancy. This has helped free up the accounting department's resources. But SCL hasn't actually reduced the number of the accounts workforce. In fact, says Dhandapani "Much more work is now possible with the same number of people there." About 100 suppliers access SCL's website per day.

Suppliers also use the latest drawings of components and their release numbers available at SCL's website to make sure that they manufacture according to the latest specifications.

On the customer front (suppliers and distributors of components), around 75 per cent of spare parts orders are received directly through the web. They also have the option to check the order service status, billing details, price lists in almost real-time, submit warranty claims, and check settlement status and account details.

They also check parts cross-reference list. This helps because, for the same part, each supplier or customer would have its own number dedicated to that part and that tends to distort information.

### **Benefits**

SCL's inventory costs have already (a few months since implantation has been completed) declined by 25 per cent. While the accompanying table gives an idea of the benefits, Dhandapani sums them up as: linking suppliers and customers with the organisation has improved planning efficiency from disguising existing processes, cost control through budgetary controls and costing system and reduced time taken for transaction processing.

### **Future**

The company will be involved in the rollout of ERP systems in its sister concerns: Harita Seating Systems and Sundaram Auto Components. It will also include modules such as human resources, payroll and project systems which are yet to be implemented. Knowledge management and business intelligence warehouse are its other initiatives around the corner.

<i>Process</i>	<i>What SAP made possible</i>	<i>Major benefits</i>
Functional area: Sales and Distribution Sales order receipt/Sale order receipt/order entry	Order entry through web - by dealers, instead of SCL personnel	Manpower, transaction costs saved. Time to register orders dips 50 pc.

*Contd...*

*Contd...*

Sales from overseas ware-house and pipe-line planning (stock at various stocking points)	Integrated in SAP and pipeline planning done by system. Sales from overseas warehouses recorded online, instead of offline.	Reduction in non-value adding time and accuracy of data. Planning accuracy up 10 pc.
Daily MIS (Management Information System) reporting	Automatic emailing of MIS reports, online display in Internet, as against earlier manual compilation and mailing of printouts	Increased data accuracy time to compile reports down by 75 pc.
Functional area: Material Management Subcontracting 33 entries and 773 printouts.	Document generation involves only 2 steps 8 entries and 20 seconds. Earlier, it took 8 steps,	Time to process documents reduced.
Suppliers communication	Communication to suppliers through website <a href="http://www.tvsapd.com">www.tvsapd.com</a>	Two working days saved in providing relevant information to suppliers; savings in manpower and stationary
Functional area: Production planning Full system	Integrated planning and execution system gives trigger for production units based on customer JIT calls after netting stock norms at SCL warehouse. Production responds to trigger. System also trigger alerts to suppliers through web. Suppliers respond to this and replenish the stock. Safety stock quantity is dynamic as per customer demand. Earlier, the manual system sent alerts on a daily basis.	Improved Service Level, Controlled inventory
Die life monitoring	Online die-life monitoring based on actual production posting that facilitates die maintenance and die replacement planning. Earlier this was done monthly based on actual production.	Improved planning for die maintenance/replacement. Improvement quality fo die casting

## Questions

1. What is the scope of 'Enterprise' SCL has considered while implementing SAP ERP?
2. What is the business process scope and MIS scope handled by SAP ERP?
3. Who are the users and how they are benefited?
4. Identify the functions, which are supported by SAP ERP and state the benefits realised.
5. Identify the technologies, which are supporting SCL, in business operation management.
6. Explain how IT has helped in implementing various management controls and management by exception.

(Source acknowledgement: e-world, October 19, 2004. Case material is an extract for learning benefit to students).

# Strategic Management of Business Performance: Creating a Model of Organisation Excellence

## LEARNING OBJECTIVES

- Business Performance
- Strategic Planning
- Business Strategy; Process of Development
- Class and Types of Strategy
- Business Analysis for Strategy Development
- KRAs, CSFs, KBIs, and KPIs
- Balance Score Card, Score Card, Dash Board
- Business Model of a Business Enterprise
- EFQM Model of Organisation Excellence

### 3.1 ESSENTIALITY OF STRATEGIC PLANNING

There are some compelling reasons which force all the organisations to resort to strategic business planning. The following reasons make planning an essential management process to keep the business in a good shape and condition:

1. Market forces
2. Technological change
3. Complex diversity of business
4. Competition
5. Environment (Threats, Challenges, and Opportunities)

#### Market Forces

It is very difficult to predict the market forces such as the demand and supply, the trend of the market growth, the consumer behaviour and the choices, the emergence of new products

and the new product concepts. The ability of the organisation to predict these forces and plan the strategies is limited for the various reasons. The market forces affect the sales, the growth and the profitability. With the problems arising out of market forces, it is difficult to reorient the organisation quickly to meet the eventualities adversely affecting the business unless the business is managed through a proper business plan.

### **Technological Change**

There are a number of illustrative cases throughout the world on the technological breakthroughs and changes which have threatened the current business creating new business opportunities. The emergence of the microchip, plastic, laser technology, fibre optics technology, nuclear energy, wireless communication, audio-visual transmission, turbo engines, thermal conductivity and many more, are the examples which have made some products obsolete, threatening the current business, but at the same time, have created new business opportunities. The technological changes have affected not only the business prospects but the managerial and operational styles of the organisations.

In the absence of any corporate plan, such a technological change can bring the organisation into some difficult problems and, in some cases, can pose a threat to its survival. The corporate plan is expected to ensure the recovery of the business investment before such a technological change takes over.

### **Complex Diversity of Business**

The scope of business is wide, touching many fronts. The variety of products, the different market segments, the various methods of manufacturing, the multiple locations, the dependence on the external factors, such as the transport, the communications and the manufacturing resources brings complexity in the management of business. Many factors are uncontrollable and unless there is a plan, prepared with due consideration to the diverse and complex nature of business, handling these factors is not possible. This might lead to the loss of business opportunity.

As the business grows, it reaches a stage where the strategies such as the expansion—vertical or horizontal, integration—forward or backward, diversification—in the same line or in the diverse line of business, are the issues which the management is required to handle. These issues are investment-oriented and have a far-reaching effect on the business growth, direction and profitability.

### **Competition**

Facing competition in the business means fighting on a number of fronts. Competition could be direct or indirect. It may share the market or create a new product which will shift the market affecting your business. Competition could be solely in the management of business, when there is hardly any product distinction or it may come from certain sectors which are being promoted by the government. The companies compete on the merits such as the know how, quality, prompt delivery, after sales service, etc.

Competition is a natural phenomenon in business, and it has to be dealt within a proper manner to protect business interests. This means that the management has to continuously

evolve new strategies to deal with the competition. Evolving strategies and their implementation, calls for forward thinking and planning, without which it is not possible to handle competition.

Competition forces the management to look for new products, new markets, and new technologies to keep the market share intact, the process controlled and the quality improved. Strategies also have to be implemented in a proper sequence as business competition demands an intricate planning, testing and implementation of the strategies. The competition should never be underestimated and has to be met squarely through corporate planning.

### **Environment**

The environment is beyond the control of the management. Depending upon the organisation's business and its propose, different environments have bearing on the fortunes of business. It could be one of the social, business, economic, industrial, technological environments affecting the business. Many a times, it would be a mix of different environments. The environmental changes are difficult to predict and are generally slow. Therefore, many times the managements, are caught unaware by the environmental changes. To illustrate the environment's impact on business, some examples of recent origin are mentioned as follows.

Widespread education programmes have created new opportunities for knowledge processing and communication. The introduction of television has adversely affected the film industry and its immense popularity has considerably restricted other amusement activities like going for a picnic or to a circus. Personal computers are fast replacing the typewriters on account of changing office environment.

Values and attitudes make the penetration in the market difficult. The difference in the values and attitudes of the rural and urban consumers calls for separate products, with different advertising strategies for them. The attitude of the consumer towards fast food or frozen food decides its spread and popularity. Similarly continuous increase in the cost of transport affects the tourism and hotel industry, but promotes the home entertainment industry. The policies of the Government also affects the business and the industry. The international laws and agreements create new opportunities and threats to the business.

Forecasting the probable environment changes like the change in population, population mix, consumer preferences and their behaviour, government policies, new opportunities and so on and so forth, is a major task under corporate planning. Evolving the strategies to meet these changes is another major task.

Business planning, therefore, is absolutely essential for the survival of the business. Peter Drucker defines long-range planning as the process of making the present managerial (risk taking) decisions systematically and with the best possible knowledge of their futurity, organising systematically the efforts needed to carry out these decisions and measuring the results of these decisions against the expectations through organised systematic feedback. Planning is neither forecasting nor making future decisions today; it is making current decisions in the light of future.

Planning does not eliminate the risk but provides an effective tool to face it. Comprehensive corporate planning is not an aggregate of the functional plans, but it is a systematic approach aiming to manoeuvre the enterprise direction over a period of time through an uncertain environment, to achieve the stated goals and the objectives of the organisation.

### 3.2 TOOLS OF PLANNING

Planning, long-range or short-range, strategic or tactical, involves a series of decisions to be taken by the managers in the organisation. So when we talk about the tools of planning, we are talking about the tools of decision-making with reference to planning.

Decisions relate to several aspects of corporate business planning. There are a number of alternatives, choices and options available while planning the business. Further, there is selection of resources and their allocation in an optimum manner to maximize the gains. Then there is selection of method whereby the efforts at all the levels are coordinated towards a common goal and direction. The planning, therefore, involves decision-making with the help of tools. These tools are based on one or more factors. These factors are: Creativity; Systems approach; Sensitivity analysis; and Modelling.

#### Creativity

Creativity comes out of an experience, a judgment, an intuition of an individual or a group of individuals. When decision-making is called for a situation which has no precedent then creativity is the only tool to resolve the problem of decision-making. Creativity is the result of the conceptual skills of an individual. The conceptional skills comprises the following skills.

1. The ability to generate a number of ideas rapidly.
2. The ability to change quickly from one frame of reference to another.
3. Originality in interpreting an event and generating different views on the situation.
4. The ability to handle with clarity and ease a complex relationship of various factors in a given situation.

A person who possesses these skills is said to have a conceptual fluency. If an organisation has a number of people, at least at key positions, with conceptual fluency, then it becomes a creative organisation. Such an organisation creates new ideas and new strategies for development of business. The plans are made on the strength of experience and conceptual fluency.

#### Systems Approach

Systems approach to planning considers all the factors and their inter-relationship relevant to the subject. It takes a course to an analytical study of the total system, generates alternative courses of action and helps to select the best in the given circumstances. It is used in a situation of risk or uncertainty, and examines the various alternative courses of action. It helps to find solutions to problems.

The systems approach helps to understand the situation with clarity. It helps to sort out the factors on the principles of critical and non-critical, significant and insignificant, relevant and irrelevant, and finally controllable and uncontrollable. It tests the solutions for feasibility—technical, operational and economic. It further studies the problems of implementation of the solution.

Broadly, the systems approach has the following characteristics:

1. It uses all the areas and the branches of knowledge.
2. It follows a scientific analysis to identify the problem.

3. It uses a model of a complex situation to handle the problem.
4. It weighs cost against benefit for assessment of the alternatives.
5. It deals with the problems where time context is futuristic.
6. It considers the environment and its impact on the problem situation.
7. Every solution is tested on the grounds of rationality and feasibility, and accepts a given criterion for selection of the most preferred alternative.
8. It uses operations research models if the problem is well defined. Alternately, it uses a simulation approach to solve the problem. It uses tools such as Gantt chart, PERT/CPM, Network analysis for scheduling and coordinating the activities.

The systems approach is a way of looking at a problem in a systematic manner using the scientific methods and applying the principles of a rational decision-making to solve the problem.

### **Sensitivity Analysis**

The sensitivity analysis helps to test the validity of the solution in variable conditions. The problem situation is handled with certain assumptions and conditions. Based on these considerations, a rational solution is found. Sensitivity analysis requires to know whether the solution will still remain valid if the assumptions changed, constraints were relaxed and new conditions emerged. It helps to assess the impact of change on the solution in economic terms. If various factors are involved, the sensitivity analysis helps to assess the criticality of the factor against the impact it makes on the solution. Some factors will be highly sensitive and some will not be so. Most of the decision-making problems are resolved on the principle of optimality, where you are trying to balance the two aspects of the problems, such as, inventory carrying cost versus ordering cost, waiting time cost versus idle time cost, costs versus benefits, opportunities loss versus investment cost and so on. The sensitivity analysis helps to test the validity of the optimal solution under changed conditions.

Sensitivity analysis helps to test the solutions on the principle of utility. A solution which is economically rational and is based on a sound business principles may be rejected on the principle of utility. The utility profiles of all the people in the organisation are not the same. The utility profile, alternately known as a preference curve, shows the attitude and preference of the decision-maker towards the gains and the losses against a time scale. The profile shows indirectly the risk-taking ability of the decision-maker. It uses techniques such as the decision tree analysis, methods of discounting, payoff matrix, simulation, and the modelling.

### **Business Modelling**

A model is a meaningful representation of a real situation on a mini scale, where only the significant factors of the situation are highlighted. The purpose of a model is to understand the complex situation based on only the significant factors.

There are several types of models. The model could be a physical model, like a model of a house, a park, a sports complex, etc. The model could be a scale model reducing a large body to small one. The model could be mathematical model like break even analysis model, linear programming model, queuing model, network model, etc. Here a situation is represented in a mathematical form such as equations, matrices graphs and polynomials.

A complex situation is represented using variables, constants and parameters which play a significant role in that situation. The model is based on the relations the variables have. The relation among the variables may be linear or non-linear. The model only considers the relations of high significance. The model, when a situation is complex, tries to simplify the complexity by ignoring minor factors and emphasising only minor important factors.

A model could be static or dynamic. The physical models are static models. Some business models like the break even analysis model, the statistical regression models and some of the O.R. programming models are static models. The static model does not change over a time period.

All the planning models and all the forecasting models are dynamic models. In a dynamic model, in addition to the variables considered, time is a dimension of the variables. The values of these variables change with the change in time. Such variables are called the stochastic variables.

A model, physical or mathematical, static or dynamic, needs to be tested for its utility or effectiveness. The model can be tested by using the control results already obtained. This would show the difference between the result given by the model and the actual result in a real life situation. If the difference is not significant, then one can say that the model represents the real situation. Once the model is proved useful, it is used for testing the various solution alternatives. The selection of a solution, from many alternative solutions, depends on the objective chosen. In a linear programming model, a solution is selected on the principle of maximization of the profit or minimization of the cost. In the queuing model a solution is selected, when the cost of the waiting time of a customer is less than the cost of the idle time of facility. The selection of a solution is based on the attainment of certain value of some aspect of the business, such as the turnover, the cost and the profit and so on.

The planning model considers those business variables which affect the business prospects and which show a significant impact on the business results. The long-range strategic models are, generally, dynamic models and the short-range management and operations models are mostly static models.

### **Business model**

We apply modelling concept to understand how business enterprise conducts its business and achieves its objective. This is done through building a Business Model of an enterprise. The enterprise is in the business for some purpose. This purpose is achieved through establishing a delivery framework of 'Input- Process-Output'. This framework could be different for different organisations in the same business. Oil and Petroleum, Banks, Auto manufacturing, Hotels and Airlines, and many more are the businesses serving the society. But organisations in each of them have different delivery frameworks (Business Models) framed to suite their strategy implementation and achievement of goals. These business frameworks are very complex to understand. We build business model to get over the problem of understanding the complexity.

The Business Model (BM) is a simpler way of representing complex framework of business operations and how they deliver results.

Before we discuss more about business model, let us understand the meaning of the following. What is business? And what is the purpose of business you are in? Answering these questions would help the meaning, purpose and use of business model in managing business for achieving excellence, superior performance.

- **What is business?**

Business is an economic activity driven by human efforts involving well-defined tasks namely buying, making and selling an 'output' for which market exists. Business may deal with products or services. A business that makes nothing but money, is a poor kind of business, say's Henry Ford.

- **What is the purpose of business you are in?**

Dr. Peter Drucker says: If we want to know what a business is, we have to start with its purpose. And the purpose must lie outside the business itself. In fact, it must lie in the society, since a business enterprise is an organ of the society. There is only one valid definition of business purpose: to create a customer. The customer is a foundation of the business and keeps it in existence, if the customer interest continues in a big way. There is no unanimity, however, on the meaning of business purpose. Some believe it is to maximise shareholder profit; some believe it is a service to community at large. Some are of the opinion; that it is for the achievement of the entrepreneur's personal goals and the interests of serving people and the society.

Here are some illustrations of business model and business purpose.

- *The Amul business model of dairy development is a three-tiered structure with the dairy co-operative societies at the village level federated under a milk union at the district level and a federation of member unions at the state level.*

*Amul is founded with the purpose of providing quality products to consumers at an affordable price while safeguarding the interest of both our major stakeholders—the farmers—and the consumers whose loyalty is essential to our continued success. (Gujarat Cooperative Milk Marketing Federation Ltd. (GCMMF), [www.Amul.com](http://www.Amul.com).)*

- *Business model of Konkan Railway is People Public Participation (PPP). The business purpose of Konkan Railway is to provide the missing link between India's commercial capital, Mumbai, and Mangalore. The 760-kilometre line connects Maharashtra, Goa and Karnataka states—a region of criss-crossing rivers, plunging valleys and mountains that soar into the clouds. ([www.konkan railwy.com](http://www.konkanrailwy.com))*

### **Definition of Business model**

A business model is defined as the framework of how an organisation conducts its business and creates and delivers value to the customer. The delivery processes and the value offered are attractive to the customer to pay and for the organisation to earn profit. Business model explains the business in terms of Infrastructure, People Organization structure, and Business functions structure and many other facets of business.

Business Model, if studied in depth, reveals management's vision, mission and strategic content planned to deliver value to the customer to make profit.

Also should be noted, BM is not a static model, but if it continues to be static disregarding the changes around in environment, enterprise runs a risk of loosing on business. Hence BM needs continuous monitoring to ensure its continuity in a changed environment as well.

Business leaders those who see the shadows of changes in advance take innovative steps to modify the business model consistent to new needs of customer, market and so on. They may change vision, mission, and strategies to meet the challenges of changed environment. The BM undergoes a change.

Though there is a general agreement on 'What is a Business Model', there is no standard design of Business Model which can be applied to all enterprises. In global business environment of the day, Michael E Porter, Professor, Harvard University, USA has defined five competitive forces that shape strategy to face these forces. This is deliberated in an interview given to Harvard Business Publishing.

The five competitive forces which an enterprise are required to manage very effectively to remain a leader in business are following.

- **Potential Entrants:** Economics of Scale, Proprietary Product Differences, Brand Identity, Switching cost, Absolute cost advantage, Government Policy....

*Potential entrants can come through technology route where economies of scale can be achieved by application of technology making product or services attractive and cost becomes the value proposition.*

*Another possibility of new entrant coming in is the entrant has distinguishing, differentiating product or service to offer. (Godrej and LG).*

*Entry of superior brand in the market like Nokia or Micromax is a force to reckon with.*

*The new entrant may have product, process, technology and core competency giving the entrant unbeatable absolute cost advantage. Many times developing countries declare policies to facilitate such entries from world over. Development of SEZ, IT parks, development of industry specific clusters, tax concessions and so on.*

- **Rivalry among existing competitors:** Product differences, Brand identity, Switching costs, Industry growth, Fix costs, Core competencies, Creativity & Innovation.

*Existing competitors are in the market because of product differences which appeals to different market segments. If the total market and its segment mix undergo a significant change, then it is a threat to the business. For example, middle class in India is rising every year opening new customer needs through product and services. The products or brands which were not high on sale would show immediate rising trend. In this case, Brand identity and consciousness is also becomes a value for customer. Dissatisfied customers switch brand or product if cost of switching is not very high and gains are higher in switching.*

*Laptop, house hold consumer goods, low end cars in Auto sector are some examples of where switching cost is not high.*

- **Supplier Power:** Differentiation of inputs/supplies, Switching cost, Supplier merits, Cost % in total cost, Possibility of forward integration.

*Suppliers get upper hand and play significant role in driving your business. For example, supplier has a power over you because of high switching cost you will incur if you think so. Further, if the supply is a high % component in the total cost, you will consider twice switching. In many cases, the core competency of the supplier is a power which assures you to be with the supplier. Many suppliers have competencies to give you a supply through forward integration making your cost & quality. The supplier power is a result of such factors.*

- **Buyer/customer Power:** Volume of business, Low Switching cost, Substitute products, Price sensitivity, Buyer Brand.

*Buyer/customer power is similar to supplier power. Customer exercises this power in every business dealings, pricing, delivery priority, some freebees and so on. If customer being loyal and is a major buyer, then this power is very high. Buyer also threatens if switching cost of your product or service is low. If the customer's profit margin is low, then his price sensitivity is very high refusing to accept any price correction. The Customer/Buyer is a reputed brand in the market.*

*Such brand in your customer list is actually your power. The buyer brand, being a customer, you can afford to lose.*

- **Substitutes as threat:** Switching cost, Relative Price Performance, Buyer/customer propensity to substitute.

*If your business offers product or services which has a potential of substitute and if switching cost is attractive, then your business has a threat. Examples are Rubber vs Plastic, Desktop vs Laptop vs Notebook, Cotton vs Teri-cot. In all substitute situations, cost may not be an issue. It could be service, design, and relative price performance. In brief it is a trade off between substitute vs your product will decide the strength of the threat.*

The professor also prescribes eight key aspects of business which every enterprise must manage to face five competitive forces. They are

- Value Proposition: Why should customer buy from you?
  - *Compelling Value Proposition for customer to choose among others. Nirma soap: 'Doodh ki safeti' or shoodh safety.*
- Revenue Model: Different revenue streams.
  - *Revenue streams designed to appeal different types of customer segments.*  
*Auto manufacturers; different revenue streams for different customer segments; Individuals, corporate, taxi drivers, corporate employees.*
- Market Opportunity: Is there a market for that value? Market space, an opportunity and its size.
  - *Does customer sees value in your value proposition and is that customer segment large enough to venture in. 'Tata nano': large segment at the bottom of the pyramid and take pride in becoming a car owner.*
- Competition: Who else is in that space?
  - *Your competitors holding significant market share and are threat to you.*  
*In auto business Maruti vs Hyundai vs Chevrolet are threat to each other.*
- Competition Advantage: What is it brings to market which you don't?
  - *Your advantage or edge over competition. LIC Corporation: Experience in insurance policy marketing in India is a competitive advantage.*
- Market Strategy: How do you plan to promote to attract customers?
  - *Appropriate marketing strategy to raise market share. Private banks used technology-driven market strategy for attracting young professionals.*

- Organisation structure: What structure (s) is necessary to execute business intent.
  - *Present organisation structure empowered to execute strategies and deliver the value. Telecoms, private banks are examples of empowered organisation structure for implementing business processes.*
- Management Team: Do you have core competency, experience, expertise etc?
  - *Key personnel at the top, possessing core competency, knowledge which competition do not have. Pharmaceutical and Airplane manufacturers have core competency and knowledge which competition does not have.*

Hence, the best way of building a business model for any business enterprise is to identify these eight aspects followed by a statement of vision and mission of the enterprise. If you want to study a business organisation and its complex business operations, an approach of building a business model is the easiest one.

### 3.3 BALANCE SCORE CARD, SCORE CARD AND DASH BOARD

A new approach to strategic management was developed in nineties by Dr. Robert Kaplan and Dr. Davie Norton. They recognised some weaknesses and ambiguity in then prevailing traditional approach to strategic management and thought of new approach termed as 'Balance Score Card (BSC); Unlike the traditional approach which rely on accounting data, BSC takes a comprehensive balance view of four business aspects; Finance, Process, People and Customer. Hence, the new approach is termed as Balance Score Card. The view talks about objectives, measures, targets and initiatives in these four aspects of the business. The advantage of BSC is that it clarifies the organisation's vision and enables to think in terms of more clear strategy for action. BSC deals with internal business processes and their outcomes, and impact of outcomes on business performance.

Kaplan and Norton called new approach as innovation as it destabilises traditional approach to strategic management based on measuring what has happened? And extrapolating into future. They agreed that this approach does not focus on capabilities and critical success factors and customer relationships, which are important in Information driven organisation working for competitive advantage. They advocated that approach now should be to create value through innovation by investing in customers, suppliers, employees, processes and technology.

BSC approach recommends view of organisation in four perspectives with setting clear vision and then for evolving effective competitive strategy.

The perspectives are

- The learning and growth HR perspective
- The business process perspective
- The customer perspective
- The financial perspective

Traditionally the business plans were a combination of different project plans and financial plans. And, therefore, organisation performance indicators were also basically financial ratios and project progress indicators. The business model was the push model organisation,

required to focus on internal operations and its impact on the balance sheet. Financial planning and control through financial tools of performance measurement were adequate to manage an organisation.

However, the environment of business has undergone a radical change during the last two decades. The competition has become global due to globalisation and liberalisation of world markets. The management has become 'Strategic Management' and planning has become Strategic Planning. New tools of strategic management like Total Quality Management (TQM), Business Process Re-engineering (BPR) has appeared on the scene. Profit and Profitability have given way to Value-added and Economic Value-added (EVA) and Market Value-added (MVA) analysis.

Financial measures using financial tools are inadequate for guiding and evaluating the performance and operational effectiveness of an organisation's business strategies. They are lagging indicators. The Balanced Scorecard complements financial measures of past performance with measures added using four perspectives: Financial, Internal Processes, Customers and HR and growth.

The Balanced Scorecard provides managers a tool they need to navigate to future competitive success. Today, organisations are competing in complex environment, so, an accurate understanding of their goods and the methods for attaining those goods is vital. The Balanced Scorecard enables companies to track financial results while simultaneously monitoring progress in building the capabilities and acquiring the intangible assets they need for future growth.

The Balanced Scorecard is a management system that enables organisations to clarify and communicate their vision and strategy to all employees and stakeholders and translate them into action. It provides feedback on both the internal business processes and external outcomes providing guidance to improve business strategy performance and results. Balanced Scorecard transforms strategic planning from a board room exercise into the action and decision centre of a business enterprise.

Balanced Scorecard provides managers a fast and comprehensive view of the performance of a business in key result areas through "Key Operations and Performance Indicators."

The Balanced Scorecard is made up of four key elements. These elements are defined as:

**LEARNING AND GROWTH: HR Perspective:**

Identity and Resources of the Organisational Framework

**Measures:** HR Performance, Employee Satisfaction, Training, IP developments, Empowerment, Knowledge creation.

This perspective works at the ability of employees. Internal business processes will only succeed if adequately skilled and motivated employees, supplied with accurate and timely information, are driving them.

**INTERNAL BUSINESS PROCESS: Efficiency, Effectiveness Perspective**

Internal Perspectives are the critical processes necessary for delivery of superior performance in achieving results in key result areas.

**Measures:** Project Performance, Operation Performance, Rejections/Reworks, Cycle Times, Success Rates, Repeat business value.

In this perspective, the managers must identify the internal mission critical key processes that are crucial to the organisations operations and performance. These processes are the ones that deliver superior value to their customer and achieve financial targets.

**CUSTOMERS: Satisfaction and Loyalty, Perspective:**

Identifies Customers, Markets, Value Proposition and Satisfaction

**Measures:** Market Share, Retention, New Customers, Satisfaction Indices, Customers Profitability, Customer retention, and so on

This perspective aims at identifying the customer and market segments in which the business units will choose to compete.

**FINANCIALS Perspective:**

Financial indicators will vary from organisation to organisation but they are based on the expectancy of the organisation's strategic objective.

**Measures:** Revenue, Growth, Reductions, Margins, Profitability, Cash Flow, ROI, Forecasts, Financial ratios.

The Balanced Scorecard retains the financial perspective as a measure of economic consequences of action already taken. Financial performance measures indicate whether a business strategy implementation and execution are contributing to bottom-line improvement.

The learning and growth perspective focuses on sustaining the ability of the organisation to change and improve. The customer perspective focuses on what customers perceive as their need which an organisation should deliver. The business processes perspective identifies the processes, which are capable of delivering the customer need. Financial perspective focuses on perceiving shareholders needs while meeting customer needs. BSC prescribes these perspectives to measure and evaluate every activity of the organisation. BSC is a strategy management system driven by four perspectives. The BSC system development process can be described on following lines as shown in Table 3.1.

**Table 3.1** BSC System Development Process

BSC Process step	Process description	Understanding of the step
1	Set vision	Where are we and where should we be after some period?
2	Evolve strategies to achieve vision	How do we reach there?
3	Decide strategic actions to implement strategy	Which actions/decisions will make strategy a success?
4	Take BSC perspectives and determine CSFs and link them to strategy and action	Which critical success factors (CSFs) will be affected by strategy and actions?
5	Determine the measures and targets to evaluate perspectives and impact on CSFs	How to measure and evaluate the effectiveness and impact on CSFs?
6	Prepare action plans, fix responsibilities and implement BSC	How it will happen and who will be responsible?

The essential founding propositions of BSC are:

1. A successful organisation will have well stated strategic objectives communicated to all and understood by them.
2. An organisation has a well-defined value proposition, which is customer centric and has significant impact on financial results and business performance as a whole.
3. Organisation has excellent processes in operations to create that value.
4. Top management gives top priority to all such processes and ensures through innovation that they produce excellent results on continuing basis.
5. Organisation's information system structure gives information support to track the process of the strategy implementation, and provides measures on financial results, customer needs and delivery, process performance, and employee performance. Such information support is a key enabler for successful BSC implementation.
6. Since there is a time lag between strategic action ad resultant achievement of financial results and performance targets, a system like BSC is essential to measure the performance against the target, and get the feedback and act proactively to achieve stated vision, goals, objectives and targets.

The benefits of BSC approach to strategic management of business can be summarized as follows:

- It helps link performance measures to strategy at all levels in the organisation i.e. strategy – plan and action, operations, and outcomes and impact on targets.
- It provides a multidimensional comprehensive view of operations and performance, and its impact on vision and target.
- People (Customers, Suppliers, Employees) have one method (BSC) to understand and communicate vision, goals, strategies, plan, action, targets and achievements.
- Generates business knowledge on continuing basis through strategic feedback to become a learning organisation.

From the view point of MIS, it can be said that BSC provides a clear platform to work upon to develop information system to support. BSC implementation information systems should be designed to capture data and process it to analyse and evaluate BSC effectiveness in attaining the business performance and organisation development.

The balance score card is a strategic planning and management tool that is used in organisations to align business activities to the vision and strategy of the organisation. It was originated by Dr. Robert Kaplan and Dr. David Norton as a performance measurement framework that added strategic non-financial performance measures to traditional financial measures represent a more 'balanced' view of organisational performance.

With the introduction of the Balanced Score card, use of Score card and Dashboard began emerging as a tool for displaying, trending, analysing and executing actions to improve performance using the balanced scorecard concepts. The score card and dash board are the tools used for assessing and monitoring the business performance and the process performance which achieves it. A majority of organisations have adopted scorecards and dash boards as their preferred way of viewing performance information.

In many ways, dashboards and scorecards represent the culmination of business intelligence. A dashboard or scorecard interface finally makes it easy for a majority of key managers

to quickly find, analyse, and explore the information they need to perform their jobs on a daily basis.

Every organisation no matter how big or small needs a score card and dashboard to give a feel of direction, a measure to gauge, that they know where organisation is headed. The dashboard is steered by the company's mission statements, visions, strategic directions, and strategic initiatives.

The names 'dashboard' and 'scorecard' are chosen with respect to their real-world usage and understanding people have. A scorecard is a report card on points scored by Manager, CEO, Business unit or Entity in business operations with respect to certain goals over a given time period. A dashboard indicates the performance in key performance areas through a set of indicators about the state of a process, or business metric such as cash on hand or year to date sales at a specific point in time.

There is a subtle distinction between score card and dash board that is worth understanding. This is illustrated in Table 3.2.

**Table 3.2** Score Card and Dash Board: Difference and Distinction

	<i>Dashboard</i>	<i>Scorecard</i>
<b>Purpose</b>	Displays performance	Displays progress
<b>Usage</b>	Performance monitoring	Performance management
<b>Updates</b>	Real-time feeds	Snapshots at chosen time interval
<b>Input Data</b>	Events	Operations Results Summaries
<b>Measures</b>	Metrics built on KPIs	Key performance/result indicators
<b>Context</b>	Exceptions, 3As	Targets, thresholds, standards
<b>Impact</b>	Strategy	Strategy Implementation plans

## Dash Board

Dashboards monitor and measure processes performance. The common industry perception is that a dashboard is more real-time in nature, like an automobile dashboard which informs driver continuously of the current speed, fuel level, and engine temperature at a glance. It follows that a dashboard is linked directly to operating systems of the car and its performance. It warns driver through 3As, (Attention, Alert, and Action) or exception display, when performance measured by speed, fuel level, and temperature deviates from the norm. Internally, the system works out different metrics to conclude whether car is running safe and if not 3As are displayed. Hence dashboard focuses on processes which drive the car and reports on their performance. Dashboards provide alignment, visibility and collaboration across the organisation by allowing decision makers to define, monitor and analyse business performance and business strategy via key performance indicators (KPIs).

## Score Card

Scorecard charts progress at a point of time, day, week or month towards reaching objective. Score card is build for key result areas in business operations by choosing Key Operations Indicators. Business organisations evolve strategies for implementation to achieve significant

results in key areas of business. The common perception of a score card is that it displays periodic snapshots of performance associated with an organisation's strategic objectives and plans. It measures business activity at a summary level and compares against predefined targets to see if the performance of business operation is within acceptable ranges. Its selection of key indicators helps executives to communicate strategy performance and enables focusing on the highest priority tasks required to execute plans and strategy.

Dashboard informs executives how processes are doing and a scorecard tells them how well they are doing. In other words, a dashboard records performance while a scorecard charts progress. A dashboard is a performance monitoring system, whereas a scorecard is a performance management system.

Dashboards and scorecards are mutually exclusive and hence both are required for use to do well in business. Dashboards measure performance against key business objectives. Scorecards empower users with actionable information to change business outcomes.

### **Basic Design of Score Card and Dash Board**

#### ***Basic Design of Score Card***

Main score card will be containing Key business operations results, such as Sales, Order book, Receivables, Payables positioned against their respective targets or norms set by the management. It also shows operations performance by% or ratios. For example, Sales vs Receivables percentage would show whether sales realized are at desired credit level. These are snapshots shot at equal time interval. The scorecard may show progressive trend in the key results for manager. For example, manager would see that sales target is being achieved at the cost of increased receivables.

Second component of the design of a scorecard shows exceptions or deviations which has caused the adverse impact on the key result.

For example, sales results show unexpected decline. But this decline is due to fewer sales in two market segments. Such exceptions or deviations from the set targets provide focus to manager to act.

Third component of the design could be charts, graphs, pictures, images made using the key results and highlighting the comment which requires focused attention and action.

#### ***Basic Design of Dash Board***

A dashboard design is made for real time display of various key performances and their expected or desired performance norms. It is not a snapshot but continuous on timescale.

The design is similar to a clock displaying the performance key business parameters. In a car, driver has a dashboard and in a plane pilot has several dashboards showing the performance of fuel vs miles traveled, air pressure vs height of the flight and so on with provision of different color schemes, alarms, light blinks for pilot to intervene in the flight operations.

A well designed dashboard communicates performance in context quickly and easily. It gives business manager just the information they need in a quick glance and even alerts them to the conditions that need immediate attention. The support of these new tools help managers more effectively executes the organisation's key strategic objectives, plans, and business processes.

For successful design of score card and dash board, it is important to ensure that strategy, goals, metrics and data collections are defined accurately. The goal of utilising dashboards for display and analysis of KPI's is to show the health of each area of your business, improve efficiency and gain new insight into business processes that contribute to the success or failure of the organisation.

Let us now illustrate these ideas on design and contents of score card and dash board.

Let us take a case of a customer service organisation where organisation is engaged in servicing the customer on call basis. The manager is responsible for customer support function. In service business customer needs prompt service, quick resolution of the problem and supportive relationship. This is a key performance area of the service business. The well thought out score card and dash board would go a long way in enabling the manager to fulfill the customer support functions.

The scorecard could contain following measures along with the goals aimed to achieve:

- Median issue resolution time (4 hours)
- Average issue resolution time (5 hours)
- Percentage of issues resolved at first contact (70%)
- Percentage of issues resolved at second contact (30%)
- Percentage of issues resolved within a certain amount of time (2 hours, 20%)
- Utilisation of Service center staff (95% per month)

These would all be collected over a time period regularly, say monthly, and would be typically be base lined against specific goals, either in absolute terms or as improvements versus a prior period. This score card would give information on achievement of goals at the end of month and also would indicate how achievement is in progress over six or eight months. It would also give comparison with the period over previous year.

The dashboard for this manager might contain Key Performance Indicators (KPI) such as:

- Number of issues in queue awaiting attention vs number of issues being attended
- Current waiting time for issue to get service attention vs number of people in service function.
- Current hold time for escalations
- Current number of issues under service attention
- Current average resolution time of an issue

All KPIs together reflect on the quality of service, Issue Resolution Process, and its efficiency. Each KPI would have a pre determined threshold and dash board system will continuously monitor the process performance real time against these thresholds.

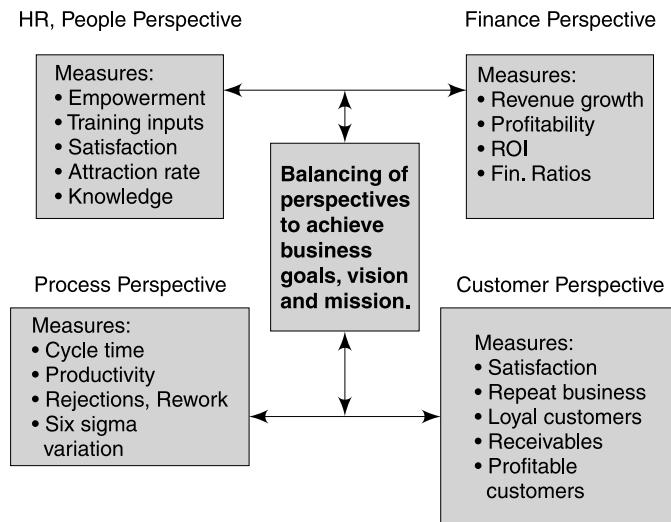
- Dashboards work better for data in fine time-slices (hours or minutes), while scorecards tend to be better-oriented to data that is more appropriately understood over a longer time context (weeks or months). Consider the cycle time of the activity driving the data. For example, the manager of sales campaign for credit card protection services, in which the sale cycle is measured in minutes, could benefit from a dashboard to see how changes in a call script impact conversions. On the other hand the VP of sales for credit card is more interested about activity by week or by month, which fits better into a scorecard model.

- Dash boards are effective when they are used at the level of point of action and results. Its aggregation and display on the board does not offer great sensitive information. For example, there is little value to a VP of manufacturing for a multi-site operation seeing unit production per hour in real time, while there is substantial value in looking at unit comparative trends in daily or weekly production.
- Dashboards are usually ineffective for project-driven businesses or business segments because there are very few meaningful indicators that work in a real-time. In projects, results and progress is registered at longer intervals.. That is not to say that one can't and shouldn't monitor project performance, but there are few real-time metrics that can be applied to your research and development or new product launch group's.
- Integrate scorecards with Corporate Planning. In this model, the executive board would perform high-level strategic planning and define goals for the CEO. The CEO then meets with his subordinate and develops objectives derived from the CEOs goals and integrates those into the system, and so on. The system actually requires that each subordinate goal can be tied to one or more goals of their manager (or manager's manager, etc). At the end, the net result is that every tracked goal in the entire company can map back to a corporate objective developed by the board.
- Develop scorecards wisely—The key point here is that if you are developing a scorecard with rewards assigned to particular performance objectives, make sure those performance objectives really align with the organisational objectives.
- Make score cards and dashboards part of organisation's work culture. Use these tools to measure accountability of the individuals to their achievements. Ensure that they are used to set and track corporate goals.
- Choose actionable KPI: Choose indicators that will inform an individual of actions to take. Find Leading KPIs—Dashboards with lagging indicators aren't very useful. Lagging indicators are not actionable, at most they are informative. Leading KPIs are actionable to save or correct the situation. Provide attention, alert, and action points for each KPI.
- Not every KPI has to be monitored precisely in Real Time
- Integrate dashboards into larger MIS and make it dynamically operative in real time

We illustrate the balance score card (Fig. 3.1) approach developed by Dr. Robert Kaplan and Dr. David Nortan by its application to Multi Brand Retail business.

### **Balance Score Card (BSC) for Multi Brand Retail**

- *HR Perspective:* Learning and Growth:  
Floor Staff Performance, Employee Satisfaction, Training,  
Unit of measure of perspective: Knowledge contribution: Number of suggestions, customer queries, and complaints resolved.
- *Processes Perspective:* Efficiency, Effectiveness Perspective  
Unit of measure of perspective: Rejections/Returns, Cycle Times, Repeat/Member Business Value.
- *Customers Perspective:* Satisfaction & Loyalty Perspective:  
Unit of measure of perspective: Satisfaction Indices, Customers Profitability, Repeat buyers, 80/20 Analysis, and Availability Index.

**Fig. 3.1** Balance Score Card Model

- **Financial Perspective:**

Unit of measure of perspective: Revenue, Growth, Margins, Profitability, ROI, Financial ratios.

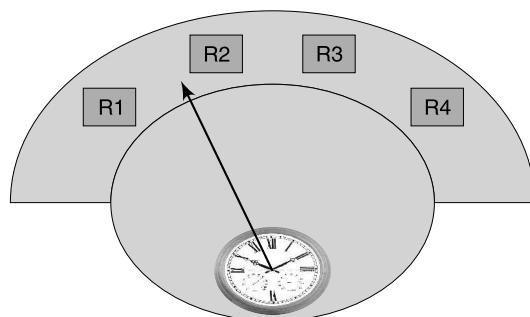
#### Score card for a day (KBI)

Parameter	Actual	Target
– Visitors	4080	5000
– Customers	2000	3000
– Members	234	1500
– No. of Bills	2769	3200
– Av. Bill value	795	1200
– Returns	35	10
– Inventory	₹ 2.6 million	₹ 2 million
– Complaints	20	None
– Queries	45	10
– Suggestions	5	10

#### Dash Board: (KPIs)

##### Actual/Target

- |  |                 |
|--|-----------------|
| • Ratio: Visitors to Customers (R1):   | 50 %/70 %       |
| • Ratio: Members to Customers (R2):    | 12 %/30 %       |
| • Ratio: Revenue to Inventory (R3):    | 1 to 4.5/1 to 6 |
| • Ratio: Complaints to Customers (R4): | 1 %/0.5 %       |



**Fig. 3.2** *Dash Board: Real time Performance Indicator*

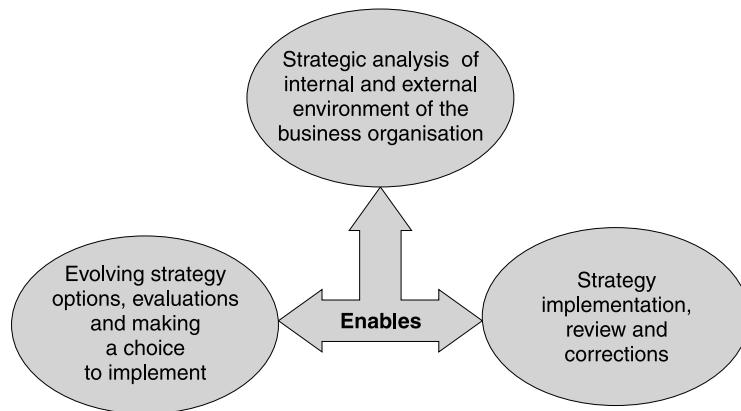
### 3.4 STRATEGIC MANAGEMENT OF BUSINESS PERFORMANCE

We are performing in a globally integrated digital world of business. Business processes run across the country and across the continents. The decision-making is information, knowledge and business intelligence driven. The business management is complex, risk-prone and highly competitive. The management processes require more strategic long-term comprehensive approach to remain efficient and effective. The business management is more now strategic, asking strategic thinking at three levels, Corporate, Business, and at Functional, operational level. It is now a strategic management of business aiming at superior business performance. So, strategic management thinking focuses on business management for achieving superior business results, and strategic performance management focuses on achieving those results efficiently and effectively.

- Strategic management is more about managing future and the new challenges, winning opportunities against odds.
- The focus of strategic management is on competition and mitigating the impact of risk.
- It focuses on building sustainable competitive advantages.
- Strategic management is about differentiation, distinction and becoming a leader in the industry.

Strategic management focuses on vision, mission and achievement of business goals. It has dual aim of achieving operations targets and Performance targets simultaneously. Strategic management is about people empowerment, customer satisfaction, improving process performance, gaining higher ROI and promotion of stakeholder interests. The core process of strategic management is shown in Fig. 3.3.

Strategic management shapes the future of an organisation in line with vision and mission set for the organisation. The strategic management ensures competitiveness, sustainability and continuity of business through an implementation of strategy mix of corporate, business and functional strategies. The strategic management is dynamic in nature as it moderates itself based on review and analysis of strategy results. This ensures the organisation's growth in a particular direction as stated in vision, mission and goal.



**Fig. 3.3** Core Process of Strategic Management

Since strategic management is about the future, it has to deal with probable threats to business, vulnerability of the organisation to the threats and making a risk management strategy provision in the evolving strategy mix. Strategic management is all about maintaining competitive necessities and creating new competitive advantages to differentiate from others.

Strategic management process takes a set of managerial decisions and actions that determine the long-term performance of a business organisation. It involves formulating, implementing, and reviewing strategies and its performance to ensure the march of the organisation in a set direction.

While understanding strategic management, it is important to understand Business Performance Management (BPM). The performance is about effectiveness of the output or outcome. The performance management aims at achieving operations targets at say least cost. For example, you may meet the target of sales, but margins have come down impacting, the bottom line. This means sales target is achieved, but at higher marketing cost. The strategic performance management aims at higher productivity in the most efficient and effective manner. It is all inclusive comprehensive concept. The strategic management of business performance means:

- Rewarding customer experience and not just customer satisfaction
- Attaining a status of zero customer problems and not zero product or service defects
- Maximising revenue at reduced cost
- Maximising revenue with higher percentage of business from loyal customers
- Improved design performance along with more functions and features
- Higher ROI while gaining higher profits
- Reduced cycle time; design to delivery

Strategic Management of Business Performance requires development and management of:

- Key Result Areas (KRAs):  
Whose performance decides the fate of the organisation's business?

- Critical Success Factors (CSFs):

In each of KRAs, there are few Critical Success Factors which contribute significantly to the successful operations and performance of KRAs.

- Key Performance Indicators (KPIs): KPIs are developed to assess the results in KRAs and management of CSFs. KPIs indicate quality of strategic management of business performance. They reflect on quality of strategic management of the business.
- Key Business Indicators (KBIs): KBIs are developed to measure results of business strategy execution. KBIs are selected few from various operations parameters.

All organisations, whichever business they are in, have KRAs, CSFs to manage to their results in operations and performance. The organisation then has to develop KBIs and KPIs

There are two dimensions of business to measure and control. One is Business Operations and second is its Performance. The business operations are measured by parameters such as Sales, Receivables, Inventory, Income, Order book and so on. These parameters are chosen and have targets to monitor. These are called operation targets and some of them are selected as Key Business Indicators.(KBIs). The KBIs could be absolute figures or ratios of two business results as well.

The second dimension is business performance. The operation targets are to be achieved at a certain level of resource inputs. Achieving business targets at higher consumption of resources is a poor business performance.

For example, performance target of sales is a ratio of marketing cost to sales, say 15 %. Performance of receivable is a target of 30 days of sales. Another performance target for sales is Sales to Inventory ratio to be 1 is to 6. So there are sales targets and sales performance targets. Both the targets are to be achieved through strategic business management and strategic performance management.

The organisation has to develop two types of strategies one set of strategies for achieving business results and another set of strategies to ensure that results are achieved with satisfactory performance.

We illustrate how the four key requirements of Strategic Management of Business Performance can be applied in the business of Multi Brand Retail Store.

#### KRAs:

- Ensuring sustained customer interest and loyalty
- Correct assessment of customer needs and buying behaviour
- Satisfying customer choices and preferences
- High on availability with high use of shelf space
- Innovative pricing and promotion:
- Continuous improvement in customer servicing cycle
- Communication and knowledge skills of floor boys and supervisors

#### CSFs:

- Managing shelf space to stock required stock keeping units (SKUs)
- Ability to reach customers through advertising and mailing
- Floor service in finding, handling and billing the items

- Satisfactory resolution of customer queries
- Business Operations Indicators in retail business are as under:
  - Number of visitors per day (Foot prints)
  - Number of bills per day
  - Revenue per day
  - Average bill value per day
  - Range of billing value: Lowest and highest
  - Billing value distribution by morning, afternoon, and evening
  - Number of member customers
  - Most bought items by class: Cosmetics, apparels, and crockery, etc.
  - Incidence of returns of sold items
  - Number of customer queries on the floor: Availability, price, performance, preferences, brand, etc.
  - Inventory by class of items

#### **Key Business Indicators (KBI )/Target**

- Number of visitors per day (Foot prints)/5000
- Number of bills per day/500
- Revenue per day/₹ 3 lakhs
- Average bill value per day/₹ 600.00
- Inventory/₹ 20 million

#### **Business Performance Parameters**

- Ratio of number of bills to number of visitors: Target 60%
- Ratio of member customers to number of visitors: Target 40%
- Customer visit pattern: Morning 30%, Afternoon 20%, Evening 50% vs Actual %
- Average bill value vs Target Average bill value ₹ 800
- Inventory to sales ratio by class of items: Target 1 to 4
- Average sales per day by class vs average sales per day on its extra promotion strategy: Target 30%

#### **Business Strategies to Succeed in KRAs**

- Efficient ICT driven procurement practices
- Automation of vendor services for ordering, sending 'Attention, alert, action' signals
- Convert 30 % vendors into Business/Alliance partners
- Conduct periodical workshops for floor personnel on communication and for sharing customer interaction experience and knowledge
- Introduce additional 2% discount on total bill value above ₹ 1000

#### **IS & IT Strategy to Implement Strategy**

- Automate billing and administrative processes for faster service
- Expand the scope of extranet to more number of vendors

- Embed automatic ordering on vendor when predetermined stock levels are reached
- Modify existing billing system with more customer specific features
- Improve displays, shelf usage and arrangement, more price scanners, etc to reduce number of queries
- Start separate billing counter for member customers

To summarise, strategic business performance management is about managing business operations and its economic performance and overall impact it makes on the society and stakeholders. SBPM has a concern about output as well as outcome making impact on business.

### 3.5 WHAT IS STRATEGY?

Strategy sets the direction of the business and gives scope of activities an organisation would undertake over the long-term. Strategy achieves competitive advantage for the organisation through its resource deployment within a challenging environment. It is designed to meet the needs of markets and to fulfill stakeholder expectations.

- Strategy is a plan comprising of different decisions, actions setting a direction to organisation's business for a long term.
- Strategy is evolved, formulated to achieve vision, mission and goals of the organization.
- Effective deployment of this plan by allocation of resources meets the needs of market and of expectations of stakeholders bringing in advantage to the organisation.
- Strategy is all about formulating, implementing and evaluating cross-functional decisions that enable the organisation to achieve its goal.
- Strategy is implemented, monitored, reviewed periodically and assessed for its performance and corrected when necessary.
- Excellent organisations implement their mission and vision by developing a stakeholder-focused strategy. Policies, plans, objectives and processes are developed and deployed to deliver the strategy.
- Broadly strategy spells out six factors which are common to all strategies (See Fig. 3.4). The strategy could be Corporate, Business and Functional, but the six factors are Direction to business, Market size, Competitive advantage, Resources required, Environmental factors and Stakeholders expectations.

Characters of effective strategy are:

- Mission, vision, goals, objectives have SMART specifications (Specific, Measurable, Achievable, Realistic and Time-bound).
- It is evolved through people participation and are clearly communicated and understood by all.
- Strategy is a result of analysis of business, competition and environment.
- Strategy is an outcome of strategy evolution process.



**Fig. 3.4 Specifications of Strategy**

How would you specify strategy so that it can be communicated across the organisation and can be translated into a plan of action?

- Clear definition of corporate, business and functional strategies
- Direction to business: Mission, vision, goals, objectives
- Time-frame of vision achievement
- Forecast of current and future scenarios of Business & Environment
- Conditions and constraints prevailing at the time of strategy launch
- A policy framework supporting implementation of strategy
- Implementation plan
- Resource allocation
- Action plan to implement strategy mix

How excellent organisations evolve strategy?

- Gathers needs and expectations of stakeholders and market to build strategy.
- Identifies, understands and anticipates social trends, economic indicators and market trend which may affect the organisation.
- Identifies, understands and anticipates opportunities and threats to the business.
- Evolves a plan of action for long-term to fulfill these requirements within the scope of mission and vision.
- Analyse and understand operational performance trend, core competencies and potential organizational and managerial capabilities.

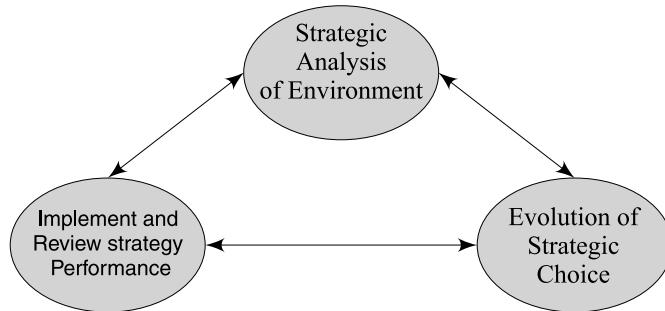
- Analyse and understand the same for business partners and its impact on the organisation.
- Compare these with a prevailing benchmark and competition to understand their relative strength and level of improvement needed.
- Analyse and understand new technologies and emerging technologies and its probable impact on the organisation's performance.
- Create mission and vision linked appropriate strategy and frame supporting policies to succeed.
- Identify key results and KRAs which have a direct impact on the achievement of mission and vision.
- Ensure effective application of core competencies in planning for achievement of present and future objectives.
- Understand and manage effectively Key Business Drivers for economic, societal and ecological sustainability.
- Communicates strategy, goals and expected outcome in clear terms to all.
- Establish and communicate performance indicators and operations targets to measure strategy impact.
- Deploy strategy, and supporting policies, if any.
- Align organisation structure and key or critical processes to be in sync so that strategy and policies are deployed for optimum balance of efficiency and effectiveness.

### 3.6 THREE APPROACHES TO DEVELOPMENT OF STRATEGY

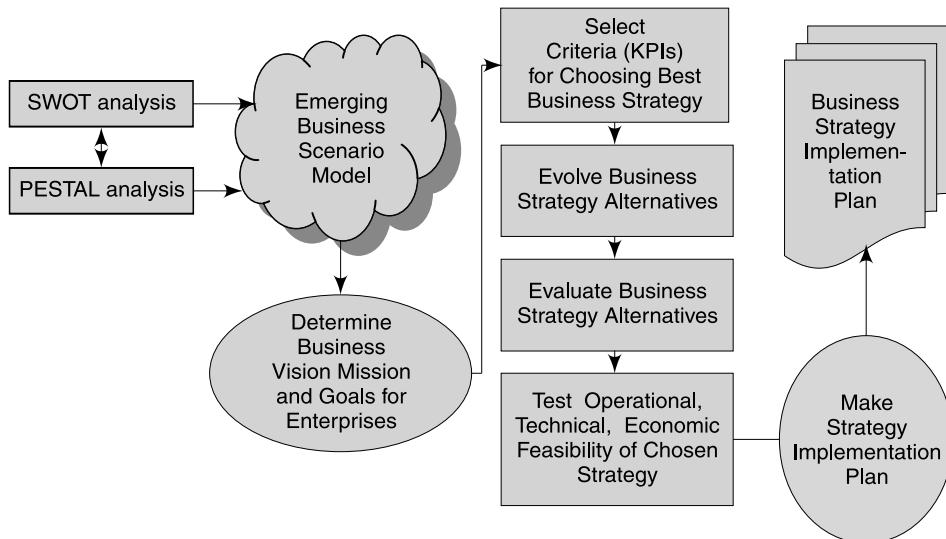
- **Focus on New opportunities** identifying new opportunities for radical and substantial change in the fortunes of the organisation. SWOT analysis and PESTLE analysis results are encouraging.
- **Focus on Current business and its growth.** Current situation is complex, uncertain and riddled with problems and conflicts of interest. SWOT is not very encouraging in long-term perspective. The strategy adapted, therefore, is to solve short-term problems and win the collaboration of the people around. Keep the current market position intact. Ensure continuity of business with Year- On -Year targets achievement.
- **Focus on current 'S' growth** curve. ( Initiation- Growth- Maturity- Decline)  
Road map of business movement, growth is clear. Organisation is a leader with clear differentiation through couple of competitive advantages. It may have 'first start' advantage. There is clarity about the way an organisation would move. Series of strategic decisions are made and planned for execution based on where business is on the growth curve to day. The strategy focus would be to remain a leader in business.

Whichever may be the approach chosen by the organisation; the process of business strategy begins with analysis, making strategy choices, selecting one satisfying requirement of vision, mission and business goals, making an implementation plan, implement and review for strategy performance.

### Process of Business strategy implementation: Analysis: Evolution: Implementation



**Fig. 3.5** Business Strategy Analysis: Evolution and Implementation



**Fig. 3.6** Business Strategy Analysis: Evolution, Choice and Implementation

### SWOT Analysis

SWOT, an acronym for Strength, Weakness, Opportunities and Threats to business, is an analysis approach for evolving a strategy. The strengths and weaknesses are internal, while opportunities and threats are external to a business organisation.

The strengths of organisation could be Products, Brand, Patents, Know-how, Management Team, easy access to resources and so on. The strengths are organization-specific and cannot be generalised. The same is true of weaknesses. Some weaknesses of the business organisation could be no product differentiation, Low market share, No specific competitive advantage, No core competency, etc. SWOT analysis focuses on finding an organisation's strengths

and weaknesses. Clarity on these factors makes it easy to look at opportunities and threats to the business. The strategy which we are talking about will be built around strengths of the organisation. The weaknesses will also be dealt so that main strategy effectiveness is not reduced.

Opportunities, on external analysis, could be Opening of trade, Special concessions to start business, Relaxation of tax laws, Emergence of new technology and so on. Threats could be sudden entry of competition, development of substitute products, better technology-making cost no longer a differentiation. On completion of SWOT analysis, a strategy matrix is built for evolving strategies and making a choice of strategy mix (See Fig. 3.7).

	Strengths	Weaknesses
Opportunities	Strategy options exploiting Opportunities through leveraging on strengths	Strategies to overcome weaknesses to exploit opportunities.
Threats	Strategies to contain vulnerability due to threats	Strategies to overcome weaknesses so threats are not a risk

**Fig. 3.7** Strategy Matrix

### PESTLE Analysis

PESTLE is an acronym for Political, Economical, Social, Technological, Legal and Environmental analysis of the environment. A PESTLE analysis is a useful tool for understanding the environment in which an organisation intends to invest to grow business or exploit opportunities. PESTLE analysis helps in understanding or assessing political, economical, social, technological, legal, and environmental risks prevailing in the country or a state. If such risks are very high then decision to invest is not right though SWOT analysis may be a positive one.

Let us apply PESTLE analysis to India. On political front, the economy assures to grow at 6/7% per annum, but political climate is not conducive for investment. The coalition government is not able to pass political reforms bills. Investors, foreign and domestic investors do not see political climate very attractive. Economic analysis of India indicates weak signals due to high inflation, rupee becoming weak every weak, stock market shows decline in SENSEX, agriculture productivity continues to be low, unemployment on the rise. On social front, there is unrest in lower income group and farmers threatening to go on strike. There is unrest in education sector as institutions find it difficult to run the institutions. Student community is becoming restive and agitating. Farmers and common man in general is living in strained social environment.

Technological aspect of India is very bright. Manufacturing, IT, are now matured technologies. The trained manpower is available to make a start. Engineering colleges, IITs and IIMs are supporting HR requirement of the industry. There is ample evidence that India is a techno-savvy country.

The legal system in India is not unfriendly. Though there is a fair amount of liberalisation industrial sector starting a business in India is a long legal battle. The laws like reservations, % procurement from local vendors, export restrictions are some laws which make business operations difficult and challenging.

In environmental analysis, environment protection laws are in place. There is no clear policy on waste management. The climate is varying in varying times, but not a weakness. The environment in general is conducive for investment and growth.

SWOT and PESTLE analysis are tools for environment analysis and provide inputs to evolve strategies and its implementation. SWOT gives strategy framework and PESTLE gives caution and guidance before its implementation.

### 3.7 CLASS AND TYPES OF STRATEGY

There are two classes and several types. The classification and labelling them in types is a matter of convenience for understanding and bringing some clarity in strategy thinking.

#### Red Ocean Strategy

The name red comes out of the fact that you are in the business of fierce competition. It is a bloody war among competitors. As the market space gets crowded, prospects for profits and growth are reduced. Products become commodities or niche making differentiation of any kind is extremely difficult. The strategies which need to be evolved should be of cutting edge. It is a fight for market share or recapturing market share. It is about driving competition out of business. Red ocean strategy means compete in the existing market space, beat the competition through some unique offers, win more share of existing demand, and reach customer through attractive value cost tradeoff.

#### Blue Ocean Strategy

The blue ocean is a contrast of red ocean described above. Blue ocean is quite large and deep. Competition is virtually not there. Market is large and untapped. Market segmentation is not very specific. Business space is open to venture in. Blue ocean strategy is to create demand. Growth and profit are assuring. If strategy is sound, sustainability of business is guaranteed. Blue ocean strategies are generally innovative and offer an attractive value proposition.

Blue ocean strategy means create new untapped market space, identify needs and fulfill them, make the competition irrelevant by developing new rules of the game, capture new demand, break the value cost trade off making customer see value for money.

#### Types of Strategies

It is very difficult, almost impossible to find all business strategies and bracket them into different types. All strategies have impact on growth, profit, and competition. No strategy lasts for ever. It undergoes a change as it starts performing and showing results.

- **Growth Strategy:** Growth in current business may occur by introducing new products or raising sales of current products by adding features, facilities, functionalities making product offer more valuable to the customer. Growth strategy assumes that market for the product exists and still untapped.

Growth strategy includes decisions such as expanding delivery, distribution network to reach more customer base in different segments. A strategy which expedites the growth is a growth strategy. Growth strategy is successful when market exists, competition is less and product meets basic needs of customer.

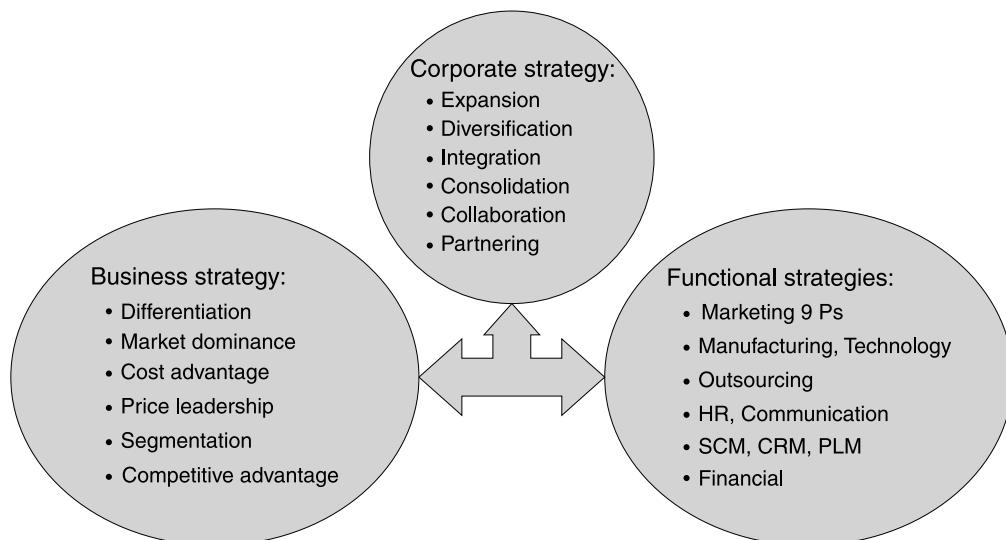
- **Diversification Strategy:** Growth can happen through expansion of current business or expansion by entering new business areas. For example, agro business can be expanded by going into food processing. AMUL has moved up and grown by expanding into milk processing, cheese making and industrial production of ice creams.
- **Integration Strategy:** You are in a business and have process from raw material processing to finished products. Expansion of such business may occur by integration strategies—forward and backward. Integration strategy gives better command on business and your competitiveness also increases. Forward integration means take your finished product and make more other products out of it for which market exists. Backward integration means you buy vendors business who is supplying raw material. Both these strategies need good business economic analysis before decision of integration made.
- **Differentiation Strategy:** Differentiation strategy is used to differentiate you and the competition to raise the market share. The differentiation in your offer (product or service) is made through excellent design, full functionality, highest quality, quality of service and so on which customer regards as a value. Differentiation could be due to low cost, longer life. A parameter of differentiation is the one where the customer sees in it the value and competition does not offer.
- **Competitive Advantage Strategy:** Competitive advantage strategy is considered when competition is very close on you and could be a threat. Creation of competitive advantage is taken up when the competition does not have any added value to your offer to customers. If this advantage is a significant one, it keeps you ahead of competition.
- **Cost Advantage/Leadership Strategy:** Cost advantage strategy is generally by design, meaning either you are very close to major resource consumption or you are close to market or you have manufacturing technology which the competition does not have. Due to this, your costs are lowest in the industry. You could be the cost leader or price leader.
- **Market Dominance Strategy:** Market dominance is a strategy chosen by the organisation when they are first in the market. They enter into the market in a big way, creating a barrier for others to enter.
- **Price Leadership Strategy:** When an organisation is the leader in the business due to certain other strengths, this strategy is used to beat the competition. It determines the price and others are forced to fall in line. Price leadership forces competition to evolve different price strategies, lower price or discounted price or same price, with little more scope in the offer and so on.
- **Segmentation Strategy:** This strategy is adopted when market is flooded with products making the product differentiation difficult. Using customer data analysis tools, a new customer segment is carved out whose needs are precise and clear. The segment is also fairly large for the organisation to offer a new or re-engineered product.

- **Business Functions Strategy:**

These are broadly

- **Manufacturing strategy:** Lean manufacturing, outsourcing, use of latest technology reducing 'design to delivery' time
- **Marketing strategy:** Built around 7 Ps of marketing mix for target market (Product, Price, Place, People, Physical evidence, Promotion, Process)
- **HR strategy:** Creating a knowledge based learning organisation, building competencies, making organisation structure lean
- **Financial strategy:** Lowest cost of capital, better working capital management, improving wealth and asset management raising ROI
- **Service strategy:** Reduced service cycle time, controlling service variations, faster delivery, very high customer response time

Strategy is a comprehensive plan for achieving competitive advantage, leadership in business, and achieving desired growth. Hence, there are different classes and types. Organisations develop strategies at the corporate, business and functional levels. Corporate strategy is about the business organization. It deals with direction, vision and mission of the corporate. Business strategy is about the business and its competition and creating competitive advantage, growth and so on. Functional level strategies are about performing best in manufacturing, marketing, HR management, and finance and service delivery. Growth and diversification strategies focus on expansion through mergers and acquisitions. Restructuring and divestment strategies focus on consolidation of business (See Fig. 3.8).



**Fig. 3.8** Strategy Mix for Performance Management

If business performance has to be excellent, strategy performance has to be excellent. Both the performances are dependent on how the organisation's management framework

functions. Is it at its excellence? EFQM model of excellence is a tool for creating management framework, a system, to keep the organisation's performance on the path of excellence.

### 3.8 EFQM MODEL: A PRESCRIPTION FOR ACHIEVING ORGANISATION EXCELLENCE

European Foundation for Quality Management (EFQM) Excellence Model 2013 is developed together by leading international organisations working for quality, excellence & strategy design and implementation. The EFQM Excellence Model is a non-prescriptive framework for an organisation's business management systems designed for achieving excellence in every aspect of business operations. The EFQM Excellence Model is a practical tool to help organisations to measure where they are on the path to excellence; where are the gaps and where they should focus to bridge the gaps.

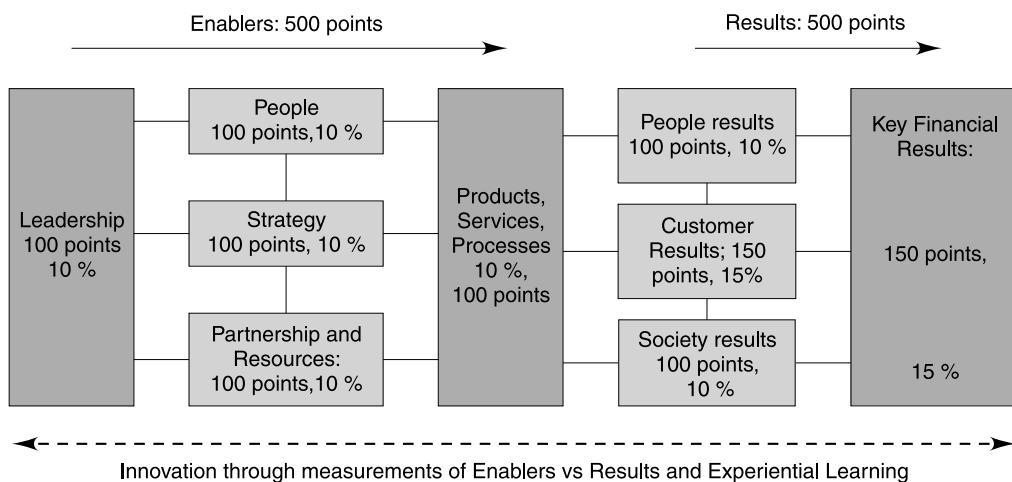
Confederation of Indian Industries (CII) has adopted it for annual corporate performance assessment for excellence. It announces awards CII – Exim Bank Award for Excellence and offers certificates to organisations who participate in annual contest achieving certain level of excellence.

The leading organisations are from USA, Europe, Australia, Japan, South Africa, and Singapore.

While developing EFQM model, the following country specific models are considered.

- US Malcolm Baldrige National Quality Award
- The European Quality Award
- The Australian Business Excellence Award
- The Japan Quality Award
- The South African Excellence Award
- The SPRING, Singapore

EFQM Model is shown in Fig. 3.9



**Fig. 3.9** EFQM Model of Excellence

Enablers and Results have equal points, 500. Among results, customer results and key financial results have 150 points. All other factors in the model have 100 points. The model stipulates that enablers drive the business results. If enablers are handled at its best results both in operation and performance term are bound to be excellent.

## Definition of Enablers and Results as Specified in EFQM Model

### *Enablers (500 points)*

- **Leadership:** Excellent organisations have leaders who shape the future and make it happen acting as role models for its values and ethics and inspiring trust all times. They are flexible, enabling the organisation to anticipate and react in a timely manner to ensure the ongoing success of the organisation.

Leaders are

- Good at noticing at contrast, equivalence, and incompatibility
- Good at seeing trend, pattern
- Good at data analysis
- Good at anticipating, forecasting the future
- Good strategist
- Good at articulation
- Quick in getting at the problem
- Good at systems analysis
- Good at adopting appropriate leadership style

Leadership styles are Authoritarian, Autocratic, and Task-oriented, Participative, by Delegation and Charismatic. The broad classifications of leaders are two types, Transactional and Transformational. Excellent results are achieved by negotiation and give and take with people around. This is transactional. When leader innovates and brings in such results through people around, the organisation and its business is transformed to excellence. The leaders in both the cases may adopt one or more styles as the situation demands.

- **Strategy:** Excellent Organisations implement their mission and vision by developing a stakeholder-focused strategy. Policies, Plans, Objectives and Processes are developed and deployed to deliver the strategy.

Strategy is all about formulating, implementing, and evaluating cross-functional decisions that enable organisation to achieve its goal. It is an act performed through a series of decisions to take the organisation and its business on the new path of growth and excellence.

- **People:** Excellent organisations value their people and create a culture of empowerment for the balanced achievement of organisational goals and personal goals. Excellent organisations develop capabilities of their people to promote fairness and equality among them, care to communicate, reward and recognise, in a way that motivates people, Builds commitment and enables them to engage for the benefit of the organisation.

- **Partnership and resources:** Excellent organisations plan and manage external partnerships, suppliers and internal resources in order to support strategy and policies,

and the effective operation of processes. They ensure that they effectively manage their environmental and social impact.

Partnership is a voluntary collaborative agreement between two or more parties in which all participants agree to work together to achieve a common purpose. They share risks, responsibilities, resources, competencies and benefits.

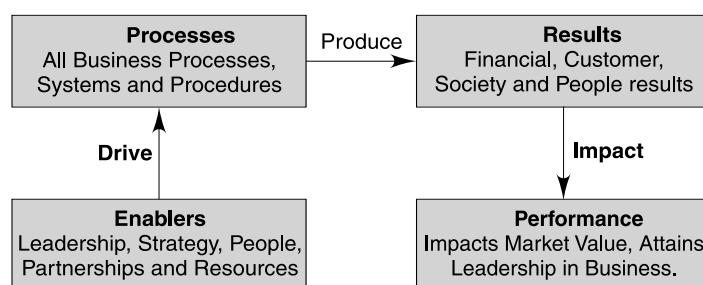
- **Processes, product and services:** Excellent organisations design, manage and improve processes to generate increasing value for customers and other stakeholders.

#### Results: (500 points)

- **People results:** Excellent organisations develop and agree a set of performance indicators and related outcomes to determine the successful deployment of their people strategy and supporting policies based on people needs and expectations
- **Customer results:** Excellent organisations develop and agree a set of performance indicators and related outcomes to determine the success of their strategy and supporting policies based on customer needs and expectations
- **Society results:** Excellent organisations develop and agree a set of performance indicators and related outcomes to determine the successful deployment of their societal and ecological strategy and related policies based on needs and expectations of the external stakeholders
- **Key financial results:** Excellent organisations develop and agree a set of key financial and non-financial results outcomes to determine the successful deployment of their strategy and related policies based on needs and expectations of their key stakeholders

#### Analysis of EFQM Model

EFQM model has four parts—Enablers, Processes, Results and Performance. Enablers drive the processes. An organisation's processes together produce results. The results impact on market, leadership and competitive position in industry as shown in Fig. 3.10.

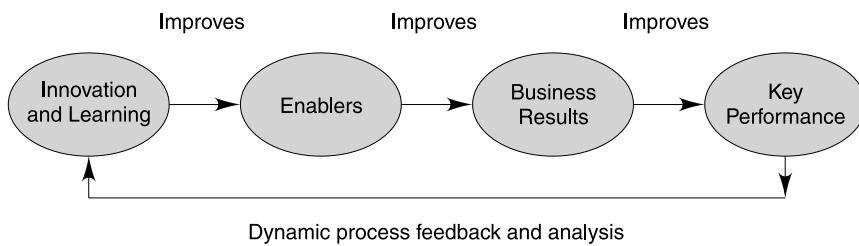


**Fig. 3.10** Four Parts of EFQM Model of Excellence

EFQM model is not a static model. It is a dynamic model. Among enablers leadership by nature has to be dynamic constantly monitoring and tracking strategy performance through evaluation of results, and changing strategy where necessary. The strategy scope includes

Business strategy, HR strategy, Partnership and Resource management strategy and most important Process strategy. If the strategies are in order and implemented efficiently and effectively, results are bound to be meeting and in some cases exceeding the targets leading to a Superior Performance. Excellence is a function of organization's ability to manage five enablers and its application to business processes.

Assume some targets are not achieved, then because of dynamic nature of the model leadership people learn out of experience of strategy development and its implementation. They build knowledge out of this experience to change to better strategies and improve results. This dynamic nature is explained in Fig. 3.11.



**Fig. 3.11** Dynamic Nature of EFQM Model

### Fundamental Concepts of Excellence

Excellent organisations meet their Mission, and progress towards their Vision through planning and achieving a balanced set of results and, it is all about exceeding fundamental concepts of excellence.

Let us understand the meaning of 'Excellence' in context of business organisation. There is always a room for improvement in excellence. It is not a pre-defined peak like Everest in Himalayan Mountains. Further,

- Excellence is an all inclusive comprehensive.
- Excellence is not equivalent to success.
- Excellence does not mean perfection.
- Excellence is not relative to others.
- Excellence is not a conquering and a fixed goal post but going beyond it.

Also talking in different terms, Excellence is not just

- Achieving higher profit year on year
- Maintaining good human relations
- Higher capacity utilisation
- Higher customer satisfaction
- No customer rejections
- Increase in repeat business
- Achieving budgets & targets

On the background of this, Fundamental Concepts of Excellence specified in EFQM Excellence Model 2013 for an organization are as under. In all there are eight concepts, which organization should aim to achieve. These eight concepts together when you improve,

organization is on the journey of excellence. Organization excellence therefore is all about achieving these eight criteria and exceeding them, where possible.

- **Adding value for customers:** Excellent organizations consistently add value for customers by understanding, anticipating and fulfilling needs, expectations and opportunities.
- **Creating a sustainable future:** Excellent organizations have a positive impact on the world around them by enhancing their performance whilst simultaneously advancing the economic, environmental and social conditions within the communities they touch.
- **Developing Organizational capability:** Excellent organizations enhance their capabilities by effectively managing change within and beyond the organizational boundaries.
- **Harnessing Creativity & Innovation:** Excellent organizations generate increased value and levels of performance through continual improvement and systematic innovation by harnessing the creativity of their stakeholders.
- **Leading with inspiration, vision & Integrity:** Excellent organizations have leaders who shape the future and make it happen, acting as role models for its values and ethics.
- **Managing with agility:** Excellent organizations are widely recognized for their ability to identify and respond effectively and efficiently to opportunities and threats.
- **Succeeding through talent of people:** Excellent organizations value their people and create a culture of empowerment for the achievement of both organizational and personal goals.
- **Sustaining outstanding results:** Excellent organizations achieve sustained outstanding results that meet both the short and long term needs of all their stakeholders, within the context of their operating environment.

(Source: The British Quality Foundation, The European Foundation for Quality Management)

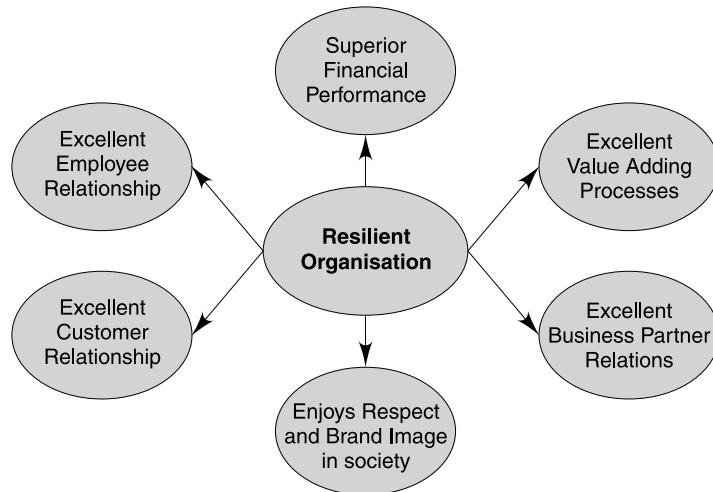
EFQM excellence model is a tool to monitor progress against the vision, mission and performance of strategy, enabling leaders to make effective and timely decisions in all areas of management. Herman Van Rompuy, President of the European Council. "The EFQM Excellence Model provides this framework that encourages cooperation, collaboration and innovation that we will need to ensure this goal is achieved"

#### **When Organization is on the journey of Excellence?**

You would see its manifestation in business operations in number of ways, some of them can be measured.

- People of the organization contribute maximum in achieving balanced results.
- Organization is a vibrant, sensitive & responsive to environment and customer needs.
- Organization is a learning organization. It discovers knowledge and practices in business management.
- It challenges status quo and transforms itself through creativity & innovation.
- Organization develops and maintains value adding partnerships. Organization leverages on technology to gain higher ROI.

- Organisation builds strong brand in the society.
- Anticipates emerging business and technology trends and opportunities and exploits them to the organisation' advantage.
- Able to build a portfolio of competitive advantages.
- The minimum regulatory framework is met and exceeded.
- Organisation becomes resilient. See in Fig. 3.12, attributes of resilient organisation.



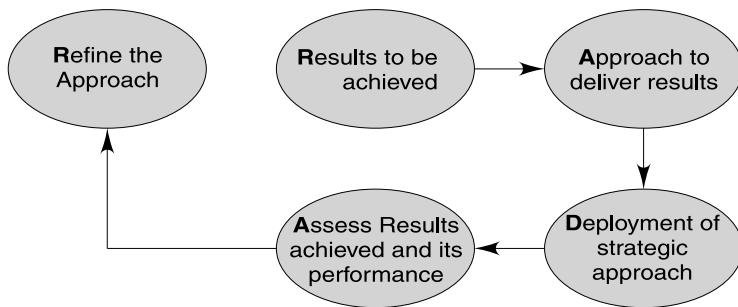
**Fig. 3.12 Attributes of Resilient Organisation: Ability to Recover from any Setback**

### RADAR Logic for Operations and Performance Review

EFQM model provides a tool 'RADAR' process of performance monitoring and control. An organisation needs to determine the results to ensure and confirm that policy, strategy; decisions and actions of theirs are just right and are producing the results aimed at. These results cover the financial and operational performance of the organisation. This process has five steps:

- Determine results
- Evolve policy, strategy which would achieve those results
- Deploy the strategy backed by policy. Examine whether it is systematic and effective
- Assess financial and operational results in terms of target as well as performance in achieving the target.
- Take a critical review to see that policy, strategy is right and needs no change or modification. If there is some doubt or issue about its impact on results, then policy strategy may change suitably.

EFQM model prescribes a process of review as a tool for controlling the strategy performance leading to excellence. The process is called 'RADAR' logic an acronym for Results to achieve, Approach to deploy, Deployment of approach, Assess Results, Refine (See Fig. 3.13).



**Fig. 3.13 RADAR logic steps**

The application of RADAR logic helps organisations to measure, monitor, and track the results, if results are not in order as planned, opportunity is taken to analyse, why there is an under-performance? Then strategy is reviewed, and change is made to bring the results on track. In some cases, refining or fine tuning strategy may be adequate.

The biggest advantage of using RADAR logic as a tool to judge strategy performance is the experience and knowledge it gives about strategy formulation and its effectiveness in delivering the results. There is a tremendous amount of learning and knowledge discovery in the process RADAR. This helps management in building innovative strategies which not only achieve the results, but some of them exceed beyond expectation.

EFQM model of excellence along with application of RADAR logic is, therefore, a very powerful tool for strategic management of business, operations and performance.

## KEY TERMS

Product Differentiation  
Strategic Planning  
Barriers to Entry  
EFQM Model  
Competitive Forces  
RADAR Logic.  
Red Ocean Strategy

Moving up on Value Chain  
Market Forces  
Resilient Organisation  
Excellence in Business  
Business Drivers  
Resilient Organisation  
Blue Ocean Strategy

## REVIEW QUESTIONS

1. What is corporate planning? Why is it necessary?
2. What is Strategic Planning? Identify environment attributes which forces organisation to go for Strategic Planning.
3. Explain three layer strategy structure; Corporate, Business, Functional.
4. If your ambition is to become CEO at the age of 35 draft a strategic plan in following specifications.

- Vision, Mission, Goals to be achieved in next eight years, Strategies behind achieving goals.  
State the relationship between Goals and Strategy.
5. Conduct for the exercise in question 4 SWOT analysis.
  6. Conduct a PESTEL analysis of India as it stands to day for a foreign investor who wishes to make investment in India?
  7. What are the benefits of constructing a Business Model for the organisation?  
What is the role of Business Model in strategic planning?
  8. Explain the difference between Operations Management and Performance Management. How KRAs, CSFs, KOIs and KPIs are used in performance management?
  9. Explain following terms with examples:
    - Value Proposition
    - Competitive Necessities vs Competitive Advantages.
    - Core competency.
    - Segmentation specific Market strategy.
  10. Explain how BSC, Score card and Dash board are better assessment and presentation tools for monitoring key performance indicators.

## CONFIRM YOUR UNDERSTANDING

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1. A business model is defined as the framework of how an organisation conducts its business and creates and delivers value to the customer.
2. Balance score card shows \_\_\_\_\_ in perspectives affecting business goals.
3. Scorecard indicates \_\_\_\_\_ of a key indicator in a given period while Dashboard indicates the \_\_\_\_\_ in real time.
4. The decision making is information, knowledge and \_\_\_\_\_ driven.
5. Strategic management is more about managing \_\_\_\_\_, winning opportunities against odds.
6. Strategic management involves formulating, \_\_\_\_\_, and reviewing strategies and its \_\_\_\_\_ to ensure the march of the organisation in a set direction.
7. Strategy is a \_\_\_\_\_ comprising of different decisions, actions setting a direction to the organisation's business for a \_\_\_\_\_.
8. Excellent organisations implement their \_\_\_\_\_ and \_\_\_\_\_ by developing a stakeholder-focused \_\_\_\_\_.
9. SWOT, an acronym for Strength, \_\_\_\_\_, Opportunities and \_\_\_\_\_ to business, is an analysis approach for evolving a strategy.
10. PESTLE is an acronym for Political, \_\_\_\_\_, Social, Technological, \_\_\_\_\_ & Environmental analysis of environment.
11. Blue Ocean Strategy means to create new untapped \_\_\_\_\_, identify needs and fulfill them, make the \_\_\_\_\_ irrelevant.
12. Red ocean Strategy means compete in existing \_\_\_\_\_.
13. EFQM model is divided into two parts \_\_\_\_\_ and Results each having \_\_\_\_\_ points weight in the model.



## CASE STUDY

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### 1. BIHAR CAUSTIC AND CHEMICALS LTD (BCCL)

Bihar Caustic and Chemicals (BCCL) belongs to the Aditya Birla group, whose flagship Hindalco and its subsidiaries together hold 54.5 per cent equity stake in the company. Apart from having strong patronage of a leading industrial house, BCCL also enjoys the advantage of having a single assured buyer like Hindalco. The latter picks up as much as 75 per cent of the total caustic soda production from the company. This acts as a major booster Bihar Caustic as it incurs little marketing costs.

Despite such an advantage, Bihar Caustic had been making losses until a couple of years back and has turned the corner recently. It has also returned to the list of dividend paying companies after a gap of four years. One of the chief factors in the turnaround of the company was the setting up of a 30 MV co-generation power plant two years back. This assured the supply of electricity at reasonable rates, enabling the company to achieve higher capacity utilisation and also cut cost of production by a substantial margin.

Caustic soda prices too have started firming up over the past quarter improving the realisation and helping the company improve its profit margins. However, the company continues to attract low discounting on its performance due to little awareness about its operations and also uncertainty about the prospects of the chol-alkali sector.

Bihar Caustic counts corporate giants like Hindalco, Indal, Balco and SAIL as its leading customers, assuring steady pick up for its output. The chol-alkali sector too is witnessing a rise in the prices of products that should enable the companies in the sector post better margins over the next few quarters.

#### Financials

The company posted healthy financial performance for Quarter 2 (Q2) of the financial year. Bihar Caustic ended the quarter to September 2004 by logging net sales of ₹ 26.28 crore, up 8 per cent from net sales of ₹ 24.34 crore in the comparable quarter of last financial year. The growth in top line has been primarily caused by higher realisation of caustic soda prices over the past three months. This has taken place because global prices of caustic soda have shot up to around \$325 a tonne from \$225 a tonne over the last quarter. The rise in the price has been caused by rising demand from China, which has been a major importer.

This has worked well for Bihar Caustic as well. The up trend in caustic soda price means getting higher profit margins at the operating profit level and gross margin level. On the profitability front, the company's operating profit for Q2 of FY05 has soared to ₹ 12.82 crore, up 24.95 per cent against operating profits of ₹ 10.26 crore in the comparable quarter of last financial year. The boost in operating profits has been provided by higher unit sales realisations of caustic soda.

Since the company had repaid ₹ 20 crore of its high cost borrowing in FY04, its interest costs for Q2 of FY05 have come down to ₹ 2.39 crore, from ₹ 3.31 crore in the comparable quarter of FY04. These measures have helped BBCL to improve upon its gross profits to ₹ 10.43 crore, up 50.28 per cent against the Q2 gross profits of ₹ 6.94 crore in FY04.

On all the parameters, the company's financial performance has proved to be better than even in Quarter 1 of current financial year. The company has ended Quarter 2 with net profit of ₹ 7.08 crore, against a nominal ₹ 2.82 crore net profit in Quarter 2 of previous financial year. The company's Quarter

2 net profit translate into a diluted earnings per share of a shade over ₹ 3, as compared to a diluted earnings per share of ₹ 1.2 of Quarter 2 of 2004. In the Quarter 1 of the current financial also, the company had posted an earning per share of ₹ 2.13, since its net profits were ₹ 4.98 crore. The book value of Bihar Caustic share lies close to ₹ 48, even though it has suffered losses on a couple of occasions in the past.

## Outlook

The company's future prospects appears to be improving considering that it is now in the process of expanding its caustic soda production capacity to 225 tonne per day from 150 tonne per day at present. This would require a capital expenditure of ₹ 110 crore. Since the company would simultaneously upgrade the technology for manufacturing the product to membrane cell method from the existing mercury cell technology, this would initiate better-cost efficiency measure in the times ahead. Also, given the fact that the global prices of chloro-alkali products led by caustic soda are showing no signs of retreat, the company's profit margins are likely to improve in the second half of current financial year.

The major advantage of selling almost 75 per cent of its caustic soda production of Hindalco has enabled it to move ahead with the expansion plan. Hindalco can easily absorb higher supplies from Bihar Caustic without stretching its production process. Once the expansion plan is complete, the company is almost assured improving upon its bottom line considerably. In FY05, BCCL could end with a net profit of Rs. 25-26 crore, translating into an EPS of around 11-12.

## Questions

1. Identify the strength and weakness in present business.
2. What strategic moves the BCCL has taken to improve the business results?
3. Identify the reasons for better margins in the recent period of operations.
4. What risk BCCL is exposed to when it depends on few customers, and one of them buying 75 per cent production of BCCL?
5. What strategic options BCCL has to think if for some reason this scenario changes adversely?
6. What 'key information' BCCL should collect about the customer to meet the contingency of sudden loss of sale?

(Source acknowledgement: Economic Times, 8<sup>th</sup> November 2004. The case material is an extract for learning benefit of the students.)

## 2. TVS ELECTRONICS (TVSE)

At TVSE our philosophy has always been to understand our customers through learning and exceeding their expectations. While serving them, we have always been guided by certain key values such as trust, loyalty and operational excellence, a long standing tradition within the TVS Group.

We believe that for a product or service to be successful, it has to touch the lives of the masses. Take a look at the 2004 elections. Half a billion people experienced the power of IT when they used the Electronic Voting Machines. IT must be taken to the masses of it is to make an impact. We are proud to say that this was the first time that an experiment of this kind was attempted, and that too successfully.

### Scanning Industry Growth

India is slowly emerging into a global R & D hub. 845 patents of the Who's Who in IT have come out of India. India currently employs over 200,000 engineers in embedded systems and design. The next version of CPUs, PDAs, printers, multifunctional peripherals are all going to be designed here. The

demand for IT products is going beyond the Tier 1 and Tier 2 cities to the SMEs and smaller players in Tier 3 towns. This trend has been largely due to an increased awareness of PC usage and growth in disposable income in this category. We, therefore, seek to cater to this increased demand by taking out coverage from 350 towns presently to over 500 towns by the end of 2005.

### Company Focus

The IT hardware industry is witnessing unprecedented growth. The IT hardware manufacturing market is expected to grow from \$5 billion to \$25 billion by 2009. With PC shipments expected to register over 35 per cent growth, demand for peripherals is also expected to grow at over 20 per cent. We'll continue to focus on our printer business by bringing cost improvements to enhance profitability, such that the business unit contributes to 70 per cent of our revenues.

With the IT hardware market growing at over 35 per cent and zero duty regime fast approaching, domestic manufacturing will grow significantly but companies need to be extremely competitive to survive in a truly global market. Indian companies, therefore, have 2 choices—innovate new products to serve markets like India or manage costs effectively to deliver products at the competitive price to the consumer. New products will become the key differentiators for India companies. We, therefore, intend to expand the portfolio of our products and provide better value at lower costs to our consumers. The retail sector is witnessing a boom, and demand for automation to improve operational efficiencies has increased not just in organised retail counters but in the stand alone outlets that are typical to our country. TVSE also seeks to cater to this segment with innovative products addressing this boom.

### Innovative Thinking

We have to constantly rethink on the conventional models. We have to come up with innovative technologies to address the opportunities in the bottom of the pyramid. We have to look at developing products with low costs and large volumes. With the plethora of opportunities that company has, it will only be a matter of time before we take out technology to the heart of India. Success comes from volumes, and volumes come from the heart of India.

### Questions

1. Explain the strategy focus of TVS in exploiting growing market of IT hardware.
2. What are the threats and opportunities TVS is seeing in the market?
3. Discuss the strategy options TVS has identified and explain strategy choice of TVS.

(Source: Acknowledgement: Adapted from article – *Bringing affordable technology to the masses* by S.S. Rao, *TVS Electronics, 360 Magazine, Volume 4, No. 23, Nov. 30, 2004.*)

## 3. MEDIAMAN INFOTECH

In 1987, when the 8.5 inch floppy and 10 MB hard disk drives were the order of the day, technology was evolving. But, the only development seen was in the desktop space. Nevertheless, Dushyant Mehta, MD and CEO of Mediaman Group of Companies, decided to leave his comparatively cushy job at Zenith Computers and venture into business of his own. At that time, printers, motherboards and HDDs formed the main line of the business. The distributor partnered with IBM for its HDDs and with Transcend for its memory products. Then circa 1995 the colour monitor revolution set in and changed the face of IT business in India.

Mediaman immediately tied-up with Samsung for its monitors, and HP for its imaging products. While the business was great, Mehta felt it was imperative to change the style of functioning if Medi-

man had to grow beyond being another box pusher. After studying international trends Mehta decided to focus on networking and memory products.

### **Wales Technologies**

Thus in 1995 Wales Technologies was set-up. Around this time networking was making it big in India. The agenda was to develop a special interest group, which could develop core competency in a particular technology. Today, Wales markets a whole range of networking products, including servers from Gigabyte, memory products from Transcend, multiserial ports from Moxa, high-end storages solutions from Acard Technologies, tray solutions from Majestic and external storage and solutions from Manpower. While first time buyers account for around 50 per cent of the business, Mehta said that a large chunk of the business comes from customers upgrading to a more high-end system.

### **Other Divisions**

Besides Wales, Mediaman have four more divisions under its umbrella. Towards the end of the last millennium, Mediaman saw a rise in the demand for laptops and PDA accessories. After considerable R & D about its market future potential Notebook Labs was set-up in 2000. According to Mehta, at that time there were only 4,000 notebooks in the market. But today, Notebook Labs itself is host to more than 200 different types of notebook batteries and over 400 different types of accessories.

Along with the rise in demand for notebook products and accessories there arose a need for notebook service and maintenance. Mehta realised that there were no organised players in this space and so decided to tap this potential. Mediaman Services was thus formed in 2003. Currently, the company has a service centre each in Mumbai and New Delhi and plans to finalise two more in Ahmedabad and Chennai by the end of 2004.

Mediaman also opened a retail showroom in Mumbai in 1999 called Here & Now, which houses notebook, accessories, desktops and ergonomically designed speakers and other peripherals on display.

But the company's biggest venture till date has been its own personal brand, Bravish, that was launched in 1998. There are a host of products available under the Bravish brand, including real time storage back-up devices, ergonomically designed mouse and keyboards and LCDs. Mehta plans to launch more than 500 different notebook accessories in the coming year.

### **New Ventures**

Mediaman plans to launch a new division to tap the growing demand for camcorders and digital cameras. The division, which will be fully functioned by early 2005, will also fulfill demand for flashcards, batteries and other accessories. Towards this end, Mediaman has already tied-up with all the major digicam manufacturers present in the country.

### **Here and Now**

From its humble beginnings, Mediaman has come a long way. Today, the company boasts an annual sales turnover of over Rs. 130 crore. Of this, Wales Technologies and Notebook Labs contribute more than 60 per cent while its trading business contributes around 5-7 per cent, to the overall revenues. The company also has officers and warehouse in Mumbai, New Delhi, Kolkata, Bangalore, Chennai and Secunderabad. Its 92 employees, who cater to around 800 resellers across the country, man these.

### **Strategy**

Mehta believes it has been the shift of focus to up-coming technologies that paid off for the company, as it ensured higher returns and better margins. But the move was fraught with considerable risks. Said

Mehta, "We wanted to be in a business where customer would need us. But since this called for total dedication we had to customer back on our trading business." But taking the risk has paid off for the company, as customers today view the company as a techno-commercial entity.

### Long Term Prospects

Going forward, Mediaman is planning e-business initiatives under the Bravish brand name. Mehta wants to position Mediaman on the lines of Targus, a US-based notebook carrying case manufacturer, which has managed to position itself as the leading player in this space. It also plans to introduce a plethora of new products under the Bravish name. Additionally, it will open service centres in cities like Bangalore, Secunderabad and Kolkata by the first quarter of 2005.

While the future seems bright for the company the zero duty regime might upset the apple-cart, as the USB products and memory sticks will be available at the same rate to the end customer. The key for the company is to keep innovating and staying ahead of the technology.

### Questions

1. Identify strategic journey of Mediaman Infotech from 'Box Pusher' to 'Techno Commercial Entity.'
2. What decisions are taken in this journey?
3. Explain why Mediaman is planning an E-business initiatives?

(*Source acknowledgement case material adapted from 360 Magazine, Volume 4, and No. 23, Nov. 30, 2004. Article Mediaman: Trader to Distributor by Stanley.*)

## 4. ASIAN PAINTS INDUSTRIES LTD (APIL)

APIL attributes the relatively low growth in the decorative paint segment during the quarter to Diwali occurring in mid-November this year, compared to last year, when it was in the last week of October. On another front, there are pricing worries in the paints segment too. Companies are facing increasing pressure from the unorganised segment. APIL reduced prices of its Tractor distemper brands and Apex exterior paints in May 2004 to become more competitive, and in August 2005, it reduced the price of Tractor Emulsion too. Tractor Emulsion is an economy emulsion that APIL is using to upgrade users to emulsion. Its Utsav range of economy products are targeted at the lower end of the consuming market. APIL expects higher productivity and cost savings to cushion it from any diverse impact on performance. On the other hand, it has also hiked prices of solvent-based products by about 2 per cent to compensate for higher petroleum product prices.

Like most chemical based products, raw material costs constitute a huge portion of sales for paint companies at about 60 per cent of sales. Of this pigments are the largest component, contributing to one third of material costs for Asian Paints. The other major components are additives, solvents and oils.

One of the key pigments used in paint making is titanium dioxide (Tio2). The situation for Tio2 producers is good, as growing demand has improved such that Millennium Chemicals, the second largest producer, has now set a 30-day lead time for all Tio2 products. That means higher inventory costs for consumers but a more direct concern is the rushing price trajectory.

Between September 2003 and September 2004, APIL has reported an increase in the price of Tio2 of 4 per cent to \$1,925 a tonne. Also, Millennium has reported a price increase effective October 1 of \$ 100 a tonne. Du Pont Titanium Technologies, the largest player to announce a similar price increases. Now, this does not mean a similar increase in cost immediately, as large buyers typically enter into long-term contracts, but the price trends is clearly up.

Apart from this, the prices of other oils and solvents used in the making of paint have risen sharply due to the global rise in commodity prices. Thus, the raw material price situation is clearly inflationary and a tough situation on the ground means that companies in the decorative segment are one, fighting the unorganised sector for share and two, existing players will engage in a fierce battle for market share in the coming years. Goodlass has indicated that it will drive growth in the decorative segment – with a new distribution channel, improve rural penetration, and focus on emulsions and distempers. In the automotive and other industrial segments, OEMs typically have an upper hand and passing on cost hikes is difficult.

Over the years, almost all the paint companies have been adding capacity and improved their process efficiency and supply chains to squeeze costs out of the system. Better working capital management means that asset turnover has improved, which is crucial in business where inventory costs too play a critical role. The structural improvements have led to better margins for paint companies over the years. The recent increase in material costs is having some impact on margins though. ICI's segment margin for the quarter ended September 2004 was flat, while APIL's segment margins declined to 5.2 per cent from 7.6 per cent in the same period last year. Goodlass Nerolac, however, reported an increase in margins to 16.7 per cent from 14.8 per cent. The coming quarters will show the extent to which sales growth is growing and also the impact on margins of higher material costs.

## Questions

1. Analyse APIL business scenario and identify issues affecting the business performance.
2. Which forces are affecting APIL's competitive position?
3. Define the value chain for APIL and which IT applications will improve the performance?
4. Explain four perspectives of APIL business in terms of Balance Score Card model.
5. Where should be the focus of MIS in APIL in today's business scenario.

*(Source acknowledgement: Economic Times 8<sup>th</sup> Nov. 2004, case material is an extract for learning benefits to students.)*

# Information Security: Threats and Management

## LEARNING OBJECTIVES

- Security Threats and Vulnerability
- Attributes of Information Security
- Practice for Information Security Management
- Information Security Measures
- Classification of Information for Security
- Security Risk Management
- Cyber Security

### 4.1 INFORMATION SECURITY: THREATS AND VULNERABILITY

As business organisations have moved into E-enterprise mode, it has raised certain issues in the areas of Secrecy, Privacy, Confidentiality, Destruction and Theft of information and information systems. These issues assumed more importance when business processes are managed through internet and telecommunication networks. The security threats are posed from internal as well as external sources of the organisation. There are five reasons, which affect the security of the information and information systems. The reasons are:

- |   |   |  |
|---|---|--|
| <ul style="list-style-type: none"><li>• Destruction</li><li>• Theft</li></ul> | <ul style="list-style-type: none"><li>• Deletion</li><li>• Corruption</li></ul> | <ul style="list-style-type: none"><li>• Bugs infection</li></ul> |
|---|---|--|

The threat to information and information systems could be accidental or malicious, and it could get generated from personnel within the organisation who have an authorised access or from personnel who are not authorised to access the system. The security challenges need to be met on three fronts:

- |  |  |  |
|--|--|--|
| <ul style="list-style-type: none"><li>• Prevention</li></ul> | <ul style="list-style-type: none"><li>• Limitation</li></ul> | <ul style="list-style-type: none"><li>• Protection</li></ul> |
|--|--|--|

One more challenge is to setup a system of recovery, should the system is affected for any reason. All this is possible through a formal security management system (SMS).

The security management system, therefore has to have goals to control the impact of security threat to business. The E-enterprises who do not address security issue properly and

effectively are facing a risk of losing key data and information to competition, loss of business due to non-availability of the system, and further loss of business opportunity. The financial impact on the business could be fatal in number of these cases.

One of the major issues in managing the security of information is privacy. It needs to tackle 'right to the privacy of individual and also protect and maintain the confidentiality of the information. In the organisation, people who have access to the system use it to manage their professional roles and responsibilities. In the process they generate, store, and communicate information for business operations. Hence, there could be information islands, which could be private, calling for security of highest measure.

The real challenge in security threat management is to draw a line between privacy of information and information of public knowledge. However, it is generally accepted that if one gets access to information contained in e-mails, records, notes and reports can then collect personal information including telephone numbers, credit card numbers, and bank account numbers. It is considered a violation of individual privacy.

In manual system, this information is marked Private and Confidential. But in E-business environment, it is difficult and impractical to mark each such information as private and confidential. Hence, it is generally accepted that e-records are private and confidential. Security challenges are met through technical solutions, imposing terms and conditions related to security in every business contract. Taking recourse to legal actions if security measures are cracked is also practiced. However, it is necessary to cover the remote possibility of risk of disaster in the organisation. The solution to recover from the disaster is to design and implement 'Disaster Recovery System' (DRS).

The role and objective of DRS is to ensure that the organisation recovers very fast from natural and human caused disasters and puts back the information system on track for normal case.

Security Management System is designed to meet security threats and has the following scope:

- Identification of threat sources and possibilities of its occurrence.
- Protecting the Information and information system from unauthorised access.
- Ensure the privacy of individual and personal information.
- Check the misuse of information obtained from unauthorised access.
- Provide methods and systems to recover from damage and to put the information system on track for normal use.

With increasing use of Internet and web technology for management of business processes, enterprise definition extending to more business partners and major customers, security threat to information and information system is increasing. The risk of threat and associated exposure is so high that it calls upon the management to pay special attention to contain the impact of threat.

While managing security related issues, one is forced to deal with the individual by keeping a watch on movement, activities, including the monitoring of information processing related activities.

While monitoring the activities, management may encroach on the right to privacy of an individual. Today's technology provides solutions to find out number of visits or accesses to

website or database or server with personal and operational details of such access. It reveals personal data, references to file, database accessed, processes carried out using application, and messages sent with content.

Computerised information systems play critical role in business, education, services, government and daily life. The organizations, whose activities heavily rely on information systems, must accept the challenge of keeping the information systems reliable, dependable and secure. The business loss due to security breach is directly proportional to the degree of reliance of the organisation on information systems.

The real challenge in security management system is to design and implement SMS, which is effective in prevention, limitation and protection but at the same time does not violate the right to privacy of an individual.

In E-enterprise there is a heavy use of technology that includes Information Technology, Networks, Internet and Web, supported by allied technologies such as RFID, Bar Coding, Smart Card, Database management, Telecommunication and so on. The storage of data, information, programme, packages, reports and information products is electronic and is either on hard disks on servers or on compact disks (CDs). Electronic medium, whether online or offline is vulnerable to many threats. The vulnerability of the systems to security threats can be met effectively only with Security Management Systems (SMS) with specific following objectives:

- Minimise the loss of physical and information assets.
- Minimise the loss of business or business opportunities.
- Ensure system integrity and reliability of data.
- Keep quality of information systems highest.
- Recover fast from any disaster.

Threats to information systems are caused from several sources and reasons. All the reasons can be put in three classes namely failure of system, human actions, and damage due to natural calamities.

- Failure of system: Hardware, Software, Network, and Telecommunication functioning.
- Human actions: Illegal access, Theft, User Errors, Programme changes.
- Natural Calamities: Fire, Earthquake, Floods.

Today's information system spread is global at different locations. They function in networked environment using network technology, Internet, wireless networks. Such complex network with different technologies makes information systems more vulnerable to various threats. We now go more into the details of threats and vulnerability to get better insight into the security problems in the organisation.

### **Failure**

Hardware, Software, Network failures are not uncommon causing non-availability of the system to the users. Hardware failure is due to poor upkeep and maintenance. Software failure is due to bad quality, and poor maintenance, and incorrect, erroneous and incomplete user actions. System failure is also caused by not providing power backup devices to control power

and frequency variations. Telecommunication networks also fail due to misuse by system developers, computer operators, maintenance staff, systems programmer and end users.

### **Human Actions**

Information systems are more vulnerable to human actions. Information systems are used by internal personnel of the organisation as well as by outside personnel who have been given access to it for limited purpose. These actions could be wrong accidentally and unintentionally, or purposely with intention of theft, copying, damaging, and corrupting the information and system. The result of such human actions is non-availability of the system, some data and information for usage. The loss of data to competition affecting the business is also a possibility.

Improper erroneous use of system could be from personnel, if they are not trained properly and have poor understanding of the information system. Human action could be wrong if unauthorised personnel from within or outside the organisation access the system. Unauthorised access also gives opportunity to insert computer viruses in the system.

As most of the information systems work on Internet, and internet security net can be penetrated, the risk of system, data, and information falling in the hands of unauthorised persons has increased considerably.

If a software package and programmes are delivered with bugs, a programme code error or defect, it can harm the system resulting into non-availability or erroneous process. Zero defects, and complete fool proof testing of the information system is not possible. Next culprit of failure is computer viruses. Computer viruses are the programmes inserted to spread rapidly through computer system networks for destroying data, corrupting the data, disrupting the processing, denying the service, and crashing the network.

Another source of failure is information system quality problems due to developers' actions. In the process of software development, if sufficient care is not taken in design and architecture, development and quality assurance; software would fail frequently while in use.

### **Natural Calamities**

Information systems are also insecure in the event of destruction due to natural calamities like fire, earthquake, floods, and so on. In such events, impact on the system could be very large. It may result in total loss of the system: both hardware and software, data files, and reports. The effect of such impact is not easily manageable for the system to make up and run for the users. The impact of natural calamities is most of the time disastrous, calling for high level protective security measures. The problems with these calamities are that they are not predictable to know when they would occur.

## **4.2 CONTROLLING SECURITY THREAT AND VULNERABILITY**

To control the threats to information system and the degree of vulnerability, an organisation must invest in proper security net developed through Security Management System (SMS). The objective of such system is to reduce significantly the incidence of failures, erroneous human actions, and predict and prepare for contingencies to minimise the damaging impact of natural calamities. SMS is a configuration of manual and automated measures that protect information systems and assure the performance as desired. Manual measures include

Security Policies, Procedures, Rules and Operations discipline, which create awareness about security and enforces administrative discipline in work process across the organisation. Automated measures such as smart cards, Id's, view monitors and such other devices are built in security mechanisms of physical infrastructure for personal access. Automated measures also need to be implemented in Information Technology and Information System infrastructure. These measures are software programmes designed to search, identify, declare, and stop the processing if anything is defective, erroneous, inconsistent, and not as per specification is observed in the operation.

### **Security Controls**

The entire SMS works with security controls designed for specific purpose and introduced at appropriate place. Security controls can be explained by classifying them in different categories as shown in Table 4.1.

**Table 4.1** Security Controls: Manual and Automated

<i>Security Control</i>			
<i>Manual Controls</i>		<i>Automated Controls</i>	
Premises:	Access control, Lock and Key and Recording entry and exit.	Input: (Document and Fields)	Control Totals, Document count, Hash totals Source check, Error Display
Hardware and Software:	Authenticity control, usage control, operational control, through password, selective rights.	Input quality (Field level)	Edit check for specification, Picture, Layout.
Operations:	Authorised setup operations, Job scheduling, Backup and Recovery, and Storage and Retrieval systems. Only authorised users.	Input processing (Validity, Rules)	Process for data integrity. Check complete input for validity, Completeness and Precision
Data:	Access control to physical data storage. Control on change or deletion.	Output (Updates, Reports)	Ensure all updates, check pre and post process conditions. Log of all reports processed

Security controls could be manual or automated through a computer system. The scope of control encompasses that quality of input – process – output is as per specification stipulated in system design. Manual controls essentially focus on physical access to premises and hardware, software, and packages. It is generally executed through policy, procedures, system operation, and documentation and controlled through recording, reviewing and auditing the events. The premises are also kept under surveillance through video spy cameras.

Automated controls are executed through computer system, which check the quality of input in terms of valid source, field level integrity and for completeness of the data. A portion of software system design focuses on confirming the input as per input data specifications ensuring all processes relevant to input are executed correctly as per process design. And further updates of processed output are carried out confirming pre and post process conditions

and post process actions such as delivering the output reports, display of messages, alerts, and prompts.

The stated security controls ensure to a great extent that IT infrastructure is safe and secured from physical damage, theft, unauthorised entry and access. Then automated controls through computer systems, integrated in software solution design controls the defective erroneous application processing making information system safe and secured for use in business.

The choices of controls are need based to specific custom situation. Not all of them are necessary always. The choice of security controls is linked to threat perception and risk exposure and degree of vulnerability of the system.

Though measures described so far control threat to security and consequential damage, it does not cater to the requirement of high availability of a system for use in business process. E-enterprise organisations heavily depend on information systems to drive the business. Such dependence is assured if information systems are live and up all the time twenty-four hours and the service level of the systems is also very high. So, to meet this requirement additional steps are required that information systems are non failing, and in the event of failure alternate system options automatically take over to continue the service. The concept is called 'High-Availability Computing.' High availability computing is very critical in businesses like Banking, Financial Services, Airlines, Health Care, CAM processing. In these businesses, risk exposure of any threat is very high.

High availability computing service to such businesses is given through specific computer systems design. The popular proven measures are provision of redundancy, load balancing, mirroring and clustering as following:

### **Fault Tolerant Computer Systems**

These systems contain redundant hardware, software, power supply to take over if the one in use fails to service the requirement. The redundancy ensures continuous, uninterrupted service to the system user. Major resource capability of fault tolerant computer system is for providing continuous, uninterrupted service.

To meet the requirement of continuous service, critical information systems are designed with various features and capabilities to make system available uninterruptedly.

A feature 'Load Balancing' is included in the design so that if processing load increases due to a sudden large number of requests, this feature distributes the requests to different servers and averts the risk of system stoppage due to heavy processing load.

Mirroring is the feature to ensure continuous availability of processing programme to the request. Mirroring feature automatically switches the request to backup server, if the primary server fails for some reasons. This however is very expensive proposition as it calls for installation of backup server, a mirror image of primary server. Less expensive proposition is 'Clustering' of computer system(s). Two computers are clustered to take over each other's service requests if any one fails. The clustering is not a redundancy while mirroring is a redundancy due to exclusiveness of the backup server.

High availability computing is an expensive feature and needs to be provided only in the case of critical systems. The cost/benefit and risk analysis of critical systems is a key to decide on this aspect of providing continuous and uninterrupted service to the users.

### **Additional Security Measures**

As it is difficult to provide technically and economically fool proof security to the information system, less expensive security measures are available to control the threat and vulnerability of the system.

#### **Physical Access Control**

Servers, PCs and other installations are controlled for access. Policy, procedures and record keeping system keep a watch on who visits and how long. Access to sensitive installation and storage areas is restricted and only allowed on authorisation from the management.

#### **Monitoring the Usage**

Another security measure, after physical access control, is monitoring the access to data: Computers and Software systems. Monitoring keeps track of users access, files referred, read, and changed. The track record is called as 'System Log,' which provides information on how the system is used by whom and in what manner. Monitoring helps trace the user of the system in whose session incidence of failure has occurred.

#### **Employee Evaluation**

The greatest risk to security is from insiders of the organisation. Their selection and appointment should be after in depth scrutiny of past record and references.

#### **Entry Level Security Codes**

Security Codes is a multilevel 'Password' system incorporated at entry level for security management. The system is built on following lines:

1. User logs in with unique ID.
2. User then asked to key in Password.
3. On gaining access to the system, the user is asked to enter a unique file name and password to read or write.

#### **Use of Security Monitors**

Security monitors are a set of software programmes, which monitor the use of network and protect them from any unauthorised use. The software is capable of handling protection of devices, programmes, data files vs users and their permitted rights to use the network and information system. The software then provides statistics on monitoring for system administrator to look into.

#### **Application of Biometric Security**

Each individual user has unique physical traits, which can be used, as 'key' to control access as well as to identify who has accessed, the files and records. The physical traits are fingerprints, hand geometry, and style of signature, keyboard usage style, face geometry, voice recognition and so on.

An individual's biometric profile built in the system using these traits is processed every time when the user attempts to access the system. When the user biometric profile is read

by the system matches with the stored biometric profile, access is granted to the user. In the event of a mismatch, the permission to access is not granted.

### Testing of Audit Trail

An audit trail is a definition of various steps through which the transaction is processed. Audit trail is used to trace the flow of execution of transaction. If the integrity of flow is tested and found correct then system is reliable in quality assurance.

### Virus Entry Protection

A virus is a hidden programme that gets entry through network and forces the system to clone the virus. The virus can travel from one computer to another on networks. They are capable of damaging data, erasing files, or formatting disks and so on. Antivirus software products are available to prevent the entry of virus. It detects the virus and destroys it through a process. The antivirus products are available for standalone PC as well as for network. 'Norton Antivirus' of Symantec, 'Virus Scan' of McAfee are the popular anti virus software products. It is advisable to use more than one anti virus software, as all of them are not protective for all viruses.

## 4.3 MANAGING SECURITY THREAT IN E-BUSINESS

Modern organisation uses Internet and public networks for E-business. E-business suite consists of ERP, SCM, CRM, and PLM packages supported by E-commerce, E-communication, E-collaboration applications. The applications running through these packages are vulnerable to security breach actions as they are virtually open due to Internet platform. Hence, any security threat becoming a reality can have an enormously wide spread impact on business operations.

E-business application architecture is a client/server and applications are linked to servers and databases spread over the network. All the hardware and software on the network is challenged by security threats. The vulnerability of the E-business systems, applications and processes increases due to very nature of its openness to internal people as well as to outside people. E-business application suite has expanded the information technology infrastructure by networking in suppliers, customers in the network of organisation's business. E-business enterprise networks are used for sending and sharing information via Internet/Intranet/Extranet to all users. This means organisation's sensitive data, processed information, knowledge base are under threat of exposure to the unauthorised user.

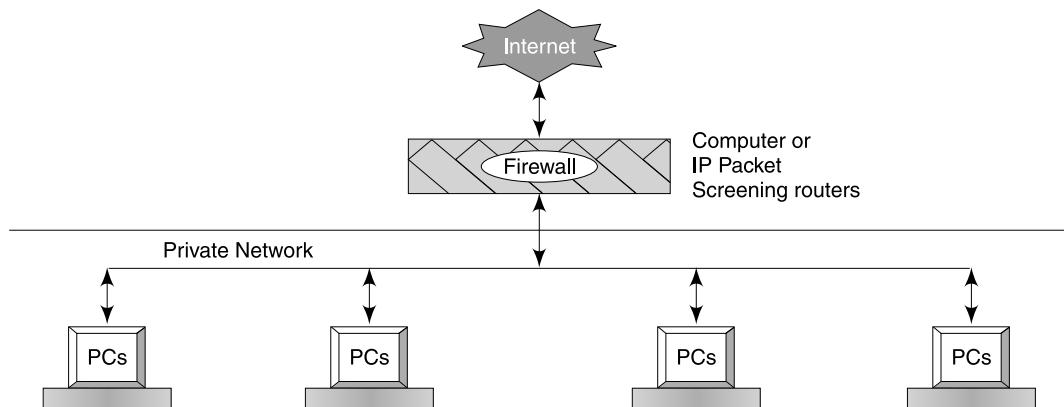
The very nature of E-business process calls for different approach to control security threat and vulnerability. In the following sections, we discuss measures, which assist in protecting information assets of the organisation. The security measures in E-business have to be e-enabled. Measures so far successful are the following:

- Firewall: Prevent unauthorised user's access.
- Encryption: Prevent reading of information, messages, reports.
- Authentication: Confirm the authenticity of a claim of other party.
- Message Integrity: Ascertaining that communication content is not disturbed.
- Digital Signature: Confirmation of sender's authenticity.

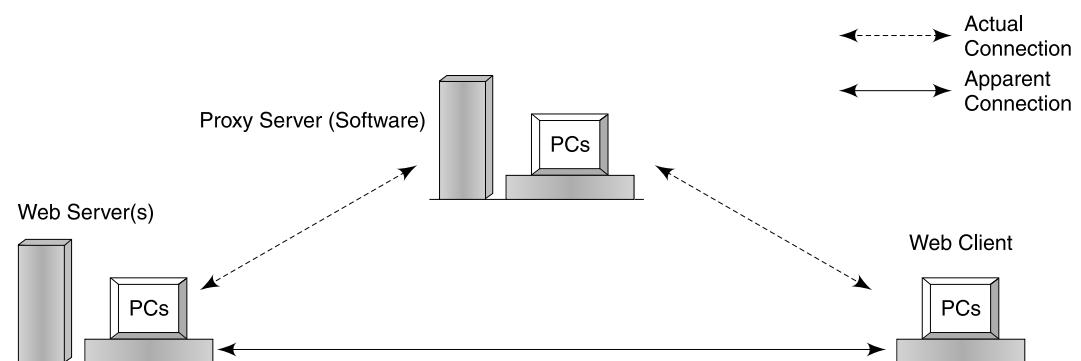
## Firewall

A firewall is placed between private networks such as LAN/WAN and external network, Internet. The role of firewall is to control access to internal network sought by the user. The user may be an employee, visitor, supplier, customer or a person not related to the organisation. Firewall processes names, Internet Protocol (IP) addresses, applications, and all incoming requests and confirms the authenticity and validity of the access by checking against access rules programmed into the system. The basic advantage of firewall is that it prevents unauthorised communication controlling the security threat to company's network. Figure 4.1 shows firewall security model.

### (Option A)



### (Option B)



**Fig. 4.1** Firewall Security Model

There are essentially two types of firewall technologies one is 'proxy' and other is 'packet.' In Packet technology, firewall scans each packet of incoming communication verifies the source and addressed to whom. Then it sets up state tables out of the package and cross checks with the user defined rules to make a decision on permission to enter the network. 'Cisco Systems' firewall products are based on this technology.

Proxy firewall stops data originating from outside, checks for the access rules, and pass a 'Proxy' of it to the network. Proxy is an application which acts as intermediary between private network and Internet to control the traffic. Proxy firewall needs programming work, system resources but is safer to a great extent to contain the threat of unauthorised access.

Whichever technology is used, user must write a set of rules on 'access' linking to people. Firewall technology is not a foolproof solution to control security threat unless Security Policy, Operations Procedure, Committed users are aware of security threat and its impact implications are supporting it.

In addition to firewall systems, software tools are available that can be installed at locations where sensitive data and information is stored. This software scans the identity references of the user before access is given to the location. The use of such software tools at a few sensitive locations is second additional control after firewall check.

If checking response is negative, access is denied or location is switched off for work, and network, an administrator is communicated to look into the incidence. The software solution is called Intrusion Detection System.

Firewall is made up of computers and software. A firewall can be a communication processor, known as router, or a dedicated server along with software written for checking, verification and decision-making for allowing or disallowing the access. Firewall checks network traffic for passwords, security codes, and access rights before any decisions are made. A corporate network can have more than one firewall installed at various locations.

In summary, one can say that:

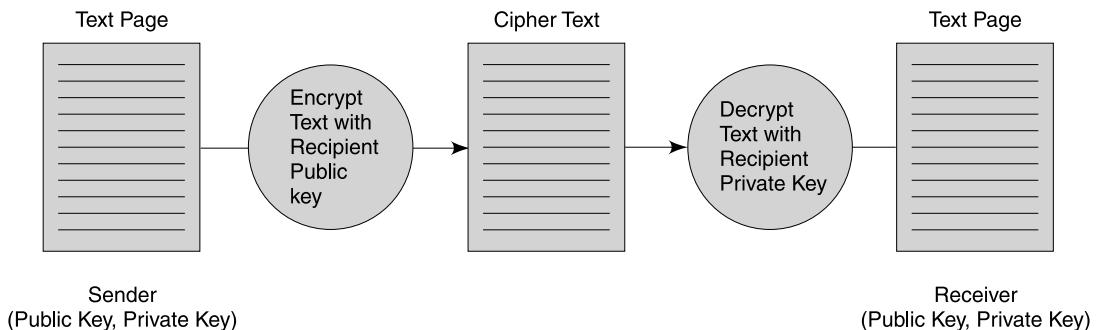
- External firewall watches unauthorised Internet users.
- Internal firewall watches access requests to sensitive data and information.
- Dedicated firewalls installed at sensitive location of data or server puts second scrutiny on the access requests.
- Password and browser security controls the access to specific intranet resources, hardware and information.
- Network security software protects backend resources, databases, application servers and so on.

## Encryption

Firewalls can deter, but not completely prevent an unauthorised access. To cover up this risk of exposure of data, information in communication mode, encryption technology is used to make the communication highly unintelligible and meaningless to everybody except the authorised user or recipient.

Encryption is a process of making information not understandable at all. The message is secured through the process of encryption and decryption. Figure 4.2 shows the process of encryption.

Encryption algorithm converts normal text into cipher text through encryption. The decryption process reconverts cipher text to normal text. Encryption method uses a pair of public key and private key unique to sender and receiver to secure the communication.

**Fig. 4.2** Process of Encryption

Algorithm is a mathematical technique chosen by the sender to encrypt the data in coded form. It is supported by features such as user authentication, verification by the receiver and confirmation of proof of origin.

To explain in brief, sender uses recipient's public key from a directory and uses it to encrypt a message. The message is sent in encrypted form over the Internet or a private network. On arrival, recipient uses his or her private key to decrypt the message to read.

An example of encryption and decryption to protect integrity of the message is as follows. Suppose company want to convey the price to the customer by sending the message.

### **Original Message Text**

The price for coupling is ₹ 392.

The message is encrypted by using an algorithm of putting next alphabet after each letter in the word and next numeric digit in the price figure. Message is encrypted using customers public key.

### **Encrypted Message using Above Algorithm is known as Cipher Text**

Uif rsjdf gps dpvqmjoh jt st 403.

When message is received by the customer, cipher text is decrypted using private key of customer.

### **Received Original Message After Decryption**

The price for coupling is ₹ 392.

### **Authentication Measures**

Firewalls protect unauthorised entry. Encryption makes reading of message almost impossible. In both these systems, it is assumed that sender or receiver is an authenticated right person as claimed in the system. 'Authentication' provides ability to individual to confirm that other party is a genuine as claimed in communication. Microsoft provides online identification service to authenticate user identification.

**Message integrity** is the ability to ensure that message received is original, and not copied or changed in any manner.

**Digital signature** is a ‘Digital code’ attached to the communication. It helps verify the origin and sender. It plays a similar role to written signature on the paper document. For digital signature to be legally binding some authorised institution must verify the authenticity of the digital signature before it is accepted for processing the request.

Digital certificates are data files constructed specifically to establish the identity of the user before user is allowed to proceed in transaction processing. A digital certificate is issued by a trusted third party known as a ‘Certification Authority’ (CA). CA is authorised to check personal details of the user with the data and signature available with it. Digital certification processes achieve multiple objectives:

- Authentication of the user.
- Encrypt identity of Communication participants.
- Provide security to transaction throughout the cycle.

Digital certificate is appended to communication to verify the identity of the sender and to provide the receiver ability to encode a reply.

SSL (Secure Sockets Layer) and S-HTTP (Secure Hypertext Transport Protocol) are protocols used for secure information exchange between senders and require over Internet.

## 4.4 DISASTER MANAGEMENT

In spite of all care taken to secure information technology infrastructure, there is an element of risk due to certain unforeseen circumstance, or unpredictable and uncontrollable cause damaging information assets of the organisation. To counter this threat, management resorts to disaster management plan (DMP). DMP is a plan of action to recover from the impact on the information systems. They are either collapsed or dysfunctional. You need a recovery process to start them all over again. Organisations like bank, airlines, railways, process automated manufacturing companies, and hospitals have many critical applications, which are their lifeline. In all such cases, a disaster recovery plan is a prime necessity. The objective of DMP is not only to start the system again but start properly from a stage when it is stopped and with all data integrity maintained after recovery to ensure that quality of output is not defective due to loss of data, incomplete data, or incorrect data.

DMP specifies the procedure of recovery action when disaster occurs. It fixes roles and responsibilities on individuals to deal with the crisis situation.

DMP also provides guidance on how to keep organisation running while DMP is being acted upon. DMP plan includes measures such as following:

- Alternative processing arrangements.
- Duplicate and offsite storage of data, hardware and software.
- Choice of systems and Applications, which should run, in any case.

A systematic approach to prepare DMP is to evaluate the security threat and vulnerability of the systems. The broad guidelines are as under:

### DMP Preparation Plan

1. Identify critical business processes.
2. Access the business risk: Probability of risk occurrence, and risk exposure with respect to time of exposure.

3. Enlist the impact target of the damage for attention to manage and recover.
4. Identify the life saving sensitive data, files, software, applications, packages, hardware, servers, and databases linked to these processes.
5. Segregate the need in two classes where an organisation can resort to following actions:
  - Switch to manual process.
  - Work at offsite with data backup created at offsite location.
6. Prepare a plan of bridging pre and post disaster scenario so that continuity of data and information is maintained.
7. Ensure all risks are suitably covered by appropriate insurance policies.
8. Authority, rights for decisions and actions in the event of disaster should be clear in DMP.
9. Test the DMP plan once a year in simulated live model event.

DMP Plan is based on the assumption that an organisation has a security policy, and management supports it. It also supposes that certain actions to meet security threat are already taken. A brief summary of these actions is given below.

### **Threats to Facilities and Structure**

- Earthquakes, Fire, Explosions, Floods, and such other events.
- Power failure and Power related problems.
- Theft.
- Damage by disgruntled employees.
- Unauthorised use of IT structure.

### **Controls**

- Place critical hardware on higher floors.
- Design buildings for the natural threats.
- Store sensitive data, applications, offsite in a different building.
- Provide security training to employees.
- Provide dedicated power lines with UPS.
- Install close circuit cameras.
- Screen employees and usual visitors and get the appropriate secrecy bonds signed from them.
- Use biometric access controls and IDs.

### **Threats to Communication Systems**

- Incorrect input due to communication break down.
- Intrusion by unauthorised persons and damage to communication system.
- Insertion of viruses.
- Defective network operations.

## Controls

- Firewalls.
- Error detection and correction methods.
- Redundant lines.
- User IDs, Passwords and PINs.
- Access logs.
- Encryption, Decryption of key inputs/outputs.
- Log of system failures.

## Threats to Database and DBMS

- Corruption of data.
- Theft of data.
- Unauthorised access.
- Data inconsistency.

## Controls

- Use of antivirus software.
- Restart and recovery procedure.
- Backup copies.
- Concurrency protection.
- Restricted authority to update, delete.
- Limited, authorised access to Database.
- Dedicated DB administrator.

## 4.5 APPLICATION SYSTEM'S SECURITY MANAGEMENT

The word 'application' here means systems developed for data processing, transaction processing, legacy systems, enterprise software, web applications, portals and database applications and so on. They run on enterprise network. Hence, they are vulnerable to attacks from any quarter. Their security is most important and critical to business operations and performance.

Each of these applications has their own design and architecture. It could be Client server, Service oriented, or any other. All of them have their data definitions, data models, process models. Some have their own data storage and some are developed on enterprise database or DWH.

In application systems security management, therefore, attention is to be given from development stage so that the application is not under threat by unauthorised individuals, hackers and so on. The focus should be on

- Data security
- Database security
- Application security

### ***Data Security***

Backing up a data is an essential security measure, easy to implement by policy. Data has gained intrinsic value, either in the manpower needed to generate that data or in the significance of that data to your customers. Data loss, both accidental and due to theft, it is a heavy cost and risk to business.

### ***Database Security***

Databases often lie within the organisation's boundary and are generally protected through 'firewall systems'. A database is considered to be secure if it assures the confidentiality, integrity and availability of the information stored. The database is insecure due to following reasons.

1. **Data tampering:** The confidentiality and integrity of information is at risk due to its tampering during its transmission from one location to other. In a distributed environment of a digital firm the possibility that an unauthorised third-party can by tampering with data as it moves.
2. **Data theft:** Any weakest link in Internet and Wide Area Network (WAN) environments, and satellite links, and number of servers exposes the information to unauthorised access. The data theft is a possibility from organisation's people if they identify such a weakest link to penetrate.
3. **Falsifying user identities:** In a distributed digital firm environment, it becomes increasingly possible for a person to falsify an identity to gain access to information. Identity theft (authentication) is one of the greatest threats to individuals in the Internet environment. Non-repudiation is another possibility which remains uncovered.
4. **Password-related threats:** In large systems, application users must remember multiple passwords for different applications and services that they are authorised to use. Users typically respond to the problem of managing multiple passwords by selecting easy-to-guess passwords, such as a name, date of birth, or a word from a dictionary, some code number or its variations. All of these strategies compromise password secrecy and service availability.
5. **Unauthorised access to Data:** The database may contain confidential tables, or confidential data in a table, which is available to all database users who are authorised to access the database. The risk of accessing the confidential data is very high if access control by selective control, user vs data, is absent.
6. **Password security management:** Database security systems require that passwords be kept confidential at all times. But passwords are vulnerable to theft, and misuse. A database without password management feature is at risk to become insecure. Most databases provide good password management features. The features include the following:
  - Account locking by the authorised user
  - Password ageing and expiration for automatic change
  - Password history to avoid repetition
  - Password complexity verification to prevent tampering.

### ***Database Authentication***

Authentication is the process by which the database server recognises the identity of the user to allow the access. Databases provide multiple authentication methods like database authentication (in-built), external authentication, global authentication, proxy authentication, etc., for recognising users before the access permission.

### ***Data Base Resource Management for Continuing Availability***

Performance of database and its continuing availability depends on number of users logging on to it. If this number suddenly increases, such increase in database usage might crash the database, leading to denial of service. Some of the resources that can be managed include storage quotas, CPU processing time, disk reads, etc.

### ***Backup and Recovery for Ensuring Availability***

There are security aspects to availability. For example, if a user is able to manipulate system resources in order to deny their availability to other users, it amounts to breaching security. Databases provide easy-to-use tools for managing backup and recovery of databases. Every database should have a proper backup and recovery plan. It is also important to have these plans tested in a test environment.

### ***Auditing of Relevant and Useful Information***

Auditing is a feature that allows the data base administrators to track what users are actually doing, when and how, in the database. Audit functions should be specific and limited to monitoring the data and actions necessary to keep the database secure. Too much auditing will also affect the performance of the transactions. Auditing can be very broad or specific. But it is important to audit only relevant and useful information about users or their actions. Maintaining an audit log is a good practice as it would contain the details of user behaviour.

### ***Secured Operating System***

The security of the database depends on the platform on which it is running. Hence, it is imperative to secure the operating system from unauthorised users. An unsecured OS on attack could cause damage to the database and files of the database. A simple change or deletion by the user of one file could crash the system.

### ***Application Security***

Application security flaw can undo the good work done by infrastructure security components. Application-level attacks often cannot be prevented or detected by infrastructure security components. Infrastructure security components can ensure confidentiality and integrity of sensitive data intended for critical servers and meant for prevalent users. They can also ensure that only the traffic intended for specific ports in applications is allowed to proceed. Moreover, the business impact of a successful application-level attack can be significantly greater than that of a successful infrastructure attack. However, a person may be able to perform a successful unauthorised transaction without any knowledge of the database scheme by using a missing authorisation check in the application logic.

### ***Issues Affecting Applications Security***

There are a few security weaknesses that may insecure applications. Surrounding security infrastructure may not be a fool proof security net around the application.

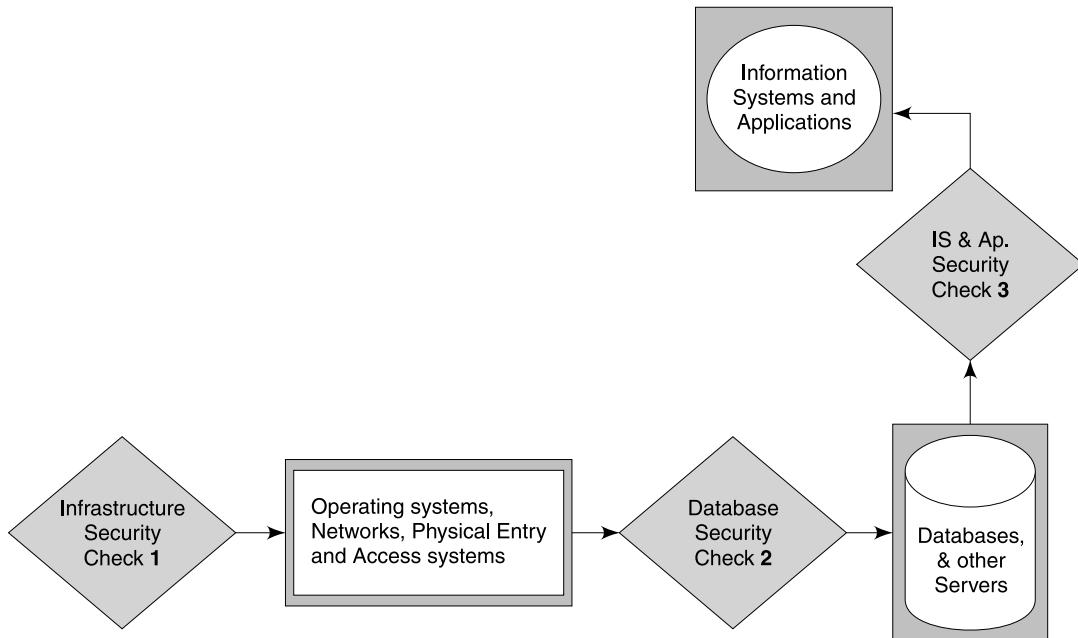
- *Inadequate semantic validation:* An application must not treat any data transmitted from the client side as safe. Appropriate validation of received data must be performed at the server-end to ensure that length and semantic restrictions have not been violated.
- *GUI based restrictions:* Many applications enforce access control at a GUI level. All checks performed by the application to enforce access control must be done at the server-side prior to processing the client request. Client-side validation is ineffective as far as security of applications is concerned.
- *Custom encryption:* Applications that rely on client developed custom encryption schemes rather than on secrecy of the key. If custom implementations of encryption schemes are cracked the server is insecure. Always rely on proven encryption algorithms and ensure secrecy of the key.
- *Predictable session identifiers:* Certain applications create their own session identifiers and its users that are predictable in nature. If an attacker can determine the next valid session identifier user can hijack user's session. Due care must be taken to ensure that session identifiers are sufficiently random. And the randomness is changed often by inbuilt scheme.
- *Inadequate error handling mechanisms:* Applications that lack error handling mechanism run the risk of displaying sensitive system information such as ODBC errors, database table names, file names, stack traces, etc. This information helps attacker to choose the target to attack.
- *Absence of an effective logging mechanism:* Logging forms is a critical component of the application. It is the only mechanism that can identify the user & suspicious behavior of the application. It pins down individual accountability on users and the application if some things go wrong.

### ***How do We Ensure Application Security?***

Best practice to ensure application security is to make security as a design principle and make it an essential component of the design. Application security thought throughout the development lifecycle becomes one of the fundamental design principles influencing the development process

Further, software testing should examine the applications for potential exposure risks. Personnel involved in the software testing process also need to be trained on application security testing to develop the ability to test the design from security angle. It is also worth while to use third party external source to test the application design from security assurance angle.

Figure 4.3 shows a three layer security apparatus the digital firm should have for ensuring the Information Security.



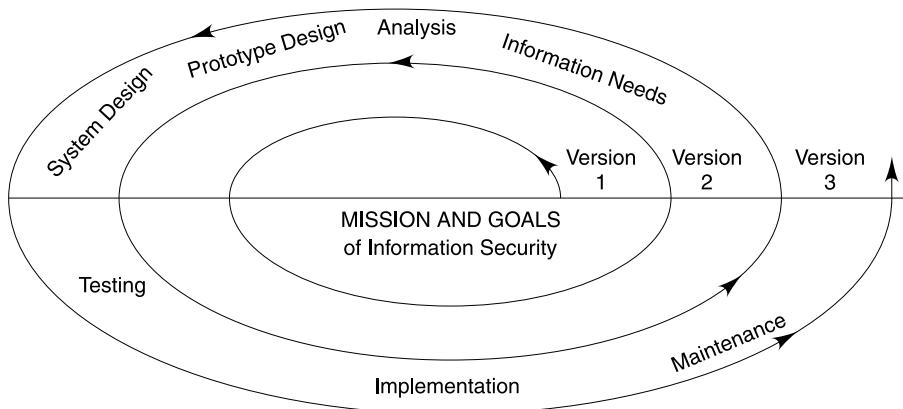
**Fig. 4.3** Security Apparatus of a Digital firm: Infrastructure to Data Base to IS and Application

## 4.6 INFORMATION SECURITY MANAGEMENT

Information security means protecting information and all resources which produce that information, from unauthorised access enabling its use, disclosure, disruption, deletion, alteration, modification, checking, downloading and destruction. If information is not protected, enterprise runs a risk of loosing information to unauthorised, unknown quarters and adverse consequences thereof. In the global world of internet-driven business, threat to information, due to misuse, disclosure, disruption, deletion, alteration, modification, checking, downloading and destruction, prevails. The business enterprise has to consider the threat to information assets and the risk of getting impacted adversely in business terms. Besides, implementing information security measures backed by policy and an organisation to support it, the management should address the issue as a Risk management in information security measures.

One can take an approach of Information Security Engineering, a systems approach to deal with Information Security and Cyber Security. Information Security Engineering is an art (skill) and science of establishing users security needs and designing and developing, information systems so that they resist, protect itself from security threats prevailing in and around of the organisation.

Information Security Systems Engineering process follows the Boehm's Spiral model of software development where information needs are 'Information security, needs (See Fig. 4.4).

**Fig. 4.4** *Bohem's Spiral Model*

#### Information security Risk Management:

Let us know the terms used in risk management through information security measures.

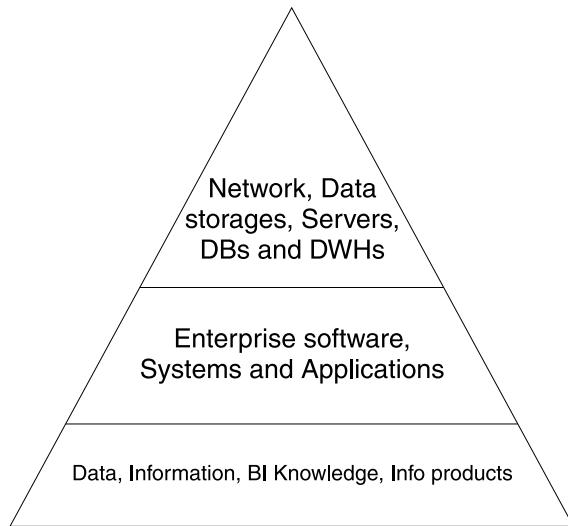
- Risk = Threat to asset  $\times$  Vulnerability of asset.
- Risk Factor: Probability of risk occurrence. A threat turning into a reality.
- Risk exposure: Risk factor  $\times$  Money value of the damage on risk occurrence.
- Threat: Actions, activities, situations, events which would harm information and systems.
- Degree of threat: Depends on potential capability of threat agent.
- Vulnerabilities: Weaknesses, shortcomings in systems, people, technology that allow a threat to become effective reality.

The digital enterprise operating globally is exposed to all kinds of threats and risks thereof, calling upon to implement information security systems and risk management. The threat and risk is across the digital organisation spread over hardware, network, and software, data information as shown in Fig. 4.5.

#### ***ISO/IEC 27002:2005 Code of Practice for Information Security Management***

The ISO/IEC 27002:2005 Code of practice for information security management recommends the following for examination during a risk assessment and its management:

- Security policy
- Organisation of information security
- Asset management
- Human resources security
- Physical and environmental security
- Communications and operations management
- Access control
- Information systems acquisition, development and maintenance



**Fig. 4.5 Threat and Risk Across Digital Organisation**

- Information security incident management
- Business continuity management
- Regulatory compliance

In broad terms, the risk management process consists of:

- Identification of assets.
- Estimating their value. Include: people, buildings, hardware, software, data (electronic, print, other), supplies.
- Conduct a threat assessment. Include: Acts of nature, acts of war, accidents, malicious acts originating from inside or outside the organisation.
- Conduct a vulnerability assessment, and for each vulnerability, calculate the probability that it will be exploited.
- Evaluate policies, procedures, standards, training, physical security, quality control, technical security.
- Calculate the impact that each threat would have on each asset. Use qualitative analysis or quantitative analysis.
- Identify, select and implement appropriate controls.
- Provide a proportional response. Consider productivity, cost effectiveness, and value of the asset.
- Evaluate the effectiveness of the control measures.
- Ensure the controls provide the required cost effective protection without discernible loss of productivity.

Management can choose risk management policy based upon value of the asset, frequency of occurrence, and the impact on the business. The choices are

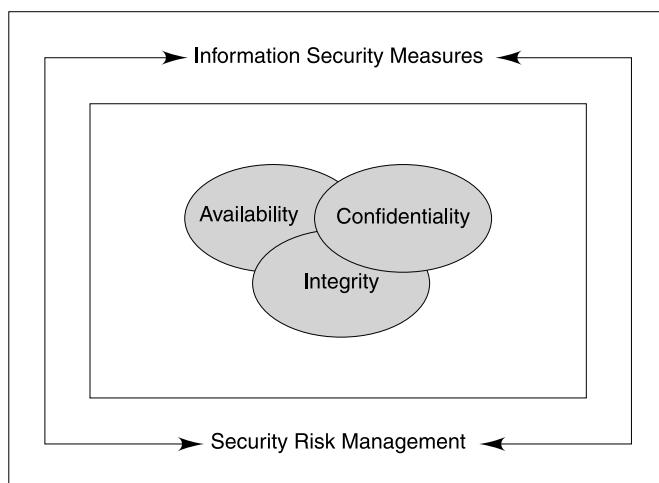
- Accept the risk and deal with consequences.
- In that case, cover the risk by appropriate insurance cover.
- Mitigate the risk by appropriate security measures.

### ***Information Security Attributes***

Information Security Attributes are Confidentiality, Integrity and Availability (CIA).

Information security measures are designed and implemented to ensure that the user is assured the confidentiality, integrity and availability of the information. Protecting confidential information in e-business world is a business requirement of the global enterprise. For the individual, information security has a significant effect on privacy.

These attributes are managed through two initiatives, implementing security measures based on policy and security risk management (See Fig. 4.6).



**Fig. 4.6** *Information Security Attributes*

Let us understand these attributes before we talk about its security measures.

#### ***Confidentiality***

Information is *confidential* when its exposure to unauthorised persons or computer systems is a threat to business.

For example, in case of an individual, a credit card number, user Id, passwords are confidential information. For an enterprise, financial data, product specifications, R&D findings, explicit knowledge competency are confidential information. If an unauthorised person manages access to this confidential information, it is a breach of confidentiality.

#### ***Integrity***

Information integrity means that it is not modified in any manner. It continues to maintain its definition, design, structure, and format in store or in transit and is useful for intended

applications. Integrity violation means it has lost its original character. Information security systems provide measures to ensure integrity in addition to data confidentiality.

## **Availability**

Information stored in any medium must always be available on call by the user or by any application. Information systems serve their purpose if input information is always made available to them. The Information system design should take adequate measures to ensure high availability. A care also should be taken that availability is assured by prevention of power failure, hardware breakdowns and system upgrades. Security measures ensuring confidentiality and integrity increase availability of information quality.

## **Authenticity for identification of an individual**

Information for use in decision making must be authentic. Authenticity is an essential character or attribute of information, if it is to be used in any manner in IS or MIS.

Unauthentic information has a risk of carrying false information. Authenticity refers to the truthfulness of origins, attributions, commitments, sincerity, devotion, and intentions of a person or transaction. Authenticity is the degree to which one is true to one's own personality, spirit, or character, despite these pressures. For example, as a credit card holder if you have a query on the bill, you call 'help desk'. Before the query is answered, the service provider asks card number, expiry date, date of birth, home town and even mother's name and crosschecks with your card master identity data, if the cross match correct and complete, further conversation is picked up. The process is called authentication. The authentication process had confirmed that the caller is a genuine credit card holder proved by verification of identity data. When you make a cheque payment, bank teller verifies account number, signature, cheque serial number. The process authenticates the genuineness of the signatory to the cheque. In E-business, M-commerce and E-commerce access to the network or to information system is first authenticated before next processing is taken up. All transactions financial or other go through a process of authentication specifically designed for that transaction. Authentication is one of the security measures to any stop access to unauthorised person. Authentication is the act of verifying a claim of identity.

## **Non-repudiation**

*Non-repudiation* ensures that a transferred message or transaction has been sent and received by the parties claiming to have sent and received the message. Both the parties own the transaction or the message. Non-repudiation is an assurance that the sender and receiver cannot deny later, it's sending or receiving.

Non-repudiation can be ensured through the use of Digital signatures and public key encryption, engaging message transfer agent and putting a timestamp.

- E-commerce uses digital signatures and technology to establish authenticity and non-repudiation.
- Confirmation services acting as the message transfer agent records transaction receipt and its sending.
- Timestamps contain the date and time as a proof of transaction's existence.

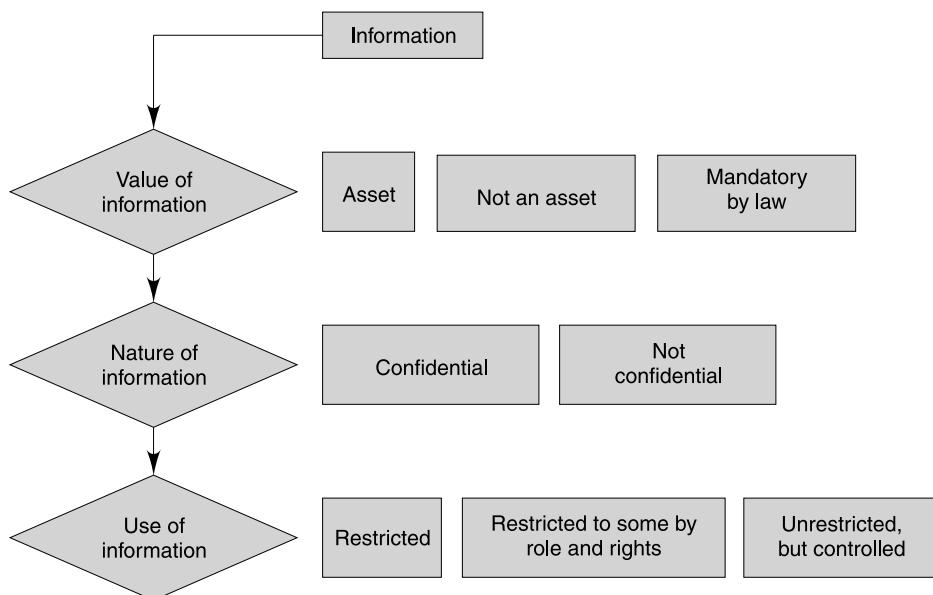
All the three measures together assure that one party of a transaction cannot deny having received a transaction nor can the other party deny having sent a transaction.

Ensuring information security calls for satisfying these concepts of confidentiality, integrity, availability, authenticity and non-repudiation.

### ***Security Classification for Information Security***

The issue is with so many measures and remedies of information security. Should we use them for all information, data, knowledge, BI across the organisation? The criteria to choose security measures are decided by its value to the organisation. The value measured in terms of risk exposure to the organisation. What is true of information is also same for other hard and soft assets of the organisation. The value decides appropriate security measure specified in the organisation's security policy. Some information such as financial transactions, reports, returns and records are to be preserved and protected for seven years. This is mandatory by the law of the land.

A broad classification structure is suggested for customisation by each organisation meeting its value proposition and security environment needs.



An important aspect which influences security policy and security measures is 'value of information and threat of risk'. Not all information is equal and so not all information requires the same degree of security cover. The second aspect is confidentiality of information. The confidential information would need stricter security measures by policy and 'Not confidential' information may need a selective approach in application of security measures. Third aspect is use of information. The use could be restricted few and also for certain application. The use could be restricted or limited by roles and rights of the job.

## 4.7 MEASURES OF INFORMATION SECURITY

### ***Access Control***

The best way to secure information control is to access to it. If access request is examined and checked then information is secured. Remember computer programs, software and processing hardware along with users must be authorised. This requires that mechanisms be in place to control the access to protected information. It is needless to emphasise, the more sensitive or valuable the information the stronger the control mechanisms need to be.

Access control systems are built starting with identification, then authentication followed by permission. Information for authentication can be used from one of the following:

- What you know: A password, mother's maiden name, and hometown
- What you have: Driver's license, any type of swipe card, passport number
- What you are: Biometrics: finger prints, voice record, eye scan

Authentication system may use one or all above depending upon class of information and the level of security. What we discussed is for the individual. When it comes to computer systems, authentication system is different.

Username is the most common form of identification and the Password is the most common form of authentication when computer systems are in the picture. Usernames and passwords are slowly being replaced with more sophisticated authentication mechanisms.

### ***Authorization to Act***

On getting access after proper identification and authentication, information security measures include checking through authorisation scheme, what actions an Individual, Program or Computer will be allowed to perform. The actions could be run the program, view the information, create a file and save, delete data, change or update the data. This is called authorisation.

Authorisation to access information and other computing services and perform some tasks is a part of information security policy. The policies prescribe what information and computing services can be accessed, by whom, and under what conditions. The access control mechanisms are then configured around these policies. All failed and successful authentication, authorisation actions must be logged and be audited by System or Network Administrator for improvement in information security policy and measures.

### **Cryptography**

Cryptography is used in information security management to protect information from exposure to unauthorised user or accidental disclosure or exposure while the information is in transit or in storage.

Information security uses cryptography, a technology to transform information into a form that makes it unintelligible for anyone other than an authorised user. This process is called encryption. Encrypted information can be transformed back into its original form by an authorised user using personal cryptographic key. The process is called decryption.

## 4.8 NETWORK SECURITY

Business organisations operate their business transactions on a computer network capable of dealing with all users, customers, vendors, employees through internet the network, therefore, is a resource, an asset preserving data, information, knowledge, application software, enterprise software, transaction records, databases, DWH and so on.

Its protection means protecting network from attack, malicious or otherwise. There are three security concepts which handle this requirement

- Authentication of network user, whoever may be the user.
- Framing security policies specifying the user's validity, access rights, usage rights and so on.
- Installation of 'Firewall' an all round security cover to implement security policies.

The network administrator under the guidance of top management decides the policy framework and implements it on the network. Network security provisions and policies are framed to prevent and monitor unauthorised access, misuse, modification, or denial of service of a computer network and network-accessible hard and soft resources. The broad process of network security mechanism has three steps.

- Authorisation to enter through authentication check.
- Check and control rights, privileges to access and its use.
- Detect and identify the user who attempts to push malware to break the network service to its users.

The most common way of protecting a network resource is by assigning it a unique name and a robust password.

### ***Network Security Concepts***

There are two main concepts which drive the network security, one authentication of user and should the user succeed prevent usage through security policy.

#### **Authentication to access**

Network security starts with authenticating the user, a person authorised to access the network. This is commonly done with a username and a password given by the user and secured by network administrator. Authentication can be made more strong and secured by adding more filters in a layered fashion. Username password is single layer authentication. To this, if you add Date of birth or Mobile phone number or Mother's name and so on. It is a second layer authentication. If you use biometric identity such as finger print, eye scan it would be third layer authentication. How many layers to use is the network administrator's decision depending on user, the application needs and the risk perception.

#### **Firewall to control access through policies**

Firewall is a first check point where network user is checked for 'valid user' by authentication process and then user is subject to further check on what is allowed to access and not allowed to access. This is governed by set of network access policies of the organisation.

A firewall enforces on organisation's access policies such as what services are allowed to be accessed by the network users. Some users may have access to all network resources and some have selective and conditional, and some may have very limited access.

Firewall, through appropriate security policy measures, may prevent unauthorised access, but may fail to check potentially harmful content such as computer worms , viruses being transmitted by the authenticated user over the network. Anti-virus software is necessary to install to detect and prevent the action of such malware. It is also a good practice to maintain a logbook of events and activities for audit purposes and for investigation.

### **Types of Attacks on Network**

Networks are vulnerable to attacks from users, internal and external to the organisation.

Attacks can be from two categories "Passive" when a network intruder intercepts data travelling through the network, and "Active" in which an intruder initiates commands to disrupt the networks normal operation.

#### **Types of attacks**

##### **Passive**

- **Network wiretapping:** Monitoring, listening telephone and internet conversions.
- **Computer port scanning:** The act of scanning a computer's port, a gate for 'In/Out of a computer information.
- **TCP port scan:** The idle scan is a made by sending spoofed packets to a computer to find services are available.

##### **Active**

- **Denial-of-service:** Security attacks that don't try to steal information, but attempt to disable a computer network.
- **Spoofing:** Spoofing (Fooling hardware and software) is the creation of TCP/IP packets using somebody else's IP address.
- **ARP poisoning:** Address Resolution Protocol (ARP) poisoning is a type of attack where the Media Access Control (MAC) address is changed by the attacker. A MAC address is a unique identifier for network nodes, such as computers, printers, and other devices on a LAN.
- **Smurf attack:** A type of network security breach in which a network connected to the Internet is swamped with replies to ICMP (Internet Control Message Protocol) echo (PING) requests. PING is a utility to determine whether a specific IP address is accessible. A Smurf attacker sends PING requests to an Internet broadcast address.
- **Buffer overflow:** The condition wherein the data transferred to a buffer exceeds the storage capacity of the buffer and some of the data "overflows" into another buffer. Malicious hackers can launch buffer overflow attacks by sending false instructions to corrupt the system.
- **Heap overflow:** A heap (data structure) overflow is a type of buffer overflow that occurs in the data structure area.

- **Format string attack:** The Format String attack occurs when the submitted data of an input string is evaluated as a command by the application. In this way, the attacker could execute the code of an application causing new behaviour that could disturb the security of the system.
- **SQL injection:** SQL injection technique is used to attack databases through a website. SQL statements are injected in a web form entry field in an attempt to get the website to pass a newly formed malicious SQL command to the database inflicting database security.

Security management for networks is different for all kinds of situations. A large businesses may require high-maintenance and advanced software and hardware to prevent malicious attacks from hacking and spamming.

- Install strong firewall and proxy server to catch unauthorised users.
- Install strong Antivirus and Internet Security Software package.
- Use robust passwords and change them frequently.
- Implement logbook for all events and activities.
- Audit logbook regularly and take corrective measures, where necessary.
- Implement physical security measures to network premises.
- Install closed circuit televisions for entry areas, server rooms and storage areas.
- Design and implement disaster management system (DMS).
- Implement biometric security measures.

## 4.9 CYBER SECURITY

The word 'Cyber' represents combined meaning of '*Computer, Computer Network and virtual reality created by internet*'. Cyber attack targets computers, computer networks with the aim of its malfunction or disruption data, data communication disabling business processes. Cyber attacks can harm application software, data bases, servers, portals, knowledge assets harming day to day business operations.

The cyber attack, if successful, causes widespread economic damage to the activity of the organisation and creates ripple effect elsewhere where the organisation is linked or can be linked. For example, confidential information collected out of cyber attack will be altered at the source and will be communicated to other related storages causing application results whenever it is used.

Another example is of Credit card/Debit card/ATM card record of a bank is altered leading to chaos among card holders and in the banking system. When cyber attack is on the computer network of a large organisation, it affects its working and that of dependent or related organisations. *Cyber attack has much wider damaging impact compared to Information security attack on the organisation's system.*

In the age of information and communication technology (ICT) and its extensive use in our personal life and in official business work, has raised issues of security risk. We use cell phones, laptops, I-pads and other hand-held devices for E-business and E-commerce through Internet. When in office, we are on the network conducting a number of business transac-

tions and messaging. Therefore, you and your organisation can be impacted by the cyber attack. Cyber security provides means to protect sensitive personal and business information through prevention, detection of attack and attacker affected through Internet usage. The person attacking the network and file stores through say e-mail virus is committing a 'cyber crime', would attract punishment stipulated in law of the land.

Hackers, intruders, and attackers are generally individuals who exploit weaknesses of computer systems and software for their own advantage. Their intentions could be a curiosity or intention to damage the system to their advantage. Hence, the best way to prevent cyber attack is to make systems, networks, applications, access to data and information storages near impossible to everybody who is not authorised by implementing policies and security measures, conducting security audits.

Cyber security standards have been created recently because sensitive information is now frequently stored on computers, networks that are used by a number of users through the Internet. Therefore, there is a need for information assurance (IA) and security. Cyber security is hence important in order to guard from cyber attacks. Businesses also have a need for cyber security because they need to protect their trade secrets, proprietary information, and personalised information of their customers or employees or vendors and stakeholders.

The Standard of Good Practice for Information Security, published by the Information Security Forum (ISF), is a business-focused, practical and comprehensive guide to identify and manage information security risks in organisations and their supply chains.

The 2011 Standard is aligned with the requirements for an Information Security Management System (ISMS) set out in ISO/IEC 27001, and provides for wider and deeper coverage of ISO/IEC 27002 control topics, as well as cloud computing, information leakage, consumer devices and security governance.

The Standard is used by chief information security officers (CISOs), information security managers, business managers, IT managers, internal and external auditors, IT service providers in organisations of all sizes.

The Standard is organised into six categories.

- Computer installations
- Networks address the underlying IT infrastructure
- Critical business applications.
- The end-user environment
- Systems development
- Security management

According to a news report (IBN live, May 2012), India is ranked fifth in the worldwide ranking of countries affected by cyber crime, claimed in a report by the Security and Defense Agenda (SDA) and McAfee. According to the report titled 'Cyber Security: The Vexed Question of Global Rules', the premium on Internet privacy in the country is quite low. SDA, a leading defense and security think-tank in Brussels, spoke to leading global security experts to ensure that findings would offer useful recommendations and actions." "Much of the vulnerability is explained by widespread computer illiteracy and easily pirated machines," pointed out the report.

At the two-day Cyber Security Summit, officials from the National Security Advisory Committee claimed that the government is firstly looking at capacity building and then

eventually will work on the draft of the national cyber security policy which is currently under discussion.

## KEY TERMS

Corruption of Information	Private Key
Cyber Security	Firewall
Authentication	Digital Signature
Application Security	Security Controls
Biometric Security Measures	Encryption
Limitation of Damage	Disaster Management
Data Integrity	Proxy Server
Security Threats and Vulnerability	Network Security
Repudiation	
Public Key	

## REVIEW QUESTIONS

1. Explain how security threats and information systems vulnerability has increased over a period?
  - Pre IT revolution: Early Eighties.
  - During IT revolution: Eighties and nineties.
  - Networks: Private and Public: Nineties to Two twenties.
  - Internet and Web: Two thousand onwards.
2. State computer security controls for following IT infrastructure of the organisation.
  - LAN/WAN of 300 computer systems.
  - Data servers, Application servers, Web servers.
  - Packaged software.
  - Customer Application System Software.
  - User developed software.
  - Databases, knowledge bases.
  - Use of Internet/Intranet/Extranet.
3. Everyday evening branches of the organisation send daily report on day's performance covering, sales, order booked, goods returned, enquiries received, quotes offered. A note on each reporting item supports this report. The report is sent through e-mail to CEO in head office.  
Explain what security measures should be taken to reduce the vulnerability of the information.
4. What is firewall? Explain firewall function in protecting the system and information assets.
5. Why additional security controls are required when computerised controls are provided?  
Explain how following controls help to ensure further security to the system.
  - Physical Access
  - Monitoring the data access
  - Employee screening before appointment

6. Explain how encryption/decryption prevents unauthorised person read or change the messages.
7. What additional security does following features provide?
  - Authentication
  - Digital Signature
  - Digital Certification
  - Message Integrity
8. What is key benefit of following measures?
  - Load balancing
  - Mirroring
  - Clustering
9. In the process of preparing 'Disaster Recovery Plan' explain the key benefit of following steps.
  - Risk Analysis vs. Threat perception.
  - Mission Critical Applications and their impact on business.
  - Testing of Disaster Recovery Plan.
10. When should one aim at designing fault tolerant system and high availability computer system?
11. Why one should pay special attention to Cyber Security?
12. Why there is an importance of Network Security in today's E-business world?
13. Organisation uses enterprise software for resource management and business operations. There are number of users of this software. Based on their role in the application, recommend, rights to access (application and data) and then different permissions to use. (read, write, update, etc)
  - Vendor
  - Store manager
  - Finance officer
  - Cashier
  - Security manager
  - HR manager

## CONFIRM YOUR UNDERSTANDING

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1. The security threats are posed from \_\_\_\_\_ as well as \_\_\_\_\_ sources.
2. The security challenges are met through prevention \_\_\_\_\_ and \_\_\_\_\_.
3. SMS scope includes among others \_\_\_\_\_ of threat sources and \_\_\_\_\_ to deal with them.
4. Security controls are have two manual and \_\_\_\_\_ controls.
5. Biometric security measures use individual's \_\_\_\_\_ profile to control \_\_\_\_\_ and \_\_\_\_\_.
6. Firewall prevents \_\_\_\_\_ information exchanges.
7. Encryption of message prevents its \_\_\_\_\_ and understanding.
8. Authentication confirms \_\_\_\_\_ of the other party.
9. Integrity check ensures \_\_\_\_\_ communication of message.
10. Digital signature confirms authenticity and \_\_\_\_\_ of other party.

 CASE STUDY

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## BALLARPUR INDUSTRIES LTD. (BILT)

Ballarpur Industries Ltd. Manufacturers has over 60 per cent of India's value added and specialty paper and accounts for nearly 20 per cent of the overall paper production in the country. The company also sports the largest distribution network with 16 regional offices and more than 100 exclusive distributors.

The quality intensive BILT is well recognised for its products in the domestic as well as international markets. With paper exports worth 15,000 tones per annum to 15 countries across the world. BILT has been awarded the coveted Capexil award for highest quality export, for four consecutive years (1995 through 1999). For a production giant the size of BILT, transitioning to an E-business model would entail a colossal IT infrastructure and a greater need to safeguard its online transactions. But that's exactly what iBILT finds it doing as the technology arm of the country's largest manufacturer of paper – BILT.

Ballarpur Industries opted for Computer Associates (CA) eTrust to prevent unauthorised access and reach a fatter security bottom line. CA solutions used are eTrust, Firewall, Intrusion Detection, and Access control.

CA solutions secure all information exchange point within the BILT network and managing and monitoring the access to IT resources, internally as well as from the partners though the web. A secure network will lead to trust among partners to adopt a new way of doing business – one that is cost efficient for both BILT and the company's partners.

The company is taking a pioneering step by leading technology and E-business initiatives in an industry often termed as "traditional." But with the changing global landscape, BILT is certain that the competitive advantages of E-business will significantly impact their revenues and future business. With the business being mainly B2B, these advantages include automating and integrating BILT's supply chain systems with trading partners and business processes; lowering transaction costs associated with identifying, negotiating and purchasing from multiple suppliers' cutting the use of low value-add intermediary brokers and dealers to reach customers; expanding the universe of buyers and sellers; and consolidating the customising multiple sources of pricing information, real-time news and industry data.

BILT currently has about 1,700 desktops spread over 16 locations. Some of these locations have just migrated from dial-up connectivity to leased lines. In the next 12–18 months, BILT is going to connect all 16 locations through leased line. Other than that a WAN, ERP and database management software are currently at various stages of implementation. This will eventually connect all its locations and give all location access to critical business applications.

BILT has initiated a massive technology drive with a planned investment of about \$10 million to adopt the benefits of the Internet, the web and other IT applications into increased efficiencies and therefore better its bottom lines thought an E-business model. "The paper industry in India is increasingly getting IT-conscious, and being at the cutting edge of technology is always one of our primary requirements," said Amrit Sethi, manager (operations), iBILT Technologies. For an entity that produces over 270,000 TPA, this requirement is easier said than done.

### Security Stays on Top

"E-business necessarily requires to be secure if it has to succeed. Unless you give that assurance to business partners, your business model is not going to work," says Sethi. Security stays at the top of iBILT's

list when it comes to E-business, a model that will finally link about 600 distributors, suppliers and customers online across the country and overseas—in small towns as well as large cities. This is expected to account for nearly 85 per cent business for BILT.

It was this need that propelled BILT to look for reliable, and robust security solutions in the market. Besides, the company's top-most concern was to completely eliminate the possibility of attacks on the network, intrusions and other kinds of vandalism once the E-business solution was ready for implementation.

"We were looking for high-quality security solutions that would be hard to break, easy to administer, implement and use, and also intuitive in nature," said Sethi. After a thorough research in the market, BILT selected 3-4 products available in the market for a final evaluation. BILT finally zeroed in on CA's award winning security solution – eTrust. Not only did the product offer the best-of-breed functionality, tight integration and bulletproof security, it was also very easy to learn and use. "We needed an integrated product as we were opening up several doors to our partners and we needed a simple but effective solution. We also received excellent feedback on Computer Associates and its products from the market," he said.

On this \$10 million initiative, iBILT managing director and CIO Ashok Tiwari says – "We are embarking on a journey to create a robust E-business model and understand the criticality of security in the networked environment. Only if we are secure, will it build confidence among our business partners, and provide that extra assurance to transact online and, thereby, enable us to achieve better returns. This model is a win-win situation for both BILT and our partners since it will help reduce cost of transactions and time to market."

### **E-trust Keeps the Faith**

Rather than waiting for an intrusion or an attack and then installing security solutions, we have made provisions in advance to avoid any vulnerability. Such an event will not only derail the implementation timetable, but also if it happens in the initial phases where we have the first few partners on board, it can reduce confidence on this business model at the very onset—both with partners and internally," said Sethi.

The eTrust Firewall helps BILT enforce security policies throughout the enterprise, safeguarding all missions—critical network resources, while eTrust intrusion Detection will combine surveillance and alert capabilities to stop network and its resources. Finally, Trust Access Control will provide the essential E-business element – regulating access to critical business assets. BILT has several applications running in its servers and access to these application is restricted depending on the function of the employee or the nature of partnership. Access will need to be regulated as per parameters set for each of them.

BILT's E-business infrastructure will have many components in the form of user databases, administration tools, and logs spanning from operating system, to applications, Internet, virtual private network or the wide area network. It will therefore critical to have a central management tool to monitor the entire security environment. eTrust Access control will do the needful here, by defining policies that prohibit unauthorized system access, and "harden" server operating system.

Once the entire IT setup is rolled out as per the master plan, the eTrust security solutions will protect the company's entire network spread across 42 locations accessed from across the world, covering all its businesses including paper, food and chemicals. The solutions will work together to provide BILT with a system that will provide defense against Internet threats, offer secure seamless access within the "Extended" enterprise, and finally, manage and monitor the entire security infrastructure. The ease of use is a boon during the roll out phase. As Sethi mentions, "it hardly takes any training for the implementation team to work on eTrust."

### **Managing Business, Building a Future with Trust**

Meanwhile, eTrust—by maintaining extreme vigil across the enterprise—will ensure that BILT's customers, distributors and employees conduct transaction and other activities with trust and that the system, applications, and networks are safe from intruders and unauthorised access. This trust will ultimately help improve the trust among the partners and encourage them to use this model of doing business and this BILT strongly believes will translate into a better, bottom line—all managed in a strong, secure environment.

#### **Questions**

1. Identify which solutions of 'Computer Associates' eTrust BILT has chosen. What benefit BILT would get of this security measure?
2. Why BILT management wants to assure the business partner that E-business model of BILT is most secured?
3. Explain why BILT chose CA's eTrust as Security Management Solution?
4. List of benefits BILT would be getting by implementing eTrust firewall, Intrusion detection, Access control.
5. Explain how BILT went through a process of selection concluding to CA's eTrust.
6. Visit [www.eTrust.com](http://www.eTrust.com) or [www.computerassociate.com](http://www.computerassociate.com) and study the eTrust tools in detail.

(Source Acknowledgement: Dataquest, April 30,2003)

# Information Technology: Impact on Society

## LEARNING OBJECTIVES

- IT Impact on Society
- IT Impact on Quality of Life
- Impact on Privacy
- Ethical Issues and its Handling
- Code of Ethics and Professional Conduct
- IS Quality and Impact on Life
- Solutions to Face the Technology Impact
- Intellectual Property, Copyright and Patents

### 5.1 INTRODUCTION

The industrial revolution in the 19th century caused many changes in the society. It affected individuals in terms of jobs and skills. Through mechanisation, jobs became simple and repetitive. With transportation, people moved from place to place for better opportunities. Faster and mass transportation capabilities made it possible to move goods from any one location to other situated within the country and outside. Revolution in manufacturing, transportation, and communication helped society to improve the standards of living, style of living and provided opportunities to start new business in storage, distribution and delivery.

Next innovation, which affected largely, is the revolution in computing and networking giving rise to new technology known as Information Technology. This technology revolutionised the business world in all its aspects. The jobs of individuals changed considerably and new IT skills were sought to perform effectively in society. The computing made processing of data faster, and networking made the processed data and information sharable to all in network. Since, data and information was readily available, roles and responsibilities of people changed to more intelligent roles. IT revolution changed a slow, bureaucratic and command control organisation to fast information driven organisation. IT revolution not only affected individuals but affected the organisation in structure and work culture.

Then came 'Internet,' which added further push to the changes already happening in the organisation. With Internet and then with web technology, business functions and operations

became feasible for all time, twenty-four hours by seven days. It made possible to expand the scope of business with new opportunities. Acquiring the resources and marketing of goods and services became global phenomena, exposing the business to bigger competition. It affected individuals in terms of job and the manner in which the job is executed. The work and workplace location became separate.

IT and Internet together affected individuals adversely. These technologies have reduced number of jobs and job opportunities. The speed at which technology is changing or reaching obsolescence, it is difficult for every individual to cope up with changes and keep fit. Many individuals became redundant in the organisation due to their inability to accept the new challenges of technology.

All these revolutions created new opportunities, reduced costs, saved time, enabled fast processing of information and decision-making. Individual became a highly productive resource, but faces new problems namely loss of privacy, depersonalisation, increased stress and stress related health problems; reduced direct human interaction due to working in virtual mode affecting the relationships between the individuals.

Individuals and organisations exist in a society in a social environment. Technology affects this existence, due to impact on privacy, culture, job opportunities, and markets. Government, Business, Individuals and Organisations are changing to new social and environment order creating a new society. Table 5.1 summarises IT revolution impact on the society.

**Table 5.1** Summary of IT Revolution and Impact on Society.

Social Aspect	Nature of Impact	Target and Nature of Effect
1. Privacy	Risk of losing privacy. Loss of confidentiality of personal or organisation's key information.	Exposure to Personal data, Financial data, Health data, Travel data, Knowledge and Information about behaviour.
2. Work Culture	Stressful, unlimited in time (24 x 7). Demands continuous improvement in skills and competencies.	Health of individuals affected. Social interaction reduced. Cost of education and learning reduced.
3. Job Opportunities	Reduced job opportunities. Demands technology enabled skills and competencies. Dehumanisation of processes due to process automation.	Standard of living very high for some while others are not affected. Time spent on learning and unlearning increased. Learning and unlearning requirement increased.
4. Market	Consumer more knowledgeable. Raises and changes customer requirements and expectations. Creates pressure for continuous innovation.	Consumer behaviour more dynamic and unpredictable.
5. Business and Organisation	Strategic and competitive. Demands innovation and creativity in every aspect of business. Risk exposure has increased.	Organisation became lean and flat. Employees became knowledge worker. Customers and vendors became business partners.

In summary, IT applications affect individuals, their family, work groups, organisation and business at large. It threatens the violation of privacy of individual or a work group or organisation. It affects, favourably, the cost of job and time taken to complete but it has a negative impact on job opportunities, puts pressure on job holder to learn continuously, raises stress level due to continuous impending job insecurity. It reduces social interaction in the job as most of the business processes are de-humanised due to extensive use of IT application on the positive side. Information Technology has contributed to material progress by way of reduced cost, faster delivery, better quality, functions and features in the product and variety of product options to the consumer. The question, therefore, arises whether it is ethical to use IT so aggressively and accept its negative impact. Issue, therefore, is how to balance benefits of IT against its negative impact and also be ethical in handling the social issues. We now discuss these impact issues in detail in the following sections.

## 5.2 IMPACT OF IT ON PRIVACY

Privacy is the right of individual to hold back certain information about self without disclosure and allow it to be collected with the consent with the assurance that it would remain protected from unauthorised access.

Information Technology is playing a mission critical role in the life of individual. Individual is a member of the family, a social group and organisation. An individual during the course of the working provides lot of personal data, and information about others. This information could be about Credit/Debit Card, E-mail address, Telephone numbers, Qualification/Skills/Experience, Bank Account Number and so on.

IT is capable of finding access to this data, download and process it in some manner and create an information set about an individual without the knowledge of that individual. This is termed as privacy violation or breach of privacy.

In the process of business execution, data about individual is collected as a requirement for processing the transaction. When goods are sold address, phone number, credit card information is collected from the consumer for billing, and post sales service. Along with the data, information about product sold is also recorded in a transaction processing system.

When a medicine is sold to the patient, name of the hospital, doctor treating and prescribing the medicine, doctor registration number are recorded by law, and processed before the medicine is sold.

When an airline ticket is purchased, personal data, and travel and hotel related information is also processed and kept as a record in ticketing information management system. These personal data sets can be put together by access, and precise information set about an individual can be constructed and be used for wrong purpose. More and more applications in business, government and society are becoming IT enabled, and individual's personal data about self, property, family, vehicles owned, medicines prescribed, hospitals visited for treatment are subject to privacy violation and then for misuse for wrong purpose.

Most people prefer to maintain their personal data in most secured place so that privacy violation is almost impossible. The organisations, which are collecting this data, have an ethical and moral obligation to protect the interest and wishes of the individuals whose data they

are using for a known requirement. The ethical obligation is when such data is put to use or given to somebody the owner of the personal data should be referred for permission. The system designer should keep a flag on the personal record for imposing such necessity when data is accessed and used for other processing requirement.

Most of E-business applications run on Internet and web platform. It is possible in these applications to track location, actions taken, password used, purchase made, information downloaded. Many organisations can use this data for processing and analysis for extended business application. When such possibility is seen, it is ethical on the part of website or E-commerce site owner to come out with privacy statement so that site visitors know how personal data is used and for what purposes.

What we discussed so far is about an individual who stands alone in the society. But such an individual could be an employee of the organisation, and then the employee is being screened for various purposes by the organisation to monitor and control movement, use of time, visits at different location and so on. All such employees are given electronic badges or ID cards to use for gaining access to various locations. A centralised system collects this data and can be used for finding how employees spend time and what is their productivity. While it can be argued that monitoring employee time usage and movement data is for time management and resource control, it should not be used for discrimination selectivity. This is then a violation of discrimination laws, and also privacy violation. Further it is a clear case that data is used for undeclared purpose, and hence its usage is unethical.

As IT provides intelligent solutions for competitive advantage, it has strength to provoke a misuse of the personal data for wrong purposes. Use of video cameras, RFID, Microchips, E-mail records can be misused for unethical purposes without the knowledge of the individual.

The laws of protecting individual privacy are different in different countries inviting the risks of privacy violation if you are in international business. This aspect is becoming critically important as most business organisations, be it in manufacturing, trading, health care, tourism and hotels have gone global across the countries. In such an environment, an individual is subject to a risk of exposing the personal record for undeclared used.

Hence, in view of this background, protecting privacy is your responsibility and with some precautionary measures, actions are to be taken by an individual as under:

1. Check why personal data is required?
2. Get commitment on what use it would be put to?
3. Declare your choice where data should not be used without your permission.
4. Do not give Credit card number, PAN number that identifies you uniquely.
5. Sign a Privacy Agreement/Contract with the organisation or obtain a standard privacy agreement signed by the party.

While individual is expected to take care through these actions, IT industry advocates certain standard ethical practices to safeguard the privacy of information.

- No secret record should be maintained about individuals after its use.
- No use can be made other than that of specified original purpose.
- If other use is required, consent of the individual is to be obtained.

- Allow individual a right of inspection and correction.
- Organisation, and processing system is responsible for the integrity of the secret data.

### 5.3 ETHICS

Ethics is a study of the principles and practices, which guides to decide whether the action taken is morally right or wrong. A well-defined and accepted code of conduct largely ensures the obligation of ethical use of IT for competitive advantages and material progress. Ethics is about values and human behaviour. The values and human behaviour is primarily regulated by various legal provisions and can be enforced through courts. When IT solution is thought and designed it is necessary to check whether it is legally tenable along with technical, operational and economic feasibility. Checking legal feasibility protects you from violation or breach of law enacted for privacy protection, obligation to provide healthy, hygienic, and congenial work atmosphere.

What is proposed is, when legal provisions and taking recourse to justice system is not feasible try to be within domain of ethics and achieve competitive advantage with least negative impact.

Respecting ethical values means making a beginning to protect generally accepted individual human rights. The rights are:

- (a) The right to healthy life and work safety.
- (b) The right to privacy.
- (c) The right to private intellectual property (Information & Knowledge).
- (d) The right to descent.
- (e) The right to fair treatment and no discrimination.
- (f) The right to be treated by just due process.

Being ethical means making ethical choice of IT solution and be responsible, accountable, and liable for action and consequences.

Privacy protection is best achieved by strict adherence to Association of Computing Manufacturers (ACM) code of ethics and providing adequate technical security measures and controls that limit the access to databases and other information.

#### ACM Code of Ethics and Professional Conduct

- General Moral Imperatives:
  - Contribute to society and human well being.
  - Avoid harm to others.
  - Be honest and trust worthy.
  - Be fair and take action not to discriminate.
  - Honour property rights including copyrights and patents.
  - Give proper credit for intellectual property.
  - Respect privacy of others.
  - Honour confidentiality.

- More specific professional responsibilities:
  - Strive to achieve highest quality effectiveness and dignity in both the process and product of professional work.
  - Acquire and maintain professional competence.
  - Know and respect existing laws pertaining to professional work.
  - Accept and provide appropriate professional review.
  - Give a comprehensive thorough evaluation of computer systems and their impact including analysis of possible risks.
  - Honour contracts, agreements and assign responsibilities.
  - Improve public understanding of computing and its consequences.
  - Access computing and communication resources when authorised to do so.
- Organisational leadership imperatives:
  - Articulate social responsibilities of members of an organisational unit and encourage full acceptance of those responsibilities.
  - Manage personnel and resources to design and build information systems that enhance the quality of working life.
  - Acknowledge, and support proper and authorised uses of an organisation's computing and communicating resources.
  - Ensure that users and those who will be affected by a system have their needs clearly articulated during the assessment and design of requirements. Later, the system must be validated to meet requirements.
  - Articulate and support policies that protect the dignity of users and others affected by computing systems.
  - Create opportunities for members of the organisations to learn the principles and limitations of computer systems.

## 5.4 TECHNICAL SOLUTIONS FOR PRIVACY PROTECTION

Protecting the privacy of individual or organisation assumed critical importance on emergence of Internet and web technology. As Internet and web enabled solutions became common, individual's risk of privacy exposure increased many fold. Implementation of code of ethics and respecting moral values is an obligation to the organisation. Some technology solutions are also available to ensure such protection and obligation.

Before understanding these technology solutions let us know how Internet and web enabled IT solutions affect the privacy of individual. The data entered, processed and sent through Internet passes through different computer systems installed on network across the world. These systems are capable of keeping the record of this communication traffic and also can capture and store the communication with all connecting references and identities.

This activity of capturing data, monitoring its use, and storing happens at backend without the knowledge of the user. The communication system capabilities can identify and analyse the following:

- (a) Identification of a person or location from where an action has started through registration record.

- (b) Which files, websites and web pages visited.
- (c) Which transactions have been attempted and completed, namely buying, selling, displaying, downloading and others.

If one can put these information sets together and analyse, it may reveal personal data, and the behaviour traits of an individual. This information then can be used proactively for relation building and business promotions.

Tools to monitor visits to website have become popular because of their ability to track the visitors and their usage of website. Many websites ask information about the visitors and visitor is volunteered to register the information. But personal information can be collected without the knowledge of the visitor using 'cookies.' The technology produces tiny files deposited on computer hard disc known as 'cookies.' These cookies are designed to collect the data about visitors and retain it for future guidance. Suppose you visited a website and purchased music CD of Lata Mangeshkar, the cookies keep this record of your interest and in your next visit to the website it announces for you the new arrival of music CD of Lata Mangeshkar.

'Web bugs' is another tool, which provides server capability to monitor the behaviour of the visitor. Web bugs are tiny graphic files inserted in e-mail messages and web pages, which monitor the visitor behaviour. These tiny files identify the visitor, and keep track of pages visited and transmit this information to website monitor computer.

To contain these practices, website owner provides facility on site by displaying boxes, which shows how site would be using the information and gives option to visitor to 'Opt-Out' or 'Opt-In.' When visitor chooses 'Opt-Out' the permission to collect and use the information is accorded by the visitor. If choice is 'Opt-In' then visitor has not given consent to collect and use information.

It is also a practice in web community to declare on site organisation's privacy policy for visitors to review. 'Trustee' seals back such publication. This seal is a stamp of confirmation that organisation has agreed to adhere to established privacy principles of disclosure, choice, access and security. Such publications are also known as Legal notice, disclaimer, and privacy policy.

If a visitor want self generated technical solutions to safeguard privacy of information, privacy protection tools are available. The presence of cookies can be controlled using 'Cookie Crusher' tools, which come along with browser. Similarly 'Blocking ads' tools control or block the ads, which pop up based on visitor's interest. Encryption technology helps scramble message or data so that no body can read and understand.

## 5.5 INTELLECTUAL PROPERTY, COPYRIGHT AND PATENTS

Information and information system products have intangible nature and are created by individuals or organisations. Information or information product such as business rule, business model, pattern, layout, diagram or specific compilation in certain format used for business advantage can be classified as intellectual property. They can be viewed, copied and distributed on network. And in such distribution, it can change in structure, content, and matter with loss of its original identity. Therefore, such intellectual property requires protection provisions from trade secrets, copyright and patent acts.

Software, if it is unique in design, architecture, process, and it is a creation from within the organisation then software is a trade secret. Protecting information and information product falling in public domain from copying is difficult as both are distributed for use, and they run the risk of getting exposed to an outsider. In the trade secret act 'Idea' behind uniqueness is a trade secret and prevents its copying by law. This includes its presentation, implementation and storage as well. In order to protect trade secret, it is necessary that those who are likely to use such product be bound by signing non-disclosure agreement. Another protection mechanism is to bring the product under license arrangement restricting the use and knowledge to known license users.

### **Copyright**

Copyright act protects intellectual property for pretty long time from copying by others. The protection is applicable against copying part or full in any manner. The infringement of this act is penal and attracts heavy penalty. The weakness of the copyright act is that it does not protect the idea behind product and its use. Hence if somebody uses the idea and develops a product with difference then it is not copying. Illegal copying of computer software is known as Software Piracy, and is considered as theft attracting all provisions of the act. As technology is becoming smart and powerful and changing very frequently, legal system protecting this aspect is not able to keep pace in offering matching protection in copyright provisions.

The professionals in IT industry and experts from law firms are questioning the basic premise whether Information/Information Product/Software is a 'property' at all. To claim ownership, what should be the degree of differentiation between the two products? If software along with computer capability generates a product, can one person or organisation be considered as author and owner? There are many aspects of intellectual property which are legal issues, and do not have foolproof legal protection, and also technical solution protecting the violation. The only recourse to contain this malice is to depend on ethics and moral commitment on the part of users of the products.

### **Patents**

A 'patent' grants the owner of the product exclusive monopoly on the ideas behind the product for number of years, sufficiently protecting the interests of the owner/inventor of the product. The patents are granted after formal application by the inventor to patent certification body of the country and after an elaborate scrutiny of the invention, the patents are granted by the patent office.

### **Challenges to Intellectual Property Rights**

Information stored in electronic media can be easily replicated, altered, and reorganised in a new format making it difficult to prove that it is a theft. With proliferation of networks and Internet with associated capabilities, it is becoming difficult to protect intellectual property. Before the Internet and network era, distribution of books, CDs, DVDs on mass scale to any location was difficult. Internet is used to transmit information in any form freely around the world. It does not distinguish copyright information and other information. With web technology, copying, altering, and configuring different information objects and creation of altogether new information object is easily possible.

Web pages can be constructed with different information objects whose owners are different. A typical web page may show a Logo, Text Content, Article Extract, links to related contents of the subject, Photograph or Drawing, Ad display and so on. The author, owner of each object is different but they are pulled and presented in a web page as one subject entity for the viewer. In such case who is the owner of the web page, and how compensation can be determined and be paid for usage of several objects. A powerful copyright patent law suitably modified for Internet and web world is necessary to protect the ownership and management of compensation payment to various object owners.

## 5.6 IMPACT OF INFORMATION TECHNOLOGY ON THE WORKPLACE

Information and information products have raised number of ethical, moral, and legal issues, and they are being resolved with acts and laws. They also have raised other issues as its application affects the workplace with negative impacts. Though positive benefits or impacts are largely in management area improving financial performance of the business, it has affected human resource in some aspects in negative manner.

Information and Information products usage or application has brought down personal interaction between human beings as most of the processes dealing with transaction, conversion, communication are automated using, AI and knowledge based systems. With the result individuals analytical and decision-making skills are getting rusted, and work and work place is boring. With no interaction, individuals are isolated affecting human behaviour. It has also created health hazards due continuous working on systems and applications under stressful conditions.

Another area where Information and Information technology has made a negative impact when it is used to monitor the work, workplace and the worker. It is used to measure worker's performance, behaviour, and personal characteristics. The people who are affected by this application resent it. However, there is no resentment if technology is used in following manner.

1. Monitor, watch and measure only those personal factors which contribute for the achievement of business objectives.
2. Before implanting such programme involve concerned persons, seek their acceptance through training and explaining the purpose behind such monitoring programme.
3. Allow persons to access the record built and the programmes used to built to win their confidence.
4. Use recorded data to improve the efficiency of the person, and do not use it to punish or to find fault or to discriminate.

Current information technology and the one emerging has potential to harm the worker though the economic benefits are very positive. We list below in Table 5.2 some of the confirmed observations about technology affecting the worker and work place.

### **Accountability and Liability**

While efforts are being made to solve the issues and challenges in the area of privacy protection, Intellectual rights protection relying on laws and acts, and code of ethics, one area which

still remains nebulae is 'Accountability' and who owns the liability if an impact is harmful. Information technology and its application involves number of people and organisations working at different locations contributing to design, development, and use of products application and so on. The entire process is operated by user, Internet services provider, certification agencies, software solution provider and many others.

In the event of damage or injury who should be held accountable, and who is liable to pay compensation.

The difficulties are manyfold to resolve this issue. In the event of incidence of breach, following problems arise:

- Pinpointing the location and users.
- Isolating cause, effect and damage and pinning it on one agency.
- Assigning clearly the cause of damage to hardware, system software, application software, user, owner of the information and so on.
- Difficulties in envisioning the probable causes and creating contingent protective mechanisms.

In view of these problems and limitations in determining accountability, Information Society has to depend on professional ethics of the participants in the whole process of information use.

## 5.7 INFORMATION SYSTEM QUALITY AND IMPACT

Users of information and information products have a capability and understanding to use it with limited knowledge obtained through training, online help, system documentation and so on. The design and architecture of the information system is based on certain assumptions of data quality, process discipline, pre and post conditions of the process, and constraints. Information systems are designed to work on certain technology platforms whose inherent technical strengths and limitations are considered as known to the users. Under such circumstances, it is difficult to define 'Information System Quality' as a benchmark or control to pinpoint the responsibility and accountability in the event of damaging impact.

Three main sources of poor information system quality and performance producing damaging impact are the following:

### Poor Input Data Quality

- Invalid source.
- Incomplete verification and validation.
- Inadequate data entry-level controls.
- Incorrect application.

### Software Bugs and Errors

- Poor testing, test case designs.
- Heavy reliance on automated testing tools.
- Non-use of walk through, reviews and mapping of RDD vs SRS vs design and architecture.

## Hardware and Software Failures

- Poor maintenance of hardware and software.
- Power failure, and associated system stoppage problems.
- Faulty software not able to support promised capabilities and features.
- Hardware and software failure caused due to natural or other causes and not supported by sufficient back-up provisions.

Though software development methodologies, tools, techniques are becoming stronger and stronger, it is believed that no software can be declared as complete and correct before it is released for use to the customer. So issue is at what stage a developer should deliver the software confidentially to the customer which is economically, technically and operationally feasible, with very low risk in its usage.

In this regard a developer is ethically bound, and professionally responsible and accountable for meticulously following and adhering industry standards, principles, processes, and practices to control the damaging impact.

The developer also has professional and social obligation to create awareness and appreciation in the minds of users and customers that:

- A system with zero error and no bugs is a myth.
- Data errors by and large are human errors.
- Systems are designed on the basis of Requirement, Definition, and Description (RDD) and Software Requirement Specifications (SRS) finalised at a point of time and in the event of change, the system results would be at variance with the expectation stated in RDD.

It is accepted that 'Zero defect Software' is a myth due to complexity and technology limitation. Detection and removal of software bugs is a continuous process. It is kept under control by implementing the system in a phased manner, first Alpha Testing, second Beta Testing, third user training and hand holding. It is supported by change management system and by a planned programme of switching to new stable system. In this area fixing accountability in the event of error is not difficult but can be disputed by the affected parties pointing errors of omissions during the software development cycle.

In the case of hardware failure caused by fire, earthquakes, accidents of unknown proportion, fixing accountability is the only safeguard for compensation.

The biggest problem is the input data quality affecting information system quality. Ensuring the input data a specified quality as stipulated in data input design is difficult, and systems of ensuring quality of data are not cent percent assuring. In such event fixing the accountability is a serious problem.

Information system quality is a gray area. Testing tools, technology, processes are available which aid in building quality in the system. But all of them help reduce the incidence of error in the system, and ensures that faulty system with many errors is not passed on to the user. Since, the whole process of development from 'concept to delivery' is not assuring a quality beyond a limit; one has to rely on professional ethics of the people involved in the exercise of software development.

## 5.8 IMPACT ON QUALITY OF LIFE

Use of information technology is now being experienced at home, in public institutions, business organisations, education, health care, transportation, manufacturing and services. It has not only touched our personal life but also affected social life of everybody.

Following four main areas are seen as affected by impact of information technology:

- People are empowered with information and knowledge. It has changed the decision-making hierarchy structure in the organisation. Many operational decisions are passed on to lower level in the organisation. Only high-risk strategic decisions are in the hands of senior and top management.
- Business dynamics and competition is changing so fast that response time to a change has to be much less than before. IT is capable of giving strength to respond quickly, smartly and on time. In such scenario people affected by such impact have to adjust very fast to faster pace of working. Those who can not adjust suffer from work stress.
- The concept of houses, family and office life is slowly getting vanished because technology exposes you to work any time anywhere in single mode or in virtual mode. This means your home could be your office. When you are in family gathering you can still pay divided attention to the family and office work. The result is relations with family members, friends and colleagues will be strained and may become weak over a period of time. You may be isolated from family and friends.
- Information technology has given birth to new crime, called as internet crime or cyber crime, a result of widespread abuse of Information Technology. The list of abuses is as given below.
  - Spamming: sending unsolicited mail.
  - Hacking: Obtain illegal access to personal, commercial data.
  - Jamming: Disabling the site so that authorised viewers can not use website.
  - Sending viruses: Insert and send viruses through Internet to disable the computers and networks.
  - Sniffing: Intercepting and collecting personal or key-information using software in communication network.

Impact on social structure or on society is large due to ease of access to information technology. The society is divided broadly in two parts: one having access to technology and other with no access. The division is called 'Digital Divide'. Those who are having access enjoy its benefits, and those who do not have are left behind. The digital divide is similar to divide known as 'Have and Have Nots' causing social tension.

Information technology, Internet and web have become part of our daily life affecting our personal, family and social life raising number of issues and challenges. While positive impact of technology is significant, negative impact is not so insignificant that it can be ignored. To protect individuals, groups, and organisation from negative impact some technical solutions are available with limited effectiveness. Large areas of problems, issues and disputes are still left to management to rely on ethical practices and moral values.

## KEY TERMS

Privacy Violation	Ethics
Code of Ethics	Professional Conduct
Privacy Protection	Intellectual Property
Copyright	Patents
IS Quality and Impact	Dehumanisation
Digital Divide	Responsibility and Accountability of Impact

## REVIEW QUESTIONS

1. List the positive and negative impact and their targets of following revolution:
  - Industrial
  - Information Technology and Networking.
  - Internet and Web.
2. Why it is necessary to depend on ethical practices and code of conduct and ethics?
3. Why Internet and web technology causes serious challenges to the privacy of an individual?
4. What measures an organisation should take to ensure that IT and IT enabled solutions are not affecting individuals privacy and organisations interest?
5. What care and measures IT solution developer should take that software solution is of a highest quality at a given point of time?
6. Study and analyse General Moral Imperatives and Professional responsibilities, and establish link between them to suggest that moral imperatives will be achieved by adhering to which professional responsibilities?
7. Name specific technologies which have affected
 

• Individual	• Family	• Organisation
• Organisation structure	• Workplace	• Work culture
8. What is digital divide? How does it affect the society?
9. Why software developer solely not responsible beyond a limit for a negative impact?
10. What action an individual should take as a precautionary measure so that privacy and human rights are not violated?
11. Why and when Information or Information product or Software solution is called an Intellectual property'?
12. What measures are suggested to protect the intellectual property? What are the limitations of these measures?
13. Name the occupational health problems Information Technology has created and reasons behind.
14. Explain the following terms:
  - Dehumanisation of Process
  - Professional Ethics

- Human Rights
  - Copyright and Patents
  - Responsibility, Accountability and Liability
15. Visit following sites for further study:
- [www.prolifics.com](http://www.prolifics.com)
  - [www.constantcontact.com](http://www.constantcontact.com)
  - [www.rediff.com](http://www.rediff.com)

## **CONFIRM YOUR UNDERSTANDING**

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1. It threatens the \_\_\_\_\_ of \_\_\_\_\_ of individual or workgroup.
2. It industry advocates certain standard \_\_\_\_\_ practices to \_\_\_\_\_ privacy of information.
3. The laws of protecting privacy are \_\_\_\_\_ in different countries inviting \_\_\_\_\_ of violation.
4. Privacy protection is best achieved by strict adherence to code of \_\_\_\_\_ and professional \_\_\_\_\_.
5. IT has brought down \_\_\_\_\_ interaction between human beings.
6. Zero defect software is a \_\_\_\_\_.
7. One good impact is IT is \_\_\_\_\_ of people.
8. One bad impact of IT is \_\_\_\_\_ in the life of individual and family.
9. Cyber crime is a result of wide spread \_\_\_\_\_ of IT.
10. It is difficult to determine IS quality norm to control abuse/misuse/damage and to pinpoint its \_\_\_\_\_ and \_\_\_\_\_.



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It is now accepted that 'Zero defect Software' is a myth due to complexity and technology limitation.

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### Questions

1. Identify which issues Proltics corporation has handled in this legal notice.
2. How have they handled responsibility, accountability and liability issues which the user or viewer may raise?
3. By displaying this legal notice on the website, which aspects of code of ethics are complied by Prolifics?

(Extract of legal notice source: [www.prolifics.com](http://www.prolifics.com). JAYCC Company, 11B John Street, New York, NY 10038)

## **2. EMAIL PRIVACY POLICY**

We have created this email privacy policy to demonstrate our firm commitment to your privacy and the protection of your information.

### **Why Did You Receive an Email from us?**

If you received an e-mail from us, (a) your email address is either listed with us as someone who has expressly shared this address for the purpose of receiving information in the future ("opt-in"), or (b) you have registered or purchased or otherwise have an existing relationship with us. We respect your time and attention by controlling the frequency of our mailings.

### **How we Protect Your Privacy?**

We use security measures to protect against the loss, misuse and alteration of data used by our system.

### **Sharing and Usage**

We will never share, sell, or rent individual personal information with anyone without your advance permission or unless ordered by a court of law. Information submitted to us is only available to employees managing this information for purposes of contacting you or sending you emails based on your request for information and to contracted service providers for purposes of providing services relating to our communications with you.

### **How Can You Stop Receiving Email from us?**

Each email sent contains an easy, automated way for you to cease receiving email from us, or to change your expressed interests. If you wish to do this, simply follow the instructions at the end of any email.

If you have received unwanted, unsolicited email sent via this system or purporting to be sent via this system, please forward a copy of that email with your comments to [abuse@constantcontact.com](mailto:abuse@constantcontact.com) for review.

### **Questions**

1. What is the meaning of "opt-in" and what is "opt-out"?
2. What is the commitment company is giving on sharing and usage of information?
3. Explain how you can stop receiving email from the company?

(Source: [www.constantcontact.com](http://www.constantcontact.com))

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# PART III

## Basics of Management Information Systems

### CHAPTERS

- 6. Decision-Making
- 7. Information, Knowledge, Business Intelligence
- 8. Systems Engineering: Analysis and Design
- 9. Development Process of MIS
- 10. Strategic Design of MIS
- 11. Business Intelligence for MIS

Though there is a cultural and operational change the way business is managed in e-business world, basics of Management science are still valid and critically important for successful excellent business performance. Business Manager therefore must have clear conceptual and application understanding of foundation basic of Management Science, Design Analysis, Systems and systems engineering and use of these basics in MIS design and development.

Learning Objective of this part is to get conceptual clarity and in depth understanding of Decision-Making Process, Quality of information and its support to decision-making information systems and MIS. Added learning objective is to have thorough understanding of Information systems and MISs development methodology with tools, and techniques using Structured Systems Analysis and Design (SSAD), and Object Oriented Systems Analysis and Design (OOSAD).

# Decision-Making

## LEARNING OBJECTIVES

- Characteristics of the Business Decisions
- Rational Decision Making and its Problems
- Herbert Simon model of Decision Making
- Types of Decisions
- Evaluation and Selection of Decision Alternatives
- Four Ways of Decision Analysis
- Behavioural Concepts and Decision Making
- Dealing with Uncertainty and Risk

### 6.1 DECISION-MAKING CONCEPTS

The word ‘decision’ is derived from the Latin root *decido*, meaning to cut off. The concept of decision, therefore, is settlement, a fixed intention bringing to a conclusive result, a judgment, and a resolution. A decision is the choice out of several options made by the decision maker to achieve some objective in a given situation.

Business decisions are those, which are made in the process of conducting business to achieve its objectives in a given environment. In concept, whether we are talking about business decisions or any other decision, we assume that the decision maker is a rational person.

The major characteristics of the business decision making are:

- (a) Sequential in nature.
- (b) Exceedingly complex due to risks and trade offs.
- (c) Influenced by personal values.
- (d) Made in institutional settings and business environment.

The business decision-making is sequential in nature. In business, the decisions are not isolated events. Each of them has a relation to some other decision or situation. The decision may appear as a “snap” decision but it is made only after a long chain of developments and a series of related earlier decisions.

The decision-making process is a complex process in the higher hierarchy of management. The complexity is the result of many factors, such as the inter-relationship among the experts

or decision makers, a job responsibility, a question of feasibility, the codes of morals and ethics, and a probable impact on business.

The personal values of the decision maker play a major role in decision-making. A decision otherwise being very sound on the business principle and economic rationality may be rejected on the basis of the personal values, which are defeated if such a decision is implemented. The culture, the discipline and the individual's commitment to goals will decide the process and success of the decision.

Whatever may be the situation, of one analyses the factors underlying the decision-making process, it would be observed that there are common characteristics in each of them. There is a definite method of arriving at a decision; and it can be put in the form of decision process model.

The decision-making process requires creativity, imagination and a deep understanding of human behaviour. The process covers a number of tangible and intangible factors affecting the decision process. It also requires a foresight to predict the post-decision implications and a willingness to face those implications. All decisions solve a 'problem' but over a period of time they give rise to a number of other 'problems.'

### Rational Decision-Making

A rational decision is the one which, effectively and efficiently, ensures the achievement of the goal for which the decision is made. If it is raining, it is rational to look for a cover so that you do not get wet. If you are in business and want to make profit, then you must produce goods and sell them at a price higher than cost of production. In reality, there is no right or wrong decision but a rational or an irrational decision. The quality of decision-making is to be judged on the rationality and not necessarily on the result it produces.

The rationality of the decision made is not the same in every situation. It will vary with the organisation, the situation and the individual's view of the business situation. The rationality, therefore, is a multi-dimensional concept. For example, the business decisions in a private organisation and a Public Sector Undertaking differ under the head of rationality. The reason for this difference in rationality is the different objectives of the decision makers. Any business decision if review by a share-holder, a consumer, an employee, a supplier and a social scientist, will result in a different criticism due to difference individual's rationality. This is because each one of them will view the situation in different contexts and the motive with in different objectives. Hence, whether a decision is right or wrong depends on a specific rational view.

The question which further arises: Is a decision "rational"? If it turns out to be wrong in terms of the results it produces, can we cast doubts on the rationality?

Simon Herbert A\* differentiates among the types of rationality. A decision, in a given situation is:

- *Objectively* rational if it maximises the value of the objective.
- *Subjectively* rational if it maximises the attainment of value within limitation of the knowledge and awareness of the subject.

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\*Herbert Simon A, *Top Management Planning*, The Macmillan Company by George A Steiner.

- *Consciously* rational to the extent the process of the decision-making is deliberate and a conscious one.
- *Organisational* rational to the degree of the orientation towards the organisation.
- *Personally* rational to the extent it achieves an individual's personal goals.

In other words, so long as the decision maker can explain with logic and reason, the objectivity and the circumstances in which the decision is made, it can be termed as a rational decision. Whether the rationality applied is appropriate or not could be point for debate. Gross Bertram M\* suggests three dimensions of rationality. First, the degree of satisfaction of human interest. Second, the degree of feasibility in achieving the objectives. Third, a consistency in decision-making. If a decision maker shows a consistent behaviour in the process of decision-making, then one can say that he meets the test of the rationality.

### **The Problems in Making Rational Decisions**

#### **(a) Ascertaining the Problem**

As Peter Drucker points out, "the most common source of mistakes in the management decisions is the emphasis on finding the right answers rather than the right questions." The main task is to define the right problem in clear terms. The management may define the problem as the "Sales are declining." Actually, the decline of sales is symptomatic, the real problem may be somewhere else. For example the problem may be the poor quality of the product and you may be thinking of improving the quality of advertising.

#### **(b) Insufficient Knowledge**

For perfect rationality, total information leading to complete knowledge is necessary. An important function of a manager is to determine whether the dividing line is reached between insufficient knowledge and the enough information to make a decision.

#### **(c) Not Enough Time to be Rational**

The decision maker is under pressure to make decisions. If time is limited, he may make a hasty decisions which may not satisfy the test of rationality of the decision.

#### **(d) The Environment May Not Cooperate**

Sometimes, the timing of the decision is such that one is forced to make a decision but the environment is not conducive for it. The decision may fail the test of rationality as the environmental factors considered in the decision-making turn out to be untrue. For example, in a product pricing, the factor of oil and petroleum product price is considered as stable. But the post-decision environment proves the consideration to be wrong.

#### **(e) Other Limitations**

Other limitations are the need for a compromise among the different positions, misjudging the motives and values of people, poor communications, misappraisal of uncertainties and risks, and inability to handle the available knowledge and human behaviour.

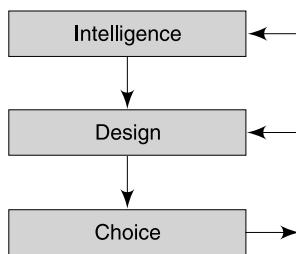
How do we then ensure rationality? It is ensured, if the process of decision making is carried out systematically, whereby all the aspects of the decision making discussed above

\*Gross Bertram M, *The Managing of Organisations*, New York, The Free Press of Glencoe, 1964.

are taken care of. Herbert Simon said that a decision maker follows the process of decision-making disregarding the decision or the type of decision and the motive behind the decision. This process is followed consciously or without knowing it. We can put this process in the Decision-Making Model.

## 6.2 DECISION-MAKING PROCESS

Decision-making is a process which the decision maker uses to arrive at a decision. The core of this process is described by Herbert Simon in a model. He describes the model in three phases as shown in Fig. 6.1 viz.: (a) Intelligence; (b) Design; and (c) Choice. MIS follow this model in its development stage.



**Fig. 6.1** *Herbert Simon Model*

### ***Intelligence***

Raw data collected, processed and examined. Identifies a problem calling for a decision.

### ***Design***

Inventing, developing and analysing the different decision alternatives and testing the feasibility of implementation. Assess the value of the decision outcome.

### ***Choice***

Select one alternative as a decision, based on the selection criteria.

In the intelligence phase, the MIS collects the data. The data is scanned, examined, checked and edited. Further, the data is sorted and merged with other data and computations are made, summarised and presented. In this process, the attention of the manager is drawn to all problem situations by highlighting the significant differences between the actual and the expected, the budgeted or the targeted.

In the design phase, the manager develops a model of the problem situation on which he can generate and test the different decisions to facilitate its implementation. If the model developed is useful in generating the decision alternatives, he then further moves into phase of selection called as choice.

In the phase of choice, the manager evolves a selection criterion such as maximum profit, least cost, minimum waste, least time taken, and highest utility. The criterion is applied to the various decision alternatives and the one which satisfies the most is selected.

In these three phases, if the manager fails to reach a decision, he starts the process all over again from the intelligence phase where additional data and information is collected, the decision-making model is refined, the selection criteria is changed and a decision is arrived at.

The MIS achieves this in an efficient manner without repeated use of the Simon Model again and again. An ideal MIS is supposed to make a decision for the manager.

An example of the Simon Model would illustrate further its use in the MIS. For example, a manager finds on collection and through the analysis of the data that the manufacturing plant is under-utilised and the products which are being sold are not contributing to the profits as desired. The problem identified, therefore, is to find a product mix for the plant, whereby the plant is fully utilized within the raw material and the market constraints, and the profit is maximised. The manager having identified this as the problem of optimisation, now examines the use of Linear Programming (LP) Model. The model is used to evolve various decision alternatives. However, selection is made first on the basis of feasibility, and then on the basis of maximum profit.

The product mix so given is examined by the management committee. It is observed that the market constraints were not realistic in some cases, and the present plant capacity can be enhanced to improve the profit. The same model is used again to test the revised position. Therefore, additional data is collected and an analysis is made to find out whether the average 20 per cent utilisation of the capacity can be increased. A market research for some products is made and it is found that some constraints need to be removed and reduced. Based on the revised data, LP Model is used, and a better optimum solution obtained.

### **Decision-Making Systems: Types**

The decision-making systems can be classified in a number of ways. There are two types of systems based on the manager's knowledge about the environment. If the manager operates in a known environment then it is a closed decision-making system. The conditions of the closed decision-making system are:

- (a) The manager has a known set of decision alternatives and knows their outcomes fully in terms of value, if implemented.
- (b) The manager has a model, a method or a rule whereby the decision alternatives can be generated, tested, and ranked for selection.
- (c) The manager can choose one of them, based on some goal or objective criterian.

Few examples are a product mix problem, an examination system to declare pass or fail, or an acceptance of the fixed deposits.

If the manager operates in an environment not known to him, then the decision-making system is termed as an open decision-making system. The conditions of this system in contrast closed decision-making system are:

- (a) The manager does not know all the decision alternatives.
- (b) The outcome of the decision is also not known fully. The knowledge of the outcome may be a probabilistic one.
- (c) No method, rule or model is available to study and finalise one decision among the set of decision alternatives.
- (d) It is difficult to decide an objective or a goal and, therefore, the manager resorts to that decision, where his aspirations or desires are met best.

Deciding on the possible product diversification lines, the pricing of a new product, and the plant location, are some decision-making situations which fall in the category of the open decision-making systems.

The MIS tries to convert every open system to a closed decision-making system by providing information support for the best decision. The MIS gives the information support, whereby the manager knows more and more about environment and the outcomes, he is able to generate the decision alternatives, test them and select one of them. A good MIS achieves this.

### **Types of Decisions**

The types of decisions are based on the degree of knowledge about the outcomes or the events yet to take place. If the manager has full and precise knowledge of the event or outcome which is to occur, then the decision making is not a problem. If the manager has full knowledge, then it is a situation of certainty. If he has partial knowledge or a probabilistic knowledge, then it is decision-making under risk. If the manager does not have any knowledge whatsoever, then it is decision-making under uncertainty.

A good MIS tries to convert a decision-making situation under uncertainty to the situation under risk and further to certainty. Decision-making in the operations management, is a situation of certainty. This is mainly because the manager in this field, has fairly good knowledge about the events which are to take place, has full knowledge of environment, and has a pre-determined decision alternatives for choice or for selection.

Decision-making at the middle management level is of the risk type. This is because of the difficulty in forecasting an event with hundred per cent accuracy and the limited scope of generating the decision alternatives.

At the top management level, it is a situation of total uncertainty on account of insufficient knowledge of the external environment and the difficulty in forecasting business growth on a long-term basis.

A good MIS design gives adequate support to all the three levels of management.

### **Nature of Decisions**

Decision-making is a complex situation. To resolve the complexity, the decisions are classified as programmed and non-programmed decisions.

If a decision can be based on a rule, method or even guidelines, it is called the programmed decision. If the stock level of an item is 200 numbers, then the decision to raise a purchase requisition for 400 numbers, is a programmed-decision-making situation. The decision maker here is told to make a decision based on the instructions or on the rule of ordering a quantity of 400 items when its stock level reaches 200.

If such rules can be developed wherever possible, then the MIS itself can be designed to make a decision and even execute. The system in such cases plays the role of a decision maker based on a given rule or a method. Since the programmed decisions are made through MIS, the effectiveness of the rule can be analysed and the rule can be reviewed and modified from time to time for an improvement. The programmed decision-making can be delegated to a lower level in the management cadre.

A decision which cannot be made by using a rule or a model is the non-programmed decision. Such decisions are infrequent but the stakes are usually larger. Therefore, they cannot be delegated to the lower level. The MIS in the non-programmed-decision situation, can help to some extent, in identifying the problem, giving the relevant information to handle the specific decision-making situation. The MIS, in other words, can develop support systems in the non-programmed-decision-making situations.

### **The Law of Requisite Variety**

In programmed decision-making, it is necessary for the manager, to enumerate all the stages to the decision-making situation, and provide the necessary support through rules and a formula for each one of them. The failure to provide the decision-making rule, in each of them, will lead to a situation where the system will not be able to make a decision. It is, therefore, necessary to cover a requisite variety of situations with the necessary decision response.

The requisite variety of situations means that for efficient programmed decision-making, it is necessary for the manager to provide:

- (a) All the decision alternatives and the choices in each probable state;
- (b) The decision rules to handle the situation; and
- (c) The system or the method to generate a decision choice.

It has been found that in a closed-decision-making situation, the programmed-decision-making system works efficiently, while in the open-decision-making situation, it is not efficient. With the advent of expert systems and the knowledge-based artificial intelligence systems, it is now possible for a computer to develop the alternatives, test them and handle them on the criteria of selection leading to a decision. The MIS is expected to provide the necessary information and knowledge support to the computer based system.

### **Methods for Deciding Decision Alternatives**

There are several methods to help the manager decide among the alternatives. The methods basically are search processes to select the best alternative upon satisfying certain goals.

There methods for selection of decision alternatives with the goals in view are: (a) Optimisation Techniques; (b) Payoff Analysis; and (c) Decision Tree Analysis.

All the operational research models use optimisation techniques, to decide on the decision alternatives. When a decision making situation can be expressed, in terms of decision versus the probable event, and its pay-off value, then it is possible to construct a matrix of the decision versus the events described by a value for each combination. The manager can then apply the criteria such as the maximum expected value, the maximum profit and the minimum loss or the minimum regrets.

The method of decision tree can be adopted, if the decision-making situation can be described as a chain of decisions. The process of the decision-making is sequential and a chain of decisions achieves the end objective.

The use of both the pay-off matrix and the decision tree requires a probabilistic knowledge of the occurrence of events. In many situations this knowledge is not available and the MIS has to provide the information support in this endeavor.

### ***Optimisation Techniques***

Linear Programming, Integer Programming, Dynamic Programming, Queuing Models, Inventory Models, Capital Budgeting Models and so on are the examples of optimisation techniques. These methods are used in cases where decision-making situation is closed, deterministic and requires to optimize the use of resources under conditions of constraints. To handle these situations, software packages are available. These methods are termed operational research (OR) techniques.

All the OR methods attempt to balance the two aspects of business under conditions of constraint. In the linear programming model, the use of resources versus demand is balanced to maximize the profit. In the Inventory Model, the cost of holding inventory versus the cost of procuring the inventory is balanced under the constraint of capital and meeting the demand requirement. In the Queuing Model, the cost of waiting time of the customer versus the cost of an idle time of the facility is balanced under the constraint of investment in the facility and the permissible waiting time for the customer. In the capital budgeting model, the return on investment is maximised under the capital constraint versus the utility of the investment. The MIS supports the formulation of a model, and then using it for the decision-making.

### ***The Payoff Analysis***

When all the alternatives and their outcomes are not known with certainty, the decision is made with the help of payoff analysis. The payoff matrix is constructed where the rows show the alternatives and the columns show the conditions or the states of nature with the probability of occurrence. The intersection of column and row shows the value of an outcome resulting out of the alternative and the state of the nature. A typical payoff matrix in pricing decision is as given in Table 6.1.

**Table 6.1** Payoff Matrix I

Your decision alternative	Competitor's Decision: probability	No change	Increase	Decrease	Expected gain
		0.50	0.20	0.30	
No change in the price		4	5	8	5.40
Increase the price		6	4	3	4.70
Decrease the price		10	12	4	8.60

For example, if the decision chosen is 'no change in the price' and the competition also does not change the price, then your gain is '4'. The decision is taken by choosing that decision alternative which has the maximum expected value of outcome. Since, the expected value in case of the third alternative is the highest, the decision would be to decrease the price.

The concept of utility relates to the money value considered by the decision maker. Utility is measured in terms of utile. Money has a value of a different degree to different decision makers depending upon the amount, and also the manner in which it is received. If rupee one is equal to one utile, then ₹ 100 million is not 100 million utiles but could be much more. The utile value will be different if the money is received in one lot as against in parts in several years. The utility function is different for different decision makers. The utile value of utility has an influence on the risk taking ability of the decision maker. A well placed manager with

a sound business will tend to gamble or take more risk, than a manager not so well placed in the business. In such decision-making situations, the monetary values of the outcomes are replaced by the utility values, suitable to the decision maker's utility function. In our example of pricing, if we replace the values by utilities, the matrix would be as given below in Table 6.2.

**Table 6.2** Payoff Matrix II

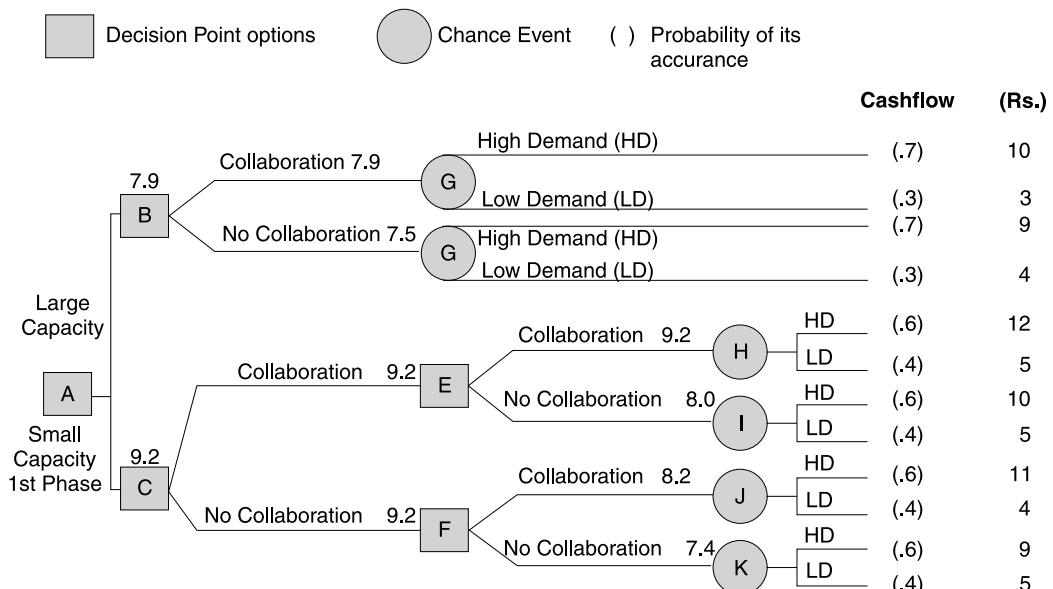
Decision	Competitor's choice: probability	No change	Increase	Decrease	Expected utility
		0.50	0.20	0.30	
No change in the price		4	50	200	72.00
Increase the price		200	4	400	220.80
Decrease the price		100	20	4	54.12

Since the highest value of utility is 220.80 utiles, the decision would be to increase the price.

### **Decision Tree Analysis**

When a decision maker must make a sequence of decisions, the decision tree analysis is useful in selecting the set of the decisions.

The method of analysis can be explained by an example. The decision tree is drawn in Fig. 6.2 with the help of symbols.



**Fig. 6.2** Decision Tree

Let us take an example of investment in production capacity for a planning period of five years

In this decision situation there are two decision points and six paths as given below. The path which gives maximum cashflow is the right decision path. The cashflow values are as under:

Path			Expected cashflow
ABG	—	Collaboration	7.9
ABD	—	No Collaboration	7.5
ACEH	—	Collaboration IInd Phase, Collaboration IIInd Phase	9.2
ACEI	—	Collaboration IInd Phase, No Collaboration IIInd Phase,	8.0
ACFJ	—	No Collaboration IInd Phase Collaboration IIInd Phase	8.2
ACFK	—	No Collaboration IInd Phase No Collaboration IIInd Phase	7.4

The problem is whether to expand now with a large capacity or to invest now in small capacity and make a decision of expansion after one year with the help of a collaboration or without a collaboration under certain demand conditions.

Since the highest expected cashflow path is ACEH, the decision is to invest in a small capacity in the IInd phase and invest in the remaining capacity in the second phase with the assistance of the collaboration.

The decision tree approach is useful when you visualise a series of decisions having alternative paths with the associated probabilities and the cashflows for each path for more than one year.

### 6.3 DECISION ANALYSIS BY ANALYTICAL MODELLING

Based on the methods discussed, a decision is made but such decision needs to be analysed for conditions and assumptions considered in the decision model. The process is executed through analytical modelling of problem and solution. The model is analysed in four ways.

- What if analysis
- Sensitivity analysis
- Goal Seeking Analysis
- Goal Achieving analysis

#### What If Analysis

Decisions are made using a model of the problem for developing various solution alternatives and testing them for best choice. The model is built with some variables and relationship between variables. In reality, the considered values of variables or relationship in the model may not hold good and therefore solution needs to be tested for an outcome, if the considered values of variables or relationship change. This method of analysis is called 'what if analysis.'

For example in decision-making problem about determining inventory control parameters (EOQ, Safety Stock, Maximum Stock, Minimum Stock, Reorder level) lead time is assumed

fairly constant and stable for a planning period. Based on this, the inventory parameters, are calculated. Inventory manager wants to know how the cost of holding inventory will be affected if lead time is reduced by one week or increased by one week. The model with changed lead time would compute the cost of holding inventory under new conditions. Such type of analysis can be done for purchase price change, demand forecast variations and so on. Such analysis helps a manager to take a more learned decisions. What if analysis creates confidence in decision-making model by painting a picture of outcomes under different conditions.

### Sensitivity Analysis

In what if analysis you test the effect on solution by changing the value of number of variables simultaneously or changing the relations between them. But in sensitivity analysis, a special case of what if analysis, only one variable is changed and rest are kept unchanged.

In our problem of inventory, sensitivity analysis can be used to assess the cost of holding inventory, if cost of item increases by 20 per cent in sensitivity analysis, you are testing how sensitive is the cost of holding inventory to the change in cost of item. Sensitivity analysis helps to understand the significance of variable in decision-making and improves the quality of decision-making.

### Goal Achieving Analysis

In goal seeking analysis, you analyse the problem in exactly reverse way as that of what if analysis or sensitivity analysis. In goal seeking analysis, goal is fixed and you go down to analyse the variables and values, which would help to seek that goal. We work backward from the goal.

For example in our inventory problem you would fix a goal of achieving the cost of holding inventory of an item at the level of ₹ 10,00,000. Goal seeking analysis will help you to arrive at values of parameters to attain the inventory level of ₹ 10,00,000.

### Goal Seeking Analysis

In goal seeking analysis, you do not fix the goal but you try to achieve a goal of an optimum value arrived at after satisfying all the constraints operating in the problem. In optimisation analysis, you come to know which are critical constraints and which are limiting the value of goal. The decision maker can use this analysis to work on constraints and resources and find ways to improve upon solution to seek highest goal.

## 6.4 BEHAVIOURAL CONCEPTS IN DECISION-MAKING

A manager, being a human being, behaves in a peculiar way in a given situation. The response of one manager may not be the same as that of the two other managers, as they differ on the behavioural platform. Even though tools, methods and procedures are evolved, the decision is many a times influenced by personal factors such as behaviour.

The managers differ in their approach towards decision making in the organisation, and, therefore, they can be classified into two categories, viz., the achievement-oriented, i.e., looking for excellence and the task-oriented, i.e., looking for the completion of the task somehow. The achievement-oriented manager will always opt for the best and, therefore, will be

enterprising in every aspect of the decision-making. He will endeavour to develop all the possible alternatives. He would be scientific, and therefore, more rational. He would weigh all the pros and cons properly and then conclude.

The manager's personal values will definitely influence ultimately. Some of the managers show a nature of risk avoidance. Their behaviour shows a distinct pattern indicating a conservative approach to decision-making—a path of low risk or no risk. Further, even though decision-making tools are available, the choice of the tools may differ depending on the motives of the manager. The motives are not apparent, and hence, are difficult to understand. A rational decision in the normal course may turn out to be different on account of the motives of the manager.

The behaviour of the manager is also influenced by the position he holds in the organisation. The behaviour is influenced by a fear and an anxiety that the personal image may be tarnished and the career prospects in the organisation may be spoiled due to a defeat or a failure. The managerial behaviour, therefore, is a complex mix of the personal values, the atmosphere in the organisation, the motives and the motivation, and the resistance to change. Such a behaviour sometimes overrides normal decisions based on business and economic principles.

The interplay of different decision-making of all the managers in the organisation shapes up the organisational decision-making. The rationale of the business decision will largely depend upon the individuals, their positions in the organisation and their inter-relationship with other managers.

If two managers are placed in two decision-making situations, and if their objectives are in conflict, the managers will arrive at a decision objectively, satisfying individual goals. Many a times, they may make a conscious decision, disregarding organisation's objective to meet their personal goals and to satisfy their personal values. If the manager is enterprising, he will make objectively rational decisions. But if the manager is averse to taking risk, he will make a decision which will be subjectively rational as he would act with limited knowledge and also be influenced by the risk averseness. Thus, it is clear that if the attitudes and the motives are not consistent across the organisation, the decision-making process slows down in the organisation.

## 6.5 ORGANISATIONAL DECISION-MAKING

An organisation is an arrangement of individuals having different goals. Each individual enjoys different powers and rights because of his position, function and importance in the organisation. Since there is an imbalance in the power structure, the different individuals cannot equally influence the organisational behaviour, the management process and the setting of business goals. Ultimately, what emerges is an hierarchy of goals which may be conflicting, self defeating and inconsistent.

The corporate goals and the goals of the departments/divisions or the functional goals, many a times, are in conflict. If the organisation is a system, and its departments/divisions or functions are its subsystems, then unless the system's objective and the subsystem's objectives are aligned and consistent to each other, the corporate goals are not achieved.

In case of inconsistent goals, the conflict in the organisation increases, affecting the organisation's overall performance. The organisational decision-making should help in the resolution of such conflicts. Otherwise, the organisation suffers from indecision. The organisational

behaviour theory provides different methods for resolution of avoiding such conflicting goals as explained in Table 6.3.

**Table 6.3** Methods of Conflict Resolution

Method	Explanation	Example
Allowing local rationality in the setting of goals.	Where the functional interdependence is minimum and the goals/objectives/targets do not significantly influence the corporate goals.	Security, Time office functions, Legal, Commercial, Administrative functions.
Permission to set goals which can be achieved with an acceptable decision making rule and systems.	Where there is functional dependence, to set local goals which will not adversely affect the goals of dependent functions.	Production versus Sales versus Materials functions can evolve decision rules to meet the local goals and affect the goals of the dependent functions, or the corporate goals.
Permission to achieve the goals in a sequential manner.	If the goals are conflicting, they are resolved in a sequential manner one at a time. It is a deliberate decision to ignore the conflicting goals within a bounded rationality.	Maximisation of profit, quality, level, customer satisfaction, leadership image, etc.

### Dealing with Uncertainty

The organisations perform in an environment of uncertainty. The market uncertainty, the price fluctuations, the changes in the Government policy, not knowing the moves of the competitors, the technology changes are some of the factors which make the business environment uncertain. Organisational behaviour will, therefore, be towards minimizing the risk in decision-making. The trend will be for risk avoidance with available information support.

The organisation will vote for a decision which has 90 per cent chance of earning ₹ 1 million as against a decision which has 10 per cent chance of earning Rs 10 million. The organisational behaviour in decision making tends to avoid risk and minimize cost post decision implementation. The methods for dealing with uncertainty are given in Table 6.4.

**Table 6.4** Methods of Dealing with Uncertainty

Method	Explanation	Example
Decide for a limited short period, and make a provision to correct the decision.	If the environment is reviewed at short intervals, the uncertainty impact can be reduced providing a chance to correct the previous decision.	Purchasing of smaller quantity more frequently. Adopting the policy of enhancement in place replacement by new plants and equipment.
Negotiated decision making with limited liability.	To reduce the impact of the risk, the uncertainty is converted to certainty by making decisions binding, though the negotiated contracts.	International price agreements, supply assurances and sharing the risks.

## Organisational Learning

The organizational decision-making improves with learning by acquiring an additional knowledge and experience, the training and development, the experience of implementation and so on. Learning provides a strength to review the goals and the objectives, and allows to set them more correctly. It also helps to revise and improve the decision rules. The improvements are carried out by adopting the policy of modernisation, rationalisation and the application of the management science.

The process brings with small changes in the existing policy and guidelines. Then it slowly comes to the changes in the strategic decision and planning. Further, it revamps the decision rules and also provides a systems approach to decision-making. As the time progresses, the organisation may have a new set of goals and objectives. It may go through a process of rationalisation of goals and objectives across the company. The organisation may take a fresh look at the alternatives, outcomes, implementation strategies, methods, procedures and systems.

Adopting such methods, the organisation builds skills and capabilities in the management. It creates the infrastructure to make all the decisions rational, which can be implemented effectively and efficiently, to achieve the objectives.

## 6.6 MIS AND DECISION-MAKING

It is necessary to understand the concepts of decision-making as they are relevant to the design of the MIS. The Simon Model provides a conceptual design of the MIS and decision-making, wherein the designer has to design the system in such a way that the problem is identified in precise terms. That means the data gathered for data analysis should be such that it provides diagnostics and also provides a path to bring the problem to surface.

In the design phase of the model, the designer is to ensure that the system provides models for decision-making. These models should provide for the generation of decision alternatives, test them and pave way for the selection of one of them. In a choice phase, the designer must help to select the criteria to select one alternative amongst the many.

The concept of programmed decision making is the finest tool available to the MIS designer, whereby he can transfer decision-making from a decision maker to the MIS and still retain the responsibility and accountability with the decision maker or the manager. In case of non-programmed decisions, the MIS should provide the decision support systems to handle the variability in the decision-making conditions. The decision support systems provide a generalised model of decision making.

The concept of decision-making systems, such as the closed and the open systems, helps the designer in providing a design flexibility. The closed systems are deterministic and rule based; therefore, the design needs to have limited flexibility, while in an open system, the design should be flexible to cope up with the changes required from time to time.

The methods of decision-making can be used directly in the MIS provided the method to be applied has been decided. A number of decision-making problems call for optimisation, and OR models are available which can be made a part of the system. The optimisation models are static and dynamic, and both can be used in the MIS. Some of the problems call for a competitive analysis, such as a payoff analysis. In these problems, the MIS can provide the analysis based on the gains, the regrets and the utility.

The concepts of the organisational and behavioural aspects of decision-making provide an insight to the designer to handle the organisational culture and the constraints in the MIS. The concepts of the rationality of a business decision, the risk averseness of the managers and the tendency to avoid an uncertainty, makes the designer conscious about the human limitations, and prompts him to provide a support in the MIS to handle these limitations. The reliance on organisational learning, makes the designer aware of the MIS and makes him provide the channels in the MIS to make the learning process more efficient.

The relevance of the decision-making concepts is significant in the MIS design. The significance arises out of the complexity of decision-making, the human factors in the decision-making, the organisational and behaviour aspects, and the uncertain environments. The MIS design addressing these significant factors turns out to be the best design.

## KEY TERMS

Rational Decisions  
Closed Decision System  
Law of Requisite Variety  
Payoff Analysis  
'What if' Analysis  
Sensitivity Analysis

Perfect Rationality  
Open Decision System  
Optimisation Technique  
Decision Tree Analysis  
Goal Seeking Analysis  
Organisational Learning

## REVIEW QUESTIONS

1. Why do decision-making situations arise?
2. Identify few decisions in your life, where the outcomes were known with certainty, risk and uncertainty.
3. Why do two people disagree on the choice of a decision? Is it then better to resort to programmable decision-making?
4. Why is more time spent in problem analysis and problem definition as compared to the time spent on decision analysis?
5. If a person is indecisive, is it due to lack of information support or some human factors or both?
6. Why does the decision maker resort to bounded rationality in a decision-making situation? Can a decision be called as right or wrong? What is the measure of correct decision?
7. Can you automate the process of decision-making? The answer is 'Yes' and 'No'. Explain. What best must be aimed at?
8. Explain the role of a model in problem solving. Explain the process of abstraction used in constructing the model.
9. List the different criteria which can be used in decision-making.
10. Can the quality of decision-making be improved? Explain how it can be improved.

11. Explain the need of information requirement for decision-making if manager is of type Risk averse, Risk neutral and Risk seeking.
12. Explain how MIS would support Risk Mitigation, Monitoring and Management Plan.
13. Explain the support role of MIS in implementing Herbert Simon model. Identify various systems in MIS, which contribute in three phases of model.
14. Explain with example how MIS improves risk perception of the manager?
15. Explain with example how MISs help to change decision-making scenario from uncertainty to risk to certainty?  
Identify the systems in MIS, which contribute to organisation learning.

## **CONFIRM YOUR UNDERSTANDING**

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1. One of the four characteristics of the business decision is it is \_\_\_\_\_ by decision maker's \_\_\_\_\_ values.
2. Rational decision is the one which \_\_\_\_\_ and \_\_\_\_\_ achieves the decision \_\_\_\_\_.
3. For perfect rationality, decision maker must possess complete \_\_\_\_\_ of the decision requiring problem situation.
4. Decision-making systems are of two types, \_\_\_\_\_ and \_\_\_\_\_ wherein open system; decision-maker does not know all the \_\_\_\_\_ and their \_\_\_\_\_.
5. A good MIS tries to convert a decision-making situation from \_\_\_\_\_ to \_\_\_\_\_ to \_\_\_\_\_.
6. Programmable decision is the one which can be handled by use of \_\_\_\_\_ or algorithm.
7. Payoff analysis uses payoff \_\_\_\_\_ built out of decision alternatives and their \_\_\_\_\_ under each probable condition (probability).
8. In 'what if analysis' the decision alternative is tested for \_\_\_\_\_ relations between \_\_\_\_\_ considered in problem.
9. In 'goal seeking analysis' you fix the goal and test whether \_\_\_\_\_ and the \_\_\_\_\_ would achieve that goal.
10. Organisation decision making improves with \_\_\_\_\_ due to \_\_\_\_\_ acquired by work experience.
11. In 'what if analysis', we test the decision for \_\_\_\_\_ in conditions and \_\_\_\_\_.
12. In 'sensitivity analysis', We test the impact on decision if certain \_\_\_\_\_ are changed in value.


**CASE STUDY**


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## 1. UNIVERSAL FOODS AND DRINKS LIMITED (UFDL)

*(Decision Types)*

The Universal Foods and Drinks Limited (UFDL) is a company, manufacturing different types of packaged foods and drinks. The product range consists of more than 50 items and 200 packaging units. The company's products are popular throughout the country and the company is known for its quality products.

The Universal Foods and Drinks Limited has processing plants in the various parts of the country like Jammu & Kashmir, Madhya Pradesh, Himachal Pradesh, Maharashtra, and Kerala. It has a wide network of distributors and dealers, who stock the UFDL products and deal with all types of customers. The company, through this network, reaches to over 50,000 retail points in the urban and the rural markets.

Some of the products of the UFDL are produced throughout the year and are sold through this wide network. Some products are seasonal in production but are sold throughout the years. And some products are popular in certain seasons and not in demand at all in the other seasons.

The business performance of the company is assured good, if the UFDL produces the products as per the varying demand pattern of the customers. Since, the company has established its strength in the distributor dealer network, the success comes through the appropriate decisions in the purchase of fruits, vegetables, cereals and pulses and putting them through processing and packaging, and dispatching them to the various locations where the distributors are located.

It is the policy of the company to launch each year at least one new product in the country. This policy has paid rich dividends, to the company in terms of its image and the customers have always looked forward for such an announcement from the company's end. The UFDL uses, well in advance, the different advertising media such as the newspapers, hoardings, magazines, sample tests and demos, T.V., etc. for announcing and promotion of its new products from time to time. However, the selection of the media is based on the product and its overall position in the product range and the targeted market segment.

In spite of considerable strength in many aspects of business, the company has failed in the launching of new products. It was also not able to meet the demand owing to the inadequate purchases of raw materials, the wastage of the raw materials as the processing plant of the company was not available due to its maintenance schedule or it was scheduled for some other food processing operation. The company also faces the problems of high seasonal inventory which, if not disposed of in time, becomes a non-moving and sometimes a non-saleable inventory.

The UFDL has its Marketing Division headed by a Manager—Marketing supported by the Product Manager for a group of its products.

### Questions

1. Identify the different decisions which the Management of the Company is making during the course of the business execution.
2. Classify these decisions in terms of the type—certainty, risk and uncertainty.
3. Which of these decisions can be converted into the programmable decisions? Give a model of one programmable decision, and suggest a decision support system (DSS) for the same.

4. Which of these decisions will be taken by the top, the middle, and the operational management of the UFDL?
5. Suggest the different Decision Support Systems which the management of the UFDL may use for strategic management of the business.
6. Suggest the external sources of information for the top management to support their decision-making, justifying its position in an MIS.
7. Suggest an MIS model showing various subsystems and their relations. The model should show data bases, transaction processing systems, decision support systems and their interface to each other.

## 2. BLUELINE BEARINGS LIMITED (BBL)

*(Decision Making Methodologies)*

The Blueline Bearings Limited manufactures and sells automotive bearings to the vehicle manufacturers and diesel engine manufacturers. The manufacture of bearing on a large scale call for a heavy capital investment for quality production. The bearings run into a large variety according to the size and the type of engine. The process of manufacturing is to make individual bearings and then make the set of bearings. The product of the Blueline Bearings Limited, therefore, is the bearings and the set made out of its.

The market for the Blueline Bearings Limited is the OERs (Original Equipment Replacement Market), the OEMs (Original Equipment Manufacturers) and the dealers in the open market.

The Blueline Bearings Limited has two other competitors within the country plus competition from imported bearings and sets. Under the circumstances, the pricing of bearings is always a decision problem for the Company as the demand is price elastic.

The Blueline Bearings Limited, in some part of the existing product range, enjoys the leadership and hence commands the price leadership. The price fixed is based on the cost plus mark-up with a variation in the price for the OEMs, the OERs and the dealers. In some other cases of the product range, where the Blueline Bearings Limited does not enjoy the market preference, the price is quoted on the order quantity, stocks and customer type.'

In terms of preference to the order, the OEM gets the first preference; the OER the next and the dealers the last. The pricing decision revolves around the base price and the rules provide different discount rates depending upon the stock condition in the stores and the order quantity asked by the customer.

The rule to decide the discount is shown in the following table.

In case of some bearings, the rules are framed in relation to the order quantity and disregarding the type of the customer. These rules also provide different credit terms.

If the order quantity is less than 500, the price is the base price and 30 days credit; if the Order Quantity is less than 1000, the price is less 10 per cent and 45 per days credit; if the Order Quantity is 1001 or more, the price is less by 20 per cent with 60 days credit. The above conditions are for those bearings which have good stock position and which contribute to high turnover.

<i>Customer</i>	<i>Stock</i>	<i>Order quantity</i>	<i>Discount %</i>
OEM	High	High	20%
	High	Low	10%
	Low	High	10%
	Low	Low	Nil

*Contd...*

*Contd...*

OER Dealers	High High Low Low N.A.	High Low High Low N.A.	10% 5% 5% Nil Nil
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In case of some bearings, the raw material has to be imported. There are two sources available—one from the United Kingdom and the other from the United States of America. The demand for these bearings varies from year to year. However, there is a 50 per cent chance that the demand will be high; 30 per cent chance that the demand will be normal; and 20 per cent chance that the demand will be low. The choice of import is based on the general price conditions agreed with the source. It has been observed in the past that the negotiated price is maintained 70 per cent of the times by the source at the United Kingdom, while only 40 per cent of the times by the source at the United States of America. Depending upon the procurement price, the value of the sales of these bearings will be as under:

Sales (₹ Million)

Demand	Probability of sales	Price maintained		Not maintained	
		UK	USA	UK	USA
High	0.50	100*	100	80	95
Normal	0.30	70	70	40	60
Low	0.20	30	30	10	20

\*The sales expected are ₹ 100 million, if the source of the import of the raw material is the United Kingdom and probably of high demand.

Based on this sourcing decision, the Blueline Bearings Limited decides the price of the bearings keeping in mind the cost plus mark-up formula.

The railways are important customers of the company. The Indian Railways buy certain bearings on a tender basis for which the Blueline Bearings Limited quotes. There is only one competitor for this business. The total business of the Railways is about ₹ 50 million. The Blueline Bearings Limited adopts one of the following strategies.

The matrix shows the value of outcome, if the Blueline Bearings Limited adopts a strategy and the competitor adopts same or the other strategy. This is the most difficult pricing decision the Blueline Bearings Limited has to make.

Adoption of the Competitor's Strategy			
	Probability of Competition	Price Strategy	
BBL price strategy and the value of outcome	0.50	0.40	0.10
A: Last Year's Price (LYP)	A	B	C
A: Last Year's Price (LYP)	50*	50	-5
B: LYP + 10%	-5	50	-5
C: LYP - 10%	45	45	50

\* If the Blueline Bearings Limited Chooses the price strategy 'A' and competition also chooses A with a chance of 50 per cent, then the value of the outcome is 50.

## Questions

1. Discuss the methods of pricing the Blueline Bearings Limited is adopting in various situations. How MIS would support the price decision process?
2. Draw a process flow diagram for pricing in case of the orders received from the customer who could be an OEM, an OER or a dealer.
3. Also include the process flow diagram for offering the credit terms on the lines given for general customers.
4. Which of these pricing decisions can be made as an integral part of the order processing system? Explain why and how?
5. Which decision is advisable to keep outside the order processing system? How can this decision-making situation be improved over a period of time to bring in decision-making accuracy?

# Information, Knowledge, Business Intelligence

## LEARNING OBJECTIVES

- Differentiate between Data, Information and Knowledge
- Effective Information Presentation
- Quality of Information
- Classes of Information
- Application of Value Concept to Information
- Value of Additional Information
- Human as Information Processes
- Difference Between Tacit and Explicit Knowledge

### 7.1 INFORMATION CONCEPTS

The word ‘information’ is used commonly in our day to day working. In MIS, information has a precise meaning and it is different from data. The information has a value in decision making while data does not have. Information brings clarity and creates an intelligent human response in the mind.

In MIS a clear distinction is made between data and information. Data is like raw materials while the information is equivalent to the finished goods produced after processing the raw material. Information has certain characteristics. These are: Information

- improves representation of an entity.
- updates the level of knowledge.
- has a surprise value.
- reduces uncertainty.
- aids in decision-making.

The quality of information could be called good or bad depending on the mix of these characteristics. A sales report shown in Table 7.1 will highlight this point.

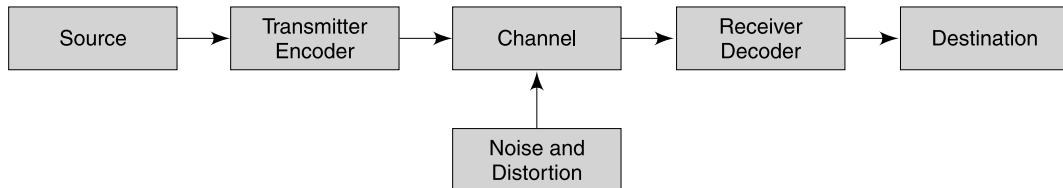
It can be noted in the above example that sales data is processed with the budget data and further some results are computed, providing information of an exceptional nature, that is, the sale of new product in the total sales. The sales data progressively becomes an information when processed with other data such as the budget and the new product sales.

**Table 7.1** Sales Information

<i>Particulars of sales data</i>	(₹ Lakhs)	<i>Characteristics</i>
Sales	10/day	Represents sales/day.
Budgeted sales	15/day	Represents budget/day.
Cumulative sales	510/60 days	Updates the knowledge about sales as on date.
Cumulative budget	600/60 days	Makes the information meaningful by a comparison with budgets and has a surprise value as it is significantly below the budget.
Ratio of sales performance to the budget.	85%	15 per cent less than budget. Represents performance of Sales vs. Budget
Sales of new products	80/60 days	Reduces the uncertainty of sales of new product as expected sales were only ₹ 70 Lakhs.

Davis and Olson defines information as a data that has been processed into a form that is meaningful to the recipient and is of real or perceived value in the current or the prospective actions or decisions of the recipient. Data is defined as groups of non-random symbols in the form of text, images or voice representing quantities, actions and objects.

Whether an entity is a data or an information, it must be transferred through communication from the 'Source' to the 'Destination' without loss of content. The general model for such communication is given in Fig. 7.1.

**Fig. 7.1** Conceptual Model of Communication

The above model of communication is used in the MIS. The MIS is equivalent to the transmitter which provides information and sends through reports (channel) to the various receivers, which is decoded or interpreted by the receiver at the destination. The poor quality of an information due to various factors would create confusion and misunderstanding, which is equivalent to a 'Noise' and a 'Distortion' in the communication model. A good MIS communicates the information without a noise and a distortion to the user.

### Information Presentation

Presentation of the information is an art. The data may be collected in the best possible manner and processed analytically, bringing lot of value in the information; however, if it is not presented properly, it may fail to communicate anything of value to the receiver. The degree of communication is affected by the methods of transmission, the manner of information handling and the limitations and constraints of a receiver as the information processor, and the organisation as the information user.

The methods used for improving communication are summarisation and message routing. The concept of summarization is used to provide information which is needed in the form and content. The information can be summarised in a number of ways as shown in Table 7.2.

**Table 7.2** Information Summarisation

<i>Key for Summarisation</i>	<i>Focus of information</i>	<i>Operations</i>
Management position	Responsibility	General Manager, Divisional Head Marketing, Materials
Management functions	Performance, Goals, Targets	Production Target
Levels in the organisation	Relevance to the level	GM, Manager
Selective on condition	Exceptions	Only those products, where sale is below the budget

The principle behind summarisation is that too much information causes noise and distortion, i.e., confusion, misunderstanding and missing the purpose. The summarisation suppresses the noise and the distortions.

Another method of improving the degree of communication is through message routing. The principle here is to distribute information to all those who are accountable for the subsequent actions or decisions in any manner. That is if the information is generated with a certain purpose for a primary user, then such information may have secondary purposes to some other users in the organisation. This is achieved by sending the copies of the reports or documents to all the concerned people or users. The principle of the message routing achieves the spread of information to the appropriate quarters.

Knowledge is a power and an intelligent person in the organisation can misuse this power to achieve personal goals undermining the functional and organisational goals. This tendency should be curbed. Further, the decision maker may call for the information on the grounds that, just in case required, he should readily have it. Apart from the misuse of information, it has an impact on the cost of information processing.

In order to curb the misuse of information, a control is exercised on the content of information and its distribution. The methods shown in Table 7.3 are available for use with discretion.

**Table 7.3** Methods to Avoid Misuse of Information

<i>Method</i>	<i>Reason</i>	<i>Example</i>
Delayed delivery of information	A possibility of immediate action or decision is reduced. It will have only a knowledge value.	Sales report to the sales representative or a copy of invoice to the sales representative.
Change in the format and content of the report	Provide only that information which may be needed, hence the misuse is averted.	Sales information to operations management, sales versus target for the middle management sales with a trend analysis to the top management.

*Contd...*

*Contd...*

Suppression and filtering of the information of confidential and sensitive nature	To avoid the risk of exposure and the misuse of information for achieving the undesirable goals.	The price, the cost information. Drawing and design information.
Suppress the details and references of data and information	Make it difficult to collect, and process the data at the user end to meet the personal needs of information.	Statistical reports with no references.
Truncated or Lopsided presentation	Make it difficult to read through the information and avoid its probable misuse.	A focus on high value sales and production and suppress the details.

### Bias in Information

While choosing the appropriate method of communicating information, a care has to be taken to see that it is not biased. For example, while using the techniques of classification or filtering the information, it should not happen that certain information gets eliminated or does not get classified. That is, a deliberate bias in covering certain information is to be avoided. This bias enters because people try to block a sensitive information which affects them. To overcome this problem, a formal structure of organisation should be adopted and the type of information and its receiver should be decided by the top management.

Many a times the data and the information are suppressed but the inferences are informed, with no or little possibility of verification or rethinking. In this case one who draws inferences may have a bias in the process of collection, processing and presentation of data and information. Though the deliberate enforcement of the inference on the receiver avoids a possibility of the multiple inferences, but in this case processor's bias is forced on the receiver. For example, organisations have departments like Corporate Planning, Market Research, R and D, HRD and so on, which collect the data and analyse for the company and communicate the inferences. In all these cases personal bias, organisational bias and management bias may be reflected in the entire process of collection, processing, and communication inferencing.

The presentation of the information will generate a bias and may influence the user. For example, if the information is presented in an alphabetical order and if it is lengthy, the first few information entities will get more attention. If the information is presented with a criteria of exception, the choice of exception and deviation from the exception creates a bias by design itself. For a quick grasp, the information is presented in a graphical form. The choice of scale, the graphic size and the colour introduces a bias in the reader's mind.

The bias, which may creep in inadvertently because of the information system design, can be talked by making the design flexible, so far as reporting is concerned. Allow the manager or the decision maker to choose his classification or filtering criteria, the scope of information, the method of analysis and the presentation of inference. However, somewhere balance needs to be maintained between the flexibility of the design and the cost, and its benefits to the manager. Disregarding the bias in information, it must have certain attributes to increase its utility as shown in Table 7.4.

**Table 7.4** Attributes of the Information

<i>Attribute</i>	<i>Explanation</i>
The accuracy in representation	The test of accuracy is how closely it represents a situation or event. The degree of precision will decide the accuracy in representation.
The form of presentation	Forms are qualitative or quantitative, numeric or graphic, printed or displayed, summarized or detailed. Appropriate form is important.
The frequency of reporting	How often the information is needed? How often it needs to be updated?
The scope of reporting	The coverage of information in terms of entities, area and range, and the interest shown by the recipient or the decision maker.
The scope of collection	Internal from organisation or external to organisation.
The time scale	It may relate to the past, the current and the future and can cover the entire time span.
The relevance to decision making	The information has a relevance to a situation and also to a decision-making. The irrelevant information is a data.
Complete for the decision considerations	The information which covers all the aspects of the decision situation by way of the scope, transactions and period is complete.
The timeliness of reporting	The receipt of information on time or when needed is highly useful. The information arriving late, loses its utility as it is outdated.

Redundancy is the repetition of the parts or messages in order to circumvent the distortions or the transmission errors. The redundancy, therefore, sometimes is considered as an essential feature to ensure that the information is received and digested.

In MIS the redundancy of data and information, therefore, is inevitable on a limited scale. Its use is to be made carefully so that the reports are not crowded with information.

## 7.2 INFORMATION: A QUALITY PRODUCT

Information is a product of data processing. Even if we take care of the aspects discussed in the above section, the manager will determine the quality of the information based on the degree of motivation it provides for action, and the contribution it provides for effective decision-making. The quality of information is high, if it creates managerial impact leading to attention, decision and action. The quality of information can be measured on the four dimensions, viz., utility, satisfaction, error and bias.

The *utility* dimension has four facets—the form, the time, the access and the possession. If the information is presented in the form the manager requires, then its utility increases. If it is available when needed, the utility is optimised. If the information is easily and quickly accessible through the Online Access System, its utility gets an added boost. Lastly, if the

information is possessed by the manager who needs it, then its utility is the highest. Many of the organisations suffer from the possessive nature of the managers making an access difficult for the other users of the information. Improving the quality through increasing a utility means an increase in the cost. The balance, therefore, is to be maintained between the cost and the utility.

The concept of the utility of the information is subjective to the individual manager, at least in terms of the form, time and access. Since in the organisation there are many users of the same information, the subjectiveness would vary. Therefore, the one common key for measuring the quality could be *satisfaction* of the decision maker. The degree of satisfaction would determine the quality of the information. If the organisation has a high degree of satisfaction, then one can be safe in saying that the information systems are designed properly to meet the information needs of the managers at all the levels.

An **error** is the third dimension of the quality of the information. The errors creep in on account of various reasons, namely:

1. An incorrect data measurement
2. An incorrect collection method
3. Failure to follow the prescribed data processing procedure
4. Loss of data or incomplete data
5. Poor application of data validation and control systems
6. A deliberate falsification

An erroneous information is a serious problem because the decision maker cannot make the adjustments as he is not aware of it in terms of the location and the quantum of error. To control errors, it is necessary to follow the methods of systems analysis and design. The approach should be that, the errors should be prevented, failing that they should be detected, and if not, they should be controlled.

The processing of data for information processing should be allowed only after a thorough validation of the transactions and the contents, as a whole, on a logical plane. Care should be taken that the information is processed after ensuring the correctness of the data in terms of the time and the number of documents, and the transactions in the period. The data should be checked against the master data wherever possible and the balance should be controlled through logical processing by using rules, formulae, the principles, etc., which will ascertain the correctness of the data.

The measures of system auditing, the use of the test data and conducting a physical audit of the record versus the reality would help considerably to control the errors arising out of wrong processing.

### Parameters Impacting Quality

The parameters of good quality are difficult to determine, however, the information can be termed as of a good quality if it meets the norms of impartiality, validity, reliability, consistency and age. The quality of information has another dimension of utility from the user's point of view. The users being many, this is difficult to control. Therefore, if one can develop information with due regards to these parameters, one can easily control the outgoing quality of the information with the probable exception of the satisfaction at the user's end.

### ***Impartiality***

An impartial information contains no bias and has been collected without any distorted view of the situation. The partiality creeps in, if the data is collected with a preconceived view, a prejudice, and a pre-determined objective or a certain motive.

### ***Validity***

The validity of the information relates to the purpose of the information. In other words, it is the answer to the question—does the information meet the purpose of decision-making for which it is being collected?

The validity also depends on how the information is used. Since the information and the purpose need not have one to one correspondence, the tendency to use it in a particular situation may make the information invalid. For example, if the quality of the manufactured product is deteriorating and it is decided to select the causes of poor quality, then one must collect all the possible causes which may affect the quality. Quality is a function of the raw material, the process of manufacture, the tools applied, the measures of the quality assessment, the attitude of the people towards the control of quality. However, if the information collected talks only about raw material and the process of manufacture, then this information is not sufficient and hence it is not valid for all the decisions which are required to control the quality.

### ***Reliability***

It is connected to the representation and the accuracy of what is being described. For example, if the organisation collects the information on the product acceptance in the selected market segment, the size of the sample and the method of selection of the sample will decide the reliability. If the sample is small, the information may not give the correct and a complete picture and hence it is not reliable. The reliability is also affected, if the data is not collected from the right source.

### ***Consistency***

The information is termed as inconsistent if it is derived from a data which does not have consistent pattern of period. Somewhere, the information must relate to a consistent base or a pattern.

For example, you have collected the information on the quantity of production for the last twelve months to fix the production norms. If in this twelve months period, the factory has worked with variable shift production, the production statistics of the twelve months for comparison is inconsistent due to the variable shift production. The consistency can be brought in by rationalising the data to per shift production per month. The regularity in providing the information also helps in assessing the consistency in the information.

### ***Age***

If the information is old, it is not useful today. The currency of the information makes all the difference to the users. If the information is old then it does not meet any characteristics of the information viz., the update of knowledge, the element of surprise and the reduction of uncertainty, and the representation.

Maintaining these parameters at a high degree always poses a number of problems. These problems are in the management of the operations, the sources, the data processing and the systems in the organisation. A failure to maintain the parameters to a high degree affects the value of the information to the decision maker.

### 7.3 CLASSIFICATION OF THE INFORMATION

The information can be classified in a number of ways provide a better understanding.

John Dearden of Harvard University classifies information in the following manner:

#### **Action Versus No-action Information**

The information which induces action is called an **action information**. The information which communicates only the status of a situation is a **no-action information**. 'No stock' report calling a purchase action is an action information but the stock ledger showing the store transactions and the stock balances is a No-action information.

#### **Recurring Versus Non-recurring Information**

The information generated at regular intervals is a **recurring information**. The monthly sales reports, the stock statements, the trial balance, etc. are recurring information. The financial analysis or the report on the market research study is a non-recurring information.

#### **Internal Versus External Information**

The information generated through the internal sources of the organisation is termed as an **internal information**, while the information generated through the Government reports, the industry surveys, etc. is termed as an **external information**, as the sources of the data are outside the organisation.

The action information, the recurring information and the internal information are the prime areas for computerisation and they contribute qualitatively to the MIS.

The timing and accuracy of the action information is usually important. The mix of the internal and the external information changes, depending on the level of the management decisions. At the top management level, the stress is more on the external information and at the operational and the middle management level, the stress is more on the internal information. Figure 7.2 shows the source and kind of information required vis-à-vis levels of management in the organisation.

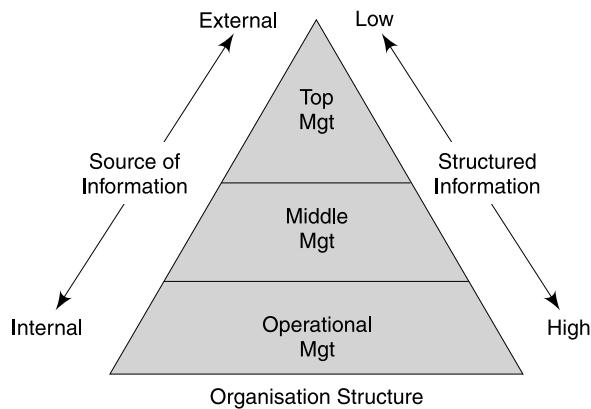
The information can also be classified as under, in terms of its application.

#### **Planning Information**

Certain standards, norms and specifications are used in the planning of any activity. Hence, such information is called the **planning information**. The time standards, the operational standards, the design standards are the examples of the Planning Information.

#### **Control Information**

Reporting the status of an activity through a feedback mechanism is called the **control information**. When such information shows a deviation from the goal or the objective, it will induce a decision or an action leading to control.

**Fig. 7.2** *Organisation and Information*

### *Knowledge*

A collection of information through the library reports and the research studies builds a knowledge base as a source for decision-making. Such a collection is not directly connected to decision-making, but the need of knowledge is perceived as a power or a strength of the organisation. A organisation data warehouse stores knowledg.

The information can also be classified based on its usage. When the information is used by everybody in the organisation, it is called the **organisation information**. When the information has a multiple use and application, it is called the **database information**. When the information is used in the operations of a business it is called the **functional** or the **operational information**.

Employee and pay-roll information is organisation information used by number of people in a number of ways. The material specifications, or the supplier information is database information stored for multiple users. Such information may need security or an access control. Information like sales, or production statistics is functional, meeting the operational needs of these functions.

## 7.4 METHODS OF DATA AND INFORMATION COLLECTION

Several methods are available for the collection of data. The choice of method will have an impact on the quality of information. Simillary the design of data collection method also decides the quality of data and information. The methods of data collection and processing become a part of the MIS. The various methods of data collection are explained in Table 7.5.

An awareness of these methods is essential to the manager. Further, he should also understand the potential problems of bias, currency, the fact versus the opinion in the various types of methods. The observation, the experiment, the survey and the subjective estimation are the methods chosen for data collection and information about a specific problem, while the remaining methods are chosen to collect data on a routine basis.

**Table 7.5** The Methods of Data and Information Collection

<i>Method</i>	<i>Comment</i>	<i>Example</i>
Observation	The first hand knowledge avoids a response bias. An accuracy of observation will decide the response. It is dependent on the observer and is influenced by the bias.	Visit to the customer for assessing the customer complaints. A visit to assess the accidental damage.
Experiment	The information on a specific parameter can be obtained through a control over variables. The quality of information depends on the design of the experiment.	Assessing the yield of a new fertiliser by a design of the control experiment. Assessing the market response to a new packaging through test marketing.
Survey	One time. Enables to cover the interested population on specific aspects. The quality of questionnaire will decide the quality of information.	Market survey, opinion polls, census.
Subjective estimation	In the absence of all the three above, the expert opinions may be called to collect the information.	Data pertaining to future like the alternate source of energy, the life style in the 21st century.
Transaction Processing Purchased from outside	The data exists but needs a processing and an integration for reporting. Easily available at a price. May be expensive and may have a bias depending on the source.	Ledgers, payroll, stock statements, sales reports. Database on the specific subject, research studies. Market and technology studies.
Publications	Low cost but may project or emphasise one view or the other. Information may be lopsided.	The government publications, the industry publications, the institutional publications such as NCL, NCRT, BANKS, UNO, the various public forums.
Government agencies	Available but may not be directly useful not knowing the details of collection analysis and is usually not the latest.	The Reserve Bank of India publications. The Tax publications, the reports and findings.

## 7.5 VALUE OF THE INFORMATION

The decision theory suggests the methods of solving the problems of decision-making under certainty, risk and uncertainty. A decision-making situation is of certainty when the decision maker has full knowledge about the alternatives and its outcomes. This is possible when perfect information is available. Therefore, the information has a perceived value in terms of decision-making. The decision-maker feels more secured when additional information is received in case of decision-making under an uncertainty or a risk. The information is called a perfect information, if it wipes out uncertainty or risk completely. However, a perfect information is a myth.

The decision theory stipulates that the value of the additional information is the value of the change in the decision behaviour resulted by the information, less the cost of obtaining the information. If the additional information does not cause any change in the decision

behaviour then the value of the additional information is zero. The value of the additional information making the existing information perfect (VPI) is:

$$\text{VPI} = (V_2 - V_1) - (C_2 - C_1)$$

where  $V$  is the value of the information and  $C$  is the cost of obtaining the information.  $V_1$  and  $C_1$  relate to one set of information and  $V_2, C_2$  relate to the new set. If the VPI is very high, then it is beneficial to serve the additional information need.

A manager is faced with the problem of decision-making under uncertainty or risk conditions, if he does not know the perfect information about the decision situation. Further, his ability to generate decision alternatives owing to the imperfect information of the situation, is limited. In other words, given a set of possible decisions, a decision maker will select one on the basis of the available information. If the new information causes a change in the decision, then the value of the new information is the difference in the value between the outcome of the old decision and that of new decision, less the cost of obtaining the new information.

It may be noted that the information has a value only to those who have the capability to use it in a decision. The experienced manager generally uses the information most effectively but he may need less information as experience has already reduced uncertainty for him, when compared to a less experienced manager.

In MIS, the concept of the value of information is used to find out the benefit of a perfect information and if the value is significantly high, the system should provide it. If the value is insignificant, it would not be worth collecting the additional information. The decision at the operational and the middle management level are such that the value of the additional or new information is low, while at the higher levels of the management, the decision being mainly strategic and tactical in nature, the value of additional information is very high.

Apart from the monetary value of information, it has a value which is to be measured as a strength in promoting the functions of the management. Some information have the strength of motivating the manager to think in futuristic terms. Some information has the strength of confirming the beliefs or understanding the business process. It also reinforces the right and wrong of a decision-making process that the manager is following.

## 7.6 GENERAL MODEL OF A HUMAN AS AN INFORMATION PROCESSOR

A manager or a decision maker uses his sensory receptors, normally eyes and ears, to pick up information and transmit them to brain for processing and storage. The result of this processing will be a response which may be a decision, an action or at least a recognition of the event for future use. Hence, a manager can be said to be an information processor.

While processing the information for a managerial response, the manager also uses accumulated knowledge from memory. The capacity of a manager to accept and process inputs to produce output is variable and limited. That is why it is observed that all the managers of the same level do not accept or absorb all the inputs which the information may provide. The limitation arises sometimes on account of the information overload which is external to the manager. This is a case of too much information or extra information creating a problem for the user of the information to sort out the relevant from the irrelevant or the appropriate from the inappropriate. The manager in such a situation adopts the method of filtering the information.

Filtering is a process whereby a manager selectively accepts that much inputs, which his mental ability can manage to process. The methods of filtering, which the information processor adopts, are mentioned in the Table 7.6.

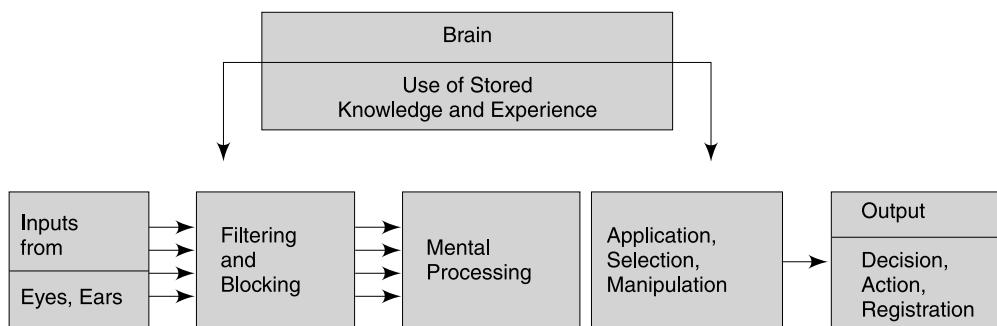
**Table 7.6** Methods of Filtering

Method	Example	Comment
The frame of reference by using knowledge and experience.	Period, products, market segments, decision rules or procedures.	Ignore the past data, consider only some products. Select only the relevant market segments. Select only that data whereby a specific decision rule can be applied.
Universally acclaimed normal decision procedure. Select data base on proven methods.	Break even analysis, methods of fixing inventory levels. Pricing, introduction of a new product, selection of technology. Critical decisions.	Ignore the intangible factors. Ignore the demand variation. Consider only the important factors affecting the decision. Use of the known decision models.

The filtering process blocks the unwanted or the inconsistent data or the data which does not match the frame of reference. An inexperienced manager or a less knowledgeable manager through filtering may omit data, distort data responses and, therefore, may draw incorrect inferences.

The information processor establishes the filters based on experience, knowledge and know-how. The choice of filters may be changed due to stress, urgency of decision-making and the confidence in a particular method of decision-making. Many a times a processor is required to perceive, process and evaluate probabilistic information. The processor may be deficient in the intuitive understanding of the information, in the ability to identify the correlation and the causality, and in the capability for integrating the information.

An experienced manager is a skillful information processor where he is able to change the frame of reference or select the decision-making tool for the available information. He is also in a position to add more knowledge to the current information to increase the value of the information. A generalised model of information processor is shown in Fig. 7.3



**Fig. 7.3** Generalised Model of Information Processor

### **Manager's Individual Differences**

The managers may come to same decision in a given situation but they may not follow the same decision process. This is because of the cognitive style of each manager. Each manager has his own style, a method to perceive the data, organise and process the same as per his frame of reference, confidence in the decision procedures and the time available for the decision-making. The managerial ability, skills and tools play a considerable role in the cognitive style of the manager. These styles affect the information system design and the satisfaction of the manager. An excellent review of a research on the individual differences and the MIS can be found in Zmud, "Individual differences and the MIS success," *Management Science*, October 25, 1979. The reasons of individual differences are given in Table 7.7.

## **7.7 SUMMARY OF INFORMATION CONCEPTS AND THEIR IMPLICATIONS**

Understanding of information concepts is very important and relevant to the system designer and the information user. The concepts are summarised as follows.

### ***Filtering***

The system designer should provide an appropriate filtering mechanism so that the information is not suppressed and relates to the frame of reference of the user. Care should be taken in the process that certain valid information does not get blocked or over emphasised. A filtering process is used to select and suppress the information.

### ***Simon Model and its Application***

The designer should attempt to provide such information that it clearly defines the problem space and also take cognisance of the user's knowledge. The design of the system should be such that an appropriate mix of these sources should yield a decision, leading to a solution of the problem.

### ***Codes and Representation***

The system designer should evolve such coding system that is easy for the users of the code to interpret. Secondly, the designer should report the data in such a manner that the user can grasp it quickly.

### ***Highlighting***

The designer should provide the information in such a way that the significant differences between the targets and the achievements, the standards and performance, the budgets and the actuals, are highlighted, so that they become easily noticeable by the user without search.

### ***Statistical Analysis***

The designer should provide the information in such a way that the information not only represents something meaningfully but also aids in the statistical analysis by the user. The information should provide the additional results such as variance, correlation, coefficients, and futuristic estimates and give a measure of statistical significance for the user to consider during decision-making.

**Table 7.7** Reasons of Individual Differences

<i>Individual differences</i>	<i>Explanation</i>	<i>Effect on information processing</i>	<i>Examples</i>
Locus of control inter or external to the situation.	The degree of perception in assessing the control which is internal to the organisation or external to the organisation.	More information gathering and analysis, if internal.	The production deering decisions, selection of tools and materials etc.
Personal dogmatism.	The degree of faith in beliefs, opinions and past experience.	Low dogmatism, then more information collection and processing	The pricing, advertising in a competitive environment.
Risk propensity.	The ability to take the risk.	If Higher, then less information need of tools and technology.	The top management decision-making in a strategic planning.
Tolerance for ambiguity.	Level of clarity required in the information. The ability to read through the information	Tight tolerance then more information collection and analysis	Manager Constantly asking for more information.
Manipulative intelligence.	The ability to manipulate the data and information vis-à-vis the stored information and knowledge.	High ability, then less information and more self analysis.	Experienced and skill ful managers rely on the manipulative intelligence.
Experience in decision-making.	Extent of experience at particular level of decision making.	High, then correct filtering of data and appropriate choice of decision making process.	The managers with a wide experience in the different fields of management call for precise and less but pertinent information.
Knowledge of the task, tools and technology.	The extent of knowledge in the application of the tools and technology.	Higher, then less difference of relevant to technology and tools, information	The Technocrats scientists, and managers of technology have definite information needs based on tools, models, methods used for decision making.
The management level from lower to higher.	The nature of management decisions differ from lower to higher level.	Higher, then the unstructured information different analysis, and the use of the new decision models. Factual information at lower level.	The top management decisions regarding expansion, and diversification and the strategic business decisions.

(Source: MIS by Gordon B Davis and Margrethe H. Olson by McGraw-Hill duly modified.)

### ***Format***

The designe should present the information in the form or format which is complete in all respects and in which all data is processed as per the frame of reference of the user. The user should not be required to do additional processing with other data set through the computer systems or mentally by using the data set from the memory.

### ***Referencing and Adjustment***

The designer should evolve a system in such a way that it covers the valid system boundaries and provides a reference to an acceptable point (the year, the product, the norm, the standard, the knowledge), giving a facility to make an adjustment to results or status which the information provides.

### ***Cognitive Style***

Each user has his own style of resolving or reconciling his internal view and an understanding of the problems or environment versus the actually perceived or seen or as it exists. In line with his individual style, he also evolves a process of the decision making which is personal to him. The designer of the system should provide the information in such a manner that these individual styles are accommodated fully.

### ***Learning Theory***

The designer should appreciate that the user inadvertently is learning through the information and is building his knowledge set. Hence the information should be such that the user is not overloaded with the supply of information which is already known to him.

### ***Feedback Loop***

The designer should provide the information feedback loop, so that the user understands that the process of decision implementation is smooth and the results are evaluated with reference to the norms or the expectations, giving the user a sufficient motivation to change, amend or act.

### ***Perceived Value of Data***

Some data or information may not have a value or an importance in the current operations of the business. But same data or information may have a value in context of further requirements. The designer would keep this data out of the current processing and reporting. However, the designer should provide a system whereby user can have access to this unused data, if required.

### ***Information Absorption***

The designer should provide only that amount of information which the user is able to grasp and use. Any additional information, beyond the ability of the user's absorption, will be ignored or go unnoticed without any response.

### ***Individual Differences***

The information needs of different managers will differ based on individual's sets and processing ability and cognitive style. The designer should support all such needs effectively by making the separate information reports.

The concepts discussed here are very important and the system designer should take care of them while designing the data gathering and processing systems. The proper incorporation of these concepts while designing the MIS would call for a thorough understanding of the business environment, the management process, the strengths and weaknesses of the organisation, the abilities of the management in planning and decision making, the organisation structure and the individual differences of the managers and their cognitive styles of solving the problem.

The system designer has several choices of designs starting from a rigid system design meeting the individual preferences to a flexible design, meeting all the needs together. The risk of choosing a design from the extreme ends is very high, but at the same time designing a system which considers the best of both ends is complex.

The system designer's managerial ability of the MIS development and a good relationship with the users of the information will help him steer through the system development task.

## 7.8 KNOWLEDGE AND KNOWLEDGE MANAGEMENT SYSTEMS

Among the innovations TQM, BPR, enterprise management and competence based strategy that have made impact on the world of management and more particularly on business management in last decade, knowledge and its management assumes the highest position and aroused the greatest interest. Application of knowledge management (KM) extends to strategic management of business starting from lowest operations management to high level business functions.

Knowledge is a set of information which provides capability to understand different situations, enables to anticipate implications and judge their effects, suggests ways or clues to handle the situations

Before we go further, let us understand the word knowledge which is distinctly different from 'Information' and 'Data'. Organised data with context and focus is Information. Information evokes mental response and may motivate a person to perform. Knowledge is not an advanced stage of information and nor it is a wisdom. Knowledge is a capability to handle a complex situation. More the knowledge, higher is the capability. It is made of mental models, scripts and schemas including linkages to concepts and meta-concepts and operational and behavioural patterns. Knowledge driven capability has three components: Visualisation of strategic options to handle complex situation, anticipation and assessment of its results and forecasting its effects in terms of benefits, cost, losses and damages. Wisdom represents decisive ability to decide whether 'Knowledge' is truly applicable to resolve a complex problem situation.

The differentiation between data, information and knowledge is best illustrated by following example.

- Rainfall record collected every day is a 'Data'
- When data this data is processed by region and month, it is an 'Information'.
- When this information is analysed using analytical tools, it reveals rainfall pattern. This pattern is 'Knowledge'.

- When this knowledge is processed taking other relevant variables and information to build a forecasting model to predict the rainfall, the model is a Knowledge asset. This model is built by Dr. Govarikar and is an acknowledged 'Intellectual Capital' of Meteorological lab of India.

Knowledge is of three types, explicit, tacit and intellectual. Explicit knowledge is the one which can be codified and/or modelled. Software products are packaging explicit knowledge. Tacit knowledge is intangible and can not be codified. The consultants and experts possess tacit knowledge. Intellectual knowledge could be tacit or explicit and is owned by some body. It is also termed as intellectual asset or capital. IC is made out of leveraging on personal understanding of organisation's action capabilities and use of other intellectual assets. Further knowledge is not a static entity. It improves changes and also obsoletes after some time. In a new business scenario knowledge plays a key role in management. In contrast with previous periods of economic development, the primary factor of production in today's economy is knowledge as against to capital and labour. In terms of inputs, the primary assets of the business are intangibles such as technology, brand, capabilities rather than land, machines, inventories and financial assets. In terms of outputs the shift is from 'manufacturing of goods' to 'delivery of services' where goods not only meet basic needs of customer but also fulfils other expectations - quality, delivery, support and continuous value addition.

There is a shift in business management paradigm. It is no longer only a management of resources of the organisation but also that of business partners who are in the organisation's network. It is also affected by the pace of change. The change is rapid, innovating and path breaking. The product life cycles are shorter and organisations must improvise products and services to remain competitive.

To manage this shift, knowledge is the key resource of the organisation and workplace. Due to this critical importance of knowledge, business economy is termed as Knowledge Economy.

### **Knowledge Management**

Knowledge management is the systematic and explicit management of knowledge related activities, practices, programs and policies within enterprises to create a vital knowledge share it with others and improve continuously its content and quality. Knowledge management comprehensive strategy is to focus on three perspectives of business operational, tactical and strategic.

Knowledge management dispels some myths which must be mentioned for correction.

- 'KM initiatives and activities lead to more work'. Instead, improved knowledge and its use enhance competitive ability of organisation with less work and rework.
- 'KM, initiatives and activities, is an additional function'. Instead, it is an extension to existing technology driven information management function.
- 'People are often afraid to share their knowledge'. Instead, such fear is unwarranted as most people enjoy sharing as they tend to be considered important in the community, and gain status and recognition.

To be competitive, proactive business organisation must increasingly manage knowledge systematically through knowledge management. KM activities and functions are implicit in

each employee's and departments daily work. Organisation will continue to be motivated by several end goals and evolve strategies to achieve them. In this endeavour, KM objective is to develop the best available knowledge (Explicit, Tacit and ICs) to make people and enterprise capable as a whole to act effectively to implement various strategies.

### Driving Forces Behind KM

The emergence of KM is a result of many forces. In today's business world KM is not an alternative or luxury, but is a necessity due to demand of customer centric business initiatives. The forces which drive KM are external and internal.

#### *External Forces*

Business organisations perform in environments that they can not control. Their success depends on how they deal with these forces and still grow. The more impacting forces in external environment are following.

- **Globalisation of business:** With loosening of trade barriers and advances in Internet/Web technology, business operates beyond the local and national boundaries. It has a bigger market to tap and more sources and resources to bank upon. The immediate impact is business organisation finds itself in stiff competition.
- **Demanding customers:** Customers have easy access to information about product and services, and are now more knowledgeable to demand more value at least cost. Customers drive your business by demanding higher quality, new features, quick response and door delivery.
- **Innovative competitors:** Competition is no longer limited to quality and cost but extended to providing value adding new features using technologies and best practices.
- **Resourceful vendors:** Vendors continue to increase their capabilities by use of technologies, innovative product features and better logistics.

These external forces together demand business organisation to be more effective in business operations, be more knowledgeable on customer needs, be always in learning mode to remain competitive and get into collaborative partnership arrangements with resourceful vendors.

#### *Internal Forces*

Like forces in external environment, there are forces internal to organisation which impact business operations. To control negative impact of these forces knowledge initiatives are necessary

- **Bottlenecks in effectiveness:** Organisations have implemented various management and technology strategies to remove bottlenecks in workflow and processes. Bottlenecks are no more physical but intangible, namely capability of anticipating the change in market and environment requiring proactive action to deal with it.
- **Technological Capabilities:** Business operations need technology implementation to bring in efficiency and effectiveness. Today business operates through collaborative work, high end information management and technology and use of advanced search

engines for information search. All this put together is an organisation's technological capability.

- **Understanding of human cognitive functions:** People and organisation behaviour affects effectiveness of the business enterprise. Knowledge about people, in terms of understanding mental models and associations affecting decision making is essential. KM initiative is the result of this requirement.

These forces require organisation to work with knowledge, calling for formal implementation of KM with initiatives on number of technology fronts, behaviour and information management. The cutting edge for business operations is HR capability to anticipate, assess and act before competition moves in. To build such capability, KM is necessary for development and application of tacit, explicit and embedded knowledge (IC).

### ***Changing workplace***

Once KM initiatives are in, it would affect the workplace scenario drastically. Visible changes are extensive use of technology, networks, supply chain, collaborative work culture and so on. Visible changes, but more importantly, affecting the people side of the business are following:

- Configuring interdisciplinary teams for better mix of competencies.
- Work completion needs more application of conceptual knowledge.
- Work completion needs more collaboration and co-ordination between people in a network.
- People show more understanding and involvement in the work due to increased understanding of personal benefits.
- More reliance on models, search engines, embedded decision support systems and knowledge sharing.

As a result, the people in workplace would experience less physical work, more intellectual work, increased dependence on others and collaborative relation among participants.

### **Key Aspects of Knowledge Management**

There are four key aspects of knowledge management which are of importance.

- **Accelerating knowledge creation and application:** In competitive global business economy knowledge is not static it changes dynamically. Obsolescence is its character. Its application also changes. To meet this challenge searching new knowledge and developing knowledge based capabilities to remain ahead in business is a prime need. KM systems are designed for rapid search, formulate and model the knowledge.
- **Converting tacit into explicit knowledge:** Tacit knowledge is intangible, distributed and possessed by individual employees. KM converts tacit knowledge into explicit through coding, modelling, putting into manuals for acquisition and guidance to the HR. After conversion to explicit knowledge, it is integrated into processes and systems which deliver goods and services to customer.
- **Build knowledge Assets-IC:** Some of the knowledge bodies are so strategically important for organisation's business that they need to be protected taking legal recourse, such as patent, trademarks and rights to use.

In summary, KM involves knowledge generation through creation and acquisition and knowledge application through integration, pooling, replication, storage and identification.

### Designing for Business Benefits from KM

The trend in knowledge economy is to use KM for business benefit by designing products, services and process which deliver them. The processes which are largely benefited by KM are the feeder process which contributes to the efficiency and effectiveness of core process like manufacturing, purchasing, delivery and so on. The organisations which treat 'knowledge' as key resource are likely to be benefited most. The KM processes are generation and storage of knowledge, identification and exploitation of knowledge, and generation and application of knowledge delivery strategies.

These processes put together create organisation which is knowledge competent. It is important to note that there are barriers in this process of KM. The biggest barrier is people who suffer from inertia to change, lack of motivation, difficulties in transferring knowledge to new people and so on. The next barrier is management itself, afraid of giving power (knowledge) and sharing power (knowledge) with others. Knowledge management process also suffers from structural barriers namely fragmented organisation functional systems and reluctance to change traditional systems. KM processes are executed through various methods and tools. They are traditional database tools, process modelling tools, work flow/work group management tools, search engines and navigation tools, visualisation tools and collaborative tools. Using these tools, KM manages knowledge related activities, processes and policies within the enterprise; KM ensures the organisation viability through building competitive quality of its knowledge assets and applying them in all its operational, management and strategic activities.

## 7.9 BUSINESS INTELLIGENCE

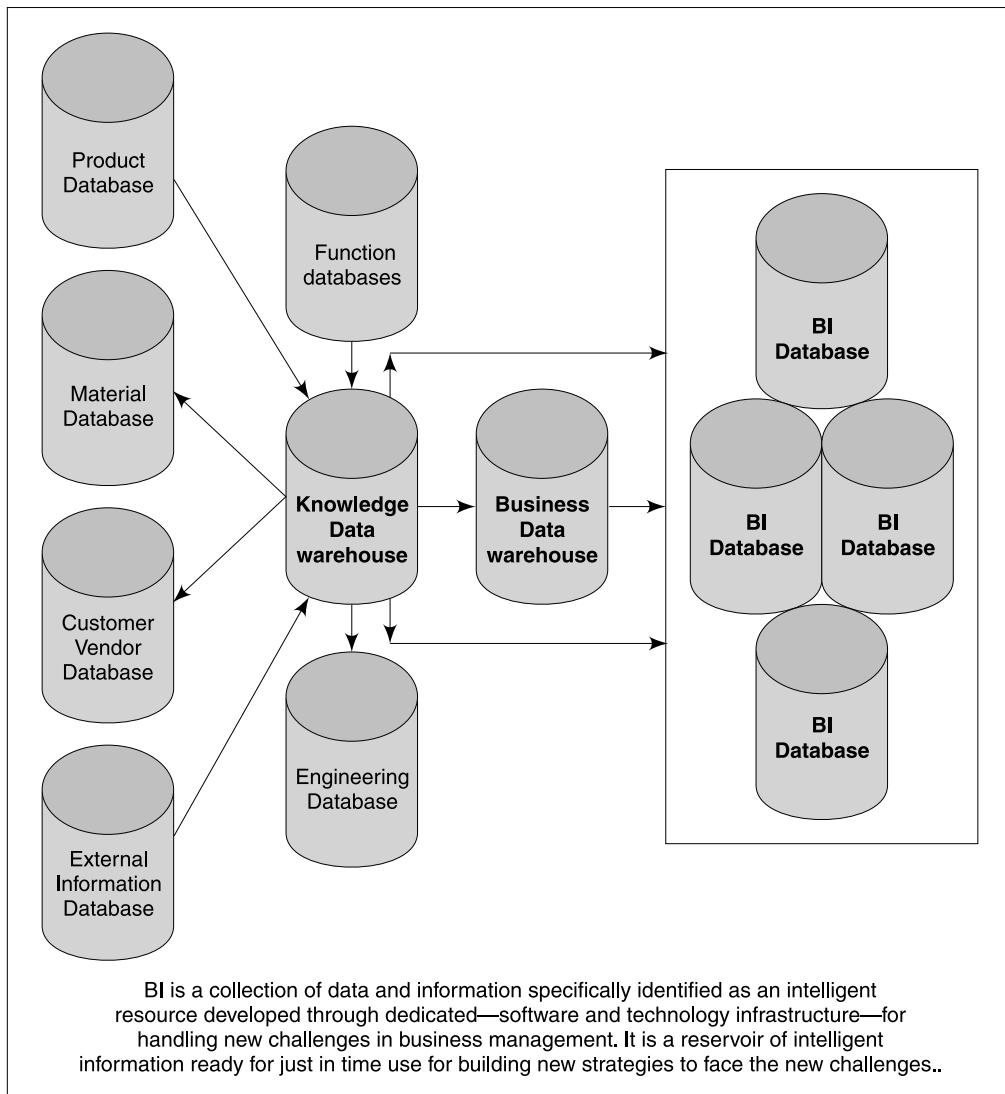
Business intelligence is a term that refers to the sum total of gathering and processing data, building rich and relevant information and maintains it live and up to a date. Organizations leverage on business intelligence to develop strategies and use it to put strategy into operations. BI is used for timely, effective decisions and better plans for the future. Business Intelligence (BI) is a terminology representing a collection of processes, tools and technologies helpful in achieving more profit by considerably improving the productivity of an enterprise and its people.

BI is an outcome of turning a raw data into intelligent information by analysing and rearranging the data according to the relationships between the data items by knowing what data to collect and manage and in what context

Business Intelligence definition and concept encompasses following things.

- *Technology and software infrastructure:* An enabler to capture and process the Data, Information, Knowledge.
- *Data bases, data warehouses:* Storing the data of current and future relevance from decision making view point.
- Develops and maintains knowledge data bases for all core functions and for business at large.

Business intelligence is a conglomerate of technology structure and of information and knowledge developed and maintained to support the decision making in all together new area of concern and in the case of a new situation. Figure 7.4 shows the difference between data, knowledge and business intelligence.



**Fig. 7.4 Data, Information and Knowledge, Business Intelligence**

Business intelligence is developed by putting different, but close context information sets, together to detect or forecast events and bring to surface certain issues. It relies on explora-

tion and analysis of seemingly unrelated information to provide insights, identify trends, discover opportunities, and take proactive decisions. In a crisis, the BI is available for ready to use supports in building new strategies to overcome the crisis. BI is built keeping a long term perspective of business needs of growth and direction. Information and knowledge are built to handle current and near future problems.

Business Intelligence is all about converting large amounts of corporate data into useful information, thereby triggering some profitable business action with the help of knowledge acquired through BI analysis.

A typical BI environment involves business models, data models, data sources,

ETL(Extraction, Transformation & Loading) tools needed to transform and organise the data into useful information in the data warehouse, data marts. OLAP analysis and **reporting tools are used on data warehouse for finding useful information.**

## 7.10 MIS, AND THE INFORMATION AND KNOWLEDGE

The goal of the MIS should be to provide the information which has a surprise value and which reduces the uncertainty. It should simultaneously build the knowledge base in the organisation by processing the data obtained from different sources in different ways. The designer of the MIS should take care of the data problems knowing that it may contain bias and error by introduction of high level validations, checking and controlling the procedures in the manual and computerised systems. While designing the MIS, due regard should be given to the communication theory of transmitting the information from the source to the destination.

A special care should be taken to handle a noise and a distortion on the way to destination. The presentation of information plays a significant role in controlling the noise and distortion which might interrupt, while communicating information to the various destinations. The principles of summarisation and classification should be carefully applied giving regard to the levels of management. Care should be taken in the process that no information is suppressed or overemphasised.

The utility of information increases if the MIS ensures that the information processes the necessary attributes. The redundancy of the data and the information is inevitable on a limited scale. MIS should use the redundancy as a measure to control the error in communication.

The information is a quality product for the organisation. The quality of information as an outgoing product can be measured on four dimensions, viz., the utility, the satisfaction, the error and the bias. The MIS should provide specific attention to these quality parameters. A failure to do so would result in a wasteful expenditure in the development of the MIS and poor usage of investment in hardware and software.

The quality can be ensured if the inputs to the MIS are controlled on the factors of impartiality, validity, reliability, consistency and age.

MIS should make a distinction between the different kinds of information for the purpose of communication. An action, a decision-oriented information should be distinguished from a no-action/knowledge-oriented information. The information could be of recurring type or an ad hoc type. The MIS also needs to give regard to the information used for planning,

performance control, and knowledge database. A distinction between these factors will help make the decisions of communications, storage and also the frequency of reporting.

Since the decision maker is a human, it requires to recognise some aspects of human capabilities in the MIS design. These human capabilities differ from manager to manager and the designer has to skillfully deal with them. The differences in the capabilities arise an account of the perception in assessing the locus of the management control, the faith and the confidence in the information versus knowledge, the risk propensity, the tolerance for ambiguity, the manipulative intelligence, the experience in decision-making and the management style.

The MIS design should be such that it meets the needs of the total organisation. For design considerations and for the operational convenience, the organisation is divided into four levels, viz., the top, the middle, the supervisory and the operational. The top management uses the MIS for goal-setting and strategic planning, key information of a higher degree of accuracy and requires. As against this, the lowest level management and the operational management uses the MIS to know the status by calling information of the current period in detail where the perceived value of information is the lowest and it usually insists on getting the information in a fixed format.

The MIS design, therefore, should ensure the input data quality by controlling the data for the factors, viz. impartiality, validity, reliability, consistency and age. The data processing and the decision-making routines should be developed in such a manner that the data is processed after thorough validation and checking, and the analysis thereof is further reported to the various levels and individuals with due regard to the differences in the individual management style and human capabilities.

Recognising that the information may be misused if it falls into wrong hands, the MIS design should have the features of filtering, blocking, suppressions and delayed delivery.

Since, the MIS satisfies the information needs of the people in a particular organisation, the design of the MIS cannot be common or universal for all the organisations. The principles of design and the use of the information concepts in design does not change but when it comes to the applications, the design has to give a regard to the organisation structure, the culture, the attitudes and the beliefs of the people and the strengths and the weaknesses of the organisation.

MIS till the end of nineties played a role of providing information to organisations for decision-making. With a size in competition, organisations that used MIS for driving the business, did better vis-à-vis competition. With globalisation of business, and internet and web technology making in-roads in business operations, work culture in the organisation changed rapidly. The traditional business model 'Make and Sale' changed to 'Sense and Respond' as customer became more knowledgeable and started demanding more and more requirements. In other words, business became customer centric and organisations must sense customer expectations well in advance and fulfill them to survive and grow. For sense and respond model only information is not adequate what is required is a knowledge, an ability to forecast the probable expectations of the customers and sense them in terms of time, and convert them into deliverables of perceived value by the customer.

Modern MIS not only should provide information but also support management by providing knowledge necessary at all levels for critical decisions. A knowledge generating knowledge management system (KMS) is now a part of MIS suite. In E-business, world organisation

has to be knowledge driven. At this point it is necessary to understand the difference between information and knowledge.

Knowledge is a result of putting different information sets together and analysing them, and viewing them in particular manner. Information has a 'surprise value' while knowledge provides a vision to solve the problem or understand the upcoming scenario.

Data processing, transaction processing, application processing systems will give different information sets. KMS on processing these information sets, first will give an explicit knowledge. Further application of the explicit knowledge over a period to solve the problem creates a tacit knowledge.

An organisation, which uses knowledge for business operations and gains competitive advantage, becomes a learning, agile organisation.

The information concepts are shown in relation to the organisation pyramid in the Fig. 7.5. It explains, with reference to the level of management, the use of the MIS, the value of information, the nature of information and its reporting.

**Fig. 7.5** *Organisation Pyramid and Information Concepts*

## KEY TERMS

Information and Knowledge  
Attributes of Information  
Recurring vs Non-recurring  
Value of Information  
Learning Ability  
Knowledge Management System

Noise and Distortion  
Action vs No-action Information  
Internal vs. External Information  
Cognitive Style of Information user  
Tacit and Explicit Knowledge  
Data, Metadata, Information and Knowledge

## REVIEW QUESTIONS

1. Since your school days, you have purchased number of books and your home library has over two hundred books. Would you call this awareness of yours as a data or information? How would you convert this awareness into information?
2. Explain why information has no specification but it has a character and value.
3. Can value of information be improved? Can information have a value which is person independent?
4. Explain the difference between data processing and information processing.
5. What is information overload? How does it occur? and how would you control it?
6. The trend now is to improve data quality, increase storage and offer distributed access; and leave the processing of data to the user of the information. Why?
7. The character and value of information is linked to the people in the organisation and to the management process in the organisation. Explain.
8. Explain how quality of information improves the knowledge and decision-making capability of the people.
9. Is it worth to invest for obtaining perfect information? Is it possible to specify the perfect information?
10. Take up a project in a known organisation and identify the information in following classes:
  - Organisational,
  - Strategic,
  - Planning, and
  - Control
11. Explain how knowledge gives a competitive advantage to the organisation.
12. Knowledge is a generic word and you have understood it well. Identify and distinguish between information and knowledge in following cases:
  - Customer: Information and Knowledge
  - Vendor: Information and Knowledge
  - Machining: Information and Knowledge
  - Product: Information and Knowledge

13. Suggest the information attributes of the following entities which raises the basic value of information.
- Product Sale
  - Sales Representative
  - Market Segment
  - Machine Centre
  - Vendor
  - Subcontractor
14. In following Organisation, identify 'Action-Vs-No-action' information and 'Recurring-Vs-Non Recurring' information at operational level.
- Bank branch
  - Life Insurance Corporation of India (LIC)
  - Multipurpose Fabrication Shop
  - Distributor of Passenger Car
  - Chain of Grocery Stores
  - Airlines Travel Agent
15. Explain the impact of training of human resource and how a trained and professional human resource will be a better user of MIS.
16. Suggest a model of information presentation, which raised its value, and would evoke an action response from the user. Suggest report formats and graphics.
- Shop floor rejection by product, process and defect.
  - Order analysis: 'Received – In pipeline – Processed – Not delivered. Delivered – Billed – Paid.
  - Daily attendance: By Department – Time in and out – Present – Absent.
  - Competitive Analysis: Sales by month – New products – Competiting products.
17. Identify key information and knowledge in following cases:
- Hospital out patient department (OPD)
  - Machine shop
  - Claim settlement office of vehicle insurance.
  - Deluxe Hotel
  - Car distributor

## **CONFIRM YOUR UNDERSTANDING**

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1. Information has a \_\_\_\_\_ value which evokes a sudden response.
2. Knowledge has a capability value and evokes an action/ \_\_\_\_\_ response.
3. Most important attributes of information are its \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ for decision-making.
4. Value of information is high if it provokes \_\_\_\_\_ in decision making \_\_\_\_\_.
5. Cognitive style is \_\_\_\_\_ and \_\_\_\_\_ of a decision maker to reconcile his view and understanding based on information with the real situation.
6. Learning ability is the ability to build \_\_\_\_\_ out of \_\_\_\_\_.
7. Cognitive style and learning ability differences create \_\_\_\_\_ needs of information with difference in it \_\_\_\_\_.
8. Knowledge is the ability of a person to \_\_\_\_\_ \_\_\_\_\_ and understand the situation to react effectively.
9. Tacit knowledge cannot be \_\_\_\_\_ but can be shared with great difficulty. Explicit knowledge can be \_\_\_\_\_ and can be \_\_\_\_\_ easily.
10. Quality parameters of information are \_\_\_\_\_, Reliability, \_\_\_\_\_ and Age.

 CASE STUDY

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## 1. KILLICKS KULKARNI COMBINE (KKC)

*(Information Management)*

The Killicks Kulkarni Combine is a large business house dealing with a number of business activities from Consultancy, Servicing to manufacturing and selling. The number of product families, it deals with, is over 50. It has more than a dozen manufacturing facilities. Some are old and some are modern. The growth of the company is very fast. The combined turnover of the Killicks Kulkarni Combine is over ₹ 1000 crore. The manpower of the Company is more than 10,000, distributed into 30 different units such as the factories and the branch offices, etc.

The Company manages a corporate business through the Management Services Centre (MSC), which provides Management Consultancy within the organisation. The business raises a number of problems in areas such as the management of technologies, operations, manpower growth and the business in general within the framework of the goals and objectives of the Company. Since the product range includes foods, consumables, durables, chemicals, plants and machinery, it is difficult for the MSC to provide a standard model for the business management of the Company.

One of the problems of the Company is information management. Though, the Company has invested considerably in computers and office automation systems, the managers at all levels, in their formal meet, complained that they are not very happy about the support which they get from this investment. Some of them expressed that the Company should not have invested to this extent while the others were of the opinion that the application of hardware and software was not being properly exploited to managerial advantage. One small group of managers expressed that the Company had to change its style of management and consider information as the most valuable resource, now available through the modern information technology and communication facilities.

The Management Services Centre conducts seminars on various subjects for its managers in its yearly meet to promote new ideas and to implement management change. This year the seminar is organised on the topic of 'strategic use of information for the company.' To make the seminar more lively and interesting the MSC asked their management to present a paper on the problems, the needs and the probable solutions they are looking for in this area. Mr K K Singh, General Manager—Marketing of the Food Speciality Division, was asked to prepare a paper on the 'Information, presentation,' Mr. A K Bose, Manager Corporate Planning, on 'Quality and Value of Information,' and Mr. S S Bhave, 'Manager Human Resource Development' on the 'Managers as the information processors.'

### Information Presentation

Mr. Singh surveyed the reports which he was getting for Marketing function, and found that he was not getting the required information. He termed the reports as a collection of statistical data, submitted in a statement format. The reports were such that even for a particular aspect of the business, it was necessary to go through the entire report and the contents were not easily noticeable. In some cases, after getting the reports, an additional working on the data was necessary to investigate the matter.

Another observation of Mr. Singh was that the reports were clumsy and not easily readable as too much data was crammed into one report. He felt that an overcrowded report may save the computer processing time or reduce the number of reports but any person, hard pressed for time, would be reluctant to examine it immediately.

He also felt that the critical status of any aspect of the business lost its identity because of the much detailed report. The report format was probably designed to meet needs of the Executives and the Officers at the operating level. Even if one made an additional effort to extract some meaning out of these reports, it took a very long time and called for complex calculations. He, therefore, felt that on the certain key areas, the reports did not reveal anything and suggested that some more additional processing would help to filter the data, classify it in different ways and provide the reports to the concerned managers with the relevant data and information.

Mr. Singh propagated the idea that for the Senior Managers, the reports should be available in a graphic format and not in an alpha-numeric statement. This approach would facilitate data-viewing for several years which may throw light on the trend of business. This is not possible if the reports are made monthly with the cumulative data reported simultaneously.

Mr. Singh said that the test of a good information report is that it must communicate information to the reader inducing mental response which, otherwise, is not possible. He further said that the information should at least update the knowledge level, even if it does not have a surprise value or does not reduce the uncertainty. A good information always stimulates managerial thought process leading to the actions or decisions. Information is a data that has been processed into a meaningful form to the recipient and is of a real or a perceived value in the current or the prospective actions or decisions.

### **Quality and Value of Information**

According to Mr. Bose the quality of information can be measured in terms of its utility, satisfaction, error and bias. An unbiased and error-free information would have greatest utility and would provide lasting satisfaction.

The utility is high if the form of information matches the requirements of the users and can be accessed easily. It further increases, if it is precisely correct, up-to-date and is available on time, and the utility is the highest to the user if he has an exclusive possession of it. The level of satisfaction, therefore, depends on how useful it is for decision making. Mr. Bose felt that the present information system appeared to be lacking in some of these aspects.

Bias, Mr. Bose said, did not seem to be a major problem as most of the data came from the internal sources which were known. The bias in presenting the information was easily noticeable because of the sources from where it came. He however, made a strong plea to examine.

- (a) The methods of data measurement
- (b) The collection methods
- (c) The data processing procedures, and
- (d) The deliberate falsification

In these options the first three are controllable while the last one is not controllable.

He, however, made a point that there was a tendency to ask for more data and more information without examining the need for it. He said that the cost of generating more information and its impact on the decision making should be evaluated. He was of the opinion that the perfect informations is a myth and instead of asking for more and more information, it would be more appropriate to sensitise the decision and weigh the pros and cons of the additional information.

### **Manager as the Information Processor**

Mr. Bhave said that even though the information systems provide good information in the classical sense as mentioned by Mr. Singh and Mr. Bose, it may not be possible to satisfy all the managers. He said that in a Company, two managers handling the same function think, decide, act and perform differently, even though the same good information support was provided to both of them. The information

provided by the system was further processed by the managers and this processing, as a human being, suffers from the individual differences.

He observed that the information needs and the processing required to satisfy those needs depended on the manager and his ability, knowledge, and application skills. It was largely dependent on the attitude the manager has towards a problem situation.

If a manager relies on the internal information and the know-how as a basis for a decision-making, then he would call for more analytical information requiring more processing in the system to up-date the knowledge. Such manager goes into the decision-making process afresh with an updated knowledge. The needs of such manager would be changing from time to time. In contrast, if the manager decides, on a fairly standard approach, as the decision-making situation is perceived on more or less same each time then his needs should be standard, well formatted and fairly stable over a period of time. Hence, the demand on information processing is constant with no modification, of any kind, in terms of the source and the method of processing, etc.

If a manager possesses high quality quantitative skills, he would call for the basic data which is valid and controlled, keeping its processing to himself as the case may be. In another case, if a manager can translate his experience in decision-making into an application system, the information processing system becomes a decision-making system.

If the manager is risk-averse type, then he would call for more information, more analysis and more data. This puts a strain on the designer and developer of the system. The risk-averse type managers continuously look for more information for satisfying their sense of security. Their ability to manage risk is poor and they would rather avoid decision-making on the pretext of lack of information.

### **Questions**

1. Discuss the problems of information management in KKC. Suggest the solutions to these problems. Discuss the methodology of determining the information needs of the organisation.
2. Discuss the various technology options and system configurations to overcome the problems of the information management.
3. How do you resolve the conflict between the demand for an additional information and the cost of providing that information?

## **2. SANJEEVAN MEDICAL CENTRE (SMC)**

*(Enterprise Management System)*

Sanjeevan Medical Centre is a 200/bed hospital. The hospital is about fifteen years old and has six different wings, viz., Pediatrics, General Medicine, Orthopaedic, Cancer, and Neurology. The hospital is being run on self generated funds with assistance from Financial Institutions. It is governed by a panel of doctors.

The hospital has about 25 honorary doctors who visit the hospital by rotation in a week and have fixed number of beds assigned to them. The Sanjeevan Medical Centre is recommended by the doctors when the patients require continuous care and attention of expert doctors, and an assistance of the latest diagnostic and medical care facilities. Sanjeevan Medical Centre has not kept an out-patient ward (OPD), so that the entire facilities and the resources are utilised for the patients who have been admitted in the hospital.

SMC has other medical service facilities such a Pathology Laboratory, X-ray and Scanning Centre, and Medical Shop, etc. with the view that the patients would not have to go out of the hospital for such services. Sanjeevan Medical Centre also has its own laundry and a maintenance department to serve the hospital needs.

The permanent staff of Sanjeevan Medical Centre is over 250. The wage bill per month is ₹ 10,00,000. The hospital runs on a no loss-no profit basis, but the Management always keeps 15 to 20 per cent allowance in the budget for a price rise, an emergency, and financing of equipments and contingencies.

The objective of running the hospital in the most economical manner depends on the occupancy of beds and overall expense control. The management of Sanjeevan Medical Centre looks into this aspect and revises the rates charged to the patient on the use of the various facilities provided. A thumb rule developed by the management is to earn a revenue of Rs. 800 per bed a day to make the entire operation economically viable. The management would like to know whether a better system could be evolved, so that the services are charged properly to make whole operation an economical one.

A system of booking common facilities such as the Operation Theatre, needs to be evolved. The Operation Theatre is available not only to the doctors attached to the SMC but also to others outside. The present practice is to reserve the theatre on a prior notice. The reservation is not made for more than two weeks. The use of the operation theatre on an emergency demand is rare. The practice of reservation of two weeks sometimes sends off the patients to other hospitals. A more scientific system of planning and scheduling of the common facilities is essential.

As regards the admission procedure, Sanjeevan Medical Centre management feels that if the doctors could be told in advance the possible availability of beds, then the occupancy of the hospital beds can be improved considerably. The occupancy dwindles any time between 80 per cent to 100 per cent with over 25 requisitions pending. The visiting doctors have expressed on a number of times that they can schedule the admissions if a reasonable notice is given to them.

For satisfactory medical care of the patients, SMC keeps a variable staff of nurses and ward boys over and above the normal strength. However, such staff has to be decided every week.

Sanjeevan Medical Centre purchases consumables worth ₹ 5,00,000 per month, besides medicines and drugs which are required to run the hospital. The number of items in this category is over hundred. The present practice is to raise a requisition for purchase every month. This practice is evolved to ensure the coverage of the consumables, so that ordering, if required, is not missed.

He store keeper has a standard requisition quantity for each item. This approach gives rise to a number of purchase orders with small quantities of the item.

Since the hospital is quite large, a large number of visitors come to see the patients in the fixed hours of 4 p.m. to 6 p.m. The reception maintains the register of patients in order of the date of admission and the ward in which they are admitted. The visitors generally do not have precise information about the patient making a quick search impossible. Identifying the patient and his/her present bed number always takes time. This causes a long queue and the hospital becomes a crowded place disturbing the cool and quiet atmosphere. Sanjeevan Medical Center has only one such counter, which deals with such queries during the visiting hours. A better system is required to clear the crowd fast.

Many a times patients come for an annual medical check-up at SMC. Sanjeevan Medical Centre prepares a docket for each patient, containing all Medico-commercial papers. Each docket has a number, the doctors name and his identity number. The patient is given a card, where the docket number has been mentioned. SMC maintains these dockets in a library. Many a times the patients come without the card, but they remember the name of the doctor and the ward in which they were treated. The docket clerk makes an elaborate search to locate the docket. The process of locating a docket is very time consuming.

Sanjeevan Medical Centre uses Computers for pay-roll, accounting and general administration. The valuation of year end inventory and billing the patients are the systems under development.

Sanjeevan Medical Centre feels that this work will go on but the Information Technology can be used for making a better use of the facilities of the Sanjeevan Medical Centre, giving rise to a higher revenue.

The Management believes that the exact decision-making rules are not possible but even if the support systems can be developed, it would improve the management productivity. There is also a strong opinion in the governing body that what is needed is an integrated Enterprise Management System (EMS) supported by the other decision support systems.

### **Questions**

1. Identify the users who should be considered for finding information requirement.
2. In each case find out the requirements of information with a specific goal assigned to the user.
3. Map information, its user and the application in such a way, that the application definition automatically develops.
4. The management of Sanjeevan Medical Centre wants an integrated solution to improve the hospital efficiency. How would you integrate the applications thought by you so that the data information is not redundant, and it is consistent an up-to-date at all levels?
5. Explain how value of the information would improve in integrated enterprise information management system?

# Systems Engineering: Analysis and Design

## LEARNING OBJECTIVES

- Systems Concepts
- System Engineering
- Handling System Complexity
- Systems Analysis & Design
- Understanding OOT
- OOSAD methodology
- Unified Approach to OO System Development
- UML & UML Diagrams

### 8.1 SYSTEM CONCEPTS

The word ‘System’ is used in day to day life very frequently in describing the subjects, such as the traffic system, education system, business system, etc. The system, provides a meaningful framework for describing and understanding the features and functions of the subject.

System is defined as a set of elements arranged in an orderly manner to accomplish an objective. Some examples are given in Table 8.1.

**Table 8.1** Examples of System

Systems	Elements	Objective
Computer	Input, process and output devices. Operating system, compliers, packages.	Process the data and provide information.
Accounting	Financial transactions, accounting principles and rules, transaction processing methods of accounting.	Process the transactions and produce monthly books of accounts and the information for financial management.
Business organisation	People, plant and machinery, product and services, communications, transport, materials.	Produce goods and services to achieve the business objectives of service, turnover and profits.

It is to be noted that a system is not a randomly arranged set. It is arranged with some logic governed by rules, regulations, principles and policies. Such an arrangement is also influenced by the objective the system desires to achieve. For example, if a computer system is designed to perform commercial data processing, then the elements will be the data entry devices, a CPU, a disk, a memory, application programmes and a printer. If a computer system is designed to achieve the objectives of design, engineering, and drawing processing, then the elements will be the graphic work stations, the graphic processor, and the languages suitable for engineering and design applications, and plotters for drawing the output.

Hence, a clear statement of objectives brings a precision and an order into the selection of elements and their arrangement in the system. Any disorder would create a disturbance in the system, affecting the accomplishment of the objective.

If a system in any field is analysed, it will be observed that it has three basic parts, which are organised in an orderly manner. These three parts can be represented in a model as shown in Fig. 8.1.

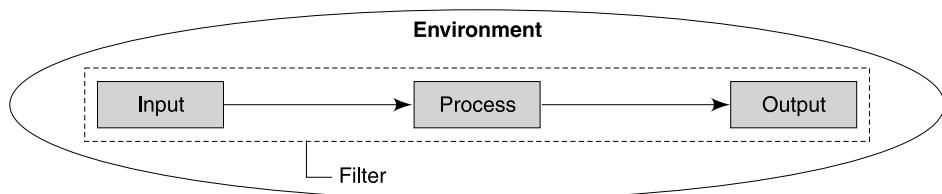


**Fig. 8.1** Parts of a System

A system may have single input and multiple outputs or may have several inputs and outputs. For example, a business organisation system has several inputs and multiple objectives, such as sales, profit, service and growth. The choice of inputs and processing methodology is governed by the objectives set for the system. Any misalignment in this arrangement would lead to a wasteful collection of inputs, and its processing will fail to achieve the desired objective.

All the systems operate in an environment. The environment may influence the system in its design and performance. When a system is designed to achieve certain objectives, it automatically sets the boundaries for itself. The understanding of boundaries of the system is essential to bring a clarity in explaining the system components and their arrangement.

If an additional objective is to be introduced in the system, it may not be possible as the new objective may fall outside the boundaries or the scope of the system. For example, a system designed to spread literacy amongst a large population cannot achieve the objective of excellence in knowledge and understanding of the language. A computer system designed for commercial data processing cannot achieve the objective of design and drafting, as the system elements and its boundaries do not permit it. A generalised model of the system in an environment will be as shown in Fig. 8.2.



**Fig. 8.2** Generalised Model of a System

The environment influences the choice of inputs, the method of processing, and the nature and contents of the outputs.

Since the systems are designed for specific objectives/outputs, the designer provides a filter around the system to control the influence on the system. For example, take a manufacturing system, where the objective is to produce products of desired quality. Since the raw material and the processes are selected with this objective, the quality control systems exercise a control on the quality of incoming raw material and keep a continuous watch on the process parameters to keep the desired quality of production. The quality control systems, therefore, provide a filter around the manufacturing system which protects the system from the undesirable influences of the environment.

The designer of the system, therefore, has to consider the environment and select appropriate inputs, and filtering mechanism to protect the system for the undue or undesirable influences of the environment.

Most of the failures of the systems lie in the area of selection of the inputs and the processes, and not providing the appropriate filtering systems.

## 8.2 SYSTEMS CONTROL

Since the systems are designed to achieve specific objectives, ensuring the achievement of the objectives through system control, becomes the integral part of the system design. The control calls for, in the first place, a measurement of the output in some terms. The device that measures the output is called a sensor. The next step is to set the standard or norm of the output as an index of the system performance. The sensor measures the output and compares it with the standard. If the measured output compares well with the standard, the system provides a feedback to continue the operations.

If the measured output does not compare well with the standard, then a feedback is provided to the system to stop the operations. The process of comparison of a measured output with the standard is done by a unit called as comparison unit.

The mechanism, which provides a signal to the system, about the quality of performance, favourable or adverse, is called a feedback mechanism.

Many times, the system may not have an appropriate mechanism to act on the signal which it receives. It is, therefore, necessary to provide an in-built mechanism which will decide, based on the feedback to stop, regulate or continue the system operations. Such a mechanism is called a corrective unit and it is responsible for ensuring the system performance. The corrective unit, in its performance, will act on inputs and processes to bring the system under control.

The process of measuring the output, comparing with the standard, sending the signal to the corrective unit and the corrective unit acting upon it, is called a control. Any break down in this path will affect the system performance adversely. A system set for a specific objective, devoid of any control, will perform in a disorderly manner and can disturb the system equilibrium. The role of a control is to regulate the system operations and performance, and keep it in an equilibrium condition. The control, therefore, is the heart and brain of the system.

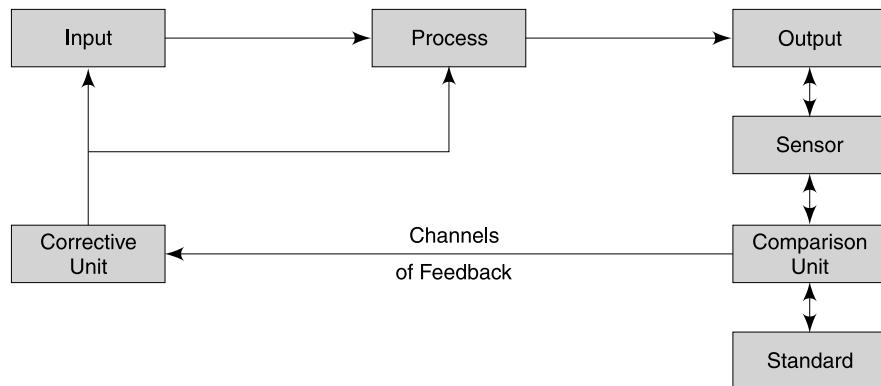
The control could either be internal or external to the system. For example, in an air conditioning system, switching on and off of the compressor is automatic and hence it is an internal

control. In the roads and traffic system, the traffic policeman acts as a control system, which is external to the traffic system. Most of the modern systems have an in-built automatic control systems.

The information system can be understood in terms of system concepts. The information system receives the inputs of the data and the instructions (a set of the Computer Programmes) to process the data according to the given instructions and give the output of the processed results.

The information systems are designed in a particular environment of business, industry and management. When the environmental factors or the inputs change, the system process is under a stress. Stress beyond a limit affects the other system elements which in turn affects the achievements of the goal. A system may have the ability to manage the stress and still be in a condition to achieve the desired goal. Unmanageable stress leads to a system failure.

The concept of control is based on the condition of a feedback. If the feedback is positive, i.e., the measure of the output compares favourably with the standard or norm, the control will keep the system operating in the same condition. However, if the feedback is negative, i.e., the measure of the output is unfavorable when compared to the standard or norm, the control will act on the input or process to bring back the system to the state of equilibrium. The control system model with a control feature is shown in the Fig. 8.3.

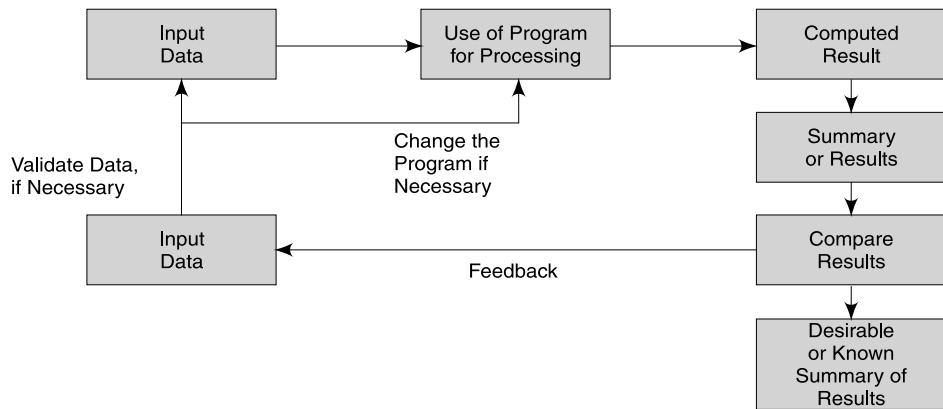


**Fig. 8.3** Control System Model

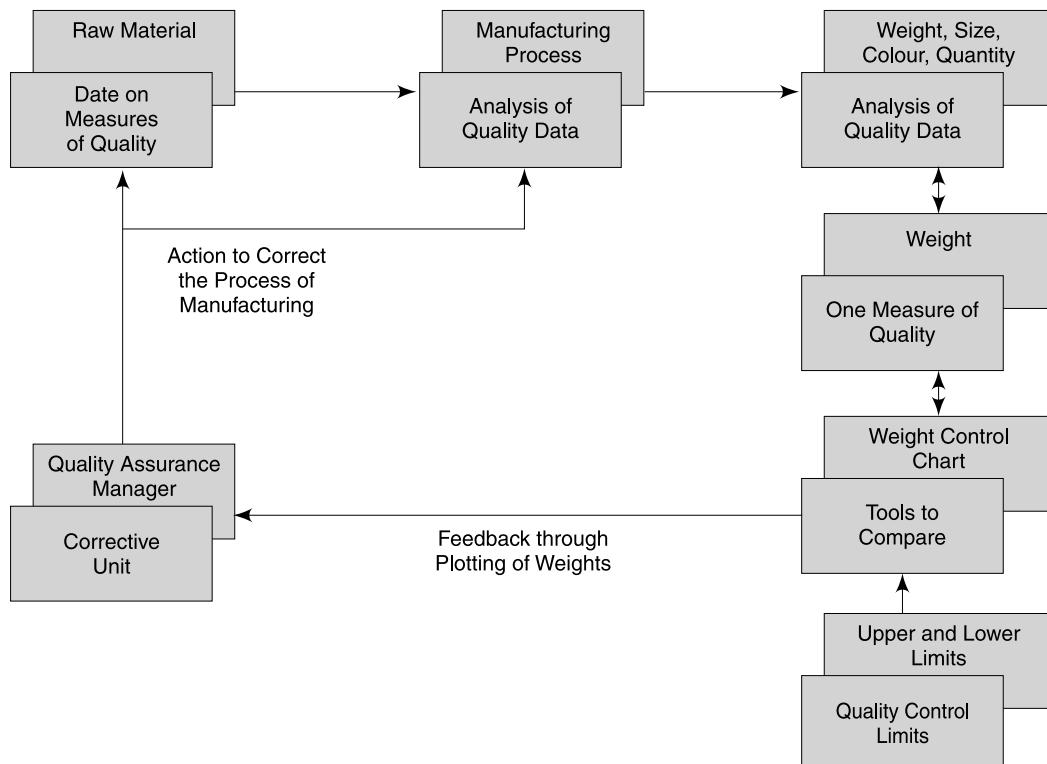
The concept of a control system model is applied to data processing where all the features are used in the programmes of the data processing, as shown in Fig. 8.4.

The same concept of the control system model is used in the management information system. The corrective unit in the MIS is the manager or the decision maker. Through a process of decision-making, the manager regulates the business system so that the desired results are achieved. The MIS model, with the control feature, is described here for a quality assurance in Fig. 8.5.

The MIS model through its control feature, provides the information needed by the Quality Assurance Manager. The MIS model which does not explicitly provide a feature of control of the business results, degenerates into a data processing system losing the propose of the MIS as a support to decision-making.



**Fig. 8.4** Control System Model for Data Processing



**Fig. 8.5** MIS Model of Quality Assurance

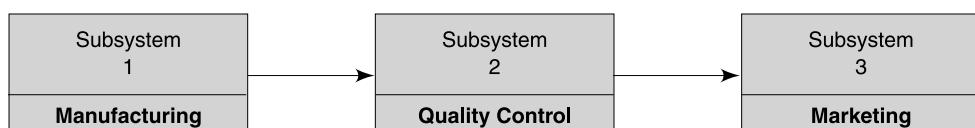
The manner in which the MIS supports the management of business is illustrated in the Table 8.2.

**Table 8.2** MIS and Support to Business

<i>System components</i>	<i>Business system</i>	<i>Management information system</i>
Inputs	Raw materials, plant and machinery, manufacturing, selling arrangement, accounting.	Data from transactions of purchase, production and sales, receipts and payments.
Process	Purchasing, manufacturing, selling, accounting.	Transaction processing and data processing.
Outputs	Quantity of production, sales, stock, income and profit.	Computation of production in numbers, sales in value, stocks in weight, income and profit in rupees.
Sensor	Profit.	Income less assigned cost.
Comparison unit	Expectation of profit vs actual profit.	Algebraic comparison module to compare income vs budgeted income profit vs budgeted profit.
Standard	Profit, Target.	Budgeted profits of various products.
Feedback	Balance Sheet and Analysis.	Exception reports after analysis showing products earning profit below the budget.
Corrective unit	Managing Director. Business decisions.	Marketing Manager. Pricing, advertising and promoting decisions.

### 8.3 TYPES OF SYSTEM

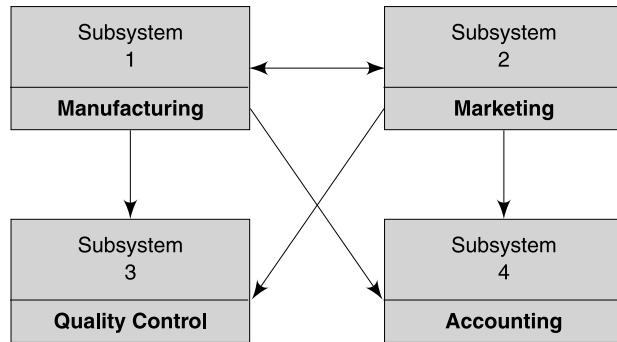
A system is defined and determined by its boundaries and objectives. It is quite likely that a system is an arrangement of smaller systems in a logical order. When many smaller systems together make a larger system, the smaller systems are called the subsystems of the larger system. A large system can be split or decomposed into smaller subsystems up to a certain level. This decomposition can go down to a level where the input and the output are more or less same. The decomposition of a system into subsystems can be in a serial form or it could be in a matrix form as shown in Figs. 8.6 and 8.7.



**Fig. 8.6** Subsystems in Serial Order

In a serial system processing, the entire output of a subsystem is the input to the next subsystem and so on. In the matrix arrangement the different outputs go to different subsystems. A subsystem receives more than one input from other subsystems.

In any system, the inputs are transformed into the output by the process. We say that the process is transparent to us when we are able to understand the system. But, if the process of

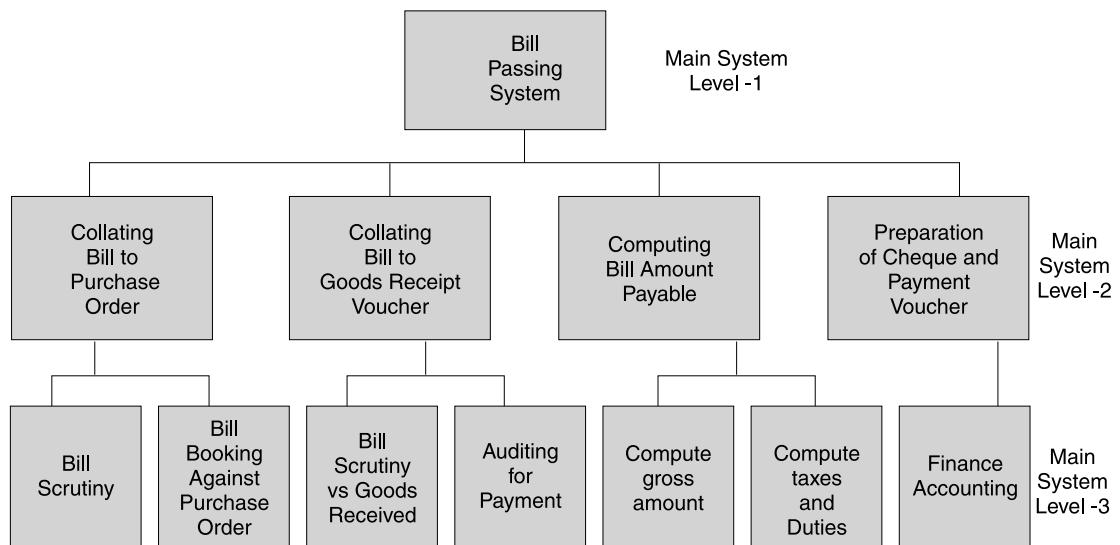
**Fig. 8.7** Subsystems Operating in Matrix Order

input transformation is not visible and understandable then we say that the system is a black box and the process is not transparent as shown in Fig. 8.8.

**Fig. 8.8** Black Box System

A large system is always complex and difficult to understand. Therefore, for viewing it in a different way, the system is split into the smaller subsystems.

Most of the systems can be viewed in a hierarchical structure. For example, a bill passing system in a commercial organisation can be shown in a hierarchical structure in Fig. 8.9.

**Fig. 8.9** Hierarchical Structure of the System

Breaking the system in a hierarchical manner provides a way to structured systems analysis. It gives a clear understanding of the contribution of each subsystem in terms of data flow and decisions, and its interface to the other subsystems.

The systems can be classified in different categories based on the predictability of its output and the degree of information exchange with the environment. A system is called **deterministic** when the inputs, the process and the outputs are known with certainty. In a deterministic system, you can predict the output with certainty. A system is called **probabilistic**, when the output can only be predicted in probabilistic terms. The accounting system is deterministic while the demand forecasting system is a probabilistic one. A deterministic system operates in a predictable manner while a probabilistic system behaviour is not predictable.

If a system is functioning in isolation from the environment, then the system does not have any exchange with the environment nor is it influenced by the environmental changes. Such a system is called a **closed system**. If the system has exchange with the environment and is influenced by the environment then it is called an **open system**. All kinds of accounting systems, viz., cash, stocks, attendance of employees are closed systems. Most of the systems based on rules and principles are closed systems.

The systems which are required to respond to changes in the environment, such as marketing, communication and forecasting are open systems. All open systems must have a self-organising ability and a sensitivity to absorb and adjust to the environmental changes. The business organisation systems are open systems. The systems of manufacturing are closed systems.

The information system is a combination of a person (the user of information), the hardware and the software. The hard ware-software system is a closed deterministic system but in combination with the user it is an open and a probabilistic system.

Generally the deterministic systems are closed, and the probabilistic systems are open. The deterministic and the closed systems are easy to computerise as they are based on facts and their behaviour can be predicted with certainty. A fixed deposit accounting system, an invoicing system, and share accounting systems are examples of closed and deterministic systems.

The probabilistic and the open systems are complex in ever aspect. Hence, they call for considerable amount of checks and controls so that the system behaviour or the performance can be controlled. All such systems must ideally have self organising corrective system to keep the system going its desired path.

For example, the pricing systems are probabilistic and open. They are to be so designed that the changes in the taxes and duties, the purchase price and the supply positions are taken care of, in the sales price computation. Since the pricing system operates under the influence of the environment, it has to be designed with flexible computing routines to determine the price. The building of self-organising processing routines to respond to the environmental influences is a complex task both in terms of the design and operations of the system.

## 8.4 HANDLING SYSTEM COMPLEXITY

Information systems are relatively complex as compared to physical systems, and, therefore, they should be handled properly enabling the system designer to understand, design, develop and implement.

To handle the complexity, the system can be viewed as an assembly of subsystems each with a clear definition of the boundaries, interfaces and their connectivity. The subsystems then are put in the hierarchical order to provide a structural view showing the developmental path to the designer. The process is called **factorisation** of the system into subsystems.

Another method of handling the complexity is to resort to **simplification** by clustering the subsystems together. Handling all the subsystems together with their interconnections is difficult.

The number of interconnections increases with the increase in the number of subsystems. Each interconnection acts as a channel for the input-output communication. The process of simplification provides a way to handle these interconnections and reduce the complexity. The method of simplification is as follows:

1. Identify the subsystems which have to be together for the functional ‘cohesion.’
2. Form a cluster of these subsystems and identify interconnections in this cluster.
3. Form clusters of the remaining subsystems.
4. Connect the clusters with an interface.

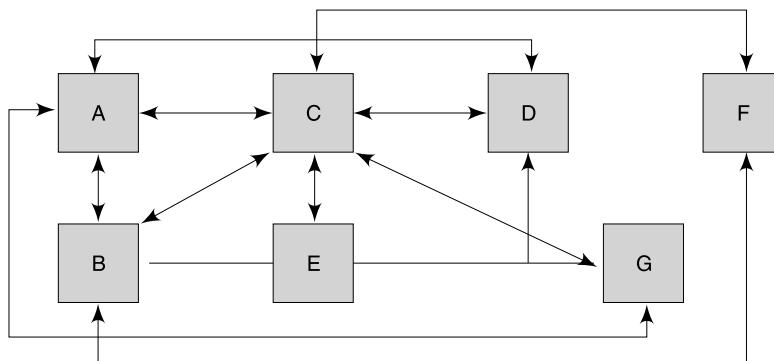
To illustrate the above let us discuss materials management system can be taken up.

### Materials Management System

The above system can be subdivided into the following subsystems for the purpose of handling the complexity as shown in Step 1 below:

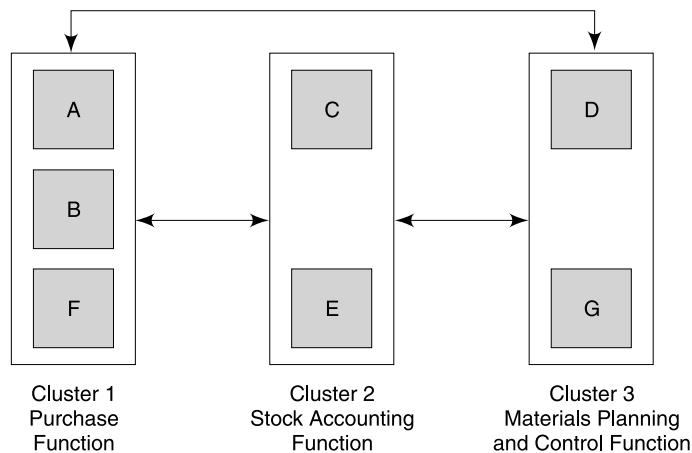
- (A) Procurement system.
- (B) Purchase order follow up system.
- (C) Receipts accounting system.
- (D) Material requirement planning system.
- (E) Material issue requisition system.
- (F) Bill passing and payment system.
- (G) Inventory control system.

Materials management system is divided into seven subsystems from A to G and their interconnections are identified as specified in Step 2. See Fig. 8.10.



**Fig. 8.10** Step 2—Subsystems with Interconnections

The subsystems can be clustered in a number of ways. In the example, we have clustered the subsystems on the basis of the managerial function such as purchase, accounting and planning as shown in Fig. 8.11. We can also cluster the subsystems by operating departments. In that case the subsystems A, B, C, and E will be a cluster, F will be the second cluster, and D and G will be the third cluster. The operating departments are Materials, Finance, Production Planning and Control, respectively.



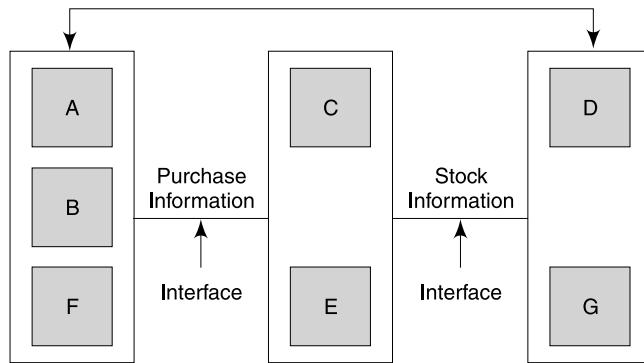
**Fig. 8.11** Step 3—Formation on Clusters on the Basis of Managerial Function

The choice of the basis for clustering will depend on the view taken by the designer of the system to handle the complexity. If the degree of complexity is more because of the functions, the choice of clustering will be based on the functions. But if the degree of complexity is more because of the operations, the clustering will be on the basis of the operations.

When the subsystems are clustered together and connected, the designer faces the problem of tight connectivity. The connectivity becomes tight because a close coordination is required among the clusters in terms of time and resources. This requires two clusters to operate in a synchronised manner. When the subsystems are of open type, where the environmental exchange causes a lot of behavioral influence, the synchronisation becomes extremely difficult. A failure in synchronisation leads to the breakdown of the system.

The solution to the problem of tight connectivity is to decouple the clusters from each other by providing an interface between the clusters. The process of decoupling makes the two clusters operationally independent of each other. The decoupling, the Step 4, in the present example is shown in Fig. 8.12 by providing an interface between the purchase and the stock subsystems, and also between stock and planning systems.

The problem of right connectivity and providing interface arises from the requirement of having the input information from the other subsystem on time. So basically it is a problem of synchronised communication in the information exchange between the two clusters. The interface provides an operational independence by allowing the other subsystem to operate on the limited information already stored.



**Fig. 8.12** Step 4—Decoupling of Subsystems' Cluster by Stock Information Interface

However, the benefits of the operational independence are not without the extra cost of providing an interface because as a subsystem, the interface also needs to be designed, keeping in view the specified needs of the interfaced subsystems.

The use of decoupling mechanism should be considered as the last alternative for reducing the rigid requirements of a communication exchange. The designer as far as possible should endeavour to avoid interfaces to control the cost of information system. The modern hardware and software offer solutions to resolve these problems.

### System Efficiency and Effectiveness

The performance of the system can be measured by two factors, viz., the efficiency and the effectiveness. The efficiency indicates the manner in which the inputs are used by the system. Being efficient means the system uses inputs in a 'right' way. If the input-output ratio is adverse, we say that the system is inefficient though it produces the desired output.

The effectiveness is the measure for deciding whether the system provides the desired output or not. Being effective means producing the right output in terms of quantity and quality. When the system is ineffective, the system is out of control and it needs a major correction.

A system has to be effective and efficient for the highest utility to the user of the system. Broadly speaking, the effectiveness is a measure of the goodness of the output, while the efficiency is a measure of the productivity, i.e., the measure of the output against the input.

### Post Implementation Problems in a System

The system designer designs and develops the information systems and implements them within the organisation. When systems are allowed to run for some time, they tend to become disorganised, resulting into system inefficiency. The process of decay and its cause is called 'Entropy.' The designer is thus called upon to introduce a negative entropy, i.e., to provide a course of action, whereby the decay is arrested and the system is brought back to the state of equilibrium, producing the desired objectives. The process of providing a negative entropy is called system maintenance. Every system is provided with a maintenance procedure as given in Table 8.3.

As a preventive measure, a negative entropy is provided as a part of the system routine. The steps are:

- (a) A periodical review of the system,
- (b) User meetings to assess the current utility of the system and the level of satisfaction,
- (c) Subjecting the system to an audit check through the test data,
- (d) Running the system under audit trail,
- (e) Bringing out system modifications.

**Table 8.3** Examples of System Maintenance Procedure (Negative Entropy)

<i>System</i>	<i>Indications of entropy</i>	<i>Negative entropy</i>
Human body	Loss of weight, headache	Medical check-up and prescribed diet and medicines.
Computer	System halts, read and write errors.	Preventive maintenance and replacement of sensitive components.
Data processing	Errors and omissions in the data on increase.	Review and introduction of the streamlined procedures.
Information processing	Decline in the utility and satisfaction, changed information needs	Resetting the goals of information system. Add revised information needs and modify the information system.

The another post implementation problem that the system designer faces is a forced change in the goal due to the other systems in the organisation having undergone the change. Another possibility is that the existing goal may have to be modified at a new level. If the system designed is capable enough to absorb the forced change of goal, then system decay is not possible. However, if the system design is inflexible, then it is not possible to accommodate the forced changes and then the system decay beings.

Problems of system decay arise in the organisation because the business environment changes, leading to a modification in the business goals and objectives. Such a change induces down the line changes in the objectives, targets and focus. The information needs of the managers change as result of the changes all around. Such a change in the requirement forces a change in the MIS goals, calling modifications to the information systems to meet the revised information needs. The system changes could be in the area so hardware and software. The change may call for more hardware and software resources such as storage and processing capability or terminal facilities in a wider area for access to more users. The system may be required to write additional application programmes, more query screens, widen the scope of the database, and provide the end user with computing facility. The system designer can easily handle such post implementation problems, if the information system plan is developed for the organisation with a long term objective.

The designer should keep in mind that the organisation is an open system bound to receive new inputs in an unplanned and unscheduled manner and the organisation should adapt itself to these new inputs to continue its existence. While designing the system, appropriate features should be provided to adopt the changes which will be forced on the system. The

efficiency of the information system is high if these changes are easily accommodated in a short time. It should also be borne in mind that when one deals with such changes, the core systems do not undergo a significant change.

The keys to handle the post implementation problems in the systems are:

- (a) The core system design must be comprehensive and flexible to undergo a quick change.
- (b) The associated peripheral systems should be built with a flexible design.

The most successful way of handling these problems is to have a business analyst in the organisation and perceive the business needs of the information and user object oriented technology for efficient system design.

## 8.5 CLASSES OF SYSTEMS

We have discussed types of systems as closed/open, and deterministic probabilistic. Further these systems perform different roles through different processes to achieve a system goal. Though at the core they satisfy all the attributes of a 'System,' they differ in nature due to the goals assigned to them. This is more particularly true for the systems in MIS. Systems, which form the part of MIS, are classified in five classes as under:

- Data Processing System (DPS)
- Business Function Processing System (BPS)
- Transaction Processing System (TPS)
- Integrated Information Processing System (IPS)
- Application Processing System (APS)

DPS is designed to capture, collect or enter the data to process in a certain specified manner to achieve the following:

Data is complete correct and valid from all aspects.

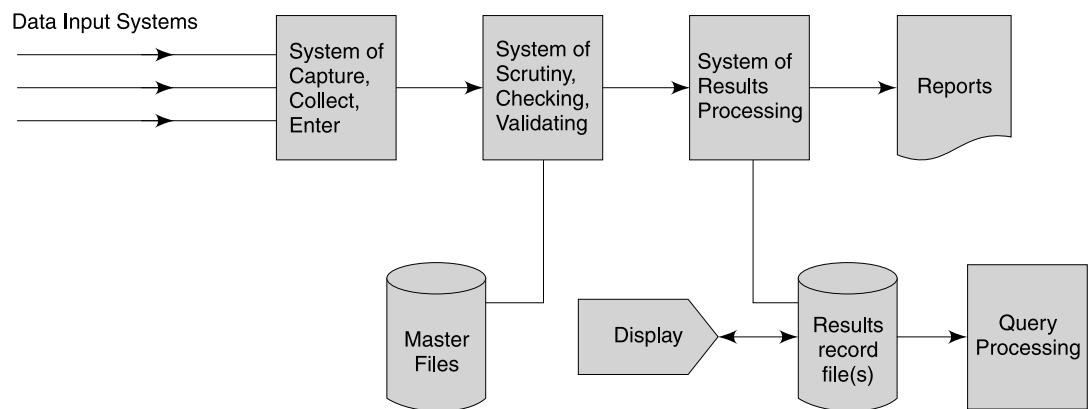
Such data then is processed and organised in some form for further processing.

DPS may have an algorithm using one or more data inputs and may produce one or more outputs. An example of DPS is an employee's daily attendance processing system designed to provide monthly-consolidated attendance for payroll application. In this system everyday attendance is processed for all employees and accumulated for the month to decide on payable days for calculation of wages for the month. Fig. 8.13 shows a model of DPS.

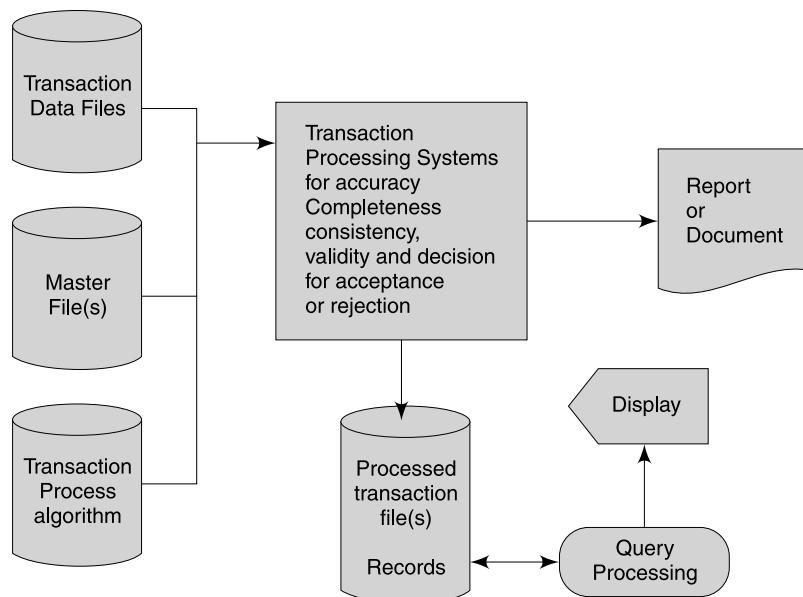
### Transaction Processing System (TPS)

TPS is designed to handle a transaction between parties. The parties could be two or more and have a designated role in TPS. TPS uses data files, master files, transaction records and processes the data in a manner specified in the transaction process designed to execute the transaction. TPS output is a transaction in itself and updating the various other records based on the result processed as a part of the transaction execution.

In a payroll system, the payment of monthly salary to an employee is a transaction. It considers payment rules, employee payable days, and salary payment terms of the employee. This transaction uses employee master file, payable days, and salary computing algorithm to compute the payable salary. In this transaction the parties are organisation and employee. The TPS has an objective of producing an amount figure of payable salary for the month for all employees. Figure 8.14 shows a model of TPS.



**Fig. 8.13** Model of DPS



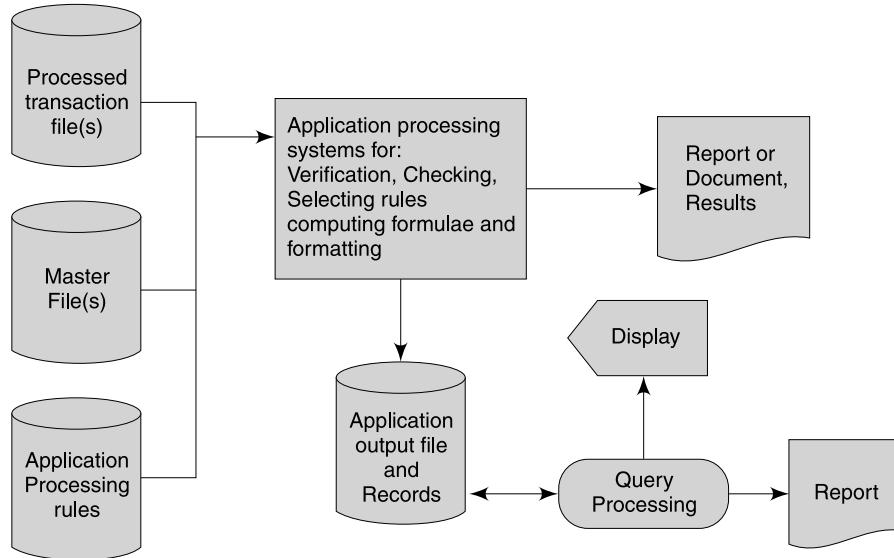
**Fig. 8.14** Model of TPS

### Application Processing System (APS)

Application Processing System is built over DPSs and TPSs. APS uses files created by DPS and TPS, and applies application-processing rules to execute the application. Application processing system may have an output as a document, a report, or a set of results required for processing further in business function system. For example, billing the customer is an application. This application system uses output files of following TPSs.

- Customer order acknowledgement
- Delivery acknowledgement and acceptance by the customer
- Product delivery to customer

Billing APS produces bill on the customer and produces number of results to update post billing effect elsewhere. The bill, bill amount, bill amount breakup are used in the Sales Processing System. Figure 8.15 shows a model of APS.



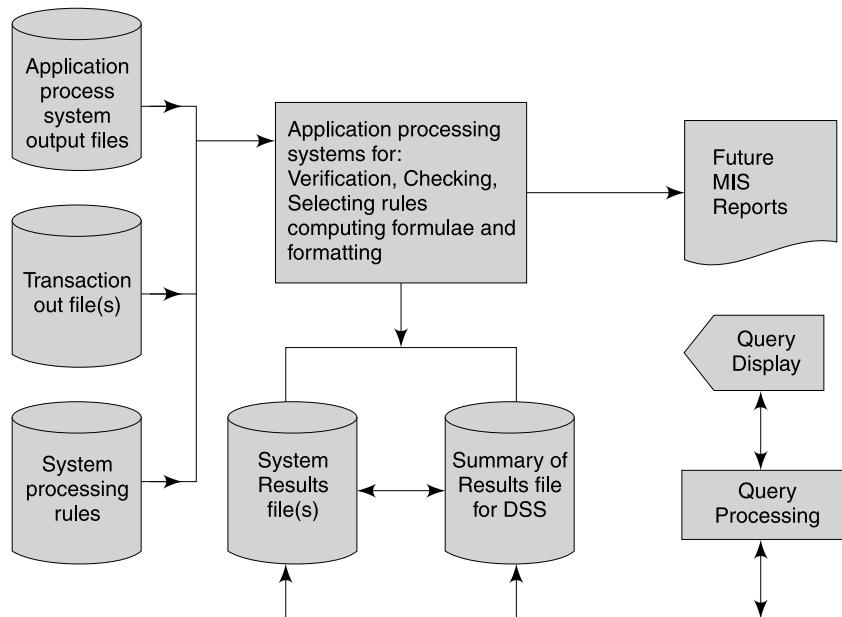
**Fig. 8.15** Model of APS

### Business Function Processing System (BPS)

BPS deals with business functions. BPS aids in business function processing and helps management in decision-making required within the scope of a business function. BPS focuses more through information support for management of business function. It brings out more MIS reports for business function management, such as Sales, Production, Materials, Customer Relations and so on. Business function is built on several business process applications. For example sales function is built on applications like Order Processing, Order Manufacturing, Delivery, Billing and Accounting. Business system uses relevant APS and TPS outputs for processing the system results. Figure 8.16 shows a model of BPS.

### Integrated Information Processing System (IPS)

Integrated Information Processing System sits on the top of the rest of the systems discussed so far namely DPS, TPS, APS, BPS. IPS draws its input from these systems, and applies information processing rules to bring out an output. IPS generally meets a requirement of top management in the area of planning, budgeting and strategic control.

**Fig. 8.16** *Model of BPS*

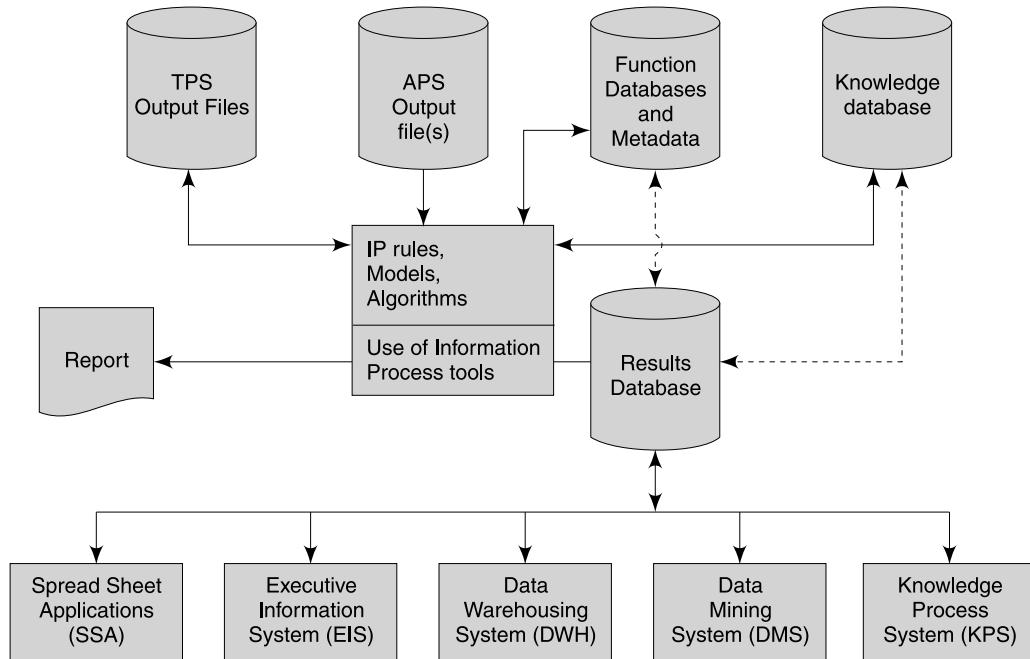
Systems like project planning, capital budgeting, manufacturing planning, preparing year-end balance sheet schedules and reports are examples of IPS. These systems use valid authenticated data and information already stored in various systems. IPS is an integrated information processing system for producing information supporting top management's decision-making. Figure 8.17 shows the model of IPS.

IPS is further used for developing systems for strategic management. The systems are executive information systems, data warehousing and data mining systems, knowledge processing systems, and large number of spreadsheet applications.

## 8.6 GENERAL MODEL OF MIS

The MIS is an arrangement of data processing and information systems in an orderly manner to support the management in achieving the business objectives. The MIS boundaries cross the limits of the organisation and draw the data from the sources external to the organisation. MIS follows a generalised model of a system as stipulated in the theory and performs on the principle of feedback and control. It works on the principle of control by exception.

MIS is designed to provide the information which is exceptional in nature from the point of view of business. The exceptions could be abnormal events, surprising developments, shocking news, or something that was not consistent with the expectations. The MIS must catch all such points and report them to the concerned management. It must, therefore, recognise all such possible points and provide a measure for comparison with the actual performance. Unless such a feature is included, the MIS will be supplying merely data and not information.

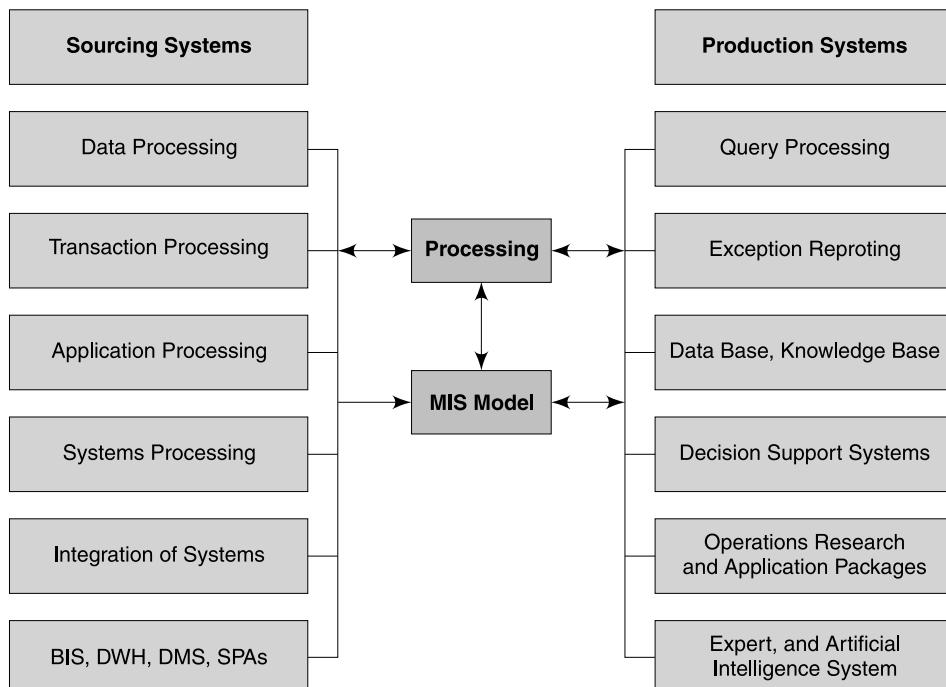
**Fig. 8.17** Model of IPS

By nature, the MIS is an open system interfacing continuously with the internal and the external environment and is self organising to meet the ever increasing and changing information needs of the organisation. This is made possible by organising the MIS in a hierarchical structure. Further, it is subdivided into smaller subsystems. The decomposing is done on the various bases, viz., the functional, the departmental, or the decision. It can also be decomposed on the basis of activity, viz., the data collection, data analysis, planning and control. The breaking up of the system into smaller subsystems is for understanding and determining the boundaries, and for setting the objectives. It also aids in chalking out the developmental path of the MIS. The complexity of the MIS is handled by simplifying the subsystem structure and decoupling the two subsystem clusters.

The performance of the MIS design starts decaying in the post implementation period and it is necessary to provide negative entropy to bring back the system to its original equilibrium.

Though the MIS is designed as an open system, its failure arises on account of the degree of flexibility kept in the system. It is observed that the core systems are not required to change but the peripheral systems often undergo a change. The MIS, as an open system, supports the organisation in the functioning of the other systems. Since the organisation by nature is built to absorb a new input in place of the old, it is required to change its goals and objectives, the management style, the systems and the procedures. The MIS must support this effort on a continuing basis. A good MIS is founded on the indepth system analysis of the business and management processes. It caters to the individuals, the groups, the functions and the different levels of the management in the organisation.

In short, the elements of the MIS are the computer hardware, the communication channels, the software and the software tools the development plan and a well defined measurable objective of the MIS consistent to the business objectives of the organisation. Irrespective of the organisation structure, the industry or the business, public or private sector, the MIS is a model consisting of the various subsystems. These subsystems are shown in Fig. 8.18.



**Fig. 8.18** General Model of a Management Information System

## 8.7 THE NEED FOR SYSTEM ANALYSIS

When you are asked to computerise a system, it is necessary to analyse the system from different angles. The analysis of the system is the basic necessity for an efficient system design. The need for analysis stems from the following points of view.

### System Objective

It is necessary to define the systems objective(s). Many a times, it is observed that the systems are historically in operation and have lost their main purpose of achievement of the objectives. The users of the system and the personnel involved are not in a position to define the objective(s). Since you are going to develop a computer based system, it is necessary to redefine or reset the objective(s) as a reference point in context of the current business requirement.

## System Boundaries

It is necessary to establish the system boundaries which would define the scope and the coverage of the system. This helps to sort out and understand the functional boundaries of the system, the department boundaries in the system, and the people involved in the system. It also helps to identify the inputs and the outputs of the various subsystems, covering the entire system.

## System Importance

It is necessary to understand the importance of the system in the organisation. This would throw more light on its utility and would help the designer to decide the design features of the system. It would be possible then to position the system in relation to the other systems for deciding the design strategy and development.

## Nature of the System

The analysis of the system will help the system designer to conclude whether the system is the closed type or an open, and a deterministic or a probabilistic. Such an understanding of the system is necessary, prior to design the process to ensure the necessary design architecture.

## Role of the System as an Interface

The system, many a times, acts as an interface to the other systems. Hence through such an interface, it activates or promotes some changes in the other systems. It is necessary to understand the existing role of the system, as an interface, to safeguard the interests of the other systems. Any modifications or changes made should not affect the functioning or the objectives of the other systems.

## Participation of Users

The strategic purpose of the analysis of the system is to seek the acceptance of the people to a new development. System analysis process provides a sense of participation to the people. This helps in breaking the resistance to the new development and it also then ensures the commitment to the new system.

## Understanding of Resource Needs

The analysis of the system helps in defining the resource requirements in terms of hardware and software. Hence, if any additional resources are required, this would mean an investment. The management likes to evaluate the investment from the point of view of return on such investment. If the return on the investment is not attractive, the management may drop the project.

## Assessment of Feasibility

The analysis of the system helps to establish the feasibility from different angles. The system should satisfy the technical, economic and operational feasibility.

Many times, the systems are feasible from the technical and economic point of view; but they may be infeasible from the operational point of view.

The assessment of feasibility will save the investment and the system designer's time. It would also save the embarrassment to the system designer as he is viewed as the key figure in such projects. One can approach the system analysis and design exercise in a systematic manner in steps, as shown in Table 8.4 below.

**Table 8.4** Steps in System Analysis and Design

Steps	Elaboration	Explanation
Need for information	Define the nature of information. Also who wants and who uses.	Identify the users and application of the information for achieving the objectives.
Define the system	Decide the nature, type of the system and its scope.	Helps to determine the system ownership, its benefits and complexity.
Feasibility	Technical success Economic viability Operational Effectiveness	Hardware and software availability and capability, for implementation. Study investment and benefits. Assess the improvement in value of the information. Determine the return on investment. Examine whether the system will perform as desired in terms of time and results. Are the users ready to use the system?
Detailing of the requirements	Identify in precise terms, the strategic, functional and operational information needs.	Study the sources of generating the information. Establish I/O linkages. Modify the existing system to satisfy the needs.
Conceptual system design	Determine the inputs, process and outputs, and design a conceptual mode.	Conceptualisation is necessary to understand the system process.
Detailing the system design	Draw the document flow charts and the dataflow diagrams, the data and system hierarchy diagrams, the data, information versus its users mapping table.	Helps in bringing a clarity in the dataflow. The responsibility centres and the process centres are identified.
Structuring the system design	Break the system into its hierarchical structure.	Helps in understanding the dataflow from one level to the other and the processes carried out at each level.
Conceptual model of computer system	Define step by step the usage of files, processes and interface. Define the data structures and draw system flow diagrams.	Helps to put down the data processing flow in the computerised system. Draw the computer system charts.
Break the system in programme modules	Make a physical conversion of the system into the programme structures in a logical order.	Modules will be data entry, data validation, data processing, reporting and storing.

*Contd...*

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Develop the test data test cases for checking the system ability	Test the modules and the integrity of the system in terms of input versus output. Plan white box and black box testing.	Confirms whether the system design is satisfactory. Suggests the modifications.
Install the system	Install on the hardware.	Install, test and run the system before the user is exposed in a live mode.
Implementation	Train the personnel. Run the system in parallel. Prepare a system manual.	Helps to identify the user problems and provide solutions.
Review and maintenance	Review the system through audit trail and test data, use change management system for modifications.	Helps to maintain the system quality and the quality of information through modification, if necessary.

## 8.8 SYSTEM ANALYSIS OF THE EXISTING SYSTEM

When the objectives of the information system are finalised, as the first step towards development, it is necessary to analyse the existing system.

Such an analysis helps in achieving the following:

- Understanding the existing system.
- Understanding the objectives achieved by the existing system.
- Evaluating the system for computerisation and its placement in the total MIS design.
- Knowing whether the system is feasible technically and operationally.
- Are the information needs fully justified?
- If so, is the cost of the system design justified to increase the value of the information?

### Procedure of Analysing the Existing System

System analyst while analysing the existing system should:

1. Carry out the analysis of the system at a place where the system is functioning. This step will ensure that the analyst is accepted as one of those operating the system.
2. Note down the key personnel in the system besides the head of the department. The key personnel are those who contribute towards the system operations.
3. Spend some time with the operating personnel and observe the system to understand the finer details of the system.
4. Define the scope of the system and its objective. The scope will cover the boundaries of the system. Further, should identify the problems faced in the system which cause difficulties in achieving the objectives.
5. Collect all the documents which are raised in the system. These documents carry data from one point to another. The documents could be printed or handwritten. While collecting the documents, the analyst should note down who raises the document, the purpose it achieves, and the manner in which it is distributed.

6. Collect separately the outputs which as statements, reports, memos, etc. made in the system to throw more light on the information it generates. If these reports and the statements are sent to other departments, make a note of it. Also find out if any register or notebook is maintained at various points, which act as data storage and reference. Note down against each such document, its use.
7. Make a list of rules, formulae, guidelines, policies, etc., which are used in running the system.
8. Note down the check points and the controls used in the system to ensure that the data flow is complete, processing of the data is correct and the analysis is precise.
9. Study the flow of data in the system in units, summary and aggregates from document to document and from one stage to the other.
10. Make a small system note as a base document and seek an appointment with each head of the department to discuss the system. In the discussion, ensure that your system view and understanding is the same as that of the head of the department. Ascertain from him whether he has any other objectives which the system should achieve.
11. Examine whether the achievement of the system's objectives is feasible in the present system. This means, examining whether adequate data exists, whether it can be processed by the rules, methods, model, already there to generate information. If so, will the information be correct, precise and complete. Further, can it be processed on time to be useful to the user or the decision maker?
12. If there are problems in the feasibility of implementation, then examine whether the present system can be modified by introduction of documents, controls, procedures and systems. If this is not possible, redefine the scope of the system and objectives in the light of the study.
13. Draw a revised system flow chart to indicate how the system runs the major steps of processing the information. This chart should include all the modifications which had been suggested and accepted.
14. Discuss the flow chart with the personnel operating the system so that they understand the system. Impress upon them that they should run the system as per the flow chart, and resist any deviations therefrom that would cause a disturbance in the system. Explain the modified system in such a way that the user would appreciate the changes.
15. Make a list of the outputs (statements, reports) containing information. Get the contents of the reports approved by the head of the department.
16. Analyse the requirements of the information and reports from the utility point of view. More the information, higher is the cost of its generation. Decide the utility based on the value of information.
17. Compare the costs of the old and the new system, and benefits offered.
18. Obtain approval of the new system from the users and the top management.
19. Write a system manual for use of the people in the department and for reference to the other users of the system.

## 8.9 SYSTEM ANALYSIS OF A NEW REQUIREMENT

It is not always necessary that the analysts are required to conduct the analysis of the existing system. In a number of cases when legacy systems have outlived their utility or a new business environment requires a totally radical approach, the analyst is called for redesigning the processes, practices and procedures.

Today's business world is beyond the four walls of the organisation. The vendors and the customers are being treated as trusted business partners of the organisation. This change in the management philosophy calls for a change in the information management function in the organisation. It cuts across all the facets of processing the data and the information, right from the input to the output and its distribution. The conventional confidential access to the information, and the practice of authorising a person to make decisions has undergone a substantial change. The decision centres in the organisation have been diffused and a substantial delegation of decision-making has taken place at the lower level.

The characteristic change in the organisation is that it is being looked as a process organisation as against a functional organisation. The work culture is changing from the single hierarchical command control principle to the collaborative working through work groups principle. These work groups are empowered to make decisions with an access to support the information. In such changed environment, the information system architecture, the design and processes, and the hardware-software configuration should be restructured to meet this changed requirement of information. The trend is towards building a system which is potentially flexible, adaptable to the new technology, easy to use, and which enables the user to meet his own needs through his knowledge and expertise.

The system analyst, in such a virgin situation of policy change, has to think globally, taking into consideration the technology, the user, and the business it serves. He is required to make analysis to evolve the system and the technology strategy, and configuring them to work for executing the business strategy through the information support. The system analyst has to choose between the client server versus the Host-slave processing strategy. He has to make a choice between the different variants of Unix OS, Windows NT and so on. He has to choose the language platform and select a variety of packages, and put them together to achieve the information support goal. He will also be confronted with techno-commercial issues arising out of the multiple vendors dealing with different technologies. Putting all the system components together to achieve the information processing strategy success is quite a complex job requiring a vision and a foresight.

Hence, the System Analysis and Design, in such situations, is an exercise at a macro level with a top-down approach in understanding the requirement.

The information system development cycle for a new application consists of the five major stages:

1. Definition of the system and its objective
2. Development of the system (Analysis-Design-Programming)
3. Installation of the system
4. Operations of the system
5. Review and evaluation

The details of this system development cycle are given in Table 8.5.

**Table 8.5** System Development Cycle

<i>Stages in development cycle</i>	<i>Steps in each stage</i>	<i>Purpose</i>
Definition of the system and its objective	Define the system and its elements. Determine the system boundaries and scope. Set the objectives for the system in line with the business objectives.	The stage assures clarity to the users of the system and the System Designer. The terms of reference are also set.
Development of the system	The system analysis of the existing business systems and changes therein.  System analysis of similar systems. Decision-making needs are identified and corresponding information needs are defined.  A feasibility of system is examined.	More clear understanding of real life situations, problems and weaknesses.  This step ensures that the information requirements are defined as a support to decision-making.
	A conceptual design of the system.  An initial prototype of the system	The technical, economic and operational feasibility is ascertained before a major effort is spent on the system.  The post feasibility understanding of the system for users and designer.
	Structured break-up of the system in the smaller subsystems/processes in hierarchical order for development.  Design a computer system output design, input design, processing design, procedure design. Flow charting the system and documentation. This includes a database design architecture and application development design.	The step ensures the supply of the basic information needs. It helps to refine and revise the information needs and then the conceptual design.  Helps to understand the system functioning and brings a clarity in the input and outputs of each subsystem.
Installation of the system and testing.	The system is tested and installed on the hardware for implementation. Switching over to computer system after thorough operational testing.	Ensures step by step approach to a computer system design and provides clarity to the user and designer through documentation.
Operations of the system	The system is operated in full course and existing systems (if any) discontinued.	The step ensures that the operational problems are resolved and the user gets live experience of the system. Modifications, if any, are carried out. Checks and controls are ensured through testing and the parallel runs.
		The user confidence is built and the designer simultaneously evaluates the performance of the computer system.

*Contd...*

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Review and Evaluation	A review is taken whether the system objectives are being met with and what are the problems in the smooth running. Steps are taken to resolve them.	This is an audit by the designer for improvement through test data and audit trail.
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Following the system development cycle approach is the best bet for the successful completion of any system project. The main advantage of the approach is that the process helps the analyst to conceive, develop, design and implement the system. Following the procedure provides the basis for management and control of the project as each step in the process is a well defined task.

The most important step in the process is the definition and the objectives of the system. Unless the user and the designer agree on this point, it will be risky to proceed further. The systems analysis is the second most important step in the cycle. The designers who spend more time on this step succeed in completing the project effectively. About 30 per cent of the time should be spent in the first two phases and about 10 per cent of the time in the post implementation review and evaluation. The prototyping step is a critical step where the user understands the system in the initial stage and helps to try out the ideas in the system leading to the process design of the information system. The life cycle procedure is a tool for the system designer. Its meticulous following is a safe method to accomplish the system objectives.

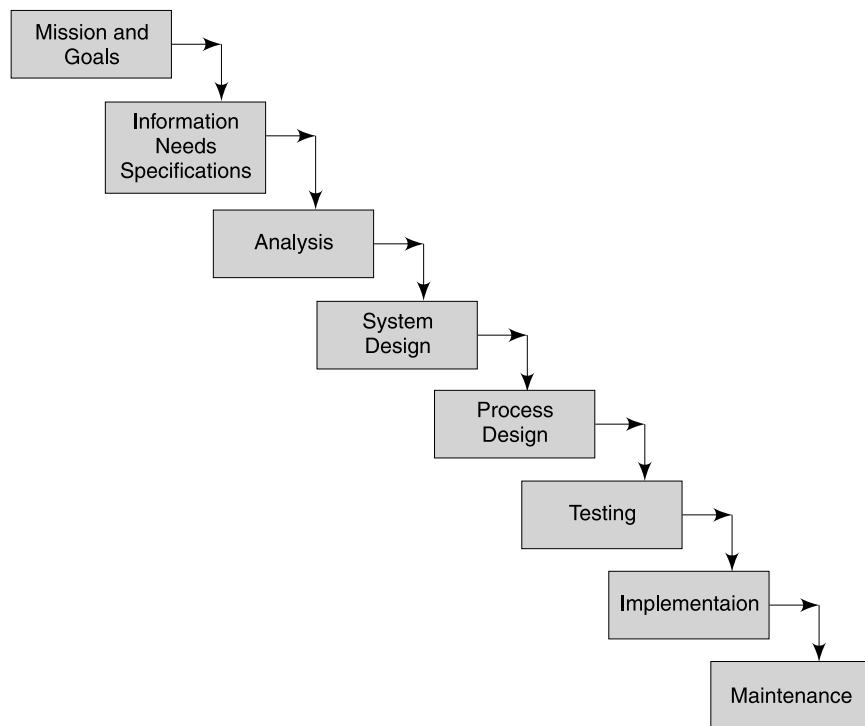
## 8.10 SYSTEM DEVELOPMENT MODEL

In order to design a good system, traditionally, the developers have used the Waterfall model as shown in Fig. 8.19.

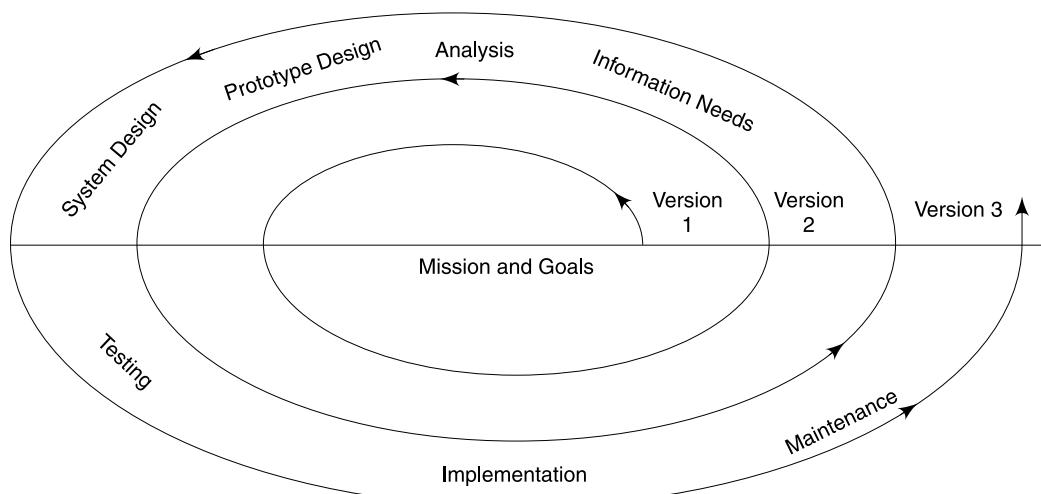
As waterfall flows from the top to the bottom, the system model shows the development process from the top to the bottom in steps. As water does not rise from a lower level to a higher level, it is presumed that once a step in the model is over, it is not required to go back. This model fits well when the changes into the requirement specifications are not required frequently. The minor changes can be taken care of through a maintenance process or through small design changes. The waterfall model applies well to the basic rule based data and information processing systems in accounting materials, production and personnel.

However, some systems are more dynamic and require changes in specifications more often to continue to be useful. These modifications are termed as the versions of the basic model. One of the popular model developed by Boehm is a Spiral model as shown in Fig. 8.20.

A spiral model fits well, when we are developing large systems, where the specifications cannot be ascertained in one stroke completely and correctly. Some of them get surfaced when the system is put to use after its testing. The continuous revision of these steps in the system development is very common and then the designers call them as versions. The new version provides an additional functionality, features, and facilities to the user, and addresses the issues of the users of the system viz. performance, response, security and so on, irrespective of which development model is used in developing the system. The user wants the system to be user friendly, reliable and effective, and one which gives correct results, while the developer wants, the system easy to modify, easy to understand, portable and compatible to other systems.



**Fig. 8.19** Waterfall Model



**Fig. 8.20** Spiral Model

The definition of a good system varies with the system's environment. In some systems the performance is the key measure of a good system while in other cases the ability to change fast is a key measure of a good system. In some cases the user friendliness could be a measure of good system. In all the cases, however, the correctness of the result is a common measure, making them reliable and dependable for the business operations.

The speed and response are the performance measures in case of large volume transaction based systems designed for real time applications. The flexible design is a measure of performance where the system needs continuous modifications to meet the revised requirements of the specifications. When it comes to complex system the user friendliness and the ease of operations become the measures of a good system. In other words, a good system design considers the environment and the users, and incorporates all the needs and expectations so that its utility is the highest.

### **The System Development Methods**

The traditional software development methods are the Structured Systems Analysis and Design (SSAD) by Ross; the Requirement Driven Design by Alford and the Structured Analysis and Structure Design (SASD) by Yourdon. All these methods deal with the functions and data separately. The modern methodology is object-oriented, where the functions and the data definitions are viewed together as an object.

A system developed with the SSAD and the similar approaches are difficult to maintain. The reason is that for each function and its behaviour the data structure is defined. The functionality behaves correctly under the conditions of the rigid data definition and structure. However, in real life the data format changes, calling for a change in the programmes to meet the revised format and its processing. The length of the programme and its complexity increases due to first checking the data condition, and then moving the control to an appropriate command set for its processing. The SSAD is, therefore, easy to understand but difficult to maintain. The user of the system does not think in terms of the data and its definition but thinks in terms of the functionality or process producing a result. In the SSAD approach, therefore, the user must have two views on the system to understand. The first view on the data and the second on its functionality. The two views create a problem of understanding the system correctly.

The Object Oriented Technology (OOT) approach differs from the SSAD approach. The difference is that the OOT views the system and then models it in terms of an item called the Object, where the function and the data are defined at its lowest level where changes rarely occur. The OOT views the functions and the data as one integrated entity. It reflects the requirements directly into the objects.

In the SSAD approach, the requirement is fulfilled through defining and associating the data for each function. While in the OOT approach the requirement is fulfilled, through the object(s) processing, where the object itself is based on the behaviour. If a new requirement arises the new object(s) view is taken and the model is modified in that portion only leaving the rest of the design and the programme structure as it is. In the OOT approach the changes boil down to the lowest level in most of the cases.

A good object model of the system does not require any changes at a 'Class' or 'Super Class' level. They are, generally, at the instance level. For example, in invoice preparation,

new functionality is required to calculate the invoice amount. In SSAD this would need a condition definition for recognition, then the changes in the data and process flow, further defining the output of the new requirement. In OOT the same situation would be handled by creating an instance where only the computing behaviour is different from the others. The instance is created by using the principle of inheritance. Hence the change in the system and the programme progress is only at the lowest level and is local, not running across the total model of the system.

In short, for a given business functionality the objects are defined in different categories and the system design is built through the objects and it is processed through object processing. Hence, in a business organisation to conduct a business, it requires the customer orders, purchase indents, material indents, work orders, purchase orders, receipts, issues, payments, delivery notes, packing notes, excise gate passes, invoices, bills, vouchers, etc. In the OOT usage the analysis is made of the business operations, and it is modelled into objects. For example, the object class 'ORDER' will handle all kinds of orders, viz., the customer orders, purchase orders, pay orders, appointment orders and so on. The objects are constructed for the documents, transactions and operations. The method which uses the objects in modelling and processing is called as the object oriented methodology.

Whether it is a Waterfall model or a Spiral model of system development, or whether it is the SSAD approach or object oriented technology approach of system development, the following steps of the development are common.

- Requirement Analysis
- Requirement Definition
- System Design
  - Input Design
  - Process Design
  - Output Design
- System Development
  - Structuring the modules
  - Developing the modules
  - Unit Testing
  - Integration of the Modules
  - Integrated System Testing
  - Implementation
  - Maintenance

The requirement analysis is carried out from the top downwards in the organisation hierarchy, linking the goals and the objectives of the business organisation, with the strategy mix decided to achieve them. In this phase the information needs of the individuals, groups and functions are analysed from a decision-making or a support point of view. Such information needs would fully satisfy the operational and management information needs. Once the needs are justified, the next step is to define them in clearer terms for the purpose of development. The requirement definition brings clarity in the content and its application in various ways in the organisation.

The third step is to design a physical and a logical system through which the outputs are designed. The processes which would give the outputs are determined, and the data which would be required by these processes is finalised in terms of definition, source, and quality. And further, the collection, creation, validation and storage of the input data is also decided.

The fourth step is to break the system design into modules in the hierarchical top-down structure of facilitate the development effort as well as its implementation.

Once the modules are developed, the unit testing is carried out to confirm data transaction and outputs' validity and accuracy. In this testing, the transaction level processes are checked to confirm the input-process-output relation, and the data storage and the transaction level updating.

When the unit testing is over and the module level processing is confirmed, the modules are put together to generate the information as determined in the requirement definition. The process of putting the modules together is a process of integration. It is intended to produce the results of data integration.

The system so developed is tested as a whole for several aspects such as information, quality, performance, utility, user acceptance and so on.

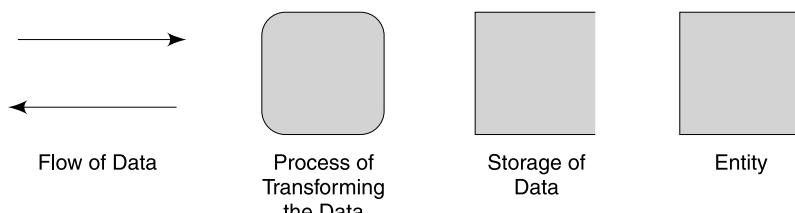
Once the system testing is complete, the system is implemented at site, on the hardware and software platform. The implementation step has its own procedure starting from the installation of the hardware and the software, training the users, and then shifting to a fully designed system. While implementing the system some minor modifications/adjustments, may be required for the ease of acceptance by the user.

Even after complete installation, the system may require modifications or changes in terms of functions and features over a period of time. The process of introducing these new requirements without disturbing the time tested basic system is called maintenance. Such changes are required swiftly and hence they are required to be carried out very easily. The system is designed keeping this natural requirement in post implementation period.

A good system design and its implementation has high user acceptance because it helps to solve the problems in achieving business performance.

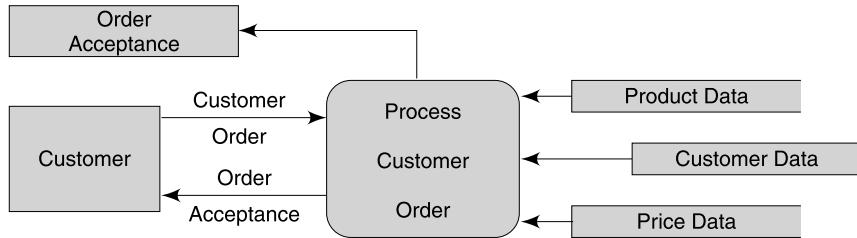
## **8.11 STRUCTURED SYSTEM ANALYSIS AND DESIGN (SSAD)**

The structured systems analysis develops a conceptual, logical, and graphical model of the system. It is developed with reference to the objective and taking into consideration the constraint under which the system operates. The model is developed with symbols as given in Fig. 8.21.



**Fig. 8.21** Symbols in SSAD

For example, the logical model of the customer order processing and issuing the order acceptance can be shown in the DFD model, using these symbols (Fig. 8.22)



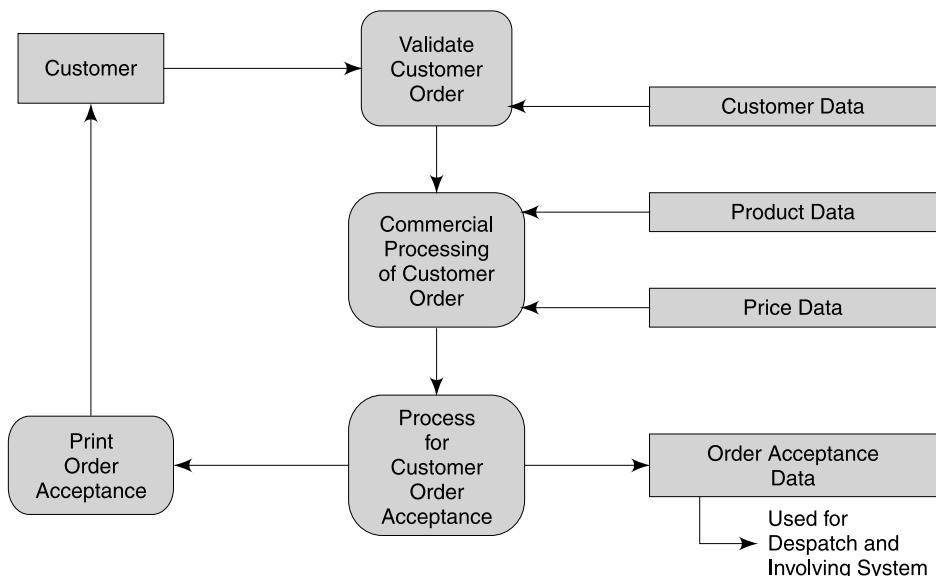
**Fig. 8.22** Data Flow Diagram

This model illustrates the following:

1. Documents in the system.
2. Sources of documents.
3. Process centre for converting the customer order into the order acceptance.
4. Use of stored data in the process centre.
5. Output or documents provided by the process centre and its destination.

Such dataflow diagrams (DFDs) provide a logical clarity in terms of input, output, use of stored data or master data already available in the system.

The use of DFDs can be made by detailing the system in a hierarchical manner. In this process, we are detailing the activities which are performed in the system in its logical order as shown in Fig. 8.23.



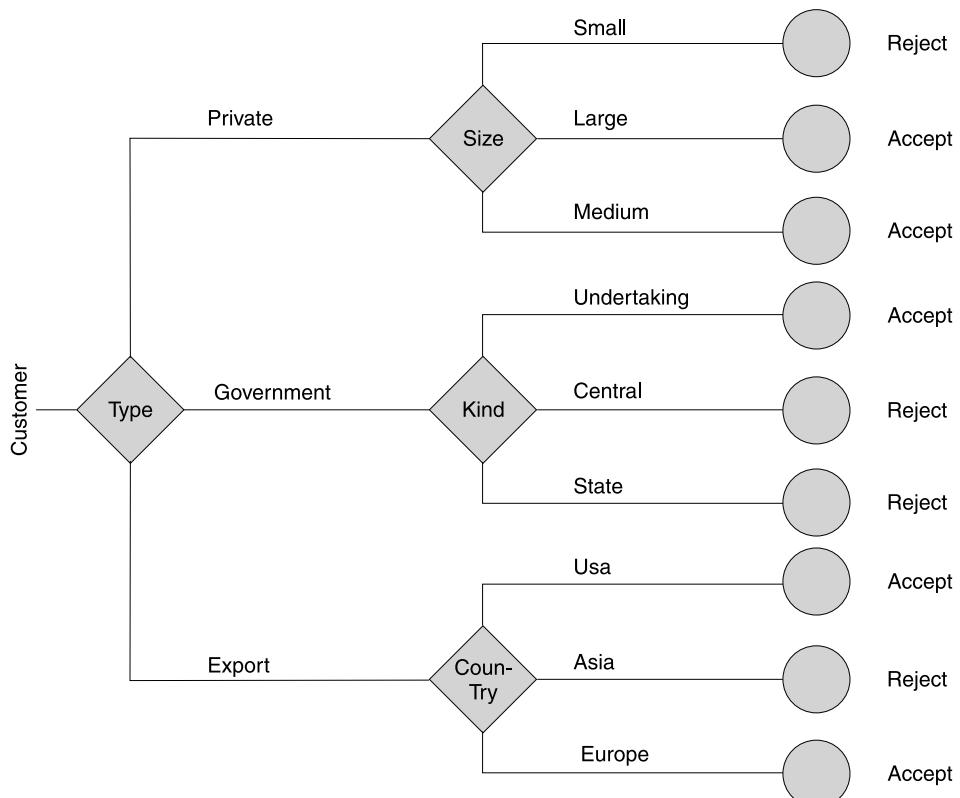
**Fig. 8.23** DFD of Customer Order Processing

In the example of order processing, the processing is carried out in three stages—validating, commercial processing and decision-making for customer order acceptance.

The main system is divided into three levels in its logical order. It conveys that unless the customer order is validated and commercially accepted, it will not be processed for an order acceptance decision. It also indicates that at each level, which stored data in the system is used.

After detailing the system in the DFDs, the system designer has to define the data in the dictionary. The data dictionary is an assembly of the data used in the system giving its picture definition and its use. For example, the customer is a data entity and its presentation in the dictionary will be defined with specifications. The customer name is defined of thirty character length and the pin code is defined as six character length.

The third task which the system designer undertakes is to define, in detail, the process of transformation in its logical order. For example, the process of the customer order acceptance validation will be graphically modelled as shown in Fig. 8.24. The figure shows the process design of the order acceptance decision.



**Fig. 8.24** Customer Validation: Process Model

The graphical model of the validation process indicates that this process decides whether the customer order is to be accepted for commercial processing. The decision of acceptance is based on the type of customer and further on the specifications such as the size, the type and the zone.

To summarise, the Structured Systems Analysis has three steps, viz., the modelling of the system in the DFDs, constructing the data dictionary and process modelling. The SSAD provides a methodology to the system designer to analyse the existing system in an orderly manner and enables him to put the proposed system in a logical order. Since the entire system is presented in a graphical manner, the communication with the users becomes easy and effective. Any change in the post-implementation phase is easy to implement as it is possible to know its implications on the other processes.

## 8.12 OBJECT ORIENTED ANALYSIS (OOA)

The purpose of OOA is to understand the application in terms of its functional requirement. The OOA contains the following steps:

1. Finding the objects—Object view of the application
2. Organising the objects—View the objects in terms of a relation representing an application.
3. Specifying object interaction—Identifies the objects association and relation to each other.
4. Defining the operations of the object—Mechanism to change the status.
5. Constructing the objects in terms of behaviour, attributes and parts—Model the object in a microscopic detail.

### Finding the Objects

The objects can be found in the area of application. They are the entities which are the role players in the application. Finding objects in the application means taking different views on the application for modelling. The first level search would be to find those objects which would remain stable throughout the life cycle of the application. The object is stable when it has very low probability of the change or modification in the life of application. The second level search would bring out those objects which are likely to change frequently. Such detail search of objects helps to create a model covering the application domain fairly close to reality.

The objects so chosen can be of different types. Jacobson\* proposes the types based on the characteristics, such as

- |                       |                     |
|-----------------------|---------------------|
| • Active/Passive      | • Private/Public    |
| • Physical/Conceptual | • Shared/Non-shared |
| • Temporary/Permanent | • Generic/Specific  |

An object is active when it plays a dynamic role in the application affecting a number of other objects or instances. An object in the application may have a temporary role to play till

\*Source: Ivar Jacobson, *Object Oriented Software Engineering*, Addison-Wesley

certain situation exists. The moment such situation vanishes the object will cease to exist. The object is generic when it exists in more than one application and behaves more or less in same manner. Some could be specific to that application. An object is private being typical to the organisation, while an object could be public when it is sourced from public domain and has some role to play in all business models. Some objects are sharable because of its nature of behaviour and attributes, while some objects are created for specific application to achieve unique functionality.

Examples of various types of objects are given in Table 8.6.

**Table 8.6** Objects and Their Types

Object	Type
Receipt	Active
Letter	Passive
Voucher	Physical
Internal A/C transfer	Conceptual
Credit card	Permanent
Discount coupon	Temporary
Inter office memo	Specific
Cheque	Generic
Passport application	Public
Membership application	Shared
Company address	Shared
Debtor's address	Non-shared

A typical object could have more than one characteristics and hence could belong to more than one type. For example, company's address is a passive, permanent and shared object.

### Organising the Objects

Once the objects are categorised in different types, the next step is to view them and group them by certain criteria. The criteria could be similarity of objects. For example, all types of orders, all kinds of bills are same in their role, functionality and purpose. This means large content of these objects are same and have identical behaviour. A criteria of objects working together can be chosen for their grouping. For example, all delivery related objects work together with the order objects. They are in a way dependent upon them. A set of objects do not have separate existence unless they are associated with other objects. There is a kind of dependency through association and relations with other objects.

### Specifying Objects Interaction

When we specify the object's interactions with other objects, we are positioning them in the object model of the system. A positioning of an object in a specified way generates a *usage* of

the object in relation to other objects. The moment positioning is changed, the systems behaviour would change. For example, the object 'customer order' takes part in the system of order processing. It also takes part in the system of manufacturing. The behaviour of customer order as an object is different in these two systems. If we identify the object's different positioning with reference to other objects we have described the systems view. The system designer must have the skill of identifying as many number of usage's of an object with reference to other objects. The process is called the object view of the systems through interactions.

### Defining Operations

The operation's definition is automatic when it is interfaced with other object. These operations are basic like create, add, delete, move, compute, etc. and they change object's current status to a new one when operated upon. For simplicity of design and its maintenance, the operations should be simple and not complex. If operation is complex, the objects should be split by more instances to have basic operations working on them in a simplified manner.

### Internal Constructions of the Object

Determining the internals of the object leads to the construction of the object. It specifies, parts attributes and behaviour of the objects. More precise definition of internals would lead to more objects and instances. The instances inheriting from other objects would share the information of the objects from where they inherit.

When the internal structuring of all objects is complete, behavioural interaction is specified, grouped and positioned in terms of relation, association, and interface with other objects, it is said to be the object view of the system. This is termed as *OO analysis model* of the system.

## 8.13 SYSTEM DEVELOPMENT THROUGH OOT: A USE CASE MODEL

System development is a complex task. It begins with the definition of the application domain for which the system is sought. The first step towards system development is to understand application user's requirement. Their requirements are presented by the user in terms of data, information and access needs. The user also has certain functional needs meaning thereby that application should be executed using certain methods, processes and practices. These are termed as functionalities. The user submits report formats and information controls also. In all these specification user, in addition specific certain decision making, messaging and control needs using the data and information generated in the system. Use case model is built on user's interaction.

The requirement specification emerges after close interaction with the people involved in the system. The people are decision makers, and initiators of the system to fulfill their role needs of responsibility and accountability in the system.

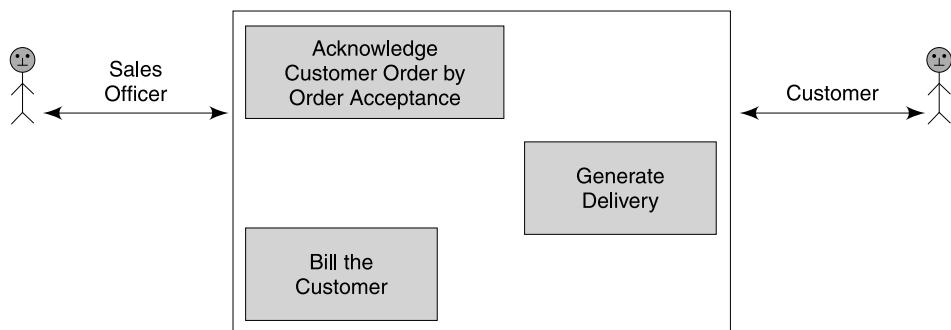
When requirements are enumerated, they need to be modelled for the understanding of the developers. The system developer will not understand and will not be in a position to use the requirement specification in a text mode. It needs to be modelled for ease of understanding and communication.

The requirement model is constructed by determining the following:

1. System domain which defines the broad scope of the system for which requirement model is to be built.
2. Process/operation function performed in the system is known as 'use case'. The use case is executed by external agency.
3. Interface which describes the associations and connection with other use cases which are objects of some type.

A use case when performed will generate an instance assuming a new status. The user of the application system triggers the action on the use case. In this process the user may perform on a series of use cases, and bring an instance from old status to a new status. On this new status, action is taken to generate stimuli to other objects and so on. The system performs through a series of executions of use cases in a particular order. A collection of use cases is termed as use case model of the application. A sales order processing application can be described using this concept of use case model.

Order processing, order acceptance, delivering the goods and billing the customer are the processes depicting certain functions. The system domain is explained in Fig. 8.25.

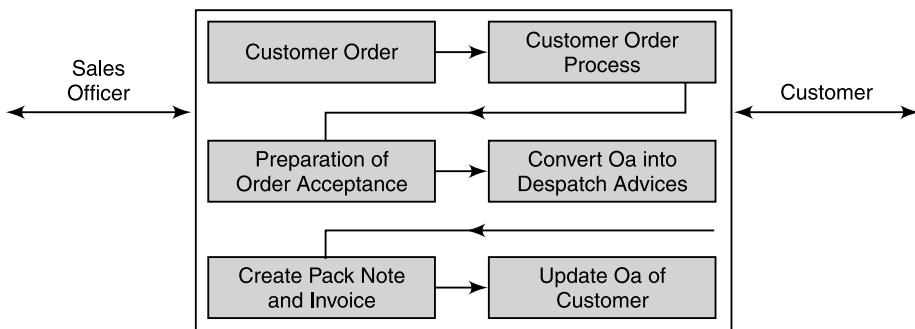


**Fig. 8.25 System Domain**

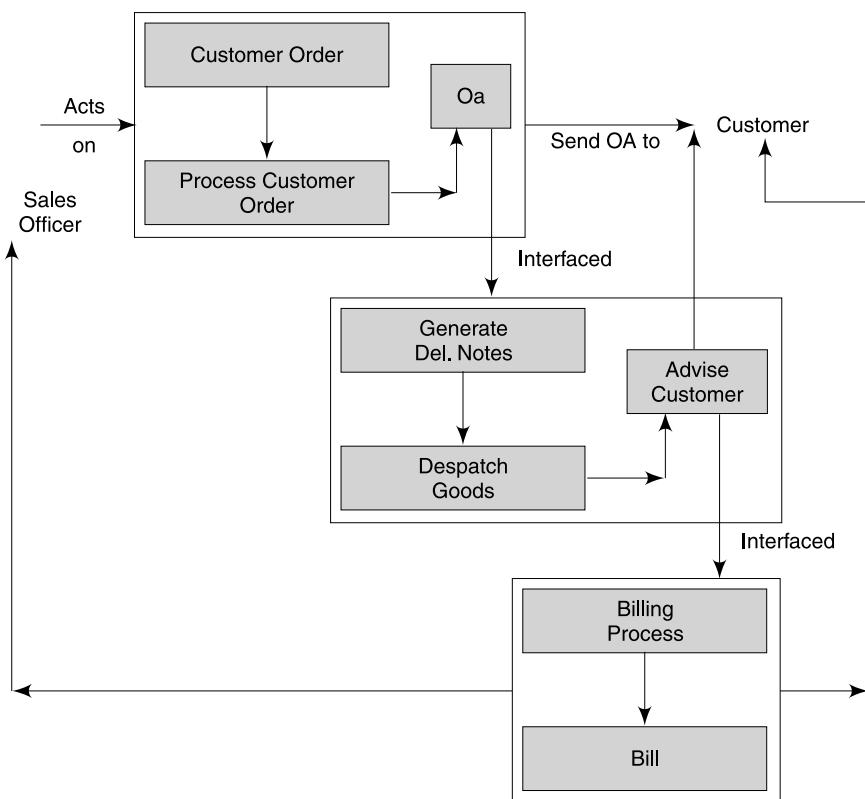
The object process of generation of order acceptance OA, is seen as three objects namely customer order, processing of customer order and outputting order acceptance. This process is interfaced with dispatch process, which in turn is interfaced with billing process. The user of this model is a sales officer and the beneficiary is the customer. Fig. 8.25 can be further expanded giving more object details of system domain as shown in Fig. 8.26.

Figure 8.27 gives use case model blow-up of sales order where the sales officer is acting through use case(s) and the customer is a beneficiary. It also shows interfaces working in use case model.

The importance of using use case method for modelling the requirement of the user is that we can discuss the model with the users before implementation. It is easy to understand as you can develop the model case by case. The use case approach helps to match user perspective of the system to its object model. The use case model uses the interfaces for blowing the requirement to a bigger comprehensive model, covering the system domain. Once the requirement model is built, it would form the basis for constructing analysis model, design model, testing model and implementation model.



**Fig. 8.26** Use Case Model



**Fig. 8.27** Requirement Model as Use Case Model

Having constructed use case model covering system domain, next step in the development is constructing an analysis model. The analysis model provides logical structure of the objects, showing for each information application through behaviour and presentation.

Jacobson uses three objects namely 'entity objects' 'interface objects' and 'control objects' for building analysis models. The entity objects hold permanent or almost permanent information throughout the life of the system. The behaviour using such information is also permanent and is part of entity object. The interface object models the behaviour and information, for the role the object is required to play, i.e., they take care of functionality of the object.

The objects work with the entity objects. For example, customer order processing requires interfacing with Product Master which provides techno-commercial information to initiate process operations. Further the customer order processing requires interfacing with a number of other objects such as manufacturing schedule, stocks, etc. When object is processed with interface objects, the functionality of the interfaced object is executed and the object status is altered. The control object by definition is autonomous in its behaviour and not dependent on any other objects related or interfaced. For example, all computing processes, which are universally accepted due to its origin from science and commerce, are control objects. The control objects could be methods such as cheque preparation, opening letter of credit, calculation of charges.

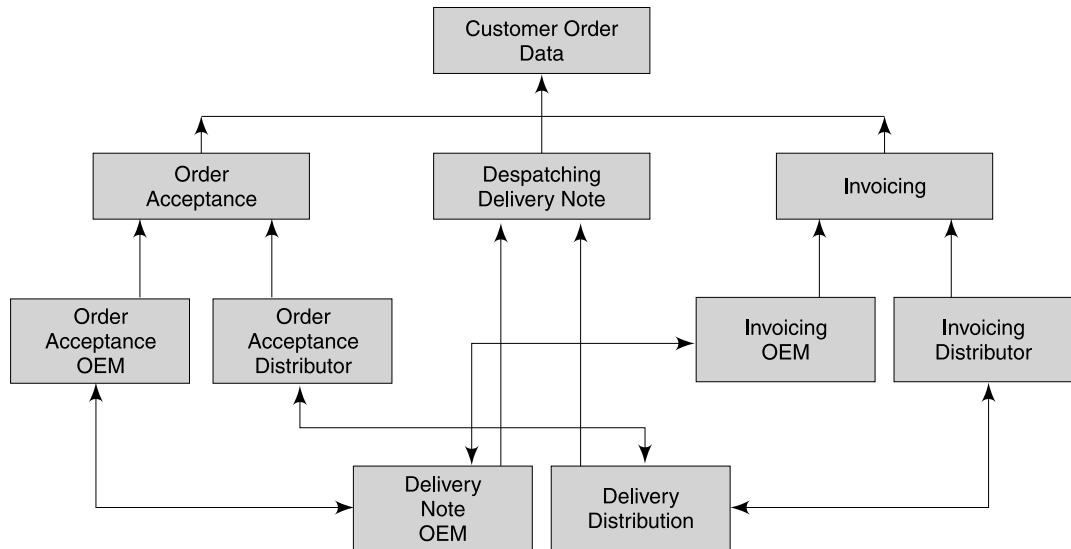
If we generate system objects in these three types namely entity objects, interface objects and control objects and structure them suitably, the object model of the system would be stable. The stability comes due to segregating the objects which are susceptible to change from the other objects. Modelling the system in three types of objects discussed above gives stable system. The purpose is not to make a rigid system but a stable system of creating least number of changes across the model. The changes in the system are in functionality and in associated interfaces. By definition entity objects are not affected by changes in the environment or functionality.

If change is in the interfacing objects it requires to change interface object and this change is local to that interface object. The change in functionality may give rise to change in information in the entity object or the interface object. In other words, if functionality is within any object then it affects those objects only. If functionality is in the interfacing object, then the interfaced object needs a change. If functionality is inter object then it affects control objects.

The OOT designer's skill lies in viewing the system in such manner that as many objects of the three types are created and placed properly through inheritance and encapsulation process, so that all changes as far as possible are local, affecting least number of objects. The objective is to build most stable and flexible system.

Let us take an example in sales system. A company sells goods to the customers and invoices them as the case may be. On analysis it is found that company sells goods to Original Equipment Manufacturers (OEM) and Distributor. Despatch of goods and invoice would be as per terms and conditions stipulated in order acceptance. In this situation, we can visualise several objects. One class of the object is dispatch advise the second is order acceptance, and third class of object is invoice. The interfacing objects could be packaging, loading, while control objects could be computing invoice amount, tax amounts, and net receivable invoice amount.

A global model of this sales system is shown in Fig. 8.28.



**Fig. 8.28** *Sales System Model*

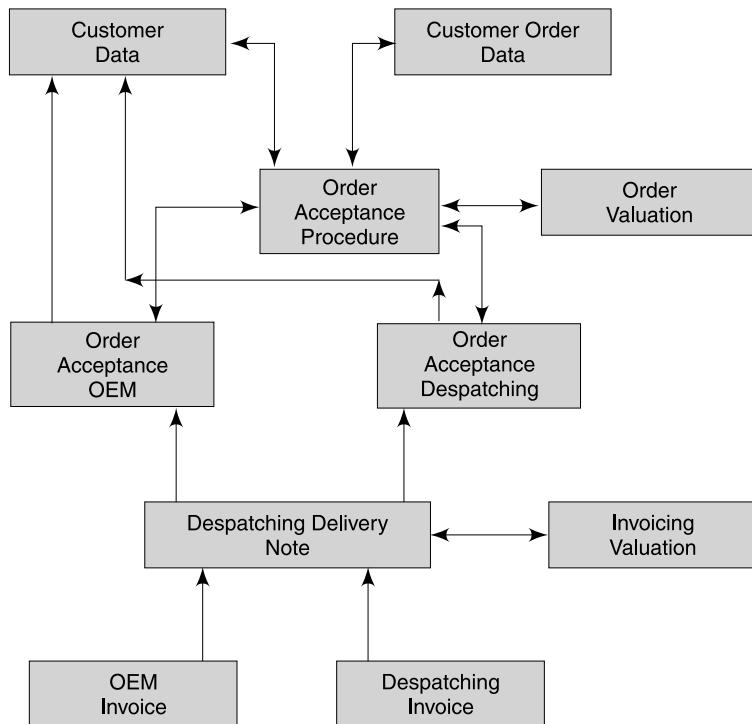
Let us take this model and discuss the aspect of a stable system. In this model objects are classified as under.

Entity objects:	Order Acceptance, Customer Order Data
Interface objects:	Delivery Note, Invoice
Control objects:	Computing of invoice amount, tax amount, and net amount

These objects are visualised on the basis of two main functionalities, sell to OEM and sell to the distributor, and respective interfacing with dispatch process. Invoicing is visualised as one object with OEM and Distributor invoice as instances.

This system model however has, following weaknesses: If new customer type is added, say consumer requiring different functionality of dispatching and invoicing, whole model gets changed at all levels including customer order data. The effect is not localised and limited. This has happened because we have tried to put number of responsibilities or behaviours or operations together in one object. Ideally, we should visualise the system and its model in much more detail using the concepts of entity, interface and control object. Revised sales model is given in Fig. 8.29.

It is important to note that this model is much more stable than the earlier one given in Fig. 8.28. Entity objects namely, customer data, customer order data are very stable. Interfacing objects namely order acceptance procedure, dispatching and invoice are susceptible to change but they are placed in isolation and any change in them is local. The control objects namely order valuation and invoice valuation can change more often and have been placed separate with one interface to other relevant object. The revised model is termed as stable because most of the changes are within the object affecting one or two objects. The clear

**Fig. 8.29 Revised Sales Model**

distinction is made between entity objects and control objects with behaviour precisely defined. Suppose new customer type is added where sale is direct to consumer, only the object, customer data and one more invoicing valuation would change in the model. The rest of the model operates with no change. The order acceptance, dispatching objects are not changed but the model would have two more objects namely Customer OA, and Customer-Invoice.

In the analysis model, objects are logically placed to describe full functionality of a typical use case. The use case functionality is a combination of several use cases which are the objects representing subfunctionality of the main use case. The objects whose role is dependent on systems environment are called as interface objects. The functionalities playing role of basic task like data handling, storage and not affected by any behaviour or operation are kept as entity objects. The functionalities which are specified in behaviour and which alter or affect the status are called as control objects. In terms of the system modification requirements over a period it is expected that most changes would come through control objects, some changes in interface objects if environment has undergone a change and no change in entity objects. Whatever change may be it is localised to these objects and not transmitted to other objects. In the analysis model, different types of objects are connected in a logical order using interface, control, and entity objects representing a use case main functionality and sub-functionalities.

On analysis of the objects, the design model is constructed. In construction phase each object's part, attributes and behaviour are defined. Then, its association and communication linkages are defined. New interface objects are thought to connect the object sets. This is organised with reference to each 'use case' behaviour. Once the design model is complete, it is taken for implementation.

## 8.14 OOSAD DEVELOPMENT LIFE CYCLE

The purpose of software development process is to transform users' needs into a software solution that satisfies their needs. The safe and least risk approach is to go through a life cycle process systematically.

The transformation takes place in the following three steps.

In step 1 Business analysis and information needs, problem statement and scope of work is established. In other words, it establishes complete RDD (Requirement Definition and Description).

In step 2 RDD is transformed to Solution Architecture and Design (SAD) and determines implementation platform and details of hardware, software, tools and technology.

In steps 3 SAD is transformed to a system comprising variety of applications, the software code duly tested for RDD fulfillment and packaging it a product as deliverable for installation, demonstration, and deployment at customer's site.

OOSAD Life Cycle consists of three parts.

- Object Oriented Analysis (OOA)
- Object Oriented Design (OOD)
- Object Oriented Implementation (OOI)

It is based on use case model. It has advantage, that all design decisions can be tracked back directly to user requirements and the usage scenarios can become test scenarios.

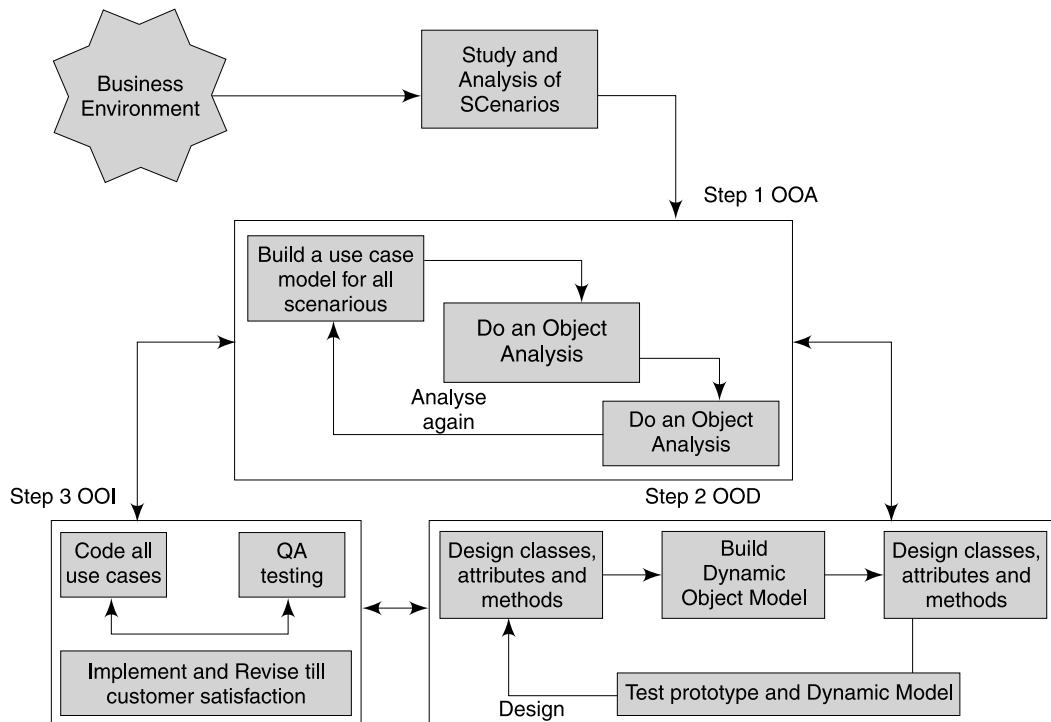
The activities in OOSAD life cycle are the following.

- |   |   |
|---|---|
| <ul style="list-style-type: none"><li>• OOA</li><li>• Prototyping</li><li>• Incremental testing</li></ul> | <ul style="list-style-type: none"><li>• OOD</li><li>• Component based development</li><li>• Implementation.</li></ul> |
|---|---|

The OOSAD life cycle is shown in Fig. 8.30.

The strength of OOSAD lies in reusability of code or components in a new system. Reusability by itself does not appear because it is OOSAD, but the analyst and designer has to take special effort and care that object is built with reusability character. It only comes through taking a object view independent of specific business need or scenario. Try to make objects as far as possible generic. Once reusable objects are built, the reuse strategy needs to be built on the following lines.

- Information hiding (Encapsulation)
- Conformance to standards
- Create a reusable object repository
- Insistence on reuse of the objects

**Fig. 8.30** OOSAD Life Cycle

### Unified Approach (UA)

The main driving force in UA is to combine the best practices, processes, methodologies and guidelines along with UML (United Modelling Language) notations and diagrams.

The methods and technology used are the following.

- Use of UML to model the different parts of object scenarios.
- Layered approach.
- Use of repository for OO system development
- Component-based development.

The strength of the UA lies in its capability of allowing you to go back and forth between design—modelling—analysis phases to modify as you go along with development. The waterfall model in SSAD does not allow backtracking at ease.

### ***Three Distinct Unique Features of UA are the Following***

- Modeling based on the Unified Modelling Language (UML)
- The UA proposed repository.
- The layered approach to software development.

### ***The Unified Approach using UML (UA)***

The unified approach is based on the best practices, that have proven successful in software development and more so on the work done by Booch, Rumbaugh and Jacobson in building unified approach. UA is not another methodology but it combines best practices, processes, methodologies and guidelines along with unified modelling language (UML) notations and diagrams for better understanding of OO concept, and its application in software development. UA uses following processes and concepts using UML.

- Use case driven development
- OO Analysis
- OO Design
- Incremental Development and Prototyping
- Iterative Development
- Layered approach to software development
  - View Layer
  - Business Layer
  - Access Layer

### ***OOSAD Methodology***

OOSAD method has following steps.

1. Define SOW (Scope of Work).
2. Determine requirement specifications (RDD).
3. Draw activity diagram of business process(s).
4. Build UML use case model.
  - Identify actors (users and benefitiones).
  - List and name use cases long with description.
  - Draw use case diagrams.
5. Draw UML interaction diagrams showing sequence and collaboration in each use case.
6. Draw UML class diagrams.
  - List business access, and view classes
  - List the purpose of each class
  - Organise 'classes' into super class, class and sub-class.
  - Prepare a table of class vs associated class.
  - Draw activity diagrams for methods stipulated in the class.
7. Prepare a test plan and test cases

### ***OO Analysis (OOA): use Case Driven***

Use case driven approach of analysis uses 'actor' as an external factor, which interacts with the system. The use cases are scenarios that describe how actors use the system. Once use cases are identified, they are used throughout in software development process.

A use case is a sequence of transactions interactions in a system whose task is to yield results of measurable value to an actor of the system.

OOA process consists of the following steps.

1. Identify the actors.
  - Who is using the system?
  - In case of new system, identify the users who could be the users of the system.
2. Develop Business Process Model using UML activity diagram.
3. Develop the use case.
  - How users use the system?
  - Document the details by use case for study.
4. Prepare interaction diagrams.
  - Determine sequence
  - Develop collaboration diagrams
5. Develop class diagram
  - Identify classes
  - Identify relationships
  - Identify attributes
  - Identify methods
6. Iterate and Refine: If needed, repeat Steps 1to 5 for improvement of analysis model.

It is necessary to understand the difference between users, actor and use case.

- User is an individual.
- Actor is a user with designation having specific role(s) in the system.
- Use case is the transaction.

Use case, actor and user are bound together by relation.

### ***Object Oriented Design (OOD)***

In OOA, the classes identified need to be revisited with a new focus of implementation. It is quite likely that new classes or attributes or methods may have to be added for implementation purpose.

1. Design classes, methods, attributes, and associations.
2. Examine class design for independence of components and minimum information content of the design. This would lead to uncoupled design with least information content. (Super class, class, subclass, etc.)
3. Design view/access layers and prototype design.
4. Test use cases to inform user satisfaction of the design.
5. Repeat the steps and test till workable design is constructed.

### ***The UA Proposed Repository***

In modern business, accepted practice is to us the best proven practice when similar requirement occurs. Best practice usage eliminates reinventing the wheel for solving each problem.

It ensures quality and consistency throughout the development ensuring quality of the solution. This is feasible as you are reusing a tested solution or best practice.

So, what is proposed is to create a repository that allows maximum use of precious experience and previously tested and used objects, patterns, framework/architecture and user interfaces. The repository gets built as you go along developing projects and capturing the experience. The assumption is that contents in the repository gets built as you go along developing projects and capturing the experience. The assumptions is that contents in the repository are reusable in a new scenario, as it has found place in repository because it is tested process and the best practice.

### ***The Repository Provided by Microsoft***

Visual Age, Power Builder, Visual C++ and Delphi contain all objects that have been previously defined and can be reused for building a new software for a new application. When new requirement emerges, it can be developed in best possible manner to find a place in a repository for reuse.

What has been said for objects is also true for behaviour. That is use patterns and framework of putting the objects together.

The repository so developed should be accessible to all concerned. The repository is a database of best practice having all good capabilities of DBMS.

### ***The Layered Approach to Software Development***

UA recommends three layered approach for development. The strength of three layered lies in the fact that it isolates the functions of the interface from the functions of the business and business from the details of the data access. To appreciate this strength, you would observe that most of two tier client/Server architecture tightly couple function—business—its data restricting free reusability or it calls for customisation as and when it is required to use in a new software development.

This is achieved through three layered approach namely

- Business layer
- View or user Interface layer
- An access layer

The three layers are so constructed that they can be modified at ease without disturbing the other layers.

***The Business Layer (BL):*** The BL contains all the objects that represent the business in terms of data and behaviour. The examples are order, customer, line item, inventory and invoice. The role and responsibility of BL is to model the objects of the business and also how they interact to execute the business process for achieving the business process goal. The BL objects are not responsible or accountable for displaying details and data access details. They stand in repository as independent of any display interface or how they are accessed. It does not matter to the business model whether the data are stored and retrieved via SQL or file I/O. The point will be appreciated if it is noted that objects are modeled in OO Analysis when display and access interfaces are not thought and worked at all.

In BL, business model captures the static and dynamic relationships among the objects.

- Static relationship means objects associations and aggregations. For example, customer could have more than one account, pay slip amount could be an aggregation of monthly wage, incentive, rewards.
- Dynamic relationships show how the business objects interact to perform tasks.

For example, order interacts with inventory to confirm availability of quantity before commitment is made to the customer. The cheque in a bank is cleared on confirming the balance or any special instruction.

The objects quoted in example can be used in all applications, where necessary, making their existence independent of function or application. BL contains control objects along with business objects to direct the application process of the business objects.

The business objects and control objects are caught in the process of use case analysis.

### ***The View or User Interface Layer (VL)***

VL consists of objects with which user interacts with as well as the objects which are needed to manage the interface. VL has a role and responsibility for the following.

***Responding to user interaction:*** For example if user clicks a particular button, VL must translate this action into meaningful result/response. The response could be 'send a message', 'open a menu', 'link to other page' and so on. It could be to open or close other interface or start a new process. VL does not have business logic. It only has knowledge of responding to action.

***Displaying business objects:*** VL has a role and responsibility display the object as per the user's need. For example in Product Analysis VL would display a graph of products sold in quantity and value. In another case, a display of data entry form or field.

VL objects are identified in OOD phase while use case analysis gives understanding of user interface requirement.

### ***The Access Layer (AL)***

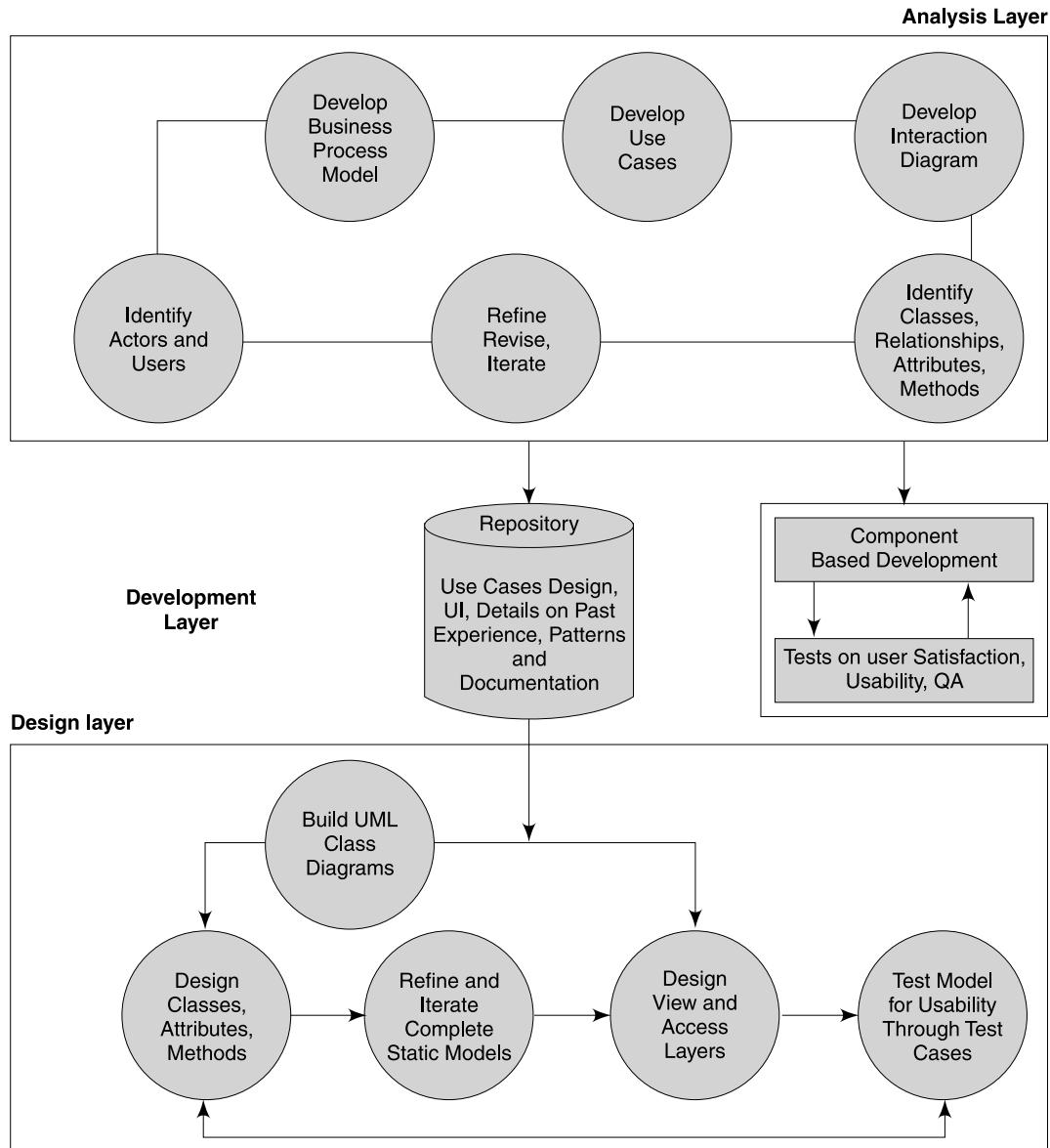
AL contains the objects whose role is to communicate with the place where data is actually stored. This could be database, mainframe, Internet or file. This role has no bearing on how data is stored and where it is stored. AL role and responsibilities are the following.

***Act on request or translate request:*** AL translates any data related request coming from business object from business layer. For example if employee code needs to be retrieved, AL must be able to create, access and retrieve the correct SQL statement and act upon it to get the code.

***Translate the results:*** AL, on translating the request and fetching the data, should then put it into appropriate business objects and pass the business objects up into business layer. That is, on retrieval of employee code, AL would pass it to pay slip business object for further action. The translation of request and use of results are based on the business objects used in the application.

In summary, UA is an effort to integrate best practices, processes, guidelines and development experience using UML (Unified Modelling Language) notations and diagrams for

understanding OO concepts and methodology. The Layered Structure of Unified Approach to Software Development in terms of processes and components is shown in Fig. 8.31.



**Fig. 8.31** *Layered Structure of UA*

### Unified Modeling Language (UML)

The Unified Modelling Language (UML) is a language for specifying, constructing, visualising and documenting the software system and its components. It is a graphical language

with set of rules and semantics. UML is not intended to be a visual programming language. It however, does have close mapping to a host of object oriented programming language. UML is used in unified approach (UA) for conducting OOSAD.

UML is developed mainly by Grady Booch, Ivar Jacobson and James Rumbaugh and many others contribute to this effort. It combines Booch's 'methodology,' Jacobson's 'Use case,' and Rumbaugh's object modeling technique. The UML is a universal language for modelling the systems. UML notations and standards in detail are covered later in this chapter.

### ***Application of UML***

UML is used for modelling the project scenario in different models.

- **Use case Model**  
Defines the outside and inside of the system behaviour.
- **Domain object Model**  
Objects of the project are mapped into the domain object model.
- **Analysis object Model**  
Presents how the source code should be written.
- **Implementation Model**  
Represents the implementation process of the system.
- **Test Model**  
Specifies test plans, specifications and test reports.

These models are used in an iterative process to perfect the model to real project scenario. UML is used to build two types of models.

**Static Models:** Represents the structural aspects of the system, which demonstrates stability and absence of change in data over a time.

**Dynamic Model:** Represent all procedures or behaviours the system would process over a time.

Software is developed for the project first by developing its static model as a base line and then going for dynamic model to incorporate change to the objects and their relationships over time.

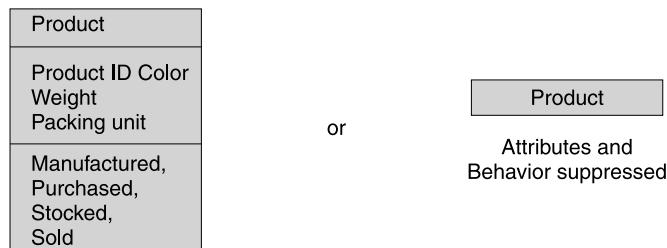
### ***UML Diagrams***

UML is used for diagramming different independent views of a model. Four graphical diagrams are proposed to represent the model to be used for software development.

1. Static Class Diagram
2. Use case Diagram
3. Dynamic Behaviour diagram (Interaction Diagram)
  - Sequence Diagram
  - Collaboration Diagram
  - State chart (state) Diagram
  - Activity Diagram

4. Implementation Diagram
- Component Diagram
  - Deployment Diagram

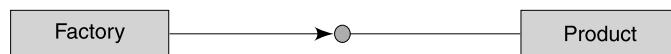
### **1. Static Class Diagram**



- A static object diagram is an instance of a class diagram.
- A class would be related to the other class through interface operation and association role.

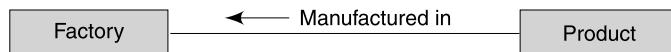
*Example:*

- **Interface notation**



'Factory' would require to interface with 'Product' to know the stock.

- **Association role**



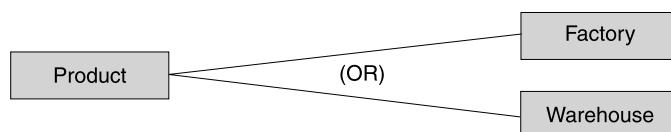
The association role may be in multiplicity.

The multiplicity of association is shown by range of integers in the format.

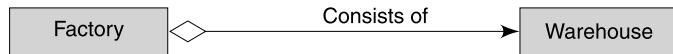
'Lower bound.....upper bound.'

The \* character is used to show unlimited upper bound.

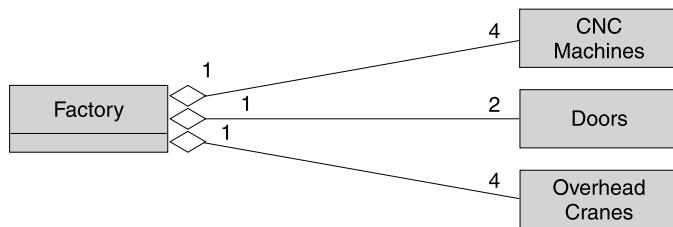
- An (OR) association is used when only one of the two associations are possible at one time.



- Aggregation is a form of association. It is shown by hollow  $\diamond$  diamond.



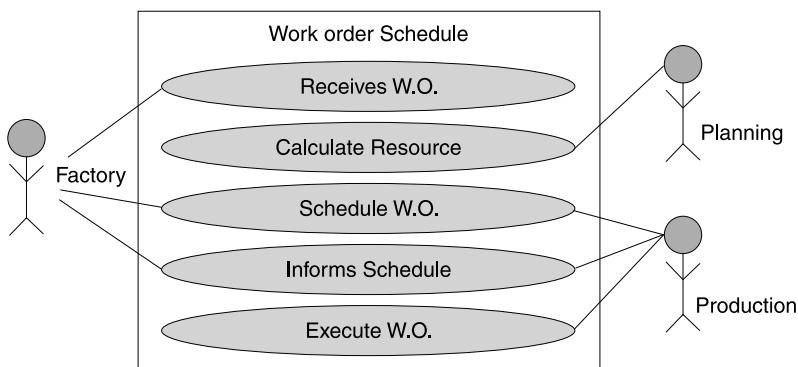
- Composition is a form of aggregation used to show a component of a complex object. The composition is shown by thick  $\diamond$  diamond.



The composition of factory is four CNC machines, two doors and four overhead cranes.

## **2. Use Case Diagram**

A use case diagram shows the relationship among actors and use cases within the system.



There are four use cases in work order schedule system and system is acted upon by three actors. The actor notation is as shown.

$\ll$  Factory Manager

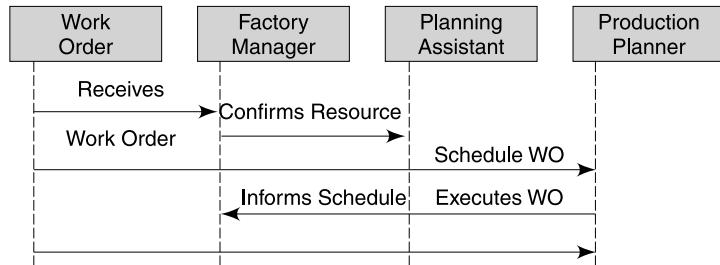
The relationships between use classes are of the following three types:

- Communication** The actor communicates with the use case shown by solid path.
- Uses** Relationship between use cases is shown by generalisation arrow from the use case.
- Extends** Relationship which shows that one use case is similar to another and also a bit more that one use case is a subclass of another use case class.

## **3. Dynamic Behaviour Diagrams (Interaction Diagram)**

These diagrams are used to show the behaviour of the class's instance with associated object class. These diagrams are known as interaction diagrams.

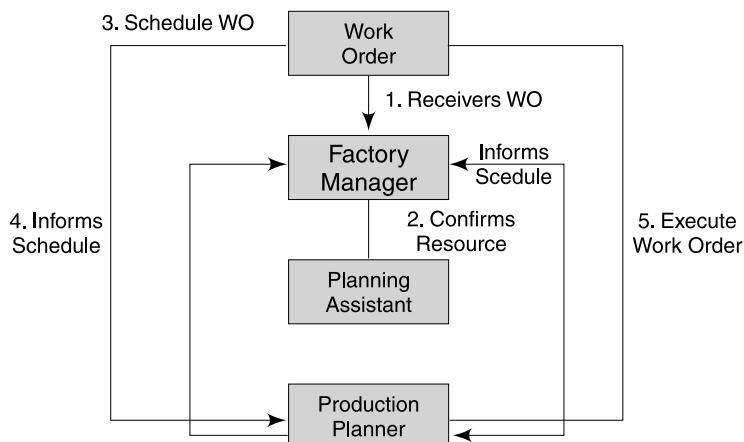
- Sequence Diagram



Sequence Diagram shows in sequence of time the interaction between two actors.

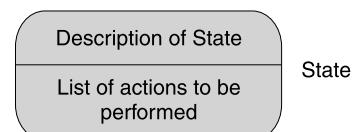
- Collaboration Diagram

The Interaction diagram (i.e. sequence and collaboration diagram) shows the behaviour of objects within a single use case. The example shows behaviour of use case 'Work order schedule'.



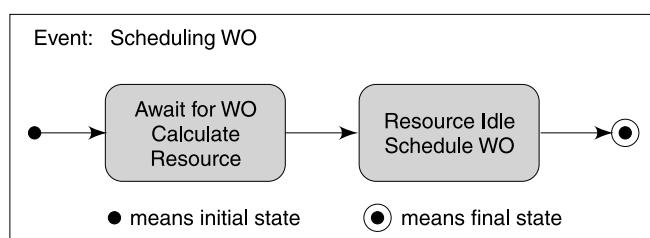
- State Diagram

This diagram shows the states through which object will go through as response to the actor action. The state diagram focuses on events occurring as a response to messages.



A State Symbol is

A nested state is shown by series of sub states.



- **Activity Diagram**

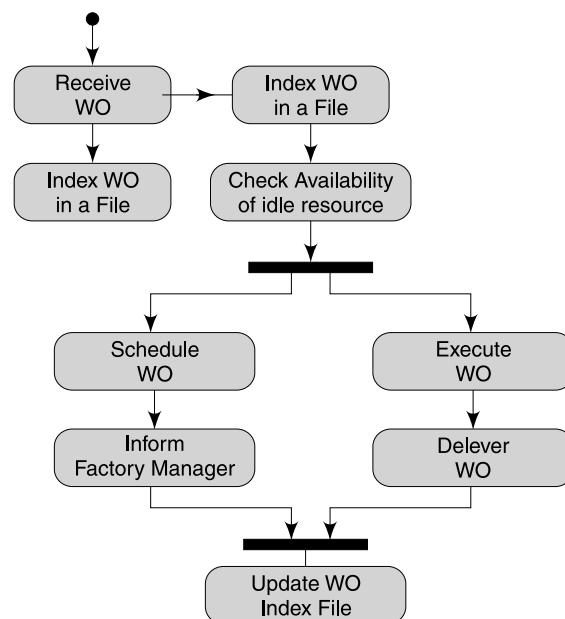
An activity diagram is used to show a business process made of series of events (shown by state diagram). The purpose of an activity diagram is to view the flows and what is going on inside a use case.

Activity Diagram for use case. Work order schedule.

**4. Implementation Diagram** Implementation diagram shows source code structure, run-time implementation structure.

The types of diagram used are two

- Component Diagram  
for showing source code structure
- Deployment Diagram  
for showing the structure of run – time system.
- **Component Diagrams**



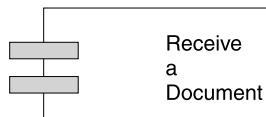
These diagrams model the physical component such as source code, executable program and user interface.

Symbol for component Diagram is

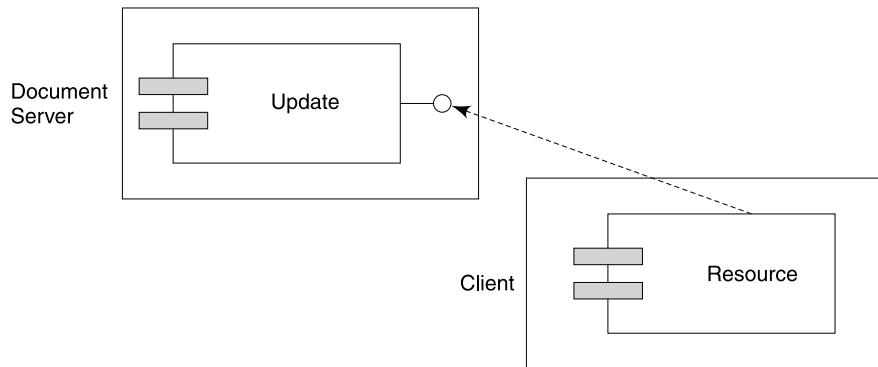
If a ‘component’ is dependent on other component, then dependency is shown by dashed arrow

- **Deployment Diagram**

Deployment Diagram shows the runtime system configuration of the component.



The component diagrams are used along with deployment diagrams to show how physical modules of code are distributed on various platforms. The symbol for deployment diagram is

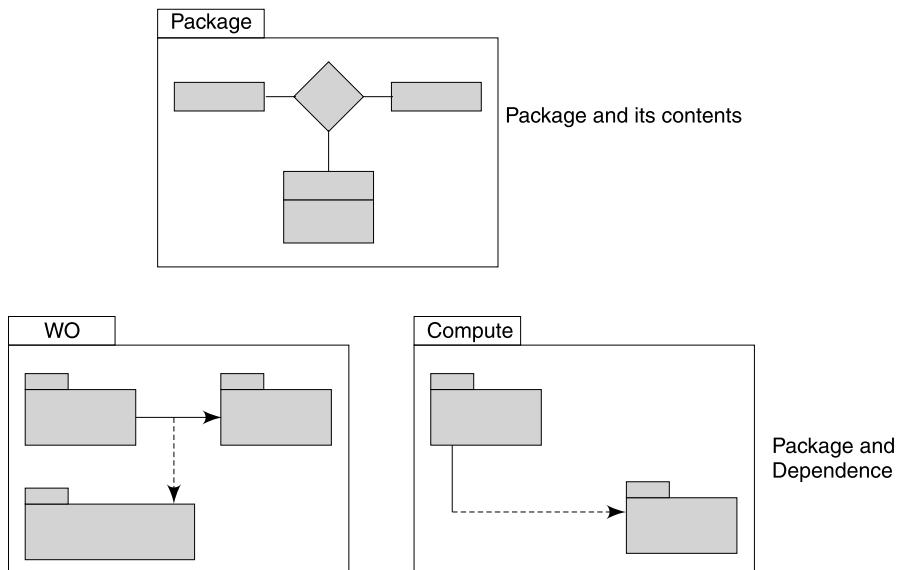


The process of receiving a document and updating is deployed on two platforms, namely Document Server and Client, with respective components locked on each platform.

The deployment diagram is a graph of boxes containing components connected to each other by dashed arrow to show the dependency.

### ***UA Model Management***

Model is managed through packing all diagrams. A package symbol is



So a software project is made of various modules using different components. The use of package symbol shows the model of software. Each symbol shows a physical component of the model. The model can be presented in a top-down structure.

## KEY TERMS

Active/Passive Object	Object Oriented Analysis
Black Box	Object/Class/Instance
Clustering	OO Languages
Computer System Design	OOSAD Life Cycle
Control Objects	OOT
Control System	Open and Closed System
DFD of a System	Shared/Non-shared Object
Enterprise Management	Simplification
Entity Objects	SSAD and OOSAD
Factorisation	System Development Models
Functional System	System Entropy
Generic/Specific Object	System Flow Chart
Integrated Information System	System Model
Interface Object	System Scope and Boundaries
Negative Entropy	UML Based System Diagrammes
Network of Business Processes	Unified Approach
Object Model of Enterprise	Unified Modeling Language
	Use Case Model
	Waterfall Model and Spiral Model

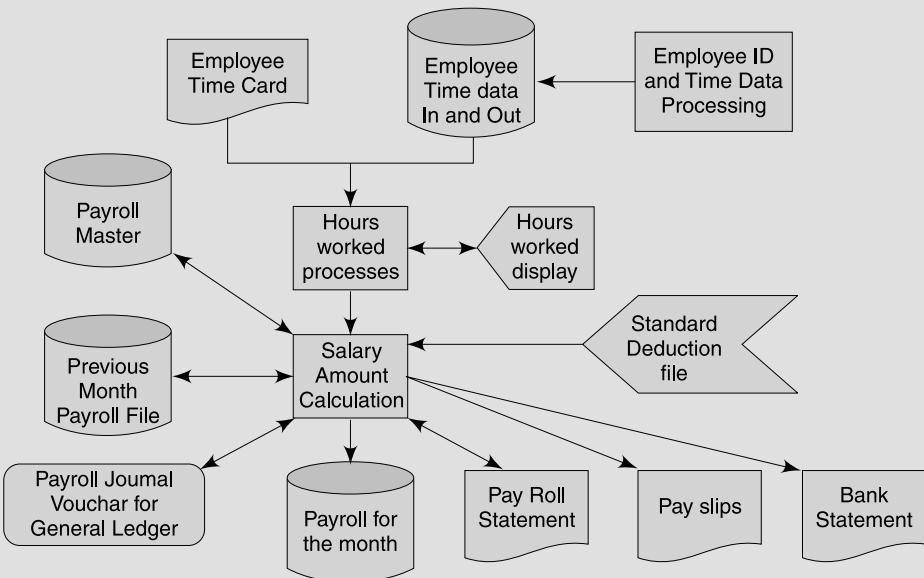
## REVIEW QUESTIONS

1. What are the components of a system? How is the system model improves from simple 'Input-Process-Output' model to complex control model?
2. How do you relate and interact with external environment in the system? Is it possible to insulate the system from the influences of the external environment?
3. What are the methods of handling the business systems for understanding, analysis and design of MIS? What benefits do you get?
4. What is the meaning of System Performance? How do you measure efficiency and effectiveness of the system? Do you need both or any one for a system?
5. Explain the concept of entropy used in system control? How would you use this concept in MIS?

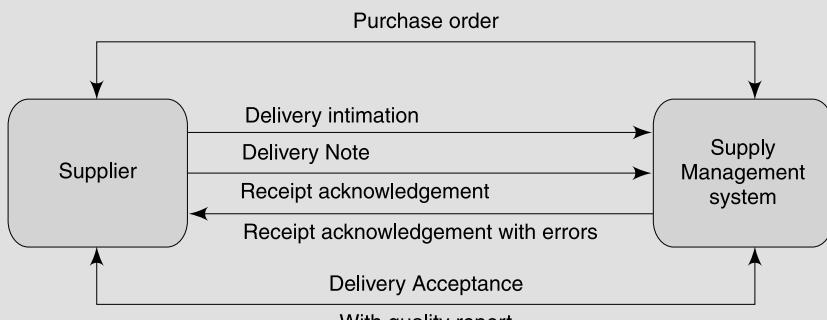
6. Apply your understanding of system concepts to organisation and explain how they are used in organisation as a system?
7. What are system reviews necessary? How often should such reviews take place? How do you decide?
8. Why are certain system short-lived? What care would you take in designing the system so that they are useful for longer period?
9. What are the good qualities of a system designer? How are they relevant?
10. Take a sales order processing system and break it in hierarchical structure showing all subsystems and their relationship.
11. Classify the following systems as either open or closed with reasons thereof
  - (a) A Chemist shop
  - (b) Security system at the factory gate
  - (c) Milk distribution system
  - (d) Mail delivery system
  - (e) ATM system
  - (f) Stock trading system
  - (g) Project planning system
  - (h) ERP system
12. Identify Data Processing, Transaction Processing, Application Processing, Functional Performance Processing, Decision Support Systems, and Document Management Systems in the following organisation.
  1. Shopper stop/Mall
  2. Bank branch
  3. Outpatient department in hospital (OPD)
  4. Online loan application processing system
  5. Sugar Mill
  6. Insurance office
13. You have an assignment of automating following system using information technology and network. As a pre-requisite take a view of the following systems in terms of subsystems, control and hierarchy.
  1. Withdrawal of cash from bank using withdrawal slip or cheque drawn on 'self.'
  2. Insurance claim processing taking into consideration, vehicle damage and repair report with estimate and policy.
  3. Returning the raw material to vendor.
14. A chemist at the end of the day submits a purchase requisition of medicines to the medical distributor on the website. On submission of the request, response display is shown about acknowledgement and promise to delivery the quantity. The chemist then acknowledges and confirms the acceptance of proposed deliver. Next day medicines are delivered and chemist acknowledges the delivery and bill.  
Identify the input data, processing routines, and output in this system. What care system should be taking to ensure quality aspect such as
  - Requisition is correct in all aspects.
  - Integrity of requisition content at distributor location before making a commitment.
15. What could be the reasons of entropy and what measures you would suggest as negative entropy in the following system.

- Courier Service: delivery cycle increased by 24 hours, increase in complaints about non-delivery.
  - Slowing down of processing and system stoppage.
  - Certain user queries and monthly reports not used at all.
16. What are the system exceptions possible in the following cases, which should be highlighted and reported?
- Material report against purchase order.
  - Customer order confirmation with credit analysis.
  - Customer order delivery delays.
17. What is audit trail? Why should it be specified? What does it achieve? State the audit trail in the following cases.
1. Payment voucher processing
  2. Bill processing
  3. Calculation of salary payable days
18. Use DFD symbols and draw dataflow diagram for issuing a purchase order for a standard inventory item.
19. What is the purpose of system flow chart? How it is different from DFD?
20. Why is input design important? Can it always be linked to output design?
21. What is data mapping and why it is done?
22. How is systems analysis approach different in new system requirement as against existing one?
23. What is SSAD? Explain the mechanics of structured analysis.
24. Requirement analysis and definition is the foundation for any systems development. It is independent of the approach you take for analysis and design. Explain.
25. Explain the following:
- Data Design
  - Process Design
  - Output Design
- How are they dependent on each other?
26. Take any small system of your knowledge and perform the following:
- (a) Define system objective(s).
  - (b) Draw document flow chart, system flow chart.
  - (c) Define the input and input document.
  - (d) How are they processed?
  - (e) Draw document versus user matrix.
  - (f) Draw data and information versus user matrix.
  - (g) Find the reports in the system and who all are using them.
  - (h) Write a note on the utility of the system to the direct users, indirect users and the management.
27. Draw a logical model and dataflow diagram for the following systems. Choose your system scope and system boundaries.

1. Fixed deposit system
  2. Credit card bill processing.
28. Suggest input validation in following cases.
1. Fixed deposit system
  2. Credit card bill processing
  3. Order configured by the customer
29. Write a text of the system flow modelled in the flow chart below. Explain each step in detail.



30. Explain functional decomposition of the system and levelled DFDs. Use following context diagram and develop Level 0 DFD, and Level 1 DFD.

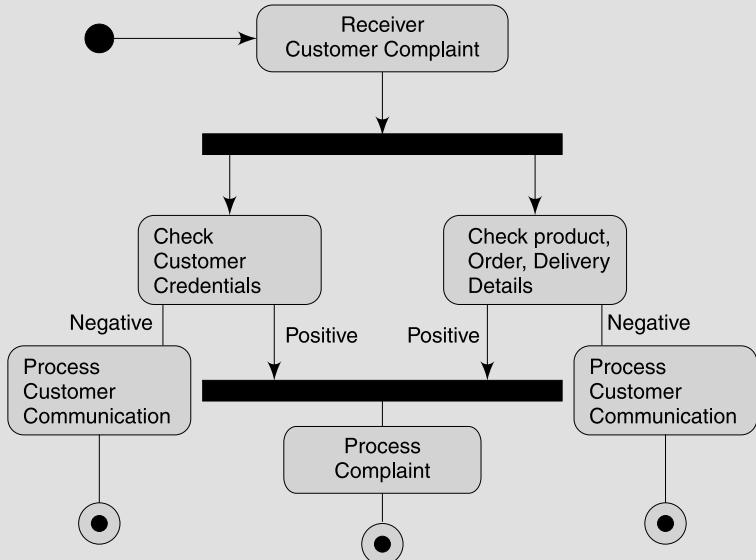


31. Write in case of 'Recipient acknowledgement' considered in question 14; the details of
  1. Input design
  2. Input Validation
  3. Process design
  4. Output design
32. What is an object? What is a class and a superclass? In OOT application, why are both class and superclass necessary?
33. How is object modelled? Explain its components.
34. What are the different object types? Why it is necessary to understand the types?
35. What is data oriented design and object oriented design? Where does object oriented design score over data oriented design.
36. In object orientation, far more system study is required as compared to data oriented design. The success of 'OO' design depends on object model. Explain.
37. What is inheritance? How is it used in OPD? Give an example of an inheritance, and multiple inheritance.
38. What is 'Use case method' of application design? How are different types of objects used in use case approach of object oriented design?
39. Has object oriented design approach solved all the problems of conventional design-based on data design? Explain your answer.
40. Can you put following subjects in object model?
  - Family
  - Automobile
  - Receipt
  - Bank Account
  - School

Explain the use of various properties of the object design which are used in modelling.
41. Object oriented systems are difficult to design but easy to maintain. Explain.
42. Create two or three classes linked by associations to represent the scenarios below. Specify relevant multiplicity and type of association.
  - (a) A student signing for courses in E-learning programme.
  - (b) A Librarian issuing books to member.
43. Draw aggregation diagrams for following scenarios.
  - (a) Vehicle & vehicle parts.
  - (b) Purchase order & Item ordered.
44. Identify the potential classes in the following systems:  
Bank Account Management System  
Fixed Deposit Management System
45. Label the classes found in problem 13 using following titles.

Active/Passive	Generic/Specific
Physical/Conceptual	Private/Public
Temporary/Persistent	

46. Describe in text the following activity diagram.



## CONFIRM YOUR UNDERSTANDING

1. A system is described in terms of input, \_\_\_\_\_ output, \_\_\_\_\_ scope and \_\_\_\_\_.
2. A system has to be \_\_\_\_\_ and \_\_\_\_\_ for the \_\_\_\_\_ it is designed.
3. A preventive measure to check negative entropy is a \_\_\_\_\_ review, assess user \_\_\_\_\_ and conduct \_\_\_\_\_.
4. A system without a \_\_\_\_\_ component is sure to fail.
5. A system is deterministic when input, processes and outputs are known with \_\_\_\_\_.
6. A system is probabilistic when output can be predicted in \_\_\_\_\_ terms.
7. Complex and large systems are handled through \_\_\_\_\_ subsystems and \_\_\_\_\_ clusters.
8. Correction to decaying system is done through \_\_\_\_\_ management system.
9. MIS is an \_\_\_\_\_ system calling frequent \_\_\_\_\_ and \_\_\_\_\_ and \_\_\_\_\_.
10. MIS has three subsystems knowledge-based management system, \_\_\_\_\_ processing system and \_\_\_\_\_ system.
11. Systems analysis helps to \_\_\_\_\_ the system and to assess the feasibility in terms of technical \_\_\_\_\_ and \_\_\_\_\_.
12. System analysis helps to identify \_\_\_\_\_, decision makers, and \_\_\_\_\_.

13. Waterfall model is good for stable systems while spiral model is good for evolving and continuous \_\_\_\_\_ systems.
14. System flow chart helps to understand \_\_\_\_\_ of the process in the system while DFD helps to understand \_\_\_\_\_ of data, \_\_\_\_\_ working on them and \_\_\_\_\_ delivered by them.
15. Modern approach to system development is \_\_\_\_\_.
16. MIS development model uses \_\_\_\_\_ model because MIS is a \_\_\_\_\_ system requiring continuous change.
17. Basic data and transaction accuracy is ensured through \_\_\_\_\_ and \_\_\_\_\_ at each stage of its execution.
18. Complexity of a system increases with complex data \_\_\_\_\_ and \_\_\_\_\_.
19. A control system components are sensor \_\_\_\_\_ standard/target and \_\_\_\_\_.
20. DFD explains \_\_\_\_\_ and system flow chart explains the flow of \_\_\_\_\_.
21. System feasibility study examines technical success, \_\_\_\_\_ and operational \_\_\_\_\_.
22. In object orientation, the behaviour of the object is \_\_\_\_\_ by ordering the object to perform the operations by \_\_\_\_\_ from other objects.
23. OOT structure is based on \_\_\_\_\_, \_\_\_\_\_ and instance hierarchy.
24. Objects are built through \_\_\_\_\_ from its \_\_\_\_\_.
25. An object is \_\_\_\_\_ when it plays dynamic role in the system affecting number of other \_\_\_\_\_.
26. Some object by design are \_\_\_\_\_ due to its attribution.
27. OOSAD is \_\_\_\_\_ /user driven while SSAD is \_\_\_\_\_ /task driven.
28. System is modelled using \_\_\_\_\_.
29. UA is use case driven, based on \_\_\_\_\_ and \_\_\_\_\_ and uses layered \_\_\_\_\_ to software development.
30. OOSAD progresses through use case diagrammes, \_\_\_\_\_ diagrammes and \_\_\_\_\_ diagrammes.
31. Object technology helps to build reusable objects and sourcing these objects from the repository saves the cost of system development.
32. OOSAD life cycle is made of three parts Ooanalysis, \_\_\_\_\_ OO implementation.
33. Unified Approach (UA) combines \_\_\_\_\_ developed by Rumbaugh, Booch and Jacobson.
34. UA uses UML and uses four sets of diagrams, Static class, \_\_\_\_\_ and Implementation diagrams.
35. Use case diagram explains \_\_\_\_\_ of actors in the process scencrio.
36. Capability of OOT to effect change quickly helped in \_\_\_\_\_ design of MIS.
37. SSAD abstracts \_\_\_\_\_ behaviour. OOSAD abstracts user behaviour.


**CASE STUDY**


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## 1. ABK MARKETING COMPANY (AMC)

*(Understanding of the System)*

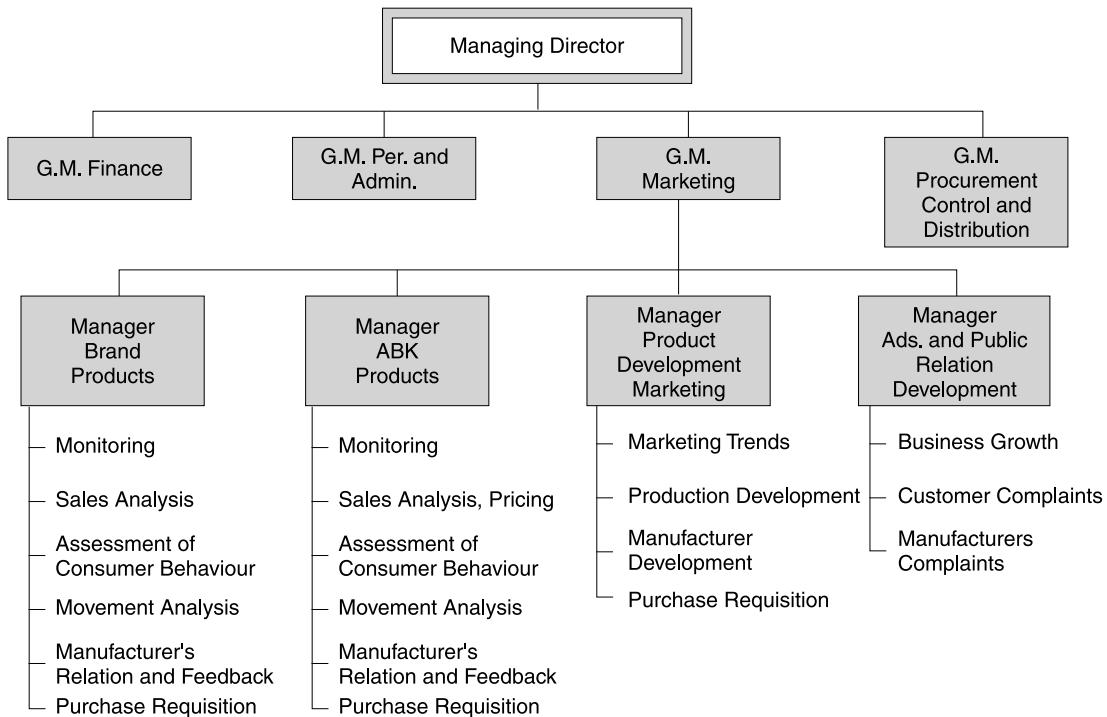
The ABK Marketing Company markets several household consumable products. The product range is packaged food, cosmetics, soaps, detergents, toothpastes, confectionery, biscuits, etc. It sells the popular brands of required manufacturers. It also evaluates the products of smaller manufacturers and markets them under its brand name 'ABK.' The variety and the range of products is so wide, that on item basis, the number will be over 5000 items. The ABK Marketing Company has warehouses in all the big cities and towns stocking these items for sale and distribution. The warehouse stocking polity considers the market it covers. The stocking levels are decided based on the demand and the lead times of supply.

The system of distribution is as follows:

Each city or town is divided in routes, which are assigned to a travelling salesman. Each store or shop on the route is coded by the ABK Marketing Company with all the necessary details such as name of the store shop, its address, turnover, locality, population statistics of the area in which the said store/shop is situated, the income group, etc. A travelling salesman is assigned a route consisting of these shops. He is provided with a three wheeler to carry the sample stocks for delivery to the shops on his route. He is expected to visit each shop, at least, once a week to collect the orders. All times marketed by the ABK Marketing Company have been coded with the information of price, size, weight, variety, brand name and the manufacturer. Every package has the basic information for stock keeping and valuing the distribution.

The salesman visits the shops and collect the orders in a standard format which will be processed by the computer department of the ABK Marketing Company under the order processing system. The Order Processing System processes the order for an availability of the item and allocates the stock to the orders received from the salesman. Once the allocation is made, the duplicate issue slips are printed—one for the van and the other for store to draw the items and put them in the containers. The driver of the van collects the container as per the issue slip and delivers it to the shop. The ABK Marketing Company sells the goods against cash or cheque payment. The driver returns the issue slip, duly acknowledged by the shop owner with a cheque or cash to the accounts department for further processing. The issue slip plays the role of withdrawal, delivery and billing. The shelf/rack space, being very limited at the shop, the shop owner would like to stock a variety of items in small quantities to satisfy the variety of customer' demands. The turnover of the shop and the patronage of the customer depends on how the space in the shop is utilised. The empty space means a loss of revenue to the shop. Hence, the salesman has to visit the shop more often and collect the orders to ensure that the space in the shop is fully utilised by the ABK Marketing Company's products. The order collection is looked after by the salesman while the order processing, execution and delivery is looked after by the distribution van of the ABK Marketing Company. The van covers a number of routes per day. The marketing business is conducted through a well built organisation structure as shown if Fig. 8.32.

The personal strength of the ABK Marketing Company is over 300 persons. The Marketing Division has about 100 personnel, and the Procurement, Control and Distribution Division has about 100 personnel, such as manager, storekeeper, helpers, drivers and travelling salesmen.



**Fig. 8.32 ABK Organisation Model**

The General Manager, Marketing deals with the brand selection, pricing, promotion, customer and manufacturer relations, and stocking decisions. He extensively resorts to the Market Research methods to judge the popularity of the product, and the consumer preference in the different market segments. The success of the ABK Marketing Company's business lies in the high turnover through a large variety of products and a continuous evaluation of existing products and new products, to keep the stock moving at a high rate to increase the inventory turnover.

The General Manager, Procurement, Control and Distribution is responsible for the purchase function where a decision to buy a product is given by the Marketing Division. The purchase price, the delivery schedules, and the stocking decisions for various locations and supporting the marketing management for a quick disposal of inventory are the functions of the General Manager. The distribution management is a major task which falls in the operations management. The creation of cost effective routes and the management of transport is a key area for effective business operations of distribution of goods to the various shops.

The orders are processed by the computer system. Issue slips, in duplicate, are generated by checking the stock of each item. The items are drawn as per the Issue Slips and a carton is made containing all the items against a particular shop order. The carton is given to the shop owner and the acknowledgement is obtained to process on the computer system for billing and accounting.

**Issue Slip (Duplicate)**

ABK Co.	Mkt.	Shop Code No: Shop Name:	Order No: Ord Dt.	Issue Slip No: Route No:
Sr. No.	Description of item	Product Code	Ordered Qty.	Issued Qty. Amount
Signature ABK Mkt.	No. of items Total Ordered Qty.	Total Issued Qty.	Total Amount	
Acknowledgement of the receipt from the shop		Date		

The ABK Marketing Company has observed that though the orders are booked by the salesman, the delivery is not made in full. An analysis has shown that 20 per cent of the items could not be delivered and 30 per cent of the items could be delivered in a part quantity leading to a loss of revenue to the ABK Marketing Company. The procedure of ordering is such that every time a fresh order is to be placed and the unfulfilled orders are cancelled automatically. The shopkeeper diverts the space to the competitors' products if the delivery promise is not maintained. The ABK Marketing Company uses a computer system for stock accounting, billing, financial accounting and the other commercial systems.

The management of ABK Marketing Company continuously discusses the issues such as product selection, inventory control, customer complaints, the rate of growth, the movement of the products, etc.

**Questions**

1. Discuss the information needs of ABK Marketing Company to design a suitable management Information System. What approach would you take to find the information needs?
2. Draw a system flow chart of the order processing system and the stock replenishment system. Note that stock replenishment system is not yet computerised.
3. What technology options can you suggest to expedite order collection, processing, routing and billing?
4. Discuss the applications of the Bar Code Technology, Network, Electronic Data Interchange, and so on to achieve an efficient procurement and distribution system to achieve the business goals and customer satisfaction.
5. Suggest an integrated system of procurement, stocking, billing and accounting.
6. Give a modular structure of this system with interfaces, connectivities and clusters.

**2. SOUBHAGYA COSMETICS LIMITED (SCL)**

(Control System Concept)

The Soubhagya Cosmetics Limited (SCL) manufactures a variety of cosmetic products and is in this business for over a decade. It manufactures the cosmetic items like nail polishes, talcum powder, soaps, oil and ointments, fresheners, skin conditioning oils and ointments, perfumes, etc. The SCL has established 'SAUBHAGYA' as a brand name in the leading cosmetic market. It ranks among the first three producers. The variety of products is its key to successful business. The variety helps to create a market

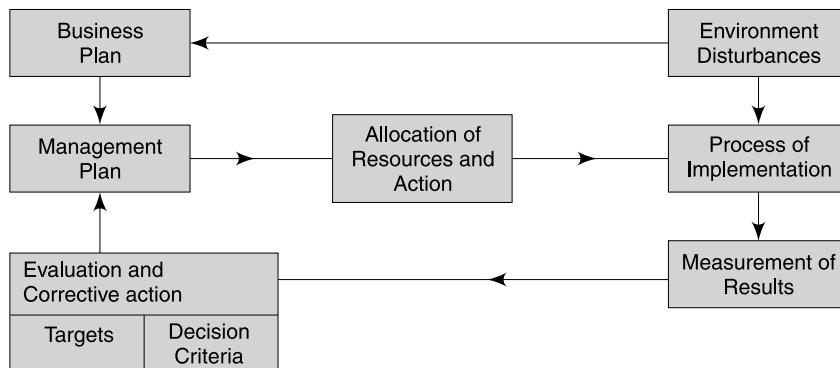
presence, image and a brand recognition. Introduction of a new product is also a necessity to enlarge a market share.

The Soubhagya Cosmetics Limited has a large Marketing department where Selling, Advertising & Promotion, Market Research, and Training are four departments. The turnover of the Company is over ₹ 100 million. The profitability of the business is dependent on how closely the marketing expenses are controlled. The Marketing Department has a total responsibility of pushing the turnover and keeping the Soubhagya Cosmetics Limited in a leading position in the market and industry.

The Marketing Department is headed by a Marketing Manager, who is assisted by four Product Managers, Manager Advertising and Promotion Manager Market Research. The country is divided into ten geographical regions where the Regional Offices are headed by the Regional Manager.

The Regional Manager has a responsibility to sell all the products and his main functions include supplying all the products in demand to all the retailers, billing and recovery, controlling the stock and attending to the customers 'and retailers' complaints.

The Product Manager has the responsibility to interact with the Manufacturing department, the Manager Advertising & Promotions, and the Manager Market Research, to ensure that the sales forge ahead as per the plan and targets. While performing these functions, the control of the marketing expenses is the responsibility of each of the managers for improving the profitability. SCL works on the principle of Management Control as expressed in the model show in Fig. 8.33.



**Fig. 8.33** Management Control Model

A marketing plan is made by the Product Manager, stipulating the product sales targets, with expenses budgets for 16 heads as under:

- Distribution
- Travelling
- Display
- Advertising:
  - Newspaper
  - TV
  - Hoardings
  - Free Samples
  - Point of Sale Demo
- Promotion
- Sales Commissions
- Discounts
- Market Research
- Transportation
- Sales Campaign
- Manpower
- Test Marketing

The expense budgets are made productwise and product family-wise as the need be. Besides these expenses, a separate campaign is made to promote the "SAUBHAGYA" brand through Corporate Advertisements.

The Marketing Manager is happy with the system of expense control through budgets. He says that the system, however, does not provide the information for a concentrated action or decision on selective basis. In this kind of business, certain expenses are committed even though they may not be highly productive. Certain other expenses are not controllable. He is of the opinion that SCL should design the system for marketing information, so that it helps in decision making.

### Questions

1. Discuss the problems of the Marketing Manager and suggest a control model for decision-making to control the expenses.
2. Based on the data available suggest the Decision Support System (DSS), with which the company should try to improve the expense control function. The areas for DSS are the sales forecasting, the target determination, budgeting, and decisions for the control of expenses.

## 3. PRUDENTIAL INVESTMENT POWER COMPANY (PPC)

*(Survey Analysis for Strategic Planning)*

Dear Investor,

Thanks to your trust in us, we have seen a tremendous growth in assets under management over the last one year. At the same time our family of investors has also grown to over 3,50,000. It is our endeavor to provide better product and services to each of our valued investors. To succeed in our efforts, we need your frank feedback on the services and products we provide and would appreciate your sparing a little time to fill out the following questionnaire given below. We have also requested a little information about yourself in order to understand you better and to help us serve you better. Rest assured that the information you provide will be kept confidential.

Please send the completed questionnaire in the enclosed pre-paid envelope, in order to be eligible for the competition, please ensure the complete questionnaire reaches us on or before June 30, 2000.

Thanking you in advance.

Sincerely,

**Suraj Bahari**

Vice President (Marketing)

### Questionnaire

#### Teleservice

#### Your Opinion Matters to Us

In the past 6 months how often have you called our customer service center?

Never       1-3 times       4-7 times       more than 8 times

If yes, you called to inquire us about:

NAVs       Products       Account Balance       Account statement  
 Correcting error       Other

On average, your call was answered in:

<1 minute       1-2 minutes       2-3 minutes       >3 minutes  
 Not answered



### Getting to Know You Better

Name              Date of Birth //  
 Folio#              Address  
 Phone              E-mail  
 Education       High school       Graduate       Post-graduate       PhD  
 Marital Status     Single       Married       Divorced/widower  
 Do you have kids?      No      Yes      Age: 1st child      2nd child      3rd child

#### What is the single most important need you save for?

- |                          |                        |                          |                  |                          |                            |
|--------------------------|------------------------|--------------------------|------------------|--------------------------|----------------------------|
| <input type="checkbox"/> | Own marriage/education | <input type="checkbox"/> | Buying a house   | <input type="checkbox"/> | Vacation                   |
| <input type="checkbox"/> | Child's education      | <input type="checkbox"/> | Child's marriage | <input type="checkbox"/> | Purchase assets (car etc.) |
| <input type="checkbox"/> | Emergencies            | <input type="checkbox"/> | Retirement       | <input type="checkbox"/> | Wealth accumulation        |
|                          |                        |                          | Other            | (specify)                |                            |

If you had ₹ 10,000 to invest—describe in which assets you would invest.

Do you own a credit card? If yes which one

- American Express     Mastercard     Visa     Diners

Do you own any of the following?

- |                  |                 |                |           |
|------------------|-----------------|----------------|-----------|
| Air Conditioning | Washing Machine | Microwave Oven | PC        |
| Car              | (specify)       | 2 wheeler      | (Specify) |

What are your interests?

- |          |          |             |             |                   |
|----------|----------|-------------|-------------|-------------------|
| Sports:  | Cricket  | Hockey      | Football    | Golf              |
| Films:   | Hindi    | English     | Language    |                   |
| Music:   | Ind. Pop | Classical   | Western pop | Western classical |
| Reading: | Fiction  | Non fiction | Magazines   | Professional      |

Signature

Thank you for your time.

### Questions

1. Design a questionnaire entry screen(s).
2. What kind of different views you can generate from this survey data?
3. What would be your proposal for using the information in section "Getting to know you better"?
4. Design information reports to take a view on the following to decide on the strategies and it's effectiveness.
  - (a) Customer prefers visits to obtain the service, hence increase front office personnel.
  - (b) Quality of communication is poor or at the most average, we should change to monthly communication as against a quarter.
  - (c) All communications are in English, we should switch to vernacular languages. If yes how would you choose the languages.
  - (d) To improve service gaps following actions are proposed. Are they necessary?
    - (i) Improve fund transaction system
    - (ii) Choose a better delivery service agency.

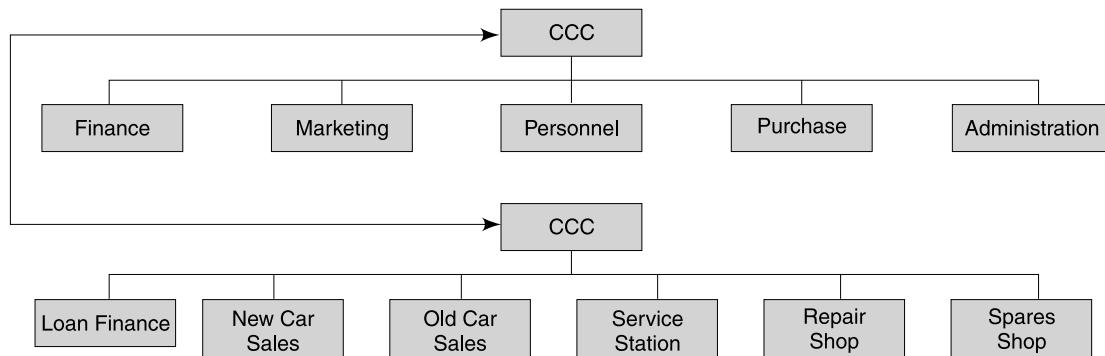
5. Generate an investor behaviour profile on following information about the investor.
  - (a) Interests
  - (b) Education
  - (c) Age
  - (d) Need to save
  - (e) Reasons to invest in Prudential.

#### 4. CAR AND CUSTOMER CARE LIMITED (CCC)

*(Intranet and Internet Application)*

Car and Customer Care Ltd. (CCC) is a dealer for reputed car manufacturers. The CCC has branches in all metro cities throughout India. Major metro cities have more than three service centers fully equipped to serve all needs of customers, spanning from buying a new car, servicing of cars, purchasing spare parts, etc.

It also has arrangement loan facility with Citibank, GE Countrywide, for the car buyers. A typical service center, functional organisation structure is given in Fig. 8.34.



**Fig. 8.34** Organization Structure

The organisation has two layers, Front end systems interacts with the customer and the back end systems deal with transaction and business processes.

A typical customer may interact with CCC; for variety of service needs. The service scope is given in Table 8.7.

**Table 8.7**

Service	Service scope
<ul style="list-style-type: none"> <li>• Purchase of car</li> <li>• Loan assistance</li> <li>• Car servicing under new car scheme</li> <li>• Regular servicing</li> <li>• Repairs</li> <li>• Purchase of spares</li> </ul>	<ul style="list-style-type: none"> <li>• Support on RTO and Insurance and Registration of car.</li> <li>• Loan agreement and arrangement of the loan.</li> <li>• Free servicing and removing any deficiencies and car check up and setting</li> <li>• Taking care of specific components and systems.</li> <li>• Major repairs as promised.</li> <li>• Ensuring availability of spares.</li> </ul>

*Contd...*

*Contd...*

<ul style="list-style-type: none"> <li>• Purchase and sale of old cars</li> <li>• Maintenance of car fleet (company cars)</li> <li>• Car rental</li> </ul>	<ul style="list-style-type: none"> <li>• Servicing, setting it in good order.</li> <li>• Providing car run time performance.</li> <li>• Good car up keep for ready to use for any time.</li> </ul>
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All most all front end systems are legacy systems each having its own database and application providing service to the customer. Transactions generated in these systems are fed back to back end systems for accounting and other applications such as procurement, inventory, finance. There is a separate marketing and sales accounting system, which focuses mainly on sales analysis and sales management applications. The focus is more to produce MIS reports on periodical basis to know the sales by product, service requirements, etc. It interacts with car vendors for managing the procurement in terms of models. Colours and features. The basis for planning procurement is sales movement of various car models. In terms of revenue earnings, car sales is higher, followed by service business coming from various lines of service offering. In the year 1999, number of dealers, service stations have come up in all locations offering stiff competition.

CCC appointed a consultant to study the business and suggest actions to the management of CCC to face the competition effectively. The trend shown in business earnings indicates very slow growth even though CCC added number of service stations believing that availability of service station close by provides incentive to car owners for servicing or repairs. The opening a service center with food service equipment calls for investment of Rs. 50 lakh and a trained manpower of forty plus to run the center efficiently.

The consultant made the study of business operations of different service centers mainly a contract maintenance, service stations, repair shops, etc.

The findings were as under.

1. At each service point there is an entry for customer details, service needs and car details.
2. Once the service is complete, the information is not available when car comes for next service visit.
3. Customer as well as CCC is not able to track the history of jobs done on the car and what needs to be done now?
4. If there are multiple jobs to be carried out car moves from one service point to other and there is no information available at service center to answer customer calls on the car status and expected delivery.  
Broadly the delivery promises are given such as 'come in the evening or come after two days' and so on. In all such cases customer had to wait for hours or to go back to visit again.
5. Because of distributed service locations and each location having its own data, centralised information on car condition is not available.
6. All transactions are paper based and the data is entered in the local systems. Only financial and inventory transactions are sent to back end system for future processing when these transactions are received, they are entered again. The information about the car and the customer is distributed at two places. The car data is available in distributed service location systems, while commercial data is put in the back end systems.
7. When customer visits he may have queries on loan and repayment status, purchase of accessory, next servicing date, spares replaced so far, etc. But the current systems are not in a position to answer these queries. In each station, he is required to move from location to location to get the queries answered.

## Recommendations

Due to competition from various alternative sources, functional efficiency of car servicing is no longer an incentive for customer to visit again. It is therefore necessary that the system should be radically redesigned to become customer centric giving comfort and confidence to the customer, that he as well as the car are cared for. He recommends a new customer centric system with the following features.

1. All data at one place.
2. Call center to answer queries.
3. Car service information tracking system.
4. Customer should have access to the system to know the status without involving service personnel.
5. At any time given the customer ID and Car No, complete report should be available on the jobs done in two parts, repairs and service with complete details and further indicating what is due or overdue.
6. Ordering standard accessories online and have them delivered at home. The items include seat cover, steering wheel jacket, car pillows and toolkits, electrical spares, etc.
7. Customer tracking system to know if customer has not shown up for quite some time. Internal data should be triggering a report for customer suggesting the jobs due.
8. Information on used car and spares on sale, different discount schemes, should be available on line to invite customer either to visit or order on line.
9. A feature providing car sales of all models of all manufacturers, design standards, price information for customer benefits to be made readily available.
10. Car care lessons for customers for taking care of his vehicle to avoid sudden, breakdown or deteriorating performance.
11. The success of customer centric system lies in taking a customer in stages from prospect to committed customer to satisfied customer to a loyal customer. This will ensure business growth and increase in market share.

In short consultant advised to convert existing system philosophy and activities from job driven to customer centric philosophy and architecture, where the service is information driven, offering care and comfort to the customer. It should offer more analysis on car performance and suggest proactive and preventive car care. Finally present system overheads spread in hardware, software and system operation, personnel should come down drastically due to effective service management with less manpower.

The corporate benefits of new customer centric system would be optimum use of service resources distributed at various locations bringing down the cost of service overheads and bringing down the customer servicing cycle by 30 per cent in time.

## Questions

1. Which technologies are available to make the new system as advised by the consultant?
2. Examine whether keeping existing systems as they are and to go for integration or build integrated system cap on the top of existing system will be a cost effective alternative.
3. Will intranet connecting all service centers and location would be a better alternative.
4. Suggest a Website architecture for CCC and its site map indicating the scope of services, execution processes and car information services. Name the site as [www.ccc.com](http://www.ccc.com).
5. Suggest MIS reports for following users.

- (a) Customer
- (b) Service centre head
- (c) Service point head
- (d) Car service turnover ratio
- (e) Number of inquiry calls vs actual jobs logged in
- (f) Repair job analysis
- (g) Customer feedback analysis.

## 5. BANK OF EAST WEST (BEW)

*(Document Processing System and Groupware Application)*

Bank of East-West is a 30 years old bank and enjoys good image in banking world. The customers of the bank get efficient services and very few customers have left the bank after having closed their accounts. The bank has operations all over India. It has over 100 branches in major cities. Each branch is attached to a zonal office and zonal office is governed by corporate office at M. G. Road. The zonal office supervises the branch operations and acts as nodal point for evaluation of bank policies and practices. It has to ensure that all statutory and RBI directions are followed and no adverse comment is made by any audit authorities.

It is a continuous endeavor of the management services division (MSD) of the bank to restructure, reengineer and modernise the bank operations to improve efficiency to offer good service to the customers. As a step towards that all branches have computerised operations and branches and zonal offices are networked. The corporate office and the zonal offices will be connected shortly. The bank has its website, [www.eastwest.com](http://www.eastwest.com) which displays information about bank and its operations, different schemes and facilities. Each branch office has an internet connection.

For the year 2000, MSD has taken a goal of improving customer interaction system by induction of information technology in all customer related processes and applications. In year 2001 the bank would like to announce Internet Banking and provide non banking services to the customers for all bill payments. The first system chosen by MSD is a loan processing system of vehicle/consumer durables. The present system is manual. It takes at least four to five weeks to process the loan application. The system is person dependent and moves on the initiative of the person. The information is not transparent and there are mistakes and delays in loan processing.

The bank has designed application form for loan request which is submitted by the applicant with necessary documents. The application is examined by the loan officer, scrutinized by the Manager (loans) and approved by the Branch Manager. The application goes through four phases; application examination, scrutiny, verification, decision-making and disbursement of loan. In the present system, the branch handles over 30 applications in a month and disburses over ₹ five million loan amount per year. This figure is expected to rise to over 60 applications. The rejections of the loan request is 25 per cent. MSD does not want to increase the staff in loan processing section and within available staff it aims to handle the increasing load.

MSD desires to have a system which has the following

- (i) Information driven and person independent.
- (ii) Rules of processing embedded in the systems.
- (iii) Eliminate discretion in processing
- (iv) Least personal interaction with the applicant.
- (v) E-mail communication at all phases.
- (vi) MIS reports giving complete status of the work, operations and performance of the loan processing section.

MSD wants to build the applicants data for warehouse application to build different services/strategies at a later date.

### A. Conditions for Loan Processing

1. Applicant must be an account holder and must have three years of account history.
2. Application form must be completed and content must be adequate and correct.
3. All enclosures must be present and must be from authorised agencies.
4. Certain data in the application is mandatory, its presence is a prerequisite for application processing.
5. PAN is essential for eligibility of the application.
6. The loan required should be minimum amount of ₹ 50,000 and repayment period should not exceed 48 months.
7. For vehicles, repayment period is 48 months or less. For consumer durables the repayment period is 24 months or less.
8. Margin money is 20 per cent of the investment amount. The 80 per cent loan amount is paid to the vendor directly by the pay order.
9. EMI amount is deducted directly by the bank from applicant account in the branch.
10. Xerox copies of agreements, policies, shares must be enclosed.

### B. Conditions for Eligibility

1. Net income plus other income should be at least three times of twelve months EMI amount.
2. In case of vehicle (car/truck), immovable assets must be owned by the applicant and the value declared must be two times the loan amount.
3. In case of consumer durables, investment in shares, debentures, mutual funds, NSC, etc. is a must and total value must be at least equal to the loan amount.
4. Twelve months EMI of all bank borrowings should be at least equal to annual income.
5. Repayment through salary deduction not permitted.

### C. Validation of Documents Enclosed

1. All documents will be validated by a loan officer in legal cell and the applications will be certified for further scrutiny.
2. Legal cell will certify that the document is enforceable and can be executed with no difficulty and market value (MV) is reasonably correct.
3. All documents are in order in terms of registration validity of period, and are properly executed with right authorities.

### D. Risk Assessment

Risk is assessed and declared in three Categories — High (H), Medium (M), No Risk (N). The factors for risk assessment and its rating are as given below. Each factor is weighed by points. The points are mentioned in the bracket for each factor. If the points are zero the case is of no risks. If the points are more than zero, the risk is on and is to be judged on the scale of zero to ten.

1. Credit Card: Yes (zero), No (10).
2. Net Income: Two times greater than 12 months EMI (zero).
3. Net Income equal to 12 months EMI (10).

4. Other bank borrowings: Yes (5), No (zero).
5. Income Tax slab: Top 10 per cent bracket (zero), Next 30 per cent bracket (zero), Rest (10)
6. Credit Balance: Always 2 times EMI (zero), Less than 2 times EMI (5)
7. Cheque operations: No cheque bounced (zero), Bounced (10).

The risk is assessed on following basis.

<i>Risk</i>	<i>Total points</i>
No Risk	zero to 10
Medium	10 to 30
High Risk	30 to 50

### E. Loan Sanction: Decision

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. No risk and certified by legal cell</li> <li>2. No risk and not certified by legal cell</li> <li>3. High Risk</li> <li>4. Medium Risk</li> <li>5. Any level of risk, but not certified by the legal cell</li> </ol> | <ul style="list-style-type: none"> <li>• Loan is sanctioned</li> <li>• Loan is not sanctioned</li> <li>• Loan application is rejected</li> <li>• Loan sanctioned but classified for close watch</li> <li>• Loan application is rejected.</li> </ul> |
|---|---|

It is the policy of the bank not to negotiate on terms and conditions. Hence, the applicant gets quick decision on the request of a loan. If applicant has better things to offer, he is requested to make a fresh application.

MSD wants an efficient system with the roles of participant in the system clearly defined. The owner of the system is the Loan Officer.

The other participants in the loan processing system and their roles are:

1. Manager (Loan)—Recommendation.
2. Legal officer—Certification
3. Manager (Accounts)—Certification.
4. Branch Manager—Approval and disbursement

### Questions

1. Design an architecture for loan application processing system in IT environment.
2. Design a computerised system for application processing.
3. Design MIS reports (Standard and Exception) for Branch Manager and Zonal Manager.
4. Design following queries.
  - (a) Given a Loan/Application Number to know the status on the progress.
  - (b) Given a Loan/Application Number whether party has taken a loan before.
  - (c) Number of applications rejected from Date to Date for
    - (i) Lack of certification
    - (ii) High risks
5. The system should aim at disposal of the application in a week's time as against four to five weeks today.
6. Explain how suggested system architecture would help to reduce the loan processing time.

**Bank of East-West**  
**Application for Loan for Vehicle/Consumer Durables**

The Asst. Gen./Chief Manager/Branch Manager  
 Bank of East-West

Dear Sir,

Re. : Application for loan

I/We request you to grant me/us a loan for purchase of a vehicle/consumer durables.

Following particulars are submitted for consideration of the proposal in respect of myself/ourselves (applicant/s) and proposed guarantor:

	<i>Applicant/s</i>	<i>Guarantor</i>
1. Name		
2. Age		
3. Residential Address and Phone No.		
4. Whether single or married		
5. No. of dependents		
6. Status—Employed/Businessman/		
7. (a) Employer/Business Name and Address		
(b) Phone No. of Office with extension No., if any		
(c) No. of years of service/business		
(d) Dept./Nature of Business		
(e) Designation		
(f) Gross Income from salary/business p.a.		
(g) Net Income from salary/ business p.a.		
(h) Other income, if any*		
(i) PAN allotted by income tax department.		
* Please attach copy of latest salary certificate and copy of latest income tax assessment order.		
8. Estimated Net Worth		
A. Assets (*) (i) Immovables (Land and Bidg.) (with addresses given below) (Tax paid receipts to be enclosed)		
(ii) Movable: (*) Vehicles (brand, make and Regn. No.) (along with copy of R.C. Book)		

(iii) Investments: Business Shares/Debentures Units N.S.C.		
B. Liabilities: (i) Bank borrowings (specify) (ii) Others: (specify) (a) (b)		
C. (i) Credit card: (a) Bank (b) Card No. (c) Date of Validity (d) Limit.		
(ii) Cost of vehicle and accessories/cost of consumer durables (As per attached quotations)		
(iii) Amount of margin (own contribution) and source thereof		
(iv) Amount of loan required		
(v) Security offered (value)		
(vi) Repayment period required (months)		
(vii) Present Banker's Account No.		

I/we declare that all the particulars and information given in the above application form are true, correct and complete.

I/we confirm that I/we are not defaulter/s to any financial institution/s/bank/s and that no recovery litigations are pending against us/me. I/we further confirm that I/we have/had no insolvency proceedings against me/us nor have i/we ever been adjudicated insolvent. I/we further agree that my/our loan shall be governed by the rules of the bank which may be in force from time to time.

#### **Signatures**

Applicant/s

\_\_\_\_\_

Guarantor:

\_\_\_\_\_

#### **6. DURABLE FINANCING LIMITED (DFL)**

*(Work Flow Process Automation)*

Durable Financing Limited (DFL) is a ₹ 100 million turnover company in the field of financing consumer durables purchase to the customers. The customers of the DFL are in the middle and higher income group category and looking for soft options to purchase goods in the category of white goods, entertainment system, kitchen appliances, cars and other kind of vehicles.

DFL has an institutional arrangement with most of the leading brand manufactures in the above category of goods for flexible commercial options. Such arrangements help DFL as well as its vendors in improving their business.

DFL sells products through loan finance to the customers. The core procedure of loan financing is same for all the classes of products. The core process is loan application processing, evaluation of the credit worthiness and approval, financing package in terms of down payment, monthly instalments, insurance and legal compliances.

The company has a standard loan application form which seeks information on the social status of the person, financial status and the present assets held by the individual. The application also seek information on the savings bank account, insurance policy, and immovable asset like house or plot.

The initial application processing deal with verification of facts and the documents enclosed, for the scrutiny of the application certain documents are a must, such as the Ration Card, Salary Certificate, Income Tax Certificate, Driving License and Membership Certificate. Certain documents are additional depending upon the situation. For example if the person is asking loan for household purpose, then it would call for an authentication of the loan application. The application is scrutinised for all such contents before it is passed on for further processing. If the verification proves that certain compliances are not met, the application is rejected. All the applications accepted or rejected are kept on file for future reference.

Depending on the loan amount, DFL makes investigations on the references before the application is passed for further processing. Each of the application is rated on one to five linear scale on a variety of factors. The maximum score of an applicant could be 50 points. The minimum points for loan eligibility is 25. If the score is less than 30, the application is eligible for a loan amount or ₹ 1,00,000 or less. If the score is less than 40, then the eligibility is less than ₹ 5,00,000. For all higher points, the loan limit is ₹ 10,00,000.

If the application is accepted, it is sent to the credit rating counter for credit approval. Based on the income statement, the source are verified for credit stability. The investigations are carried out on phone or through field investigations for the verification of the facts.

The income growth of the person is also forecasted based on the business in which he is performing or based on the performance of the company which employs him. The credit rating and the confirmation is a non-standard procedure requiring the best assessment of the individual, which may be biased at times. In credit approval process, the application may be rejected, cancelled, declined or kept pending for decision. At times the pending application is referred to the higher-ups in the organisation for decision on approval.

If the application is approved for a particular loan amount which could be less than what is being requested in the actual application form of the customer, the customer is formally informed and called for discussion to design the repayment plan. In the discussions with the customer, the repayment plan is worked out with a varying interest and instalment facilities. The disbursement of the loan and its repayment plan is worked out. In the account books of DFL, the customer name and loan account number is opened. It is quite likely that the customer may have several loan account numbers. DFL has a practice of accepting the post dated cheques of Equal Monthly Instalments (EMI) for depositing the same each month.

Some of the customers ask for repayment facility through salary deduction of a fixed amount. For some reason, if the deduction is less than stipulated, the adjustment entry is created and posted to the employee account.

Occasionally the customer asks for any early settlement of the outstanding loan. In this case, the necessary adjustment entries are made to close the customer account.

The loan application processing is, thus, carried out in four steps, viz:

- Enquiry/Order processing.
  - Credit evaluation.
  - Preparation of disbursement and repayment plan.
  - Early settlement of the contract.
- At each stage a computer facility provided to process the application.

### Questions

1. Present loan processing system is lengthy and time consuming. Suggest a Work Flow Automation application to expedite the loan processing.
2. Make a distinction between the business process rules and the business formula or equations. What are its implications in the application design?
3. Design the system for work group application and explain where the productivity gains are higher. Evaluate Lotus notes and MS Exchange as a platform solution.
4. Draw a system flow diagram for credit administration and a credit appraisal.
5. Which different master may the system have to build?
6. The MIS reports on the following.
  - Repayment status.
  - Customer vs the class of goods vs Loan amount.
  - Cash flow statement of disbursement and repayment.
  - Product mix by loan tenor.
  - Duplicate applications.

DFL has been using the above system for a number of years. The system is computerised at every stage and has been modified number of times. DFL is facing problem related to speed, response and data handling in the present system. DFL has a variety of schemes though the basic application is for loan disbursement after a confirmation of the credit worthiness.

DFL wants to examine the possibility of redesigning the system so that:

1. The application processing cycle is reduced to half;
2. A better software engineering technology is used where the system remain the same while the changes are carried out easily to accommodate either new schemes or a new requirement of the customer.

## 7. CENTRAL FINANCE AND RECONSTRUCTION COMPANY (CFRC)

*(Application of Object Oriented Technology)*

Central Finance and Reconstruction Company (CFRC) is a financing company established by the Government to finance the various projects of the Public and the Private Sector Undertakings such as risk-funding, modernisation, expansion or diversification. The funds are offered to such needy companies on scrutiny of their needs of funds.

CFRC raises its own needs through the various schemes of funds drives such as bonds, fixed deposits, debentures and capital issues. The Company brings out various schemes with different financial benefits to the investors. At any time more than four or five schemes are floating and new schemes are being designed.

The general procedure of any one of such schemes is that a scheme for funds is announced through the media, well before the actual date of announcement for the public knowledge.

The funds are sought through an application form, with Demand Draft or Cheque enclosed. All the schemes are handled through brochures. The Schemes have common features such as a minimum amount, the rate of interest payable, the mode of payment and the period of payment, a renewal on maturity or a refund on maturity.

The interest warrant consists of warrant and corresponding counterfoils, printed in advance and availed by the investors.

Irrespective of the kind of schemes there is a common underlying procedure of collection of funds. The application form is a key document in all the schemes. The format of application is common. It has the address block, scheme, identity block, the brokers block, the interest rate, etc. followed by the signature block.

The accounting procedure for financial accounting of the collected funds is the same. The statutory returns to the Government are the same. The procedure of interest calculation and accumulation of interest is different from scheme to scheme.

All the schemes have following documents:

1. Application
2. Cheque/Demand Draft
3. Acknowledgement
4. Letter of acceptance
5. Formal document: Receipt or Certificate
6. Warrants
7. Counterfoil
8. Refund letter

The contents of these documents are more or less the same but they differ in terms of value. The actors in the system are the investors, bankers, brokers and the CFRC itself.

CFRC requires to develop a computerised system in each case of scheme which has effected the announcement of the scheme and its execution.

The management felt that all the schemes are more or less the same in the core, and only the interest calculations, and names of the various documents of the system, i.e., Bond, Share, Fixed Deposit, etc. changed. It is felt that a computer system should be built in such a way that the turn around time of the system is much shorter.

The chief executive officer of CFRC attended a seminar on Information Technology, where one session was on object oriented technology. The technology evoked a lot of interest and the chief executive officer decided to look into the development approach afresh. The chief executive officer has appointed you as a consultant to go into the details of the technology and its application to CFRC funds processing system.

## Questions

1. Identify the objects in the CFRC funds collection schemes.
2. Can you define a parameter class or a super class and objects which can be used effectively and efficiently in the various schemes? Design an object model for the business of CFRC.
3. Identify different 'Use Cases' involved in the funds procuring applications.
4. Draw an interaction diagram of one of the 'use case' declaring the interface objects, entity objects and the control objects. Further identify the role of each object as an actor, a server or an agent.

5. Test your object model on five principles of good object design, viz., coupling, cohesion, sufficiency completeness and primitiveness.
6. Identify the interface objects in three parts, viz., the Public Protected and Private.
7. What benefits would CFRC get by switching over to OOT?

## 8. SUNRISE CONSTRUCTIONS LTD. I (SCL-I)

*(Application of OOSAD)*

SCL is a civil engineering firm engaged in construction of bungalows, apartments, club houses, row houses and so on. Their sales turnover per year is over ₹ 5000 million. The business core competency of SCL is mainly design and construct as per the customer requirement. SCL does engineering and designs of the construction to ensure that design is attractive and cost effective for the customer.

The customer accepts the design and agrees to pay by rate per sq. foot/meter. Generally the agreement is signed with the customer for all deliverables of the construction and the changes if any to be paid for. In this process SCL sales revenue is fixed and it is the challenge to the management to construct the house at lowest cost and within budget so that profit margin is not affected.

When design and construction specifications are finalized, cost of various construction activities are estimated and activity cost is budgeted. Material budget is also estimated and finalised for execution and control. All major material items are budgeted for procurement planning and cost control. The construction activity is controlled for project costing and material is controlled for cost control to remain within budget.

Each construction project has two budget heads, one Activity and second is Material. The material cost contributes over 60% to the total cost of the project.

Material cost is controlled through appropriate use of material as per specifications and attempt is made to purchase the material at the rate used for estimation and budget. Since, purchases are project specific, once the material is purchased and received, it is treated as consumed and material cost budget is updated for the value of the material receipt at site.

All items in material list are purchased on purchase requisition, raised by site manager and approved by project manager. Presently the entire system is manual from requisition to ordering. The new purchase order application system is to be processed on software system operating between the networks of sites and head office. The system should be internet/web based in its entire scope from raising requisition, its processing & approval, demanding quotations, quotation analysis, selection of vendor, price approval, purchase order preparation & approval & mailing to vendor.

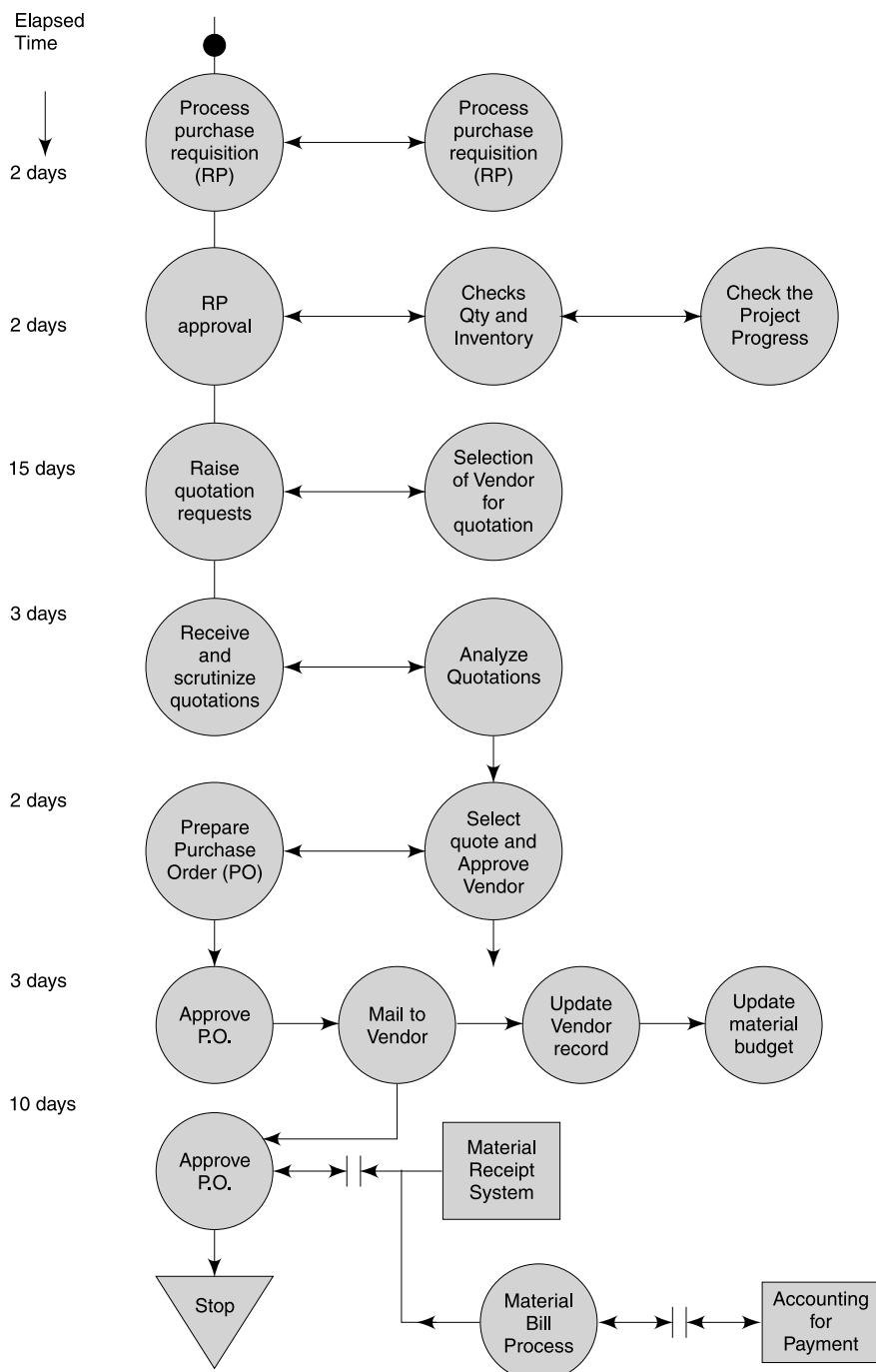
The existing system flow of the purchase order application is shown in Fig. 8.35.

While preparing purchase requisition, site engineer has to mention all details, which includes information about present inventory of items, and period of its consumption; and required delivery date of the item.

In purchase order, besides main content of the PO, Terms and Conditions are Vendor specific and PO specific. These are

Insurance,	Sales Tax,
Advance,	Octroi,
Transport,	Excise,
Inspection,	Service Tax

Though so many commercial terms are mentioned, not all of them are always applicable. These terms are important to mention, as they will be considered at the time of bill processing of the delivery.



In order to save time and paper work,

- (a) PO is raised for a Project.
- (b) PO is raised for a project but also may contain more than one item.
- (c) Delivery of item may be in multiple lots scheduled for different times.

In this manual system delays occur in preparation, approval communication to the extend of two to three weeks. This delay affects progress if delivery is not received on time as per schedule. The average delay of two three weeks raises inventory provision blocking additional working capital in the inventory.

Management of SCL is looking for radical improvement in this application processing which would reduce PO process time, cut down inventory, and faster bill processing improving Vendor relations.

### Questions

1. Two main processes are involved one PR processing and second PO processing. Draw use case model for two processes.
2. Conduct use case driven object oriented analysis (OOA). Find class/objects using use cases and OOA.
3. Describe the type of class/objects you have found in OOA.
4. Conduct OOD by designing classes, methods, attributes and associations.
5. Draw UML diagrams from class definition to class implementation.
6. Organise classes in three layers Business layer, View or user interface layer, and Access layer.

## LEARNING OBJECTIVES

- Process of MIS Development
- Linkage of Business Goals to MIS Goals
- Relationship Between Business Goals and Business Strategy
- MIS Goals and MIS Strategy
- MIS to Generate all Classes of Information for all Users
- Methods of Handling Uncertainty and Risk
- Approach to MIS Development
- Implementation of MIS
- MIS: Factors of Success and Failure

### 9.1 DEVELOPMENT OF LONG RANGE PLANS OF THE MIS

#### Introduction

Any kind of business activity calls for long range plans for success, the same is true for MIS. The plan for development and its implementation is a basic necessity for MIS. In MIS the information is recognised as a major resource like capital, time and capacity. And if this resource is to be managed well, it calls upon the management to plan for it and control it for the appropriate use in the organisation. Most of the organisations do not recognise 'Information' as a resource. They have looked at information as one of the many necessities for conducting the business activity. Hence, due regard is often not given for its planned development and use. Many organisations have spent financial resources on computers and systems purely to expedite the activity of data collection and processing.

Many organisations have purchased computers for data processing and for meeting the statutory requirements of filing the returns and reports to the Government. Computers are used mainly for computing and accounting the business transactions and have not been considered as a tool for information processing.

The organisations have invested in computers and expanded its use by adding more or bigger computers to take care of the numerous transactions in the business. In this approach,

the information processing function of the computers in the organisation never got its due regard as an important asset to the organisation. In fact, this function is misinterpreted as data processing for expeditious generation of reports and returns, and not as information processing for management actions and decisions.

However, the scene has been changing since late eighties when the computers became more versatile, in the function of Storage, Communications, Intelligence and Language. The computer technology is so advanced that the barriers of storage, distance understanding of language and speed are broken.

The computers have become user-friendly. They can communicate to any distance and share data, information and physical resources of other computers. Computers can now be used as a tool for information processing and communication. It can be used for storing large database or knowledge base. It can be used for knowing the current status of any aspect of the business due to its on-line real time processing capability.

With the advancement of computer technology more known on information technology, it is now possible to recognise information as a valuable resource like money and capacity. It is necessary to link its acquisition, storage, use, and disposal as per the business needs for meeting the business objectives. Such a broad-based activity can be executed only when it is conceived as a system. This system should deal with management information and not with data processing alone. It should provide support for management planning, decision making and action. It should support the needs of the lower management as well as that of the top management. It should satisfy the needs of different people in the organisation at different levels having varying managerial capabilities. It should provide support to the changing needs of business management.

In short, we need a Management Information System flexible enough to deal with the changing information needs of the organisation. It should be conceived as an open system continuously interacting with the business environment with a built-in mechanism to provide the desired information as per the new requirements of the management. The designing of such an open system is a complex task. It can be achieved only if the MIS is planned, keeping in view, the plan of the business management of the organisation.

The plan of MIS is consistent to the business plan of the organisation. The information needs for the implementation of the business plan should find place in the MIS. To ensure such an alignment possibility, it is necessary that the business plan—strategic or otherwise, states the information needs. The information needs are then traced to the source data and the systems in the organisation which generate such a data. The plan of development of the MIS is linked with the steps of the implementation in a business development plan. The system of information generation is so planned that strategic information is provided for the strategic planning, control information is provided for a short term planning and execution. The details of information are provided to the operations management to assess the status of an activity and to find ways to make up, if necessary. Once the management needs are translated into information needs, it is left for the designer to evolve a plan of MIS development and implementation.

### **Contents of the MIS Plan**

A long range MIS plan provides direction for the development of the systems, and provides a basis for achieving the specific targets or tasks against a time frame. The plan would have the

following contents which will be dealt by the designer under a support from the top management. Table 9.1 shows equivalence of Business Plan and MIS Plan.

**Table 9.1** Business Plan Versus MIS Plan

<i>Business plan</i>	<i>MIS plan</i>
Business goals and objectives.	Management information system, objectives, consistent to the business goals and objectives.
Business plan and strategy.	Information strategy for the business plan implementation playing a supportive role.
Strategy planning and decisions.	Architecture of the Management Information System to support decisions.
Management plan for execution and control.	System development schedule, matching the plan execution.
Operation plan for the execution.	Hardware and software plan for the procurement and the implementation.

### **MIS Plan is Linked to the Business Plan**

#### ***MIS Goals and Objectives***

It is necessary to develop the goals and objectives for the MIS which will support the business goals. The MIS goals and objectives will consider management philosophy, policy constraints, business risks, internal and external environment of the organisation and the business.

The goals and the objectives of the MIS would be so stated that they can be measured. The typical statements of the goals are as under:

- Provide an online information on the stock, markets and the accounts balances.
- The query processing should not exceed more than three seconds.
- The focus of the system will be on the end user computing and access facilities.
- Information support will be the first in the strategic areas of management such as marketing or service or technology.

Such statements of the goals and objectives enable the designer to set the direction and design implementation strategies for the MIS Plan.

#### ***Strategy for the Plan Achievement***

The designer has to take a number of strategic decisions for the achievement of the MIS goals and objectives. They are:

- (a) *Development strategy:* An online, a batch, a real time. Technology platform.
- (b) *System development strategy:* Any approach to the system development—Operational versus Functional; Accounting versus Analysis; Database versus Conventional approach; Distributed versus Decentralised processing; one Database versus multiple databases SSAD vs OOT.
- (c) *Resources for system development:* In house versus external, customised development versus the use of packages.
- (d) *Manpower composition:* Analyst, programmer skills and know-how.

### ***The Architecture of the MIS***

The architecture of the MIS plan provides a system structure and their input, output and linkages. It also provides a way to handle the systems or subsystems by way of simplification, coupling and decoupling of subsystems. It spells out in detail the subsystems from the data entry to processing, analysis to modelling, and storage to printing.

### ***The System Development Schedule***

A schedule is made for the development of the system. While preparing the schedule due consideration is given to the importance of the system in the overall information requirement. Due regard is also given to logical system development. For example, it is necessary to develop the accounting system first and then the analysis.

Further, unless the systems are fully developed their integration is not possible. This development schedule is to be weighed against the time scale for achieving certain information requirement linked to a business plan. If these are not fully met, it is necessary to revise the time schedule and also the development schedule, whenever necessary.

### ***Hardware and Software Plan***

Giving due regard to the technical and operational feasibility, the economics of investment is worked out. Then the plan of procurement is made after selecting the hardware and software. One can take the phased approach of investment starting from the lower configuration of hardware going over to higher as development takes place. The process is to match the technical decisions with the financial decisions. The system development schedule is linked with the information requirements which in turn, are linked with the goals and objectives of the business.

The selection of the architecture, the approach to the information system development and the choice of hardware and software are the strategic decisions in the design and development of the MIS in the organisation. The organisations which do not care to take proper decisions in these areas suffer from over-investment, under-utilisation and are not able to meet the critical information requirements.

It is important to note the following points:

1. The organisation's strategic plan should be the basis for the MIS strategic plan.
2. The information system development schedule should match with the implementation schedule of the business plan.
3. The choice of information technology is a strategic business decision and not a financial decision.

A model of MIS Plan is given in Table 9.2.

## **9.2 ASCERTAINING THE CLASS OF INFORMATION**

Ascertaining the information needs of the management for the business execution is a complex task. The complexity can be handled if the information is classified on the basis of its application and the user, which becomes the basis for the ascertainment. The classification could be as shown in Table 9.3.

**Table 9.2** A Model of the MIS Plan

<i>Contents</i>	<i>Particulars</i>	<i>Focus</i>
Corporate information	Business environment and current operations. Information on KRA.	Where are we?
Corporate mission/goals/objectives	Current and new mission/goals/objectives.	Where do we want to reach?
Business risk and rewards	Clear quantitative statements on these factors showing a trade off between the risk and rewards.	What is the risk? Support information to resolve risk.
Business policy and strategy	Details of the strategic and policy decisions affecting the business.	How do we achieve the goals and objectives?
Information needs	Strategic Planning: managerial and operational.	What is the key information? CSF.
Architecture of the plan	Information Technology details.	What are the tools for achievement?
Schedule of development	Details of the systems and subsystems and their linkages charted against the time scale.	When and how will it be achieved?
Organisation and execution of the plan	Manpower and delegation details. Internal and external resources.	Who will achieve it?
Budget and ROI	Details on the investment schedule and benefits.	How much will it cost? Budget and ROI.

**Table 9.3** Classes of Information

<i>Information class</i>	<i>Example of information</i>	<i>User</i>
Organisational	The number of employees, products, services locations the type of business, turnover and variety of the details of each one of these entities.	Many users at all the levels.
Functional Managerial Knowledge	Purchases, sales, production, stocks, receivables, payables, outstandings, budgets, statutory information. The trends in sales, production, technology. The deviations from the budgets, targets, norms etc. Competitor's information, industry and business information plan performance and target; and its analysis.	Functional heads and others Middle and the Top Management.
Decision support	Status information on a particular aspect, such as utilisation, profitability standard, requirement versus availability. Information for problem solving and modeling. Quantitative information on the business status. Non-moving inventory, overdue payments and receivables.	Middle management and operations management.
Operational	Information on the production, sales, purchase, dispatches consumptions, etc. in the form of planned versus actual. The information for monitoring of execution schedules.	Operational and management Supervisor, Section Officers.

The design of the MIS should consider the class of information as a whole and provide suitable information system architecture to generate the information for various users in the organisation. Let us now proceed to ascertain the information needs of each class.

### **Organisational Information**

One can define the organisational information as the information required by a number of personnel, departments and divisions or the functions in the organisation. Such information can be determined by constructing a matrix of information versus user as shown in Table 9.4.

**Table 9.4** Matrix of Information versus User for a Personnel Function

<i>Information entity</i>	<i>Manager (Personnel)</i>	<i>Manager (Production)</i>	<i>Manager (Administration)</i>	<i>Manager (Accounts)</i>
Employees attendance	X	X	X	-
Salary wages and overtime	X		X	X
Human resources information	X	X		-

It can be observed from the table that the information entity is one, but its usages are different. For example, the employee attendance information would be used by the personnel department for legal compliance of maintaining the muster recommended by the Factory Inspector. The production manager would use it for scheduling, rescheduling and loading of the jobs on the shop floor depending upon the persons present. The corporate planning and administration will use it for manpower assessment and control and manpower forecasting.

The organisational information requirement needs to be studied thoroughly and critically as it is used across the organisation. It is necessary, therefore, to map the information in terms of the data source, generation and usage, so that the designer can provide a path from the acquisition to the generation and the storage.

Since the usage of the organisational information is at different levels for different level for different purposes, it is advisable to store the data in the form of the database which will be used by the users for generating their respective information needs. The determination of the information can be done by taking each business function, such as Personnel, Sales, Marketing, Production, Commercial, etc. and develop the information versus the user matrix.

### **Functional Managerial Information**

The functional information is defined as a set of information required by the functional head in conducting the administration and management of the function. This information is purely local to the function and by definition, does not have a use elsewhere. This information is used by a manager to plan and control the function.

Functional information is largely factual, statistical and detailed in multi-dimensions of the function. for example, if you take the sales information, it can be processed in seven ways, viz. the product, the product groups, the market segment, the geographic zones, the locations, the customer, and the sales organisation structure.

The functional information is normally generated at equal time intervals, say monthly, quarterly, etc. for understanding the trend and making comparisons against the time scale. Such information is used for planning, budgeting and controlling the operations of the function.

Functional information is also used for assessing particular aspects of the business. For example, the stocks of finished goods, receivables, and orders on hand throw a light on marketing function of the organisation. The raw material stocks, WIP, orders pending and payable throw light on the purchase function. These information sets have a functional utility and are required in detail revolving around several dimensions.

The functional information can be assessed on the following three parameters—the work design, the responsibility and the functional objectives.

### ***Work Design***

For example, for the customer order scrutiny the available stock, the price, the terms of payment and the probable delivery is an information set evolved out of the work design of customer order processing. The procedure of the order processing requires this information.

### ***Responsibility***

The managers in the functional areas of management are responsible for achieving the targets and accomplishing the goals and objectives. It is, therefore, necessary to inform and update the information on target at regular intervals to enable him to make or change decisions in his domain of operations. Most of these targets are business targets such as the turnover, production, utilisation, stocks and so on.

For example, the marketing manager has a monthly target of ₹ 1 million order booking, half a million invoicing, and not more than two months receivables. Since, he is responsible for achieving the targets, it would be necessary to inform him on these aspects at regular intervals. This information is used for the responsibility accounting and decision making for achieving the targets. The manager would be assessed on the basis of responsibility he discharges in conducting the business.

### ***Functional Objective***

Each function has its own objective which is derived out of the corporate goals.

For example, the overall business plan objectives gives rise to the objectives for each business function. Some of the business plan objectives are given below based on which each function in the organisation derives its objectives.

- The total sales per month is ₹ 10 million.
- The finished goods inventory, not to exceed ₹ 1 million.
- The outstanding more than six months not to exceed ₹ 0.2 million.
- The capacity utilisation should be minimum 85 per cent.
- The employee attendance per month should be 99 per cent.

The functional goals and objectives are necessary to achieve overall corporate achievements. Most of such goals and objectives are potentially achievable within the managerial and physical resources that the manager has at his disposal. It is, therefore, necessary to inform the manager on the achievements of these targets on a continuous basis.

In summary, the functional information would emanate from the work design and procedures, the managerial responsibility accounting, and with reference to the functional goals and objectives. It would be determined by studying the work design and procedures and the responsibility which the manager holds for the business performance. That information which measures the business activity and evaluates the performance on the key target areas, is the functional information. The users of such information are the managers and their functional heads who together execute the business activity.

### **Knowledge (An Information Set)**

The knowledge creates an awareness of those aspects of business where the manager is forced to think, decide and act. Such an information shows the trend of the activity or a result against the time scale.

For example, the sales are declining and the trend is likely to continue in the next quarter. The product is failing continuously on one aspect and the reason of failure is the process of manufacturing. Such information pin-points the area or entity and forces the manager to act. It highlights the deviations from the norm or standard and also any abnormal developments which are not in congruence with the forecasts or expectations. Such information gives rise to business decisions, which will affect the process of business significantly. In some situations the strategic decisions may be necessary to solve the problem.

The knowledge may cut across the functional boundaries of the organisation. The action or decision may fall in other functional areas of business operations. The decision may fall in the domain of top management or the middle management. The knowledge is required by the middle and the top management as they are the ones who conceive, plan and implement the business plan. Hence, the knowledge information supports the functions of the middle and the top management. Knowledge is tracked continuously and reported in a fixed format, for consistency and at fixed intervals for updating the knowledge base. The nature of knowledge is analytical and relates to the past, the current and the future. The knowledge is reported in graphic formats for a quick grasp and managerial response.

### **Decision Support Information**

Most of the information required by the middle and the top management is for decision making. The information does not act as a direct input to the decision making procedure or formula but supports the manager in the efforts of decision making.

Information is used in a decision support system for model building and problem solving. The support may act in two ways, one for justifying the need of a decision, and the other as an aid to decision making.

For example, the information on the non-moving inventory justifies the decision of its disposal at a throwaway prices. The demand forecasts information aids in the decision on determining the economic order quantity for production or a sale.

The decision support information can be determined for the organisation at the problem level leaving its use to the decision-maker in a suitable manner. The source of this information could be internal or external to the organisation. It can be determined by identifying the tools, techniques, modes and procedures, used by the managers in the decision making.

## Operational Information

This information is required by the operational and the lower levels of the management. The main purpose of this information is fact finding and taking such actions or decisions which will affect the operations at a micro level. The decisions may be to stay on overtime, draw additional material, change the job from one machine to the other, send a reminder to the supplier for the supply of material. These decisions are such that they make the routine operations of the business smooth and efficient. These decisions do not fall in the category of the managerial decisions.

The sources of operational information are largely internal through transaction processing and the information relates to a small time span and is mostly current.

### 9.3 DETERMINING THE INFORMATION REQUIREMENT

The sole purpose of the MIS is to produce such information which will reduce uncertainty risk in a given situation.

The difficulty to determine a correct and complete set of information is on account of the factors given below:

1. The capability constraint of the human being as an information processor, a problem solver and a decision maker.
2. The nature and the variety of information in precised terms.
3. Reluctance of decision makers to spell out the information for the political and the behavioural reasons.
4. The ability of the decision makers to specify the information.

In spite of these difficulties, methods are evolved based on the uncertainty scale, starting from the low to the high level of uncertainty. If the uncertainty is low, seeking information requirement or needs is easy as against a very high level of uncertainty. Based on the uncertainty scale the following methods, shown in Table 9.5, have been suggested.

**Table 9.5** Methods of Handling Uncertainty

<i>Level of uncertainty</i>	<i>Level of management</i>	<i>Method</i>
Low (Near certainty)	Operations management	Ask questions such as, what do you need?
Precise probabilistic knowledge (A risk situation)	Middle management	Ask to express probability. Determine from the existing systems and methods of decision making and problem solving.
Not able to determine in probabilistic terms precisely (Very risky)	Middle and top management	Determine through the critical success factors, decision parameters and decision methodology. Sensitivity analysis.
High (Total uncertainty)	Top management	Determine through experimentation, modelling and sensitivity analysis.

There are four methods of determining the information requirements. They are:

1. Asking or interviewing
2. Determining from the existing system

3. Analysing the critical success factors
4. Experimentation and modelling.

### **Asking or Interviewing**

In this method a designer of the MIS puts questions or converses with the user of the information and determines the information requirements. Putting the questions is an art and it should be used properly to seek information.

When the user has to select one answer from a finite set of answers a closed question should be asked. For example, "Which are the raw materials used for making a product?" But an open question is put, when the user has no precise knowledge but has an ability to determine all answers and to select one out of them? For example, "Which are the raw materials which can be used in a product?" In open questions, the answers may not be immediate but can be obtained by surveying the domain of knowledge of the user.

When multiple users or several decision makers in similar functions or positions are involved, a brain storming session is performed to cover all possible answers to the questions. When several users are involved, group consensus can be sought to get the most feasible set of answers.

The experts or experienced users are asked to give their best answers—this approach is called the Delphi method. In all these methods, the system designer has to test the validity of all the answers independently. An experienced designer is able to analyse critically the answers given to the questions and determine the correct information requirement.

### **Determining from the Existing System**

In a number of cases the existing system, which has been evolved after a number of years, and has been designed out of experience gives straightaway the requirement of information. In any situations, systems from other companies can give additional information requirements.

The fund of knowledge is available from the textbooks, handbooks, research studies which can determine the information requirement. For example, systems such as the accounts receivables, the accounts payables, the pay roll, the inventory control, the financial accounting, etc., have a well determined, informatin requirements.

Irrespective of the type of organisation and business, ninety per cent of the information requirement is common and the balance ten per cent may be typical to the organisation or the business, which needs to be determined separately. The managers in the operations and the middle management use the existing systems as a reference for determining the information requirements.

This method is adopted when the rules and decision methods are outside the purview of the decision maker. They are determined or imposed by external sources such as the Government, the Authority, the principles, etc. For example, the information required to manage shares of the company are determined through the rules and regulations laid down by the Company Law Board. The manager of the shares department has very little additional information need.

In all such functions, the manager determines the information needs and the designer of the MIS can always fall back on the prescribed law books, manuals, theory and textbooks, hand books, etc. to confirm the information needs.

### **Analysing the Critical Success Factors**

Every business organisation performs successfully on efficient management of certain critical success factors. Other factors are important and play a support role in the functioning of the organisation. Many times a function is singularly critical to the successful functioning of a business organisation.

For example, in a high technology business, the management of the technology becomes the critical function. Or in a service organisation, the management of service becomes a critical factor. In a consumer industry, marketing and service becomes the critical functions. The information requirements of such organisations largely relate to these critical factors. The analysis of these functions or factors will determine the information requirements.

### **Experimentation and Modelling**

When there is total uncertainty, the designer and the user of the information resort to this method for determining the information requirement. The experimentation would decide the methodology for handling the complex situation. If the method is finalised, the information needs are determined as they have been evolved through the experimentation. Test marketing of a product is an approach of the experimentation to decide the correct marketing strategy.

Sometimes models are used for deciding the initial information needs and they are modified during the implementation stage. The information requirements determined through such methods undergo a qualitative change as the users get the benefit of learning and experience and the needs may undergo a change or get replaced completely.

## **9.4 DEVELOPMENT AND IMPLEMENTATION OF THE MIS**

Having made the plan of the MIS, the development of the MIS calls for determining the strategy of development. As discussed earlier the plan consists of various systems and subsystems. The development strategy determines where to begin and in what sequence the development can take place with the sole objective of assuring the information support.

The choice of the system or the subsystem depends on its position in the total MIS plan, the size of the system, the user's understanding of the systems and the complexity and its interface with other systems. The designer first develops systems independently and starts integrating them with other systems, enlarging the system scope and meeting the varying information needs.

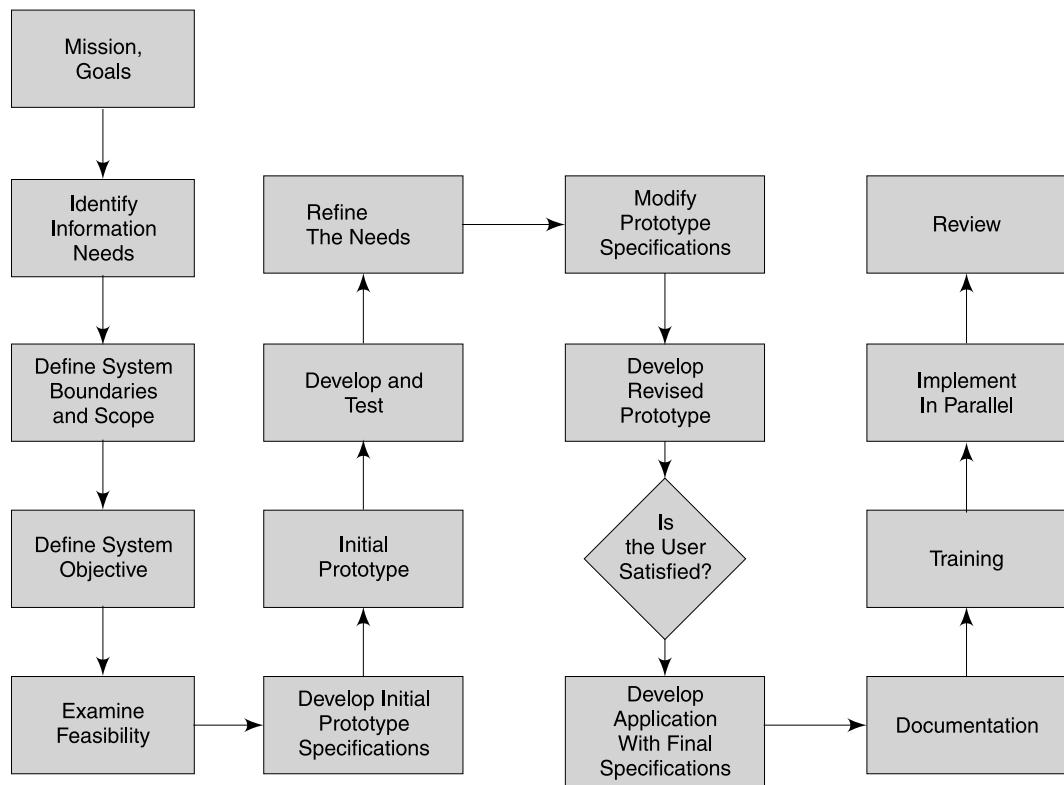
Determining the position of the system in the MIS is easy. The real problem is the degree of structure, and formalisation in the system and procedures which determine the timing and duration of development of the system. Higher the degree of structuredness and formalisation, greater is the stabilisation of the rules, the procedures, decision making and the understanding of the overall business activity. Here, it is observed that the user's and the designer's interaction is smooth, and other's needs are clearly understood and respected mutually. The development becomes a methodical approach with certainty in inputs process and outputs.

### **Prototype Approach**

When the system is complex, the development strategy is Prototyping of the System. Prototyping is a process of progressively ascertaining the information needs, developing method-

ology, trying it out on a smaller scale with respect to the data and the complexity, ensuring that it satisfies the needs of the users, and assess the problems of development and implementation.

This process, therefore, identifies the problem areas, inadequacies in the prototype vis-à-vis fulfillment of the information needs. The designer then takes steps to remove the inadequacies. This may call upon changing the prototype of the system, questioning the information needs, streamlining the operational systems and procedures and move user interaction. A typical process of the MIS development through prototyping is given in Fig. 9.1



**Fig. 9.1** *Management Information System Development Model: Prototype Approach*

In the prototyping approach, the designer's task becomes difficult, when there are multiple users of the same system and the inputs they users are used by some other users as well. For example, a lot of input data comes from the purchase department, which is used in accounts and inventory management.

The attitudes of the various users and their role as the originators of the data needs to be developed with a high degree of positivism. It requires, of all personnel, to appreciate that the information is a corporate resource, and all have to contribute as per the designated role by the designer to fulfil the corporate information needs. When it comes to information the

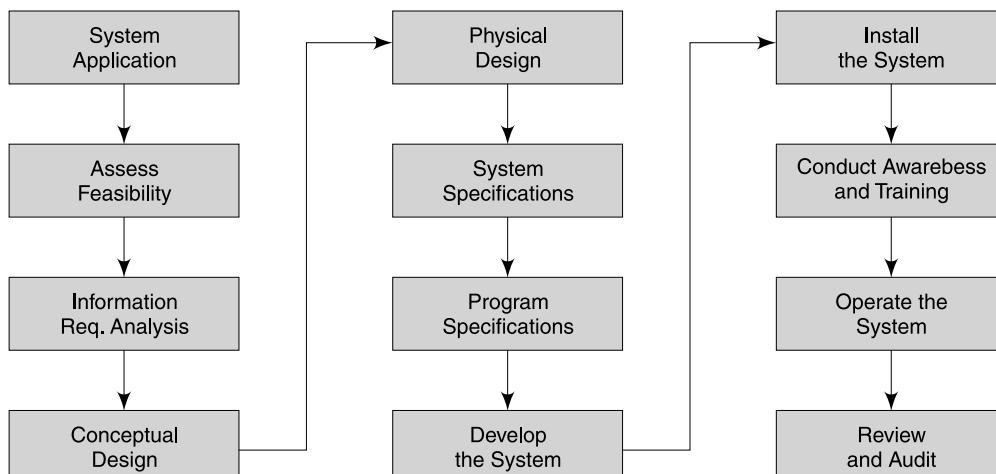
functional, the departmental, the personal boundaries do not exist. This calls upon each individual to comply with the design needs and provide without fail the necessary data inputs whenever required as per the specification discussed and finalised by the designer.

Bringing the multiple users on the same platform and changing their attitudes toward information, as a corporate resource, is the managerial task of the system designer. The qualification, experience, knowledge, of the state of art, and an understanding of the corporate business, helps considerably, in overcoming the problem of changing the attitudes of the multiple users and the originators of the data.

### **Life Cycle Approach**

There are many systems or subsystems in the MIS which have a life cycle, that is, they have birth and death. Their emergence may be a sudden or may be a part of the business need, and they are very much structured and rule-based. They have hundred per cent clarity of inputs and their sources, a definite set of outputs in terms of the contents and formats. These details more or less remain static from the day the system emerges and remains in that static mode for a long time. Minor modifications or changes do occur but they are not significant in terms of handling either by the designer or the user of the system. Such systems, therefore, have a life and they can be developed in a systematic manner, and can be reviewed after a year or two, for significant modification, if any.

Examples of such systems are pay roll, share accounting, basic financial accounting, finished goods accounting and dispatching, order processing, and so on. These systems have a fairly long duration of survival and they contribute in a big way as sources of data to the Corporate MIS. Therefore, their role is important and needs to be designed from the view point as an interface to the Corporate MIS. The life cycle approach, therefore, has a method of its own as explained in the Fig. 9.2.



**Fig. 9.2** Life Cycle Approach to the Development of MIS

Table 9.6 shows the difference between the two approaches helping the designer select an approach.

**Table 9.6** Comparison of Approaches

<i>Prototyping approach</i>	<i>Life cycle approach</i>
<p>Open system with a high degree of uncertainty about the information needs.</p> <p>Necessary to try out the ideas, application and efficiency of the information as a decision support.</p> <p>Necessary to control the cost of the design and development before the scope of the system and its application is fully determined. Experimentation is necessary.</p> <p>User of the system wants to tryout the system before he commits the specification and the information requirements.</p> <p>The system and application is highly custom oriented.</p>	<p>Closed systems with little or no uncertainty about the information needs. The system remains valid for a long time with no significant change. The design would remain stable.</p> <p>No need to try out the application of the information as it is already proven.</p> <p>Scope of the design and the application is fully determined with clarity and experimentation is not necessary.</p> <p>The user is confident and confirms the specifications and the information needs.</p> <p>The system and application is universal and governed by the principles and practices.</p>

### Implementation of the Management Information System

The implementation of the system is a management process. It brings about organisational change, it affects people and changes their work style. The process evokes a behaviour response which could be either favourable or unfavourable depending upon the strategy of system implementation.

In the process of implementation, the system designer acts as a change agent or a catalyst. For a successful implementation he has to handle the human factors carefully.

The user of the system has a certain fear complex when a certain cultural work change is occurring. The first and the foremost fear is about the security to the person if the change-over from the old to new is not a smooth one. Care has to be taken to assure the user that such fears are baseless and the responsibility, therefore, rests with the designer.

The second fear is about the role played by the person in the organisation and how the change affects him. On many occasions, the new role may reduce his importance in the organisation, the work design may make the new job impersonal, and a fear complex may get reinforced that the career prospects may be affected.

There are certain guidelines for the systems designer for successful implementation of the system. The system designer should;

1. Not question beyond a limit the information need of the user.
2. Not to forget that his role is to offer a service and not to demand terms.
3. Remember that the system design is for the use of the user and it is not the designer's prerogative to dictate the design features. In short, the designer should respect the demands of the user.
4. Not to mix up technical needs with the information needs. He should try to develop suitable design with appropriate technology to meet the information needs. The

designer should not recommend modifications of the needs, unless technically infeasible.

5. Impress upon the user the global nature of the system design which is required to meet the current and prospective information need.
6. Not to challenge the application of the information in decision making. It is the sole right of the user to use the information the way he thinks proper.
7. Impress upon the user that the quality of information depends on the quality of input.
8. Impress upon the user that you are one of the users in the organisation and that the information is a corporate resource and he is expected to contribute to the development of the MIS.
9. Ensure that the user makes commitment to all the requirements of the system design specifications. Ensure that he appreciates that his commitments contribute largely to the quality of the information and successful implementation of the system.
10. Ensure that the overall system effort has the management's acceptance.
11. Enlist the user's participation from time to time, so that he is emotionally involved in the process of development.
12. Realise that through serving the user, he is his best guide on the complex path of development.
13. Not to expect perfect understanding and knowledge from the user as he may be the user of a non-computerised system. Hence, the designer should be prepared to change the system specifications or even the design during the course of development.
14. Impress upon the user that the change, which is easily possible in manual system, is not as easy in the computer system as it calls for changes in the programs at cost.
15. Impress upon the user that perfect information is non-existent, his role therefore still has an importance in the organisation.
16. Ensure that the other organisation problems are resolved first before the MIS is taken for development.
17. Conduct a periodical user meetings on systems where you get the opportunity to know the ongoing difficulties of the users.
18. Train the user in computer appreciation and systems analysis as his perception of the computerised information system will fall short of the designer's expectation.

Implementation of the MIS in an organisation is a process where organisational transformation takes place. This change can occur in a number of ways.

The Lewin's model suggest three steps in this process. The first step is *Unfreezing* the organisation to make the people more receptive and interested in the change. The second step is *Choosing* a course of action where the process begins and reaches the desired level of stability, and the third step is *Refreezing*, where the change is consolidated and equilibrium is reinforced. Many a times, this process is implemented through an external change agent, such as a consultant playing the role of a catalyst.

The significant problem in this task is the resistance to change. The resistance can occur due to three reasons, viz., the factors internal to the users of information, the factors inherent

in the design of the system and the factors arising out of the interaction between the system and its users. The problem of resistance can be handled through education, persuasion, and participation. This itself can be achieved by improving the human factors, and providing incentives to the users, and eliminating the organisational problems before implementing the system.

## 9.5 MANAGEMENT OF INFORMATION QUALITY IN THE MIS

Information is a corporate resource, as important as the capital, labour, know-how etc. and is being used for decision making. Its quality, therefore, is required to be very high. A low quality information would adversely affect the organisational performance as it affects decision making. The quality of information is the result of the quality of the input data, processing design, system design, system and procedures which generate such a data, and the management of the data processing function. Quality, unlike any other product, is not an absolute concept. Its level is determined with reference to the context and its use, and the user. Perfect quality just as perfect information is non-achievable and has cost-benefit implications.

However, it is possible to measure the quality of information on certain parameters. All these parameters need not have a very high value. Some parameters may have lesser importance in the total value on account of their relevance in the information and its use. The quality parameters which are generally considered are shown in Table 9.7.

**Table 9.7** Quality Parameters of Information

Parameter of quality	Example	Comments
Complete data of all the transactions	All invoices of the month. All vouchers of the month.	This achieves integrity of data with respect to the time period.
Valid transaction and input data	Only correct transaction types are permitted in the system. Only that data which meet the design specifications can be used.	Ensures the validity of the data and in turn, assures a valid information.
Right use of Rule Formula	Correct use of the formula or procedure with relevant data.	Assures that the results are accurate and precisely correct based on rule, act or law using complete data.
Relevance to the user/Decision maker/Stake holder	It should be relevant to the user for a decision making strategic areas of business.	If the relevance is appropriate the quality required is high. Strong link between Business goal and MIS goal.
Timely information	Information on the sales despatch, pending position.	If the information is received late it becomes useless from a point of view of decision making.
Meaningful and complete information	Production information should be reported in terms of quantity, quality and groups, or family, and rejection and reasons. It should be given in a proper format, with references.	Incomplete information forces the user to infer or interpret erroneously leading to a wrong decision.

The quality of these important parameters is ensured by conducting a proper systems analysis, designing a suitable information system and ensuring its maintenance from time to time, and also subjecting it to audit checks to ensure the system integrity.

The quality of the parameters is assured if the following steps are taken.

1. All the input is processed and controlled, as input and process design.
2. All updating and corrections are completed before the data processing begins.
3. Inputs (transactions, documents, fields and records) are subjected to validity checks.
4. The access to the data files is protected and secured through an authorisation scheme.
5. Intermediate processing checks are introduced to ensure that the complete data is processed right through, i.e. run to run controls.
6. Due attention is given to the proper file selection in terms of data, periods and so on.
7. Back-up of the data and files are taken to safeguard corruption or loss of data.
8. The system audit is conducted from time to time to ensure that the information system specifications are not violated.
9. The system modifications are approved by following a set procedure which begins with authorisation of a change to its implementation followed by an audit.
10. Systems are developed with a standard specification of design and development.
11. Information system processing is controlled through programme control, process control and access control.
12. Ensure MIS model confirms consistency to business plan satisfying information needs to achieve business goals.

The assurance of quality is a continuing function and needs to be evolved over a period and requires to be monitored properly. It cannot be assessed in physical units of measure. The user of the information is the best judge of the quality.

## 9.6 ORGANISATION FOR DEVELOPMENT OF MIS

Proper people organisation is basic to the management of any activity or function. The same thing is true for the development of the MIS. The principles of the organisation and structuring the organisation to the specific needs of the function is a prime necessity when we talk with reference to the MIS a number of issues come up and they are not the same in all the organisations. Hence, the organisation structure of the MIS would differ from one organisation to the other.

The type, the size and the structure of corporate organisation becomes the basis for the MIS organisation for handling the MIS function and management alternatives. The major issues involved are:

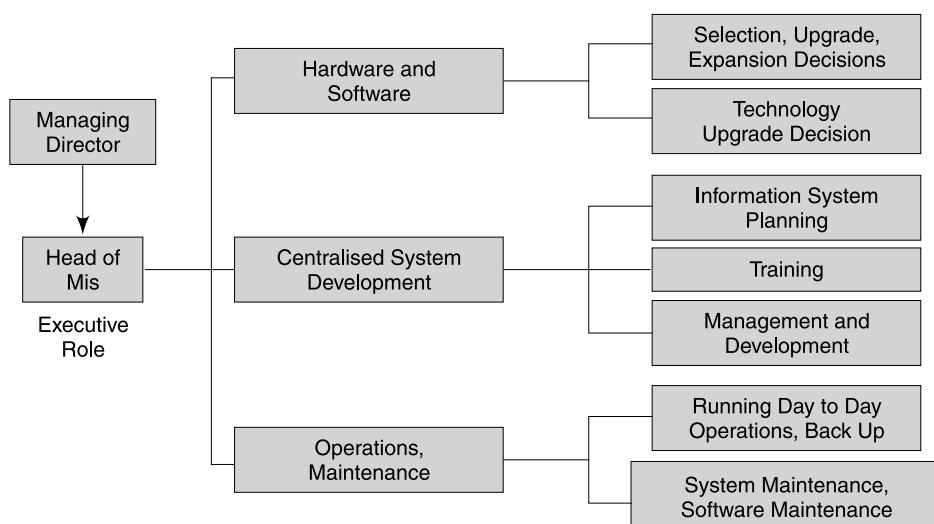
1. Whether the MIS function should be handled as a centralised or decentralised activity.
2. The allocation of the hardware and software resources.
3. The maintenance of the MIS service level at an appropriate level.
4. Fitting the organisation of the MIS in the corporate organisation, its culture and the management philosophy.

The question of centralization versus decentralisation is resolved by assessing the status of information resource management in the organisation, i.e., whether the status is the information systems management or the information resource management. When it is a case of information systems management then the organisation of the MIS would be centralised, but if it is a case of information resource management, it will be a decentralised organisation.

In a centralised set, the responsibility of acquisition of the data, of providing the information to the users, becomes the centralised function. The centralised organisation is also recommended when the information needs are more or less static. In such cases, the user of the information is free from the responsibility of designing the systems and also from deciding the hardware and the software. However, if the information needs are varying and is more strategic in nature, the reliance on the centralised set-up becomes a difficult workable proposition. When such a situation exists, a decentralised organisation is more effective.

Depending upon the situation, hardware and software solutions are available. In a decentralised set-up the allocation of hardware is a centralised decision but the collection of data and its processing becomes the user's responsibility. Training, problem solving and system development, however, is a centralised function. In all such situations, the information processing is based on the database management system. Therefore, the management of the database becomes the centralised responsibility and its use becomes the responsibility of users.

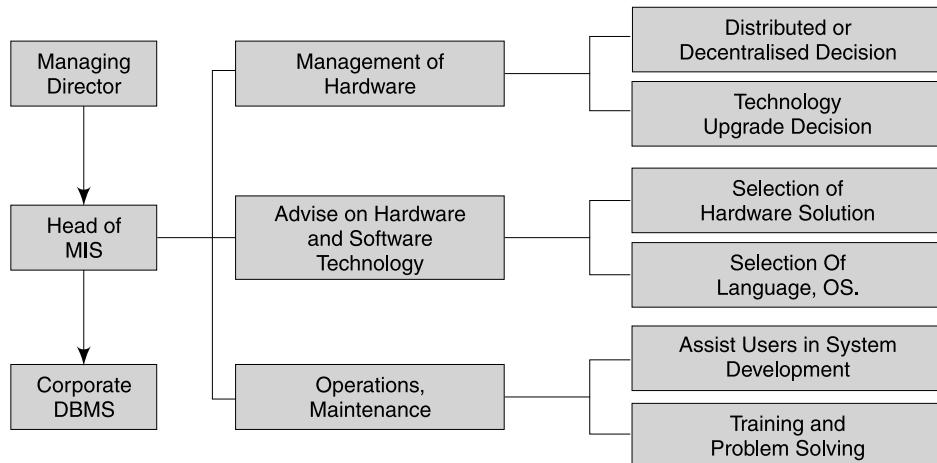
In a real life situation, the variations of these two approaches are found, mainly on account of the variety of hardware, software solutions. One can develop two models of the MIS organisation (as shown in Fig. 9.3 and Fig. 9.4), and its variations can be further developed suitable to the corporate culture, the management style and philosophy of the management.



**Fig. 9.3** Centralised Organisation of MIS\*

**Note** *Information is considered as corporate resource and hence generated centrally by the head of the MIS and made available to all the users on conditions and needs. The function of the head of the MIS is to manage the information centrally as a corporate resource from the data to the information and its technology requirement.*

\*Supplier of hardware, software and applications, and solution.

**Fig. 9.4 Decentralised Organisation of MIS\*\***

**Note** Information is considered as a resource for a division, a department, group of individuals or in other words, it is considered specific to the business function. The head of the MIS provides support to the users of the information in their task of development. The major responsibility is the management and the technology.

The MIS function in any organisation would vary on account of the issues mentioned earlier and to that extent the variations of these two models would be the organisation of the MIS.

## 9.7 MIS: DEVELOPMENT PROCESS MODEL

Many organisations use MIS successfully, others do not. Though the hardware and the software is the latest and has appropriate technology, its use is more for the collection and storage of data and its elementary processing. There are some features which make the MIS a success and some others, which make it a failure. These factors can be summarised as follows.

### Features Contributing to Success

If an MIS is to be a success then it should have all the features listed as follows:

- The MIS is integrated into the managerial functions. It sets clear objectives to ensure that the MIS focuses on the major issues of the business. Also adequate development resources are provided and the human and organisational barriers to progress are removed.
- An appropriate information processing technology, required to meet the data processing and analysis needs of the users of the MIS, is selected.
- The MIS is oriented, defined and designed in terms of the user's requirements and its operational viability is ensured.

\*\*Supplier of infrastructure of MIS, Application and solution is users responsibility.

- The MIS is kept under continuous surveillance, so that its open system design is modified according to the changing information needs.
- MIS focuses on the business results and goals, and highlights the factors and reasons for non-achievement.
- MIS is not allowed to end up into an information generation mill avoiding the noise in the information and the communication system.
- The MIS recognises that manager is a human being and therefore, the systems must consider all the human behavioural factors in the process of the management.
- The MIS recognises that the different information needs for different objectives must be met with. The globalisation of information in isolation from the different objectives leads to information overload and its non-use.
- The MIS is easy to operate and, therefore, the design of the MIS has such features which make up a user-friendly design.
- MIS recognises that the information needs become obsolete and new needs emerge. The MIS design, therefore, has a basic potential capability to quickly meet new needs of information.
- The MIS concentrates on the developing the information support to manage critical success factors. It concentrates on the mission critical applications serving the needs of the top management.

### **Features Contributing to Failures**

Many a times MIS is a failure. The common observed features responsible for this are listed as follows.

- The MIS is conceived as a data processing and not as an information processing system.
- The MIS does not provide that information which is needed by the managers but it tends to provide the information generally the function calls for. The MIS then becomes an impersonal system.
- Underestimating the complexity in the business systems and not recognising it in the MIS design leads to problems in the successful implementation.
- Adequate attention is not given to the quality control aspects of the inputs, the process and the outputs leading to insufficient checks and controls in the MIS.
- The MIS is developed without streamlining the business processing systems in the organisation.
- Lack of training and appreciation that the users of the information and the generators of the data are different, and they have to play an important responsible role in the MIS.
- The MIS does not meet certain critical and key factors of its users such as a response to the query on the database, an inability to get the processing done in a particular manner, lack of user-friendly system and the dependence on the system development personnel.
- A belief that the computerised MIS can solve all the management problems of planning and control of the business.

- Lack of administrative discipline in following the standardised systems and procedures, wrong coding and deviating from the system specifications result in incomplete and incorrect information.
- The MIS does not give perfect information to all the users in the organisation. Any attempt towards such a goal will be unsuccessful because every user has a human ingenuity, bias, certain assumptions not known to the designer. The MIS cannot make up these by providing perfect information.

### **Approach to MIS Development**

- Identify business goals.
- Determine critical success factors
- Develop business strategy and IS strategies
- Identify critical business applications
- Make decision analysis and enumerate operational and strategic decisions
- Develop business performance indicators
- Identify information entities to decision support for business
- Determine IS structure to generate information to build MIS
- Build MIS superset as prescribed in general model of MIS.

### **MIS Development Process Model**

- Study the business environment.
- Study the organisation and structure.
- Identify mission and business goals.
- Identify critical success factors.
- Identify critical business applications
- Ascertain the business strategy.
- Identify business decisions needed to implement strategy.
- Develop key performance indicators to measure the business progress and performance.
- Determine MIS goals supporting business goals.
- Identify data and information needs meeting the MIS goals and business goals.
- Develop IS & IT strategy to meet the goals.
- Determine IS & IT support structure to meet data and information needs.
- Determine MISs superset.
- Link and map MISs and information outcome to business goals and strategy.
- Design information reporting structure.
  - Periodic reports.
  - Exception reports.
  - Control reports.
- Design KMS & BI systems.

## KEY TERMS

MIS Plan  
Organisational Information  
Business Strategy  
MIS Strategy  
Mission Critical Applications

MIS Goals and Objectives  
Business Goals and Objectives  
Knowledge (An Information Set)  
Critical Success Factors

## REVIEW QUESTIONS

1. Why is a long range plan of MIS necessary? How is it linked with the business plan of the organisation?
2. What are the contents of the MIS plan? What is the purpose of each of them?
3. Draw a matrix of the class of information versus users, and explain the nature of use in each case.
4. What problems does the system analyst face in ascertaining the information requirement at the various levels of management? How are these problems tackled?
5. When should the analyst resort to experimentation for judging the requirement? How is modelling used in this approach?
6. When would you resort to prototype approach and when would you resort to the life cycle approach in the development of the MIS?
7. In the guidelines given for implementation identify the guidelines where user is involved.
8. Before a full scale MIS development plan is undertaken, it is better to study and improve rules, policies, procedures and practices. Explain.
9. A good MIS is an integral part of the management system. Why so? What would happen if it is not?
10. User acceptance and dependence on MIS is a test of a good MIS. How would you ensure that the user related issues are taken care of while designing the system?
11. Explain the following.
  - (a) Relationship between business goal and MIS goal
  - (b) Business strategy and supporting MIS strategy
  - (c) MIS and link to other Information Systems
  - (d) Mission critical applications
  - (e) Critical success factors
  - (f) Strategic information
  - (g) MIS and its use for knowledge building
12. Which approach you would recommend for developing an MIS for following organisations. You have to recommend the development model for:
  - (a) Crime analysis and reporting for police department.
  - (b) Restaurant billing system.

- (c) Toll accounting system of expressway.
  - (d) Project site MIS design for head office reporting.
  - (e) Demand forecasting system for branded toothpaste.
  - (f) Examination grading system.
13. Why ascertaining the class of information important before MIS development strategy is considered?
14. Explain where the MIS model should be strong in following systems.
- (a) Railway ticket reservation system
  - (b) Gas cylinder distribution system
  - (c) Point of sales (POS) system
  - (d) Supply chain management system
  - (e) Retail bank operations
  - (f) Cash flow planning system
15. Explain how OOSAD approach for development of information system helps to build dynamic model of MIS in a competitive environment.

## **CONFIRM YOUR UNDERSTANDING**

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1. MIS should be \_\_\_\_\_ to meet \_\_\_\_\_ needs of strategic information.
2. MIS goals should be \_\_\_\_\_ to business goals.
3. MIS is most useful to top management when it meets \_\_\_\_\_ information need.
4. MIS \_\_\_\_\_ its data and information from other supporting systems like ERP/SCM/CRM and legacy systems.
5. MIS uses extensively \_\_\_\_\_ and \_\_\_\_\_ for viewing the business and its performance in different dimensions.
6. MISs is an assembly of \_\_\_\_\_ systems, exception reporting system, \_\_\_\_\_ alter/warning/alarm systems and user driven desktop system.
7. EIS is also a part of MIS serving \_\_\_\_\_ and \_\_\_\_\_ information needs of top and middle management.
8. To ensure utility of MIS, \_\_\_\_\_ it from the angle of its \_\_\_\_\_ to serve \_\_\_\_\_ business needs to meet current \_\_\_\_\_.
9. Functional information system serves the need of \_\_\_\_\_ while MIS serves \_\_\_\_\_ business goals.
10. Business goals are achieved through linkage of MIS goals, \_\_\_\_\_ and MIS strategic plans.
11. MIS should measure \_\_\_\_\_ performance \_\_\_\_\_ and report \_\_\_\_\_.
12. Information systems and MISs should be designed after \_\_\_\_\_ of business processes.
13. Organisational transformation goes through three steps unfreezing, \_\_\_\_\_ a course of action and \_\_\_\_\_.


**CASE STUDY**


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## 1. ENLECON LIMITED (ENL)

*(Nature of Business and Management Information System)*

The Enlecon Limited is a twenty year old company operating in the area of manufacturing of the Standard Engineering Goods, Consultancy, and Lease Finance. The Enlecon is a controlling Company, which overviews the manufacturing, consultancy and the leasing business of the Company. For all the practical purposes, there are three Companies headed by the Chief Executive and a Management Committee. The Chief Executive reports to the Managing Director of the Enlecon. The turnover of the Enlecon is over ₹ 300 crore.

### **The Enlecon Manufacturing Division (EMD)**

The Company started its business with the manufacturing and selling of consumer durables such as fans, refrigerators, ovens, washing machines, etc. This business is fairly established on all fronts. The Enlecon is an established brand and has a reputation for good quality. The order book of the Company is always full calling for meticulous planning and scheduling of the procurement, production and distribution of products to the dealers and the distributors. The Enlecon adopts the strategy of 'Production of quality goods backed by an excellent after sales service.'

The products are industry standard and the only change made from time to time is in the aesthetics, use of alternative materials, etc. The production on the assembly lines are mechanized and balanced. The Industrial Engineering Department carries out continuous studies to improve the productivity of the assembly lines. Each product has a standard Bill of Material (BOM), which is used for Material Planning. The Enlecon has Material Requirement Planning System, which helps to plan and control the raw material, parts and components for a smooth production of these products.

The Company plans its twelve-month production programme giving regard to the demand variation, seasonality and optimizes the use of assembly line by resorting to an appropriate product mix. The Production Manager makes quarterly production planning with a feature of rolling programme to facilitate the changes caused by the shortages, absenteeism, breakdown, etc. This system of planning has helped for quite some time but lately more frequent changes are required in the production programme, to suit the market needs. The stock position of all goods at the Dealers and in the Finished Goods Stores alters the schedule. The second reason is the shortage of certain components which now are in a great demand by the other Companies as well. A good management information system would help the Production Manager to do more precise planning of all the activities.

In this kind of business activity, most of the decision making is in operations area of the assembly line. The assembly line production is organised with the help of the workers, Supervisors and the line Managers. There is a general purpose engineering workshop, which feeds the machined components to the assembly lines. The job planning of this workshop is linked with the Assembly line Production Programme.

The workshop is managed by a shop manager, who is responsible for planning the component production. The fast moving components are machined on separate machining lines and the other components are machined through job shop operations. To avoid the stoppage of Assembly line, intermediate stocks are built considering the various parameters such as the demand, production plan, processing

cycle, current stock, etc. The shop manager, many times resorts to an higher stocking for a fuller usage of the machine shop facility which, would remain idle. The workshop performance and the assembly line production is judged by comparing the actual production to the planned programme production. The management of the Enlecon is only interested in knowing the level of programme achievement and the reasons for the non-achievement. The Chief Executive is fully responsible and accountable for the performance of the division.

### **Enlecon Consultancy Division (ECD)**

The Enlecon Consultancy Division provides consultancy in the high tech field in the areas of Engineering, Electronics, Communication, and Chemicals. The scope of consultancy is from the management to implementation of the project. Being in the consultancy, the Enlecon Consultancy Division has to keep itself abreast in the state of the art so that the best consultancy is given to the client.

The Enlecon Consultancy Division has organised its manpower by an expertise group in the various fields. Besides this group, there is a corporate group, which probes into future to scan the business scenario to select the business area for consultancy. Based on the group's advice the Enlecon Consultancy Division created a new Consultancy Cell 'Energy Options and Management' for the nineties.

Once the group is formed, it has within it, a hierarchy of consultancy tasks. A group is headed by a specialist assisted by Scientists, Engineers, Technologists and Management Experts. The group has a total responsibility of marketing the consultancy services. The level and the scope of the consultancy demand is such that the group has to equip itself for any type of consultancy.

This calls upon the group to undertake studies and research in many related fields to prepare for the clients requirement. Some areas are such that if a requirement comes, the Enlecon Consultancy Division takes the assistance of external agencies. Therefore, another task of the Enlecon Consultancy Division is to build a term of associates to do small specialty work, important from the business point of view. This helps the Enlecon Consultancy Division to cut down the overhead costs of consultancy.

The consultancy business grows with the quality of consultancy and its ability to solve the customer's problems. Consultancy skills can be built if the Enlecon Consultancy Division develops analytical, problem solving, and decision-making abilities. Consultancy means offering viable solutions to the client. These solutions have a far reaching effect on the customers business. Hence, the solutions offered have to be correct from all the angles of business, operations and management.

The Enlecon Consultancy Division largely relies on the knowledge of the consultant and ensures that it is upto date. Besides, it provides the auxiliary supports through a computer, a library and a team of associates. It also encourages the inter disciplinary exchanges among the specialists group. The Enlecon Consultancy Division, generally, is involved in the selection-business prospects and problem solving. A good managerial information system would add to the present strength of the organisation.

### **Enlecon Leasing Division (ELD)**

The leasing and hire-purchase business of Enlecon Limited amounts to ₹ 27 million. The company achieved this business within five years. The government encourages this business under the policy of modernisation, technology upgradation and the need for the growth of infrastructure. Forty per cent income of the Company is through the hire-purchase business, and 50 per cent is through lease income. The leasing business mainly concentrates on Plant and Machinery and modern equipment such as computer, system and instrumentation. In the hire-purchase division, it concentrates on consumer durables.

	₹ Million
<b>Sources of Funds</b>	
Share holders funds	16.3
Loan funds	88.3
	<b>104.6</b>
<b>Application of Funds</b>	
Fixed assets after depreciation	<u>49.2</u>
Investment	–
Current assets	–
Debtors	50.2
Cash and bank balances	7.3
Loans and advances	6.4
	<b>113.1</b>
<i>Less: Current liabilities</i>	<u>8.5</u>
	<b>104.6</b>

The sources of funds and their application is given for the current year.

In the business of ₹ 27 million, the profit before tax is over ₹ 6 million. The expenditure profile and analysis of the sundry debtors is typical of the business.

<i>The expenditure profile is</i>	<i>₹ Million</i>	<i>The analysis of the sundry debtors</i>	<i>₹ Million</i>
Administration other expenses	2.3	Outstanding for a period of 6 months or more but considered good	1.0
Financial charges	8.6		
Depreciation	8.5	Outstanding for a period<six months Instalments not having fallen due	4.0 45.2
	<b>19.4</b>		<b>50.2</b>

The management concentrates on the selection of clients and the selection of item for lease finance or hire purchase.

### Questions

1. Discuss the approach you would take for developing the MIS in the three divisions of Enlecon Limited. Why is the approach different in each case compared to the other two divisions.
2. Identify, in each Division, the critical areas of concern, and recommend the system for each of them to manage efficiently.
3. Classify the systems suggested by you in the following classes:
  - (a) Knowledge based for strategic management.

- (b) Operations management of division's business.
- (c) Decision support systems.

## 2. BRIGHT PAINTS LIMITED (BPL)

*(Role of MIS Consumer Goods Industry)*

Bright Paints Limited (BPL) is the oldest paint manufacturing company in New Delhi. It has its wholly owned subsidiary located in Agra in Uttar Pradesh. It is in the process of setting up a new plant in Hyderabad. BPL is a major supplier to the automobile and white goods industry, the major customers being Bajaj Tempo, LML, Escorts, Telco, Maruti, Godrej, BPL and Alwyn.

It has a tie-up arrangements to supply paints to the auto companies. Its performance last year was affected due to the low purchases of paints caused due to strikes in two Companies. Overall, the company has registered a good sales growth but the margins are under pressure, due to the rising raw material prices. The company also incurs transportation cost in moving the material from North to South. The cost of transportation works out to ₹ 500 per tonne. It has to pay 4 per cent octroi on all the products.

Due to its expansion programme, the interest cost has also increased putting pressure on the margins. The depreciation write-off would also increase as and when the additional capacities go into operations.

The company has good industrial relations record so far, as it cares for the people resource by giving a better salary package as compared to the norms in the industry. However, this expense is affecting the profit margin more as compared to the competition. Table 9.8 and Table 9.9 show the financial results and the key ratios of Bright Paints Ltd.

**Table 9.8** Financial Result

	<i>BPL</i>		<i>APEX Paint</i>		<i>Indian Paints</i>	
	<i>2001-02</i>	<i>2002-03</i>	<i>2001-02</i>	<i>2002-03</i>	<i>2001-02</i>	<i>2002-03</i>
Sales	500	650	200	300	250	450
PBDIT	90	98	20	25	30	40
Interest	10	15	04	07	06	08
PBDT	80	83	16	18	24	32
Provision	08	09	02	03	04	04
PAT	43	44	08	09	12	16
Equity	20	40	06	06	10	10
Reserves	147	160	28	35	35	48
Net worth	167	200	34	41	45	58
Inventories	130	150	48	55	45	65
Debtors	49	59	20	24	37	40
Working Capital	137	200	45	50	55	80

The paint market is estimated to be over ₹ 30,000 million. There are five major players in the organised sector serving 60 per cent of the market. The remaining market is handled by hundreds of units which reach to the local market and deal with limited number of colours and shades.

The paints industry has two segments—industrial for protective purpose and decorative for home, office and other applications. The major share of each company is in the decorative business. The growth in both the segments is around 15 to 20 per cent.

**Table 9.9** Financial Key Ratios

	BPL		APEX Paint		Indian Paints	
	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03
OPM%	18	15	10	08	12	09
GPM%	16	13	08	06	10	07
NPM%	14	11	07	05	08	06
RONW%	26	22	24	22	27	28
W.C.Turnover	3.65	3.25	4.44	6.00	4.55	5.62
Debtor Turnover	10.20	11.01	10.00	12.50	6.76	11.25
Inventory Turnover	3.85	4.33	4.16	5.45	5.56	6.92

The industrial segment is a specified market as each of the applications has some specific purpose. Hence, as per the application the quality specification of the paint changes. The variety of the applications in this segment is described as the automotive parts, marine, powder coating. The customers of the Company are Original Equipment Manufacturers (OEM) like automobiles, white goods, earth moving equipment etc. The Company has a technology tie-up with a US company. The industrial segment is relatively stable and has a steady growth and is highly cost quality conscious.

The decorative paints are classified into three segments—distemper, enamels and acrylic emulsions. The demand for these paints is seasonal and is related to the civil construction industry. The demand for these paints is just prior to the festival seasons. The peak demand is in September to December. During the rainy season the demand drops and picks up in the post monsoon period. If the seasonal demand is to be met satisfactorily, large inventories are unavoidable.

The Company adopts various sales promotional measures such as cash discounts, seasonal discounts, turnover discounts, etc. for the contractors operating in this segment. The Company has a large dealer network for decorative paints. BPL has ten thousand dealers spread in over 3000 towns and cities. The Company has products in branded and non-branded general category. If the colour and the shades are put together a retailer would have at any time 200 plus items in inventory.

The raw material accounts for as much as 70 per cent of the cost of production. The price trend follows the petrochemical trend in prices. The most important raw material is titanium dioxide available in two grades to be used in the decorative paints and in the other categories of paint. The titanium dioxide is produced by the Kerala Minerals & Metals Limited (KMML), a sole producer in India. KMML suffers from power shortage and an irregular supply of power. Hence, the most of the companies resort to the import of titanium dioxide. Since the import lead time is longer, the company is forced to maintain a high inventory of titanium dioxide.

The industry experts predict 20 per cent growth in the industrial segment and 10 per cent in the decorative paints segment. The additional capacities being installed in the organised sector as well as the unorganised small business sectors, the glut in the industry cannot be ruled out. Since, the paint industry is not a capital intensive industry, an increase in the production capacity will bring down the inventorying of paints. The paint industry being cyclical in nature, substantial funds are blocked in the inventory during the lean seasons.

In the coming decade most of the growth in the decorative segment is likely to come from the rural and the low end urban market, where the low priced branded products are expected to register higher sales.

Out-sourcing is also resorted to for the production of low value small batch size products. This is possible due to the established production capacity in an unorganised sector. With the production

capacity available in abundance and the market becoming more discerning, a strong brand image and distribution networks are the key variables for pushing the products in the markets.

A strong brand image is possible through the adoption of new technology which is capable of offering a wide choice of colours. Earlier, the customers had to satisfy themselves with the available colours. The technology now offers a facility to create colour shades of the customer choice on the spot. It, however, requires installation of such machines at the various outlets. With this technology, the Company will have to maintain three to six basic colourants with the retailers reducing the variety of items in, the inventory leading to a reduction in inventory holding the costs. The new technology provides the capability to mix different shades to produce the desired colours asked by the customers.

The competition has installed a computer based technology which helps to replicate the house structure on the screen. Then it enables to try the different shades on the screen for the customer choice. Once the shade is finalised, it further helps to produce such a shade through an installed colour machine.

### **Questions**

1. Identify the business issues facing BPL.
2. Evolve business strategies for the company.
3. Spell out the role of the Management Information System in BPL and identify the business focus areas, the critical applications, and the critical success factors.
4. Suggest the information reports supporting the strategy formulations and its execution.
5. Suggest DSS, supporting the strategy formulations and its execution.
6. Discuss the need of the ERP implementation to support the Management Information System needs.
7. Consider the value chain of BPL and explain how Supply Chain Management could be a better proposition?

### **3. MACHINE TOOL TENSILE LIMITED (MTTL)**

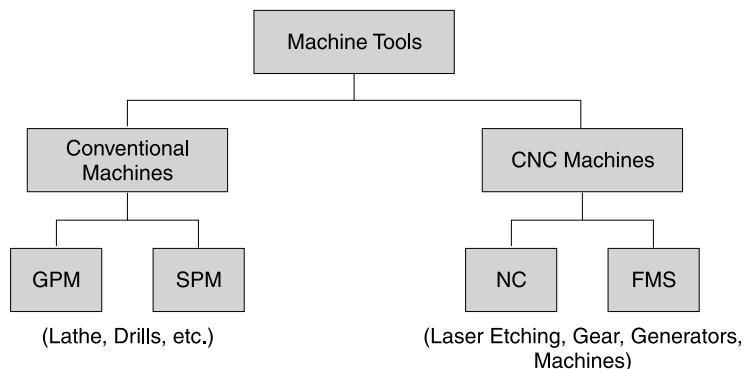
*(Role of MIS Machine Tools Industry)*

The Machine Tool Tensile Limited (MTTL) manufactures machine tools for the engineering industry. It is wholly Indian company having technical tie-ups with companies in East European countries like Russia, Poland and Germany for certain type of special machine tools. The turnover of the Company is ₹ 200 crore and is probably the second largest company in the machine tools industry. It is located in Chandigarh where, in and around the city, a lot of sub-contractors are available. MTTL concentrates on the design and the adoption of new machineing technology.

The machine tools industry is a complex one due to the sheer range of products it handles. There are broadly, two kinds of classes—the conventional machines and the computer numerically controlled (CNC) machines. The conventional machines can be classified further into the General Purpose Machines (GPMs) and the Special Purpose Machines (SPMs). The CNC machines can be put into two classes, viz., Numerically Controlled (NC) machines and Flexible Manufacturing Systems (FMS).

Figure 9.5 gives the classification structure of machine tools.

The GPMs are useful where the volumes are low and require a flexibility for producing a variety of products. The SPMs are used for the mass production requirements. The CNC machines are used when high precision and low volumes are to be handled. The trend now is towards the lean manufacturing systems using the computer technology, Robotics and laser technology. The FMS belong to this category. In India the SPMs have gained ground but the presence of the FMS is very insignificant.

**Fig. 9.5** Classification of Machine Tools

With the advent of liberalisation policy the machine tool inputs are possible and the manufacturers are looking for the FMS to cut down the cost and investment. The MTTL has been changing with times and has kept pace with the development in the industry.

The Machine Tool Industry is highly correlated with the growth of engineering sector for demand. The growth of the Machine Tool Industry lags behind the growth of the user engineering industry. The order position of the Machine Tool Industry improves with the growth of engineering industry. Most of the Machine Tool Production is against the customer when it comes to the FMS, the NC machines and the CNC machines. It is also true in case of the SPMs. The GPMs are generally available in stock.

At the moment the growth of the engineering sector is stagnant or declining. The companies in the sector cut back or defer their expansion or diversification programme.

The product mix of the MTTL is 50 per cent GPMs, 30 per cent SPMs and 20 per cent FMS, NC and CNC machines.

The MTTL has to keep pace of production when the growth is at a higher rate than the normal one. This requires more funds to finance the capital and the technology intensiveness of the industry; but relatively the benefits come at a much slower rate.

In the business range of the MTTL there are five companies in India and a number of companies abroad posing the competition. It also has competition from customers like Telco, Bajaj Auto, Kirloskar, Mahindra and Mahindra which also have in-house capabilities and capacities to manufacture machine tools.

The market of conventional machines is dominated by the HMT. Batlibai, Mysore Kirloskar, Bharat Fritz Warner, Laxmi Machine Works and ACC Designs are the other competitors. There are other small manufacturers of NC and CNC machines which compete in a small range of machines. They operate against the specific orders with financial assistance from the customers.

The cost structure of the machine tool is 60 per cent material, 10 per cent wages and salaries, 15 per cent other expenses and 10 per cent interest. After providing for power, fuel, and depreciation, etc. the Profit Before Tax (PBT) is less than 2 per cent. The improvement of profit margin is possible through the better management and assured quality. The company has gone in for the ISO certification and has obtained ISO-9002 certificate of quality.

Better management is possible through the manufacturing strategy design. The expenses can be controlled through the maximum use of core competency and out-sourcing the rest from recognised sources, where the quality can be demanded at a much lesser cost. While the GPMs do not contribute

much to the profit margins the SPMs, the NC, and the CNC machines give much high value to the margin. The MTTL management would like to evolve a proper product mix so that the overall contribution increases. This requires marketing the product and the production strategies linked closely to the growth of the Auto Consumer Durables, Intermediate Goods and Capital Goods Industry.

The machine tool industry is also affected by a periodical recessionary phase coupled with the shift in consumption. Recently, it is observed that the defence sector is buying less, the Public Sector Undertakings (PSUs) have cut down the budgets while the Auto and the White Goods industry have plans to invest. Owing to the mismatch between the capacity, the orders and the time at which the orders come, import becomes a viable alternative to the customer of the machine tool industry.

The profit margins are low in this industry. The GPMs are better than the SPMs. This is mainly due to the high volumes in the GPMs as compared to the SPMs where the fixed cost is spread over the small volume. While India scores over cost in the design engineering which is lower here than in Europe, the same is true for manufacturing but the productivity is lower than the European manufacturers. MTTL has similar cost and the productivity norms.

To cut down on the costs, MTTL tries to adopt advanced technology or reverse engineering and customisation of local requirements. This approach takes longer time and the delivery time promised to the customer is not kept. MTTL wants to look into this approach to find out whether the out-sourcing of the critical components is efficient, effective and economical. This, however, requires developing the business mix, the product and the production strategies. With the liberalisation of trade the world over, export of machine tools to the developing countries in the Indian subcontinent, Africa and South America is a distinct possibility. With the general trend moving towards the less manpower intensive technology by using the Computer and the Laser Technology and application of the software to control the processes, the demand shift from the GPMs to the NC and the CNC machines is most likely.

The growth projections of the user industries till the year 2000 are 20 per cent for the auto industry, 25 per cent for the customer durables, 15 per cent for the intermediate and the capital goods.

MTTL feels confident that they will face the coming tide in the business effectively, provided they put their Information Management function in place. Though excessive use of computers is present in the functions like the design and engineering, and manufacturing applications, in business planning, execution and control it is not very high. With the recent advances in the Information Technology, MTTL finds that its application in the business management is very low. It is evident that the enquiry and order processing cycle times are lengthy, generally over four to six months. The cost analysis is possible on a limited scale. The estimation of the cost and resources are not fairly correct. MTTL does not have information on out-sourcing, engineering database, competition, etc. The systems capability in the materials management is very poor where the costs are very high.

Though the performance of the Company is same as that of its competitors, it would like to set up an MIS for effective decision-making at all levels of management.

## Questions

1. Discuss the areas of concern in the Machine Tool Industry and then of MTTL.
2. Why is need of an MIS felt when the Company is doing well?
3. How would the MIS help in improving the present management process? Which areas of business need Information Technology application?
4. Will the MIS help in restructuring the business and business strategies to improve the performance.
5. Which decision support system would you recommend for improving the performance of MTTL?

## 4. NATIONAL INSTITUTION OF RESEARCH AND STUDIES (NIRS)

(*MIS in Research Environment*)

The National Institute of Research and Studies is an Institute, established for studies and research in Politics, Economics and Sociology. The institute runs its operations with grants received from the State and the Central Governments. But these grants are limited to the extent that they can meet the monthly expenses of administration, library, maintenance and salary of the administrative personnel. Seventy per cent of its expenditure is met through the revenue earned on the research and the study projects undertaken from time to time.

The institute has a strength of 300 personnel of which 100 are administrative personnel and 200 are Research Scientists. Depending upon the work load, the institute takes the help of research associates from outside on a temporary basis. NIRS has a modern computer system, which is used for data analysis and research. It is now also connected on the World Wide Web network. The access to the Internet has provided an access to a variety of databases required for research work.

A research project is accepted after a thorough analysis of the resource requirements, viz., the time of the research staff, the computer time, the funds for conducting the survey or gathering the data and funds required for the management and administration of the project. The resources so estimated are valued at the current rate and to such valuation 15 per cent is added for cost escalation. This amount is treated as the direct cost of the project. The project is accepted only if the client is ready to fund it at the rate of 300 per cent of the direct cost.

The Institute is a reputed Institution with a number of excellent research studies to its credit. Therefore, it is very much in demand for conducting research studies.

The management of the institute always faces problems on account of the cost over-run, and time over-run and, therefore, the expenses are always more than originally budgeted. The projects are delayed, because the key research personnel are not available whenever required. At any time 15 to 20 projects are in operation and at least 5 projects are being studied for making a price offer to the client.

A research project has its own methodology starting from setting the objectives to the submission of the report. The major tasks in the Research Project are well defined. They are as follows:

1. Study and discussions with the client.
2. Finalisation of the scope of study with the goals and objectives.
3. Discussion of the estimation resource and approval.
4. Schedule for funds release for project initiation and execution.
5. Dividing the project into small break-ups with clear identification of responsibility.
6. Allocation of funds and resources.
7. Detailing the activities and executing them.
8. Periodical reviews and revisions to access, check and correct the plan and the course of actions already taken.
9. Fixed period progress review meetings to ascertain that the project is on the right track towards achieving the deadline and the intended results.
10. The final research findings, its presentation and submission of the reports to the client.

The management of the institute controls the project by weekly meetings with the research chief, project coordinator and the key research personnel. The meetings often are inconclusive because the appropriate information cannot be produced for the project review meetings. In every meeting, some information required is not available and, therefore, it is decided to collect the same in the following meeting. The review meetings are held to assess the following:

- (a) The status of the project.
- (b) The expenses incurred as against the budgeted expenses.
- (c) The availability of key research personnel.
- (d) The probability of completing the project on time.

After the meeting, the research chief and the project coordinator are required to take the necessary decisions and actions to ensure that the project moves as per the schedule.

Since, the Institute has a computer system, management decided to develop the MIS for Research Project Monitoring and Control. Suppose you are appointed as a Consultant to the Institute, how would you answer the following questions asked by the Management of the Institute.

### **Questions**

1. Define the objectives of the Management Information System in NIRS.
2. Suggest the reports the Management Information System should give.
3. Suggest the exception reports to be taken for the weekly review meeting.
4. Give a format of two exception reports.
5. Would it be advisable to introduce an on-line enquiry system on the project? Give justification.
6. What other systems related to the project and related to the key personnel should the Institute have so that project estimating, budgeting, planning and control is easier?
7. Study Standard Project Management Packages and submit a note to the management with justification to propose its use in NIRS working.

## **5. PREMIER AUTOMOTIVE SERVICES LIMITED (PAS)**

*(Development of the System)*

The Premier Automotive Services Limited (PAS) provides services to various companies in Pune for maintaining the transport fleet run by the companies, for their use. Besides, this, it runs petrol pumps and spare parts shops too. The vehicles maintained by the Premier Automotive Services are buses, trucks, and jeeps. The total strength of the Premier Automotive Services is around 300 vehicles. The services charged are of two types—fixed monthly for the routine maintenance and variable maintenance for other services like breakdown repairs, replacements, petrol or diesel consumed, etc. The companies seeking services from the PAS are satisfied if the vehicles are kept in good condition and down time is 2 per cent of 25 days in a month.

The Premier Automotive Services finds difficulty in maintaining this service level even though a large staff and sufficient inventory of spares are available. The profitability of the company is going down due to the low quality of service rendered to the customers.

The revenue earning departments of the Premier Automotive Services are the petrol pumps, the spare parts shops, the garages and the paint shops.

The Premier Automotive Services is supposed to keep the schedule of the various services, which are required for a vehicle to be in good condition. This calls upon the replacements of the critical spares, testing of the various systems, and regular servicing, etc. It is observed that the vehicles are not called regularly and are not scheduled for such services properly. It is the customer who complains or initiates a job and then the same is carried out.

The buses are used by the companies for moving their employees. The buses are, therefore, to be kept in a good shape so that no complaints are received. The trucks are used for a long distance delivery of finished goods. The jeeps are used for the local transport requirements. Since, all the vehicles are used for

the critical transport needs their availability becomes very important. The turn around cycle time of the vehicles, once received in the Premier Automotive Services, is very important.

Each vehicle needs to be treated as one servicing unit, for its maintenance and planning. The planning caters for the general up-keep, the periodical replacements, based on some parameters, either the period or the kilometers run, and the expected break-down. In each of the vehicles the items like tyres, batteries upholstery, dynamo and fan belt, etc. are required to be replaced on such a predetermined parameters.

In order to service a vehicle, the PAS maintains a card for each of the vehicle, where the basic information is maintained. This information is like the model, the type, the owner and his residential or official address and so on. In addition to this, there is a general list of the tasks such as the base servicing, cleaning, topping, etc., which are given for each of the vehicles within the stipulated period. It also maintains the history of the services carried out on the vehicle for future planning.

The owner of the vehicle requires yearly report on the tasks carried out, the expenses incurred and the forecast of the planned expenses based on the services required in the following year.

The general procedure followed by the Premier Automotive Services, for offering various services, is as follows:

Each vehicle is scheduled for a show-up every month for planning of the service tasks. When the vehicle arrives in the Premier Automotive Services, the Service Manager takes the card of the vehicle, checks the kilometers run and decides the replacements of the various spare parts, the activities like tuning, overhauling, painting and the basic servicing. The time for the service is estimated and the driver is given a service order card, with the date for leaving the vehicle in the garage. The service order card also schedules the activities in the garage in its order, so that each Service Centre knows where the vehicle is to go next for its servicing.

At each of the Service Centres, a delivery note is written with the Service Order number mentioning the tasks carried out in terms of the skilled hours and replacements made. If the recommended replacements are not made for the non-availability of spares it is recorded for making up in the next scheduled turn. If the replacement is critical, the vehicle is kept under a hold till the item is made available.

Based on the delivery notes collected from each Service Centre, a consolidated bill is made for the vehicle which is handed over to the driver for payment.

If the time spent by each of the vehicles is analysed, it is observed that 30 per cent of the time is spent in waiting. Besides, each vehicle is required to visit the Service Centre twice for competing the task—once for getting the service order and again for the actual maintenance work.

The Management of the Premier Automotive Services wants a system which will provide all the information so that the arrival of the vehicles can be planned to ensure the availability of all the garage facilities, spare parts and other services. The PAS would like to maintain a vehicle log-book on the computer which will provide such information instantaneously for planning and control of vehicle servicing.

### Questions

1. State the objectives of PAS and MIS.
2. What kind of information is necessary to improve the service level to the customers?
3. Suggest a network system for data and information processing for the Premier Automotive Services for improving the service quality and reducing turn around time.
4. Suggest the various outputs, the MIS should provide, so that:
  - (a) The customer is informed, well in advance, about the servicing schedule.

- (b) The expected expenditure on the vehicle in the year can be budgeted by the customer,
  - (c) The Premier Automotive Services can plan the inventory of spares to ensure service with a controlled inventory.
5. In order to improve customer service PAS is willing to give access to sensitive information to major customers having large fleet of vehicles. Suggest a B2B model and explain how it would function.

## **6. MULTITEC ENGINEERS LIMITED (MEL)**

*(Integrated Project Management System)*

Multitec Engineers Limited is a Company in the business of manufacturing the selling plant and equipment of processing industries. It specialises in manufacturing plants of chemicals, cement, steel, material handling on a turn-key basis. The scope of the business is the design, manufacture, erection, installation, commission and achievement of rated performance. The order on the company would be of a value of ₹ 100 million to ₹ 1000 million depending upon the scope of supply. The company is a reputed manufacturer of plants in the chemical, cement and sugar industries. The company has a technical collaboration with four parties in West Germany, the United States of America and the United Kingdom.

Being a leading manufacturer, the Company bids for the tenders independently or as a copartner, with the collaborators in the international market. The tenders are floated by the World Bank, wherever the World Bank is financing the project. Many a times the business is earned jointly with the other manufacturers in India, i.e., the scope is divided among the manufacturers depending upon the know-how, specialisation and price. The company, has, at any time three or four orders in hand and, six or eight, under implementation.

The nature of business is such that a considerable amount of commitment is to be made to the customer on many accounts. The commitments are tied up with the clauses of penalty and damages. Further, the price once accepted is not negotiable for any reason, such as a hike in the taxes and duties, the price revisions etc. The nature of commitments are on:

- (a) The date of completion of the project.
- (b) The performance, output, and quality.
- (c) Specific supplies, design, and technology.

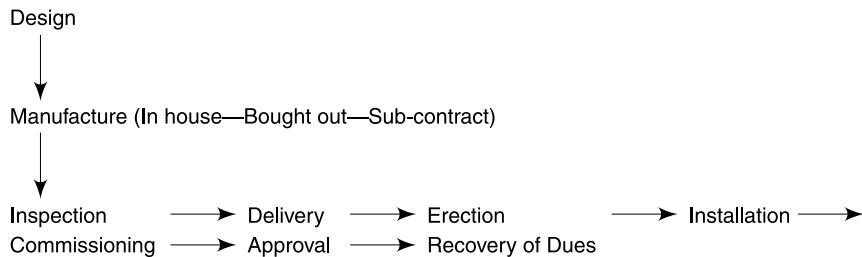
Consequent to such contractual commitments, the company binds its suppliers for similar requirements. The company for its part requirements relies on imports. Imports includes raw materials, parts and components, and systems. In order to fulfil various obligations, the Company and the customers, both employ consultants in the relevant technical field to ensure quality and performance. The quality control process starts from checking of the drawings and its approval to intermediate inspections and the final inspection to certifying the performance after commissioning the plant.

The Company has found that it is economical to do a complex job within the factory while the others can be done at the subcontractor's place. The Company also adopts the policy of using standard bought out items as a part or component reducing the load on manufacturing. When the standard items are chosen, they can be bought and supplied directly to the site where the plant is being erected.

Even in case of the subcontracting, if the item is not required in the factory, then it is sent directly to the site for erection. In order to perform these operations properly, the Company has divided these functions into three parts—the Purchase function for procurement of the raw material, the Bought out function for purchase of the standard brand/proprietary items, and the Subcontracting function, for manufacturing activities at the outside place.

There is a separate department for erection of the plant and equipment.

The broad outline of the execution of the customer order is as under:



### **Order Execution**

When a customer order is received, the Project Planning and Execution (PPE) Department gives a four digit alpha numeric number for identity of the order. For example, if Gujrath Chemicals places an order, then the order gets the number 'CO19'. The letter 'C' indicates that the order relates to a chemical plant. The number following C is a running serial number. Throughout the Company, CO19 is the order number for the planning and execution of the order of Gujrath Chemicals.

The Project Planning & Execution Department then sends order acceptance along with the specifications and other details to the design department for further processing. The design department goes into the process of plant design and prepares the drawings and the part-lists. The part-list document enumerates the details of the raw material, the bought-out items, quantity, weight, and where it will be manufactured, i.e., whether inhouse, bought out, subcontract, import, etc.

Along with this, the drawing under is also mentioned for reference. The part-list for the plant gives the details of the systems and the subsystems by which the plant is made. The subsystem is designated by a job Number in the CO19. The material procurement, the job scheduling and the loading is done with reference to the job number. The 'Job Number' is three digit alpha numeric described as E14. So, if any information is required on E14, it is necessary to put a query on, CO19 E14.

The part-list copies are sent to the materials, manufacturing, despatch, project and erection departments.

The materials department then raises a purchase requisition based on the manufacturing programme. While raising the requisition, an attempt is made to club all the quantities of a given item required for the job, which are scheduled for manufacture. This saves a number of purchase orders and economises on the purchase value. The purchase manager then raises the purchases order on the approved Vendors.

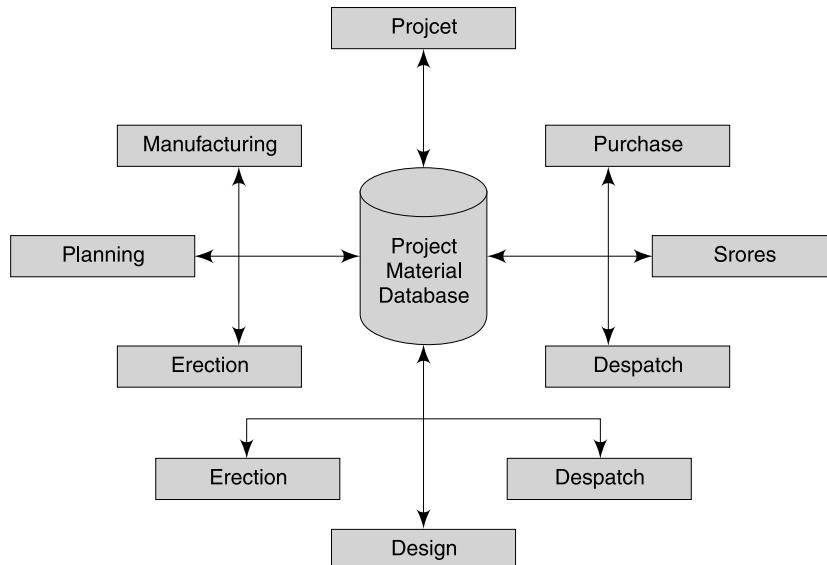
The Purchase Manager may combine several items in the purchase order. The care, however, is taken that the purchase requisition and the purchase order is prepared for one order such as CO19, with a quantity break-ups on the jobs. The Purchase Order contains the normal commercial terms and the details concerned with inspection, material transfer, etc.

The supplier sends the materials on its 'Challan' mentioning the purchase order number of the company. The material, when received in the factory, a Goods Received Note (GRN) is made with the inspection remarks. The GRN mentions the purchase order number and items serial number in the purchase order. On acceptance of the material, the same is stored in an appropriate bin location for future use. If the material is rejected, it is sent back to the Supplier on the Goods Rejection Advice (GRA). The materials planning department raises the indents for drawl of materials from the stores. The indents are raised based on the production plan.

In case of subcontracting of the items, the raw material required is despatched from the factory stores of the Company. The initiate this action, the Materials Planning Department raises a delivery note, specifying the item code, job number and the purchase order number of the subcontractors.

If the material after processing is to be despatched directly to the site, the Goods Receipt Despatch Note (GRD) is made by the subcontracting department for accounting of the material and payment to the subcontractor.

In case of bought out items, the supplier is asked to despatch the material directly to the site. The bought out department then makes the GRD for material accounting and payment to the supplier. Figure 9.6 shows different views of the Project Material Data base and Fig. 9.7 shows the Data Flow Diagram of the Material system.



**Fig. 9.6 Project Material Database Views and Application**

### Erection–Installation–Commissioning

The items manufactured at the factory, or at the subcontractor's factory, or directly purchased are received at the site, where the erection engineer of the company takes over. He is in-charge of the commissioning of the plant. The erection engineer works with the part list, erection drawing, systems drawing and plant erection manual. The erection is carried out in stages as the equipment arrives from various sources.

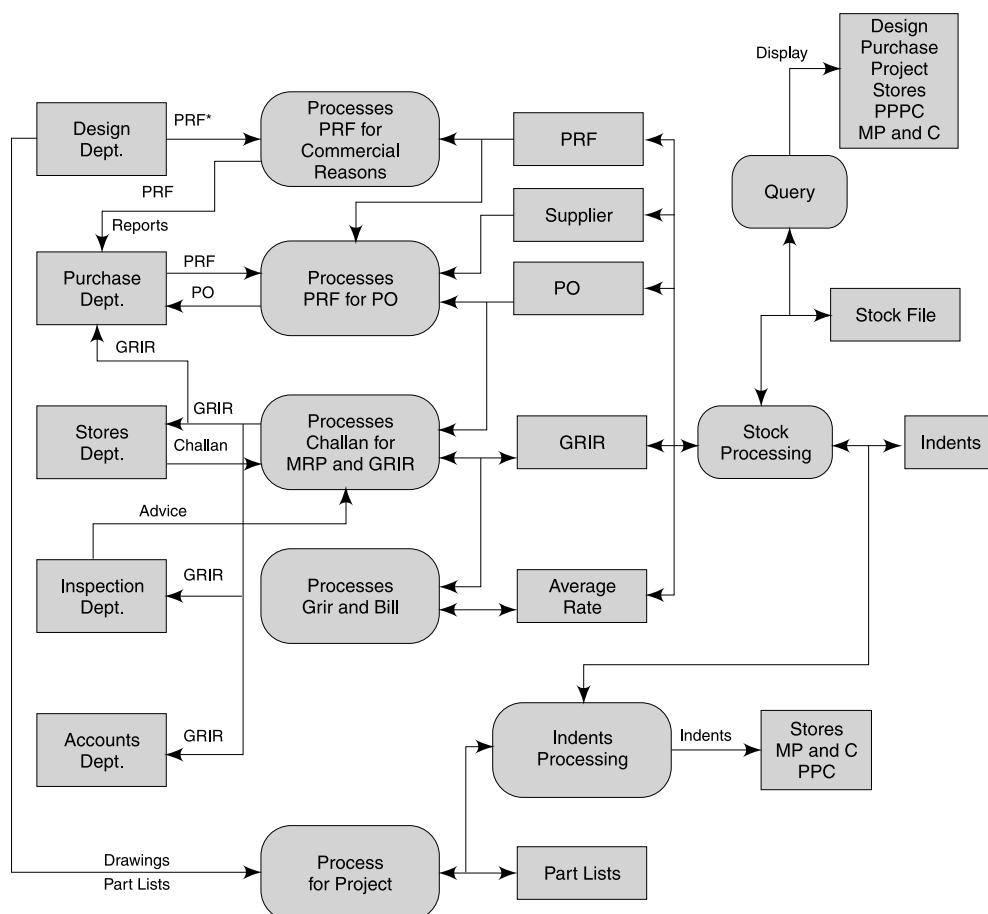
The difficulties faced by the erection engineer are of the type like sometimes a small component is not arrived made hence the erection is held up, or the material handling equipment such as Crane is down, or the material received is incomplete or wrong.

The installation is a technical procedure, which is to be strictly followed. In this process, a number of inspections by the consultant, the customer or the company's experts are conducted periodically.

The commissioning is a process of starting the total plant for testing and subsequently for performance, quality and output quantity. The erection engineer sends the erection advice as soon as the work gets over.

### Billing and Recovery: Billing Schedule

The system of billing the customer is typical of this industry. The order of the customer for a typical plant is broken into the despatchable units (DU), which is billed. For example, if the value of the order



**Fig. 9.7** Data Flow Diagram of Project Material System

is ₹ 500 million, it will be broken in the despatchable units and the value apportioned to it. The total value of the delivery units will be ₹ 500 millions. When such a large order is to be executed, the company obtains 20 per cent advance from the customer.

This advance is adjusted on a pro rata basis while billing the deliverable units. Some portion of the value is to be considered as retention money. A typical invoice of the Company contains the following.

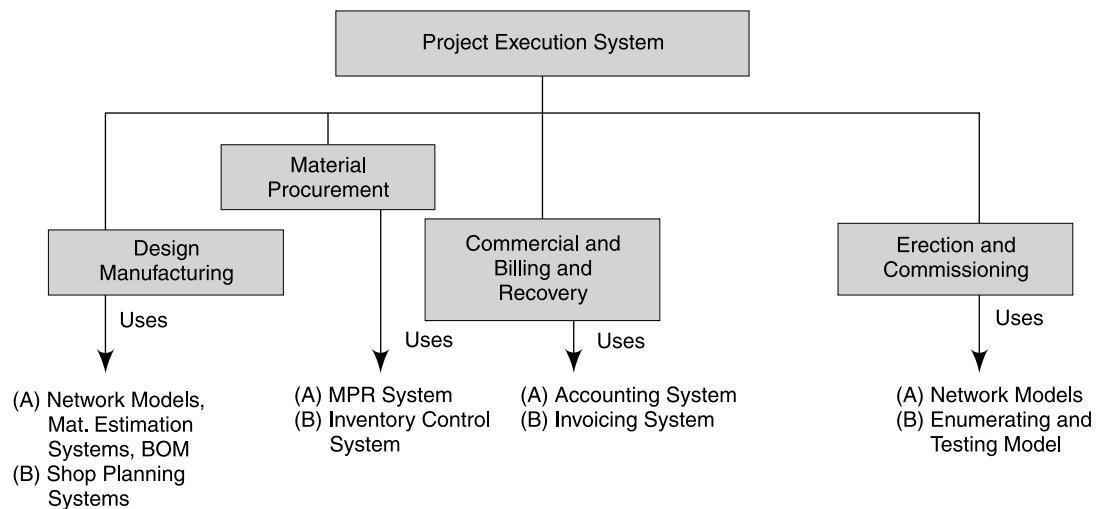
INVOICE NO.: C568			
DU No.	Description	Quantity	Value (₹)
C56	Top and bottom shaft assembly	1	2,30,000
	Adjusted against advance		46,000
	Retention amount 10%		23,000
	Balance due in 30 days against the invoice		1,61,000

The retention amount of the invoices is to be paid after successful commissioning of the plant.

The Company's Project Execution System handles the following documents:

- Customer Order
- Part List
- Drawings
- Purchase Requisition
- Purchase Order
- Goods Receipt Note
- Goods Rejection Advice
- Indent
- Delivery Note
- Shop Delivery Note
- Packing Note
- Goods Receipts Despatch Note
- Erection Advice
- Billing Schedule
- Invoice

The project execution has been planned in the following manner. The execution is carried out through five major functional activities, viz., Design, Procurement, Manufacture, Erection and Commissioning and Accounting. Each of these functions use computers and have developed planning models to support their activities. The details are given in the Fig. 9.8 and 9.9 Figure 9.8 shows System Structure and associated functions. Figure 9.9 shows the organisation for Project Execution.

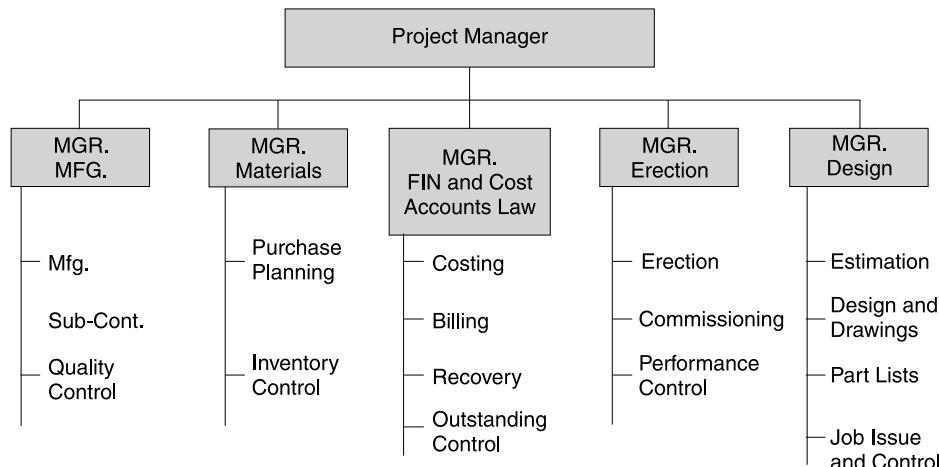


**Fig. 9.8 Project Execution System**

In the Company, five managers are responsible for the execution with the overall responsibility with the Project Manager. All these managers are at the same level in the organisational structure and they report to the managing director. Any problems and conflicts to be resolved are settled in the weekly project review meetings chaired by the Managing Director.

All the managers use computers for their planning and decision making. The information needs are studied and the systems are developed to meet the functional needs. The Company uses Standard Packages of the project management system, which helps to the extent of Planning and Control at a global level. When it is required to go into details, the Systems are felt inadequate. In this process the small systems on computers are developed to meet very local and narrow needs at the operational level.

The Project Review Meetings are always stormy and inconclusive owing to the lack of precise information. Since the systems are developed on functional basis, it was observed



**Fig. 9.9** *Organisation for Project Execution*

Manufacturing manager wants access to the data or the information, it was not possible as the data is stored in another system controlled by the other manager.

Since functional systems are developed, data duplication is much prevalent. This causes a system load in terms of storage capacity and processing. This redundancy always causes a problem of data parity between one system and the other.

Based on such system support when the review meetings are held, the observations or conclusions made by one manager is disputed by the other.

Since, different sets of data are stored in different functional systems, any integrated information is possible only after devising a computer system.

In view of the functional responsibilities, the attitude of the Managers is to take a partial view on the project execution restricted to their responsibility only or in the other words, each of them plan for achieving their functional objectives overlooking the Company's corporate objectives of meeting the various deadlines of the project.

Though all the data is available on computer, the problem is to use it in an efficient manner for the project execution. If the project is reviewed the following observations are obvious and very common.

- (a) The activity deadlines are missed affecting the project schedule.
- (b) Higher work is in process and the raw material inventory.
- (c) Shop scheduling of the jobs and the project scheduling is not consistent to each other.
- (d) Information from one report does not match with the other.
- (e) The material is dispatched but not invoiced.
- (f) The lack of coordination in the arrival of material from their sources, viz., the manufacturing shop of the company, the subcontractor and the supplier.
- (g) The data results do not match between two systems.
- (h) System orientation in one system does not match with the other. For example, in the materials system the emphasis is on the purchase order and the item code, while in manufacturing, planning and control the emphasis is on the job number. Any linkage between these two systems is cumbersome.

- (i) In the meeting the following remarks are very common:
1. The machine utilisation is maximum.
  2. 'I have controlled the inventory as per the norm given by the Management. Why can't you use the available material?'
  3. Monthly invoice budget is not met. 'I was concentrating on the creditors and Outstanding.'
  4. 'I am controlling overtime on the erection and I strictly follow the activity schedule.'

The Management of the Company felt the information crunch in spite of the investments in computers and system development. Though the individual manager could come prepared for the meetings, decision making to resolve the specific issues was always difficult. It was felt that a more precise, up-to-date, error free, unbiased information support to solve a specific problem would go a long way in improving the project execution.

The Management also felt that the present system meets the operational information needs but does not provide a control information for change, alteration or reallocation of the resources as the conflicting demands are not brought out at a time. The lacuna in the present system is its inability to provide an integrated information. This is acutely felt when the integration process of the data and information is changing.

### **Questions**

1. Discuss the problem of the management of information in MEL.
2. What should be the features of a good Project Management Information System in case of this organisation?
3. Which other functions and applications should be interfaced with this system?
4. Comment on the organisation and implementation of the Project steps.
5. Identify Critical Systems and Mission Critical Application Systems in MEL.
6. If project sites can be linked through Network and internet which additional information systems should be considered to improve MIS effectiveness.

## **7. ASSOCIATED CEMENT AND CONSTRUCTIONS LIMITED (ACCL)**

*(Organisation and the Management Information System)*

The Associated Cement and Constructions Limited is a twenty year old company, manufacturing cement in its nine different Cement Plants all over the country. The technology used in cement manufacturing is more or less the same; but the Plants vary in terms of the tonnage per day (TPD) production of cement. As a part of the diversification programme, the Associated Cement and Constructions Limited diverted into construction business of specialty. The Associated Cement & Constructions Limited constructs bridges and has special know how in the line.

The cement manufacturing is fairly a stable affair and the organisation for this is functional and hierarchical. The Finance, Sales and Personnel are the centralised functions in Mumbai, while the Production and Materials are the functions which are decentralised. The plant manager is a Chief Executive at the Cement Plant, reporting to the Managing Director of the Company. The plant manager is also responsible for the commercial, accounting and personnel and such other functions which are required to operate the plant. In fact, each plant is termed as the Strategic Business Unit (SBU) responsible for the resources and results.

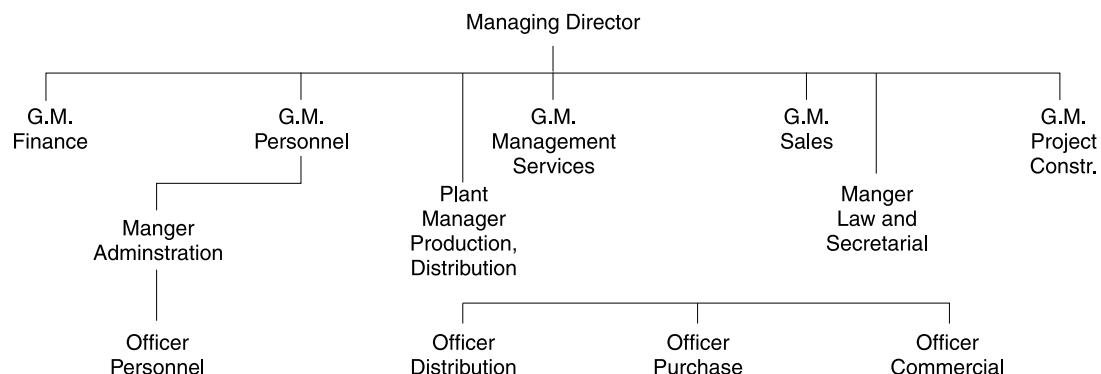
The nature of the business is such that the Chief Executive has been empowered to make decisions which will optimise the use of the resources, and the Plant performance will be closed to the rated TPD.

The infrastructure of the business is such that the Managing Director has adopted a policy of standardisation, simplification, rationalisation, backed by clear guidelines, rules, regulations, procedures and systems.

ACCL has a Management Services Department (MSD) which continuously studies the operations of the business in the light of ever changing requirements of the management of the cement business. The nature of the business is such that a fuller utilisation of the plant capacity coupled with a strict cost and expense control are the keys to a profitable business. The operations at the plant level are procurement, transportation and material handling of cement raw material, distribution of cement as per advices received from Mumbai, hiring of temporary labour to clear the peak loads of distribution, and upkeep and maintenance of the plant to reduce breakdowns and down times.

While, at the Head Office in Mumbai, it is more management control and the strategic management of technology, modernisation, spares and capital investment and economical distribution of cement manufactured at each plant, as there is not much scope for price variation and manipulation.

The organisation of ACCL is shown in Fig 9.10



**Fig. 9.10** *Organisation of ACCL*

The organisation is a typical mix of a specialised function, such as the bridge construction and staff and line functions such as finance and distribution. The decision making in ACCL is in line with the hierarchical structure. The major decision which affect the management of business are taken by the Managing Director, with the assistance of the General Managers, i.e., the choice of technology, pricing, expansion and diversification, manpower and the allocation of cement production to various orders from customers, etc.

Since the Plant Manager takes the decisions pertaining to the operations of the Plant, the decision-making authority is delegated to the Plant Manager to the extent of his operations, while he participates in the Management Decision-Making at the policy level. The Managing Director holds a quarterly meeting with the Plant Managers for reviewing the performance and decision-making to improve the plant performance. This model has been working satisfactorily mainly because the Associated Cement and Constructions Limited has standardised systems and procedures throughout the company with the norms for delegation of authority and decision making. Considerable emphasis has been given on this latter aspect of the business.

The organisational culture is fairly authoritarian. The plant manager enjoys the authority because of the position away from the top management at the remote location and derives the power to decide on the spot on many issues. Normally, the plant manager's say is not overruled. The work culture is to work with the manuals of the systems and procedures and be within the framework of the delegated authority.

The growth cycle of ACCL is very typical as far as the cement production and sales is concerned. After so many years, it has only two parts for cycle, viz., growth and maturity. The decline or the stagnancy in the business is something which the Associated Cement & Constructions Limited would not like to enter. In fact, the diversification into construction was a step towards this objective. As a part of this objective, the ACCL is thinking of closing down some plants and introducing a variety in cement quality.

Initially, the goal of the Associated Cement and Constructions Limited was to produce a mass quantity of cement for housing and maximum utilisation of plant and machinery. Then the goal was shifted to produce a cement mix for different markets with quality assurance. Then the shift came towards manufacture and sale at the minimum cost, with a product mix and the quality maintained within the resources available.

The Associated Cement & Constructions Limited uses computer at each location with a large computer system in Mumbai. At the Plant location the accounting applications are mainly processed and in Mumbai, the Corporate applications are processed.

### **Questions**

1. Discuss the organisation of Associated Cement and Constructions Limited and its implications on the Management Information System Design.
2. Identify the systems which are required at the factory and the systems at the corporate office.
3. Draw the information flow diagram between the systems at the factory and the systems at the corporate office.
4. Suggest the performance parameters which should be measured in MIS for the management attention and action.
5. For the purpose of planning and control, and for strategy development, the management wants following subsystems to be integrated at corporate level.
  - (i) Factory Accounting and Costing
  - (ii) Distribution Accounting
  - (iii) Plant performance and maintenance

Suggest integrated system to generate corporate reports.

## **8. CENTURY FINANCE LIMITED (CFL)**

*(Rule-Based Deterministic System)*

Century Finance Limited is a company engaged in the business of financing the needs of its clients by developing various financial packages. The gross income of the company is over ₹ 500 million and the net profit before tax is 15 per cent of the gross income.

Century Finance Limited has announced a Fixed Deposit Scheme to tide over its own working capital needs. The deposits are unsecured and the total requirement of the Company is ₹ 100 million. The scheme is a standard one, governed by the rules of the Reserve Bank of India. Even the application form for applying for the acceptance of the deposit contains standard information. The application form is enclosed herewith for information.

The rules of the scheme are as under.

1. The last date of application is 31st March 2005.
2. The scheme will be closed before time if the collection of Rs. 100 million is over, and the applications will be returned within 90 days.
3. The amount of minimum deposit is Rs 5,000/- and then in the multiples of thousand.

4. The interest charged per annum is 15 per cent for two years and 16 per cent for three years deposits.
5. The Tax, as applicable, will be deducted at source except in a case where the declaration in Form 15H of the Income Tax Act, 1961 is made.

### Questions

1. Identify the rules, checks and controls in this scheme for inclusion in the system.
2. Identify the data which is mandatory and 'not' so mandatory' from the system point of view.
3. Following outputs from the system are required. Give a report format for each of them.
  - (a) Fixed Deposit Register
  - (b) Interest Warrant with Counter foil.
  - (c) Datewise Fixed Deposit renewal report.
  - (d) Journal Voucher for the entry in Financial Accounting for the money received from the depositors.
  - (e) Fixed Deposit Receipt.
  - (f) Letter of Appeal to the depositors for renewal of the Deposit.
  - (g) Distribution of the amount received by category of the first named applicant.
  - (h) Report on the amount received by cheque, amount realized, the amount balance and the amount yet to be collected.
  - (i) A cash flow statement for finance department for cash planning.
  - (j) Draw a system process chart in detail showing all the processes in a fixed deposit application processing leading to acceptance letter and fixed deposit receipt.

**CENTURY**

**Century Finance Ltd.**  
**Bhandarkar Institute Road**  
**Pune - 441 018**

To

Century Finance Ltd.,

Dear Sirs,

Having read and understood the contents of your fixed deposit scheme, we apply for acceptance of fixed deposit and the details are given here below:

Cheque/Demand Draft drawn on (Name of the Bank and Branch)	Cheque/Demand Draft No.	Date	Period		Two years	Three Years
			For Office Use Only			
			Interest			
			15%	16%		
			Date of receipt of Application		Date of realisation of cheque	

Sole/First Applicant	NAME	SURNAME	AGE	Status of Sole First Applicant (Please Tick)
Name in full				<input type="checkbox"/> 1. Company
Address (Box number is not sufficient)				<input type="checkbox"/> 2. Provident/Superannuation Gratuity/Fund
Father's/Husband's Name in full				<input type="checkbox"/> 3. Body Corporate
Saving/Current A/c. No. (Refer Instruction No. 10)		Name of Bank and Branch	AGE	<input type="checkbox"/> 4. Partnership Firm/HUF
Second Applicant Name in full				<input type="checkbox"/> 5. Society Association of Persons
Third applicant Name in full				<input type="checkbox"/> 6. Financial Institution
Usual Signatures	Sole/First Applicant	Second Applicant	AGE	<input type="checkbox"/> 7. Mutual Fund
				<input type="checkbox"/> 8. Trust
				<input type="checkbox"/> 9. Individual
				<input type="checkbox"/> 10. Others (Please specify)

	P.A.N/G.I.R. No. Refer Instruction No 9	Circle/Ward/District	Specimen Signature		
Sole/First Applicant			Sole/First Applicant	Second Applicant	Third Applicant
Second Applicant					
Third Applicant					

----- TEAR HERE -----

**ACKNOWLEDGEMENT SLIP**

(to be filled by the Applicant)

Century Finance Ltd.

Bhandarkar Institute Road

Pune-411 018

Received From

An application for _____ Debentures
Chq/DD No. _____ Dated _____
Drawn on _____ for ₹ _____
(Rupees _____)
Dated _____ 1996/97

Collection Center's Stamp
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Note: Cheque and drafts are subject to realisation.

Please write serial no. on the reverse of cheque/drafts.

## LEARNING OBJECTIVES

- Strategic Management of Business
- Concept of Strategic Design of MIS
- Why Strategic Design of MIS?
- Business Measuring Parameters
- Business Performance Measuring Parameters
- Use of these Parameters to Build Balance Score Card
- Score Card and Dash Board
- The System of Designing SD of MIS
- Establishing the Link between Business Strategy
- Business and Performance Parameters
- Designing the Cards for Specific Strategy and the Goal

### 10.1 STRATEGIC MANAGEMENT OF THE BUSINESS

Strategic management is a process of formulating, implementing and evaluating cross-functional decisions that will enable an organisation to achieve its long term goals and objectives. The nature of these decisions is strategic and very critical for the business. It is the process of specifying the objectives, developing policies and plans to achieve these objectives. Allocating resources to implement the policies and plans to achieve the organisation's objectives is the key decision area. The focus of strategic management is on dealing with competition and risk of emerging threats to business. It is the highest level of managerial decision making activity, formulated by the top management and executed by the organisation's *Chief Executive Officer* and the executive *team*. Strategic management provides overall direction to the business growth of the enterprise.

Strategic management is an ongoing process that assesses the business and environment through SWOT analysis. It assesses its competition, and sets goals and determines the strategies to meet all existing and potential competitors. It then reassesses each strategy annually or quarterly to determine how it has been implemented and whether it has succeeded or needs

replacement by a new strategy to meet changed circumstances, new technology, new competitors, a new economic environment or a new social, financial, or political environment.

Strategic management process is very complex and requires strong information support measure, monitor, and track and controls the strategy operations and its performance. This requirement can be fulfilled if organization designs and implements a design of Management Information System (MIS) focusing exclusively on developing of business strategy, supporting its implementation, measuring its execution progress, monitoring and tracking its performance and so on. The design of such MIS is called as Strategic Design of MIS.

## 10.2 WHY STRATEGIC DESIGN OF MIS?

In the last decade the business world all over the globe has undergone a radical change due to new paradigm of Internet. Internet is a global network for seamless communication and collaboration available for  $24 \times 7$  hours a week. Business is no more a domestic affair; it is now international, crossing the national boundaries. The world has become a global village, where everything is near visible, transparent and fast in communication and knowledge spread.

The impact of this paradigm shift on the business and industry is the following:

- Market for goods and services is now global.
- Information access is available  $24 \times 7$  on Web from anywhere.
- Customer has a wider choice of selection of products and its vendors.
- The business model therefore is customer driven.
- The competition to business is from world market.
- The new business models, based on internet web platform, face more competition as well as threat to business.
- Due to global networking capability of internet, the business model now is distributed on an international platform.
- Business process cycles have shrunk due to fast communication and collaboration between business partners.
- Organisation structures have become flat, lean and flexible.
- Organisations are now manned by knowledgeable workers who are empowered to make decisions rejecting the principle of management by 'Command and Control'.
- Information security and privacy have assumed greater importance and is a major critical factor in business model.

Business enterprise is now a 'Digital firm', where all processes and interactions across the world are IT enabled automating the entire business cycle with virtually no intervention from the people. With the advancement of Internet, Web, communication, network and information technology the business process management scope not only crossed the boundaries of the organisation but embraced every aspect of the business, making all its operations 'Digital'. That is capturing the data or event, validating, processing, decision making, storing, and delivering. The extent of use of these technologies is so much across the boundaries of the organisation that E-Business enterprise has become completely 'Digital' in all its operations, and hence is now called as *a Digital Firm*. Business going digital has increased the competition from all angles.

Michel Porter summarises this competition under five forces.

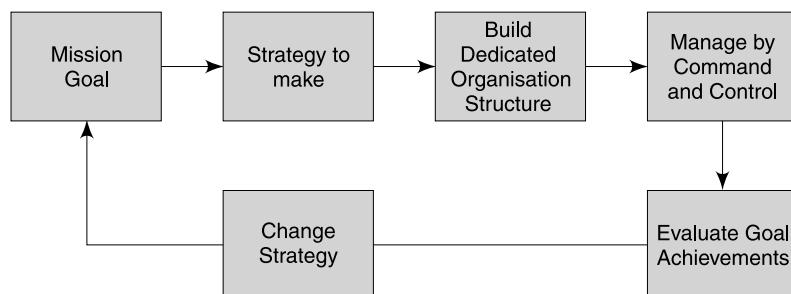
Michel Porter has identified five forces, which drive the competition affecting the enterprise performance. These forces are essentially threat to business.

- Threat from substitutes
- Threat from new design
- Threat from new entrants
- Business Rivalry among competitors
- Bargaining power of suppliers
- Bargaining power of customers

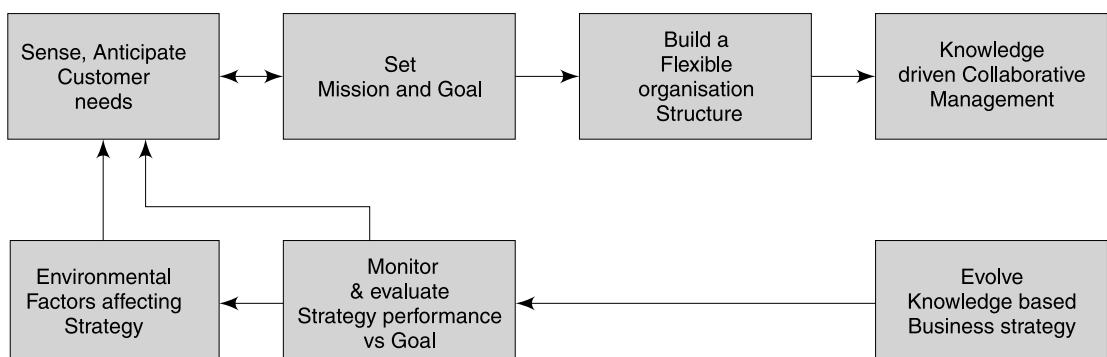
Peter F. Drucker wrote a decade ago that center of gravity in HR employment in a digital firm would be moving from manual intelligent workers to knowledgeable smart workers, who resist the conventional 'Command - and - control' model. It calls for strategic management of business aiming at innovation in business through competitive business and IT strategy implementation.

The paradigm shift in the way business is conducted to day has rejected the 'Push model' and adopted 'Pull Model' of the business. Fig 10.1 displays the difference between Push Model & Pull Model of the business.

**Push Model: Business Strategy: Make & Sell.**



**Pull Model: Business Strategy: Sense customer needs & respond to fulfill.**



**Fig. 10.1 Push Model vs Pull Model**

The pull model in technology driven business of a Digital firm calls for different business strategy, different than of Push model. The business strategy is more influenced in the pull model by information, knowledge and technology.

The requirement now is more intense strategic management of business featured as-

- Focus on efficient strategy build and its evaluation by results.
- Emphasis shifts from business measurement to performance measurement.
- 'Just in Time' information at user's desk to respond quickly.
- Knowledge and intelligence embedded Information systems.
- Embedded DSSs in business applications.
- Heavy use of stored procedures and automatic triggers in applications and processes providing Alert, Attention, Action prompts to the decision maker.

The MIS design of a digital firm therefore has to be focusing on business strategy and hence it is termed as a 'Strategic Design' of MIS.

The strategic design of MIS focuses on business strategy and its execution through information support. It generates information, knowledge and intelligence supporting decisions to implement business strategy.

It is also designed specifically to generate information assets to enable strategy generation, implementation, evaluation and its review.

It goes beyond just reporting of business results to focus on evaluation of business performance and its critical analysis to improve upon.

The strategic Design of MIS achieves the following,

- Ensures information support to strategic decision making.
- to achieve set business operations and performance parameters targets.
- Controls critical success factors which drive the business.
- Manages mission critical applications efficiently and effectively.
- Enables continuous monitoring and controlling of Business performance parameters and business operations parameters.
- Ensures through feed forward control for ensuring the achievement of business performance.

A well designed formal contemporary MIS in contrast to Strategic design of MIS is equipped to produce and report only on

- Organisation information required by all.
- Functional information on its operations and results comparing with the budgets and targets.
- Key targets such as sales, production, capacity utilisation, inventory, current assets, current liability, order book etc. These reports essentially reflect on what are the performance, and its comparison with the targets.
- Certain ratios to comment on the business results. These ratios are largely a measure of business operations without any analytical commentary on the performance.

This contemporary design of MIS serves the business management needs when scenario is

- Not very competitive.
- Not very risky. Very little or no threat to business.
- Business model is a Push model.
- Business largely local and not global.

But now, this system is not appropriate due to the change in business scenario. Now the business is competitive, customer driven, risk ridden and it is global. The focus of management attention cannot be only on 'What has been achieved but also how it has been achieved'. Since business management is more strategic management, MIS must also focus on strategy, its implementation and results it produces. It must have a strong component devoted exclusively for strategy monitoring, tracking and evaluation for management review and action.

The strategic design of MIS focuses on assessing and reporting on what has been achieved in business operations through key business operations measuring parameters and key performance measuring parameters. After deriving these parameters, the system develops

- Balance Score Card.
- Score Card.
- Dash Board.

### 10.3 BALANCE SCORE CARD, SCORE CARD AND DASH BOARD

All businesses are established to achieve certain business targets and business goals.

On the journey of this achievement, business organisations are engaged in strategy formulation and implementation, resource management, measuring the results and strategy evaluation to assess whether business is moving in the designated desired direction. Traditionally and historically the business operations and its performance is measured by financial outcome published in a comprehensive balance sheet at the end of the year. During the year progressively weekly, monthly or quarterly, the reports are obtained by processing the data internally generated through enterprise software like ERP and home grown legacy systems in different functional areas of the business. Good organisations have established formal MISs focusing on satisfying information reporting requirements of the organisation and its people.

Due to paradigm shift the way the business is conducted and managed in a digital firm, MIS should now focus more on reporting on key business operations parameters and key business performance parameters. Let us understand these two terms clearly so that they can be used effectively in designing the SD of MIS.

Let us understand these parameters as used in the game of cricket. A batsman when plays an inning and scores a century, his game is measured through *Business Parameters*' such as

- Number of runs scored.
- Numbers of balls faced.
- Number of centuries scored so far and the teams played with.

The business parameters here convey clearly what has been achieved by the batsman. But this reporting does not convey how it has been achieved. Though batsman has scored a century it does not report on the performance. The *Performance parameters* in this case, which are distinctly different from business parameters, are

- Ratio of ‘runs scored and balls faced’.
- Composition of score in terms of ‘singles, doubles, boundaries, and sixes.

The batsman’s performance, though century is scored, will be commented as

- *Good*, if the ratio is one or around one.  
That is number of balls faced and runs scored are equal or more.
- *Excellent*, if the ratio is more than one, say around two.  
That is balls faced are much less than the runs scored.
- *Poor*, if the ratio 0.2 or 0.3

That is the century is scored facing many more balls than 100.

The business parameters here report ‘runs scored, balls faced and the reason of out’. But performance parameters report how it has been achieved. A good batsman, useful for the team, is the one who scores runs with much less number of balls. You can develop on these lines the business parameters and performance parameters for the bowler as well. A good useful batsman for the team is the one who not only scores the century but scores it with much less number of balls. The batsman has to be efficient while scoring the century or any other target.

Let us apply these parameters for business organisation to evaluate their operations and performance. In a manufacturing and selling business, the Business Operations Measuring Parameters (BOP) and Business Performance Measuring Parameters (BPP) to mention few are

<b>BOP</b>	<b>BPP</b>
1. Sales	Sales/Inventory
2. Production	Sales/Receivables
3. Inventory	Production/Inventory
4. Receivables	Receivable/Payables
5. Payables	Inventory/Payables
6. Capacity utilisation	Production/capacity

Here, you will appreciate that the organisation may achieve the business targets such as sales, production and so on, but if the targets are achieved ending with high inventory and high receivables, then in spite of good business operations the bottom line in balance sheet may show loss to the organisation in that year of operation. This means organization achieved results but at a high cost reflecting into poor performance. Hence, it is not sufficient to meet the targets but to meet them by maximising the productivity of the resources. This would call for intelligent strategy formulations and its implementation. Further such strategy launch should be supported by valuable information and knowledge from the MIS of the organisation. The example under reference here illustrates the measures of Business Operations and business performance. For the sake of understanding the concept of operations and performance parameters the example uses standard norms of business evaluation. In the context of Strategic Design of MIS, these parameters need to be evolved specifically for the organisation, keeping in view the organisation’s business condition at the point of time and the vision, mission and plans of future growth.

## How to Develop Measures of Business Operations & Business Performance?

In every business, there are key result areas (KRAs) which decide the fate of the organisation's business. The success and failure in this area directly impacts the organisation's business results. In each of these areas, there are few Critical Success Factors (CSFs) which contribute significantly to the successful operations and performance of KRAs. In order to judge the developments in KRAs and management of CSFs, Key Performance Indicators (KPIs) are developed to assess the results in KRAs and management of CSFs.

The management of the organisation develops business strategies to ensure excellent results in KRAs and through better management of CSFs. KPIs, developed specifically to measure the performance in KRAs, are extensively used to make a judgment on success or failure of business strategy. MIS specifically designed focusing on KRAs, CSFs and KPIs is called "Strategic Design of MIS".

Let us illustrate this approach by taking a case of retail business operations of a mall like 'BIG BAZZAAR'. Some business details of the big bazaar are given below.

- Business: Retail. Selling day to day needs of customers.
- Type of business: Service
- Number of items: Over 5000 and 8000 SKUs.
- Employees: 300 per shop.
- Floor boys, Supervisors, Customer care personnel, Floor managers.
- Billing Clerks, Accounts and Administration Personnel.
- Number of visitors: 5000 per day, 9 am to 9 pm.

### KRAs:

1. Correct assessment of Customer needs and behaviour to keep their interest in the mall for buying.
2. Management of customer choices and preferences.
3. Inventory by SKU and floor and shelf space management.
4. Pricing and Promotion: Schemes, Offers, membership and its impact.
5. Customer Servicing Cycle: Entry to Exit with goods and bill.

### CSFs:

1. Managing shelf space to stock required SKUs as per the needs to satisfy maximum scope of customer requirement resulting into higher revenue.
2. Ability to reach customers through advertising and mailing to induce their frequent visits to the mall.
3. Ability to provide efficient floor service in finding, handling and billing the items.
4. Minimum billing time, short queues and no rush at billing counters.

### KPIs:

1. **Business Operations Parameters:**
  - Number of visitors per day (foot prints).

- Number of bills per day.
- Billing value (revenue) per day
- Range of billing value: lowest and highest.
- Billing value distribution by morning, afternoon and evening.
- Number of member customers.
- Most bought items by class: cosmetics, apparels, crockery etc.
- Incidence of returns of sold items.
- Number of customer queries on the floor: availability, price, performance, preferences, brand etc.
- Fast and slow moving SKUs in each class.

## **2. Business Performance Parameters:**

- Ratio of number of Bills to number of visitors: Target 80%.
- Ratio of member customers to number of visitors: Target 70%.
- Customer visit pattern:  
Morning 30%, Afternoon 20%, Evening 50% vs Actual.
- Average bill value vs Target average bill value. ₹ 1200.
- Inventory to Sales ratio by class of items; Target: One to four.
- Average sales per day by class vs average sales per day on its extra promotion strategy: Target 30%.

Strategic design of MIS for the mall will have specific focus on capturing and processing the data to compute Business Operations Measuring (BOM) parameters and Business Performance Measuring (BPP) Parameters. It is to be noted that these parameters are evolved to measure the business and impact of various business strategies. The industry standard business measures, such as balance sheet, inventory analysis, customer buying analysis, expense control statements and so on are given by conventional design of MIS focusing on reporting on operations of each function, individually and then in integrated manner.

When business management is more strategic in nature, the MIS design should have feature of dealing with KRAs, CSFs and KPIs.

The focus of MIS for the mall needs to shift from Just in time information to just in time actionable information. The just in time actionable information is a result of analytical processing of the business results and the strategy behind it. This is best handled by introducing Information systems designed to produce Balance Score Card, Score card and Dash Board. To display these scorecards it is necessary to develop systems to measure BOPs & BPPs as a part of executive information system. For more elaboration on Balance Score Card, Score Card and Dash Board revisit the chapter sections 1.11 and 3.8.

## **10.4 STRATEGIC DESIGN OF MIS**

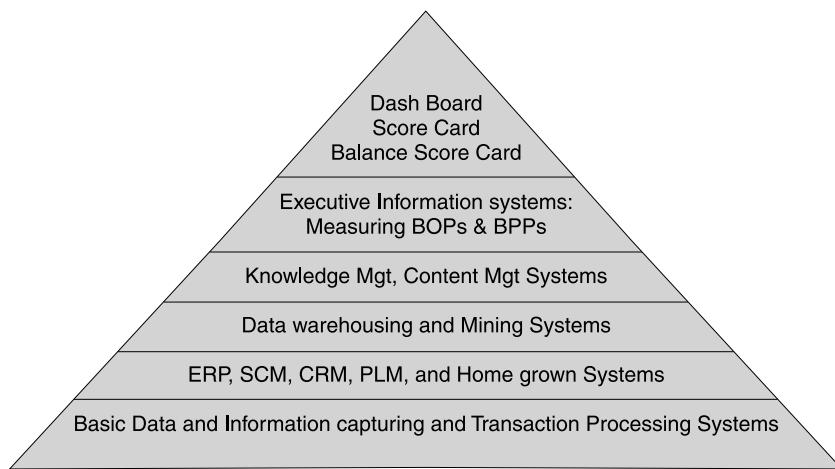
The strategic design of MIS sits over conventional MIS model designed to report the day to day and periodical business information in pre determined report formats. The reports

focus on comparison of budgets and targets with actual results throw light on its level of achievement.

The objective of strategic design of MIS is to go beyond this limited purpose and support strategy management of business through following information assistance.

- provide a measure of business operation parameters to evaluate the business growth and trend over a time expected from strategy implementation.
- provide a measure of business performance parameters to evaluate the efficiency and effectiveness business.
- highlight non performing areas of concerns and attention.
- bring attention to issues and problems inhibiting the performance.
- support strategic, managerial and operational decision making processes.
- Automate managerial decision making, where possible.
- Build knowledge and business intelligence to support strategy formulations.

Further Strategic design of MIS includes a system of computing a scorecard and dash board to measure an overall trend and direction of the business. The scorecard reports position and trend of key indicative business parameters on a time scale. The dash board system reports the position of key business performance measuring parameters on continuous time scale as a watch dog on the performance. The strategic design of MIS follows the model as shown in Fig. 10.2.



**Fig 10.2 Strategic Design of MIS**

## 10.5 DEVELOPMENT PROCESS STEPS FOR STRATEGIC DESIGN (SD) OF MIS

1. Study business environment and the competition.
2. Be clear on requirement of competitive necessities and advantages.

3. Define business goals and mission.
4. Determine KRAs of the business.
5. Determine critical success factors of the business.
6. Build Business strategies to succeed in KRAs.
7. Determine KPIs: BOPs & BPPs to reflect on strategy and its implementation.
8. Identify mission and goal critical business applications.
9. Identify the data needed to compute BOPs and BPPs.
10. Develop Balance Score Card, Score Card & Dash Board formats.
11. Develop consistent IS and IT strategy to implement strategic design.
12. Ensure MIS design has a component which links strategy to business results.
13. Examine the enterprise management systems and home grown systems to confirm that they are supportive to SD of MIS.

Let us now understand these steps more clearly in terms of purpose and its role in the design.

1. Study business environment and the competition in business.

*This study determines the position of the organisation in the domain. Also provides insight into the problems and challenges while facing the competition. It throws light on business risk the organisation is facing.*

2. Be clear on requirement of competitive necessities and advantages.

*The clarity on well defined competitive necessities and advantages helps in building strategy to achieve them. The management has then a clear goal to maintain the necessities and continue to build competitive advantages to remain ahead of the competition.*

3. Define business goals and mission.

*The study of competition and business environment and clarity on Competitive necessities and advantages enable development of definition of Goals and Mission. The mobilisation of resources and its deployment to achieve the goals becomes easier.*

4. Determine KRAs of the business impacting goal achievement.

*There is a direct link between Goals and KRAs. Efficient and effective management of key areas of the business is an imperative to achieve the goals. The strategy development and resource deployment becomes easier and focused where it is required.*

5. Determine Critical Success factors driving the KRAs.

*The success in each KRA is driven by few factors whose efficient management therefore becomes a prime necessity. They are the prime movers of the results. The choice of technology and resources, changes in systems and processes which impact results become very obvious when CRFS are identified.*

6. Build business strategies to succeed in KRAs.

*Since, CSFs and Goals are defined, business environment is understood and risks and threat to business are identified, the management is well placed in developing business strategies. The strategies so developed on implementation would give expected results in KRAs.*

7. Determine KPIs: BOPs and BPPs to reflect on strategy and its implementation.  
*In order to link business strategy to its performance, it is necessary to develop KPIs, i.e BOPs and BPPs not only to measure the strategy performance but also to highlight where the performance is lacking and Why ?*
8. Identify mission and goal critical business applications.  
*The mission and goal critical applications (Systems & Processes) are those which contribute to the successful working of KRAs. This identification then enables management to improve them through BPR and technology so that they contribute to successful strategy implementation.*
9. Identify the data needed to compute BOPs & BPPs.  
*The systems computing BOPs and BPPs would need data input to process to produce these parameters. Its identification is necessary to introduce data capturing systems as a part of MIS.*
10. Develop Balance Score Card, Score Card and Dash Board formats.  
*Use BOPs and BPPs to develop these cards to evaluate the strategy performance.*
11. Develop consistent IS and IT strategy to implement strategic design.  
*At this stage we are ready with all specifics required to generate KPIs. It is necessary to look into IS and IT to find out whether existing structure is competent to support efficient and effective working of the MIS.*  
*Such review would point out where changes are required in existing IS and IT structure.*
12. Ensure SD design of MIS design has interfaces which links strategy to business results to KPIs to Balance Score Card, Score Card and dash Board.  
*The interfaces ensure data and information flow between the systems and become enablers of integration.*
13. Examine the Enterprise management systems and home grown systems to confirm their support to SD of MIS.  
*The SD design of MIS tops on conventional design of MIS. It works on the support of enterprise software, homegrown systems and other collaborative technologies. It is important at this stage take a critical review of them to confirm that they are supportive to the SD design of MIS.*

## 10.6 ILLUSTRATING SD OF MIS FOR BIG BAZZAAR

1. Study business environment and the competition in business.
  - Retail Business is recognised as an opportunity for new business.
  - Many players are already in operations and three or four are in pipeline to launch any time. FDIs in retail business is allowed.
  - There are no barriers to entry in this business.
  - Retail business is driven by customer requirements. Fulfilling customer expectations and conforming to their perceptions is the key to retail business success.
  - It is a low margin, high volume, and high velocity business.
2. Identify competitive necessities to sustain the present growth and create competitive advantages to lead and grow more.

- Competitive Necessities: *Attractive price, assured availability of goods and services, Quality and value for money.*
  - Competitive Advantages: *Faster and short service cycles, frequent introduction of schemes and offers, Maintaining good customer relations.*
3. Define business goals and mission.
    - Raise number of visitors by 20%, from 5000 to 6000 per day.
    - Raise customer to visitor ratio from 70% to 80%.
    - Raise average bill value from ₹ 700 to ₹ 1000.
    - Reduce customer queries from 200 to 100, 50% reduction.
  4. Determine KRAs of the business impacting goal achievement.
    - Managing Inventory to ensure availability and choice.
    - Customer service quality: comfort, speed and loyalty.
    - Effective shelf space management to increase availability.
    - Attractive house keeping, displays, general ambiance to induce the buying.
  5. Determine Critical Success factors which are the drivers of KRAs.
    - Supply chain management.
    - Vendor relations.
    - Inventory management.
    - Communication and Knowledge skills of floor boys and supervisors.
  6. Build business strategies to succeed in KRAs.
    - Introduce efficient procurement practices.
    - Improve inventory management to meet space, scope and coverage of items on the shelf.
    - Introduce IT enabled vendor services for ordering, sending 'Attention, Alert, Action' signals.
    - Convert 30% vendors into Business/alliance partners.
    - Conduct periodical workshops for floor personnel on Communication and for sharing customer interaction experience and knowledge.
    - Introduce additional 2% discount on total bill value above ₹ 1000.
  7. Determine KPIs: BOPs and BPPs to reflect on strategy and its implementation.
    - Business Operations Measuring Parameters (BOP): expected vs Actual
      1. Count of visitors (morning, noon, evening).
      2. Count of customers (morning, noon, evening).
      3. Count of bills.
      4. Total revenue(bill value) for the day.
      5. Count of member customers.
      6. Average queue length at billing counter.

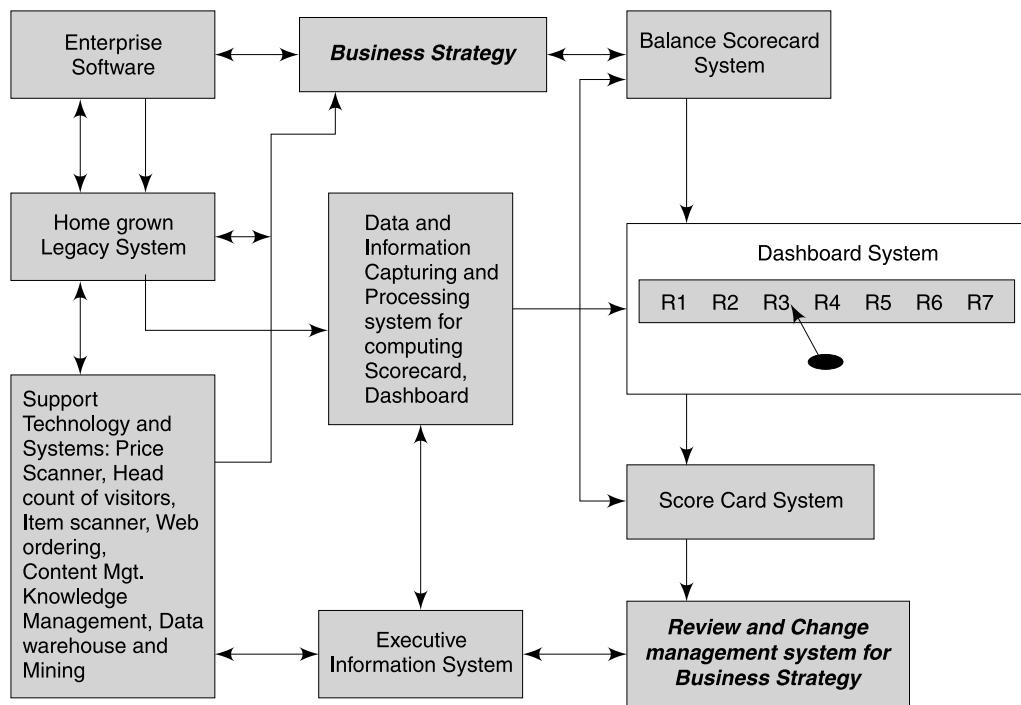
7. Average inventory.
  8. Number of unmoved items for a week.
  - Business Performance Measuring Parameters: expected vs actual
    1. Average bill value: ₹ 1200.
    2. Visitor to customer ratio: 70%
    3. Members to customers ratio: 80%.
    4. Queue length at the counter: Not more than 4 per counter
    5. Number of stock outs by class of goods and items: 2 per class
    6. Inventory to turnover ratio: 1 to 4
    8. Identify mission and goal critical business applications.
  - Supply chain management.
  - Inventory management.
  - Billing system.
  - Member relations management system.
  - Customer facing systems; communications, price scanner etc.
  - Knowledge management system.
9. Identify the data needed to compute BOPs and BPPs.
    - Number of visitors, customers, bills.
    - Bill record and item details.
    - Inventory master and stock master.
    - Vendor master.
    - Bill value record.
    - Queue length data every hour.
    - Member master.
  10. Develop Balance Score Card, Score Card and Dash Board formats.
    - **Balance Score Card**
      1. Learning and growth: *HR Perspective*:  
Floor staff performance, employee satisfaction, training, knowledge contribution.
      2. Internal business process: *Efficiency, Effectiveness Perspective*:  
Operation performance, rejections/returns, cycle times, repeat/member business value, level of automation and use of Technology.
      3. Customers: *Satisfaction & Loyalty Perspective*:  
Market share, retention, new customers, satisfaction indices, customers profitability, product/service attributes and customer preferences, 80/20 Analysis, and availability index.
      4. Financial *Perspective*:  
Revenue, growth, margins, profitability, cash flow, ROI, business forecasts, financial ratios.

- **Score card for a day(BOPs)**

Parameter	Actual	Target
1. Visitors	_____	5000
2. Customers	_____	3000
3. Members	_____	1500
4. # of Bills	_____	3200
5. Av. Bill value	_____	1200
6. Rejections	_____	20
7. Returns	_____	10
8. Inventory	_____	₹ 2 million
9. Complaints	_____	None
10. Queries	_____	100
11. Suggestions	_____	10.

- **Dash Board (BPPs)**

1. Ratio: visitors to customers (R 1)
  2. Ratio: members to customers (R 2)
  3. Ratio: revenue to inventory (R 3)
  4. Ratio: complaints to customers (R 4)
  5. Ratio: queries to customers (R 5)
  6. Ratio: rejections + returns to items sold. (R 6)
  7. Revenue by Special Promotion Schemes. (R 7)
11. Develop consistent IS and IT strategy to implement strategic design.
- Automate billing & administrative processes for faster service.
  - Expand the scope of extranet to more number of vendors.
  - Embed automatic ordering on vendors when predetermined stock levels are reached.
  - Create a separate record of special items sale for monitoring and tracking.
  - Modify existing billing system with more customer specific features.
  - Improve displays, shelf usage and arrangement, more price scanners etc to reduce number of queries.
  - Start separate billing counter for member customers.
12. Examine the enterprise management systems and home grown systems to confirm that they provide information support to SD of MIS.
- SCM system
  - Billing system
  - Supplier payment system
13. Ensure SD design of MIS has interfaces which links strategy to business results to KPIs to Balance Score Card, Score Card and dash Board as shown in Fig. 10.3.



**Fig. 10.3** Integrated SD of MIS with Interfaces

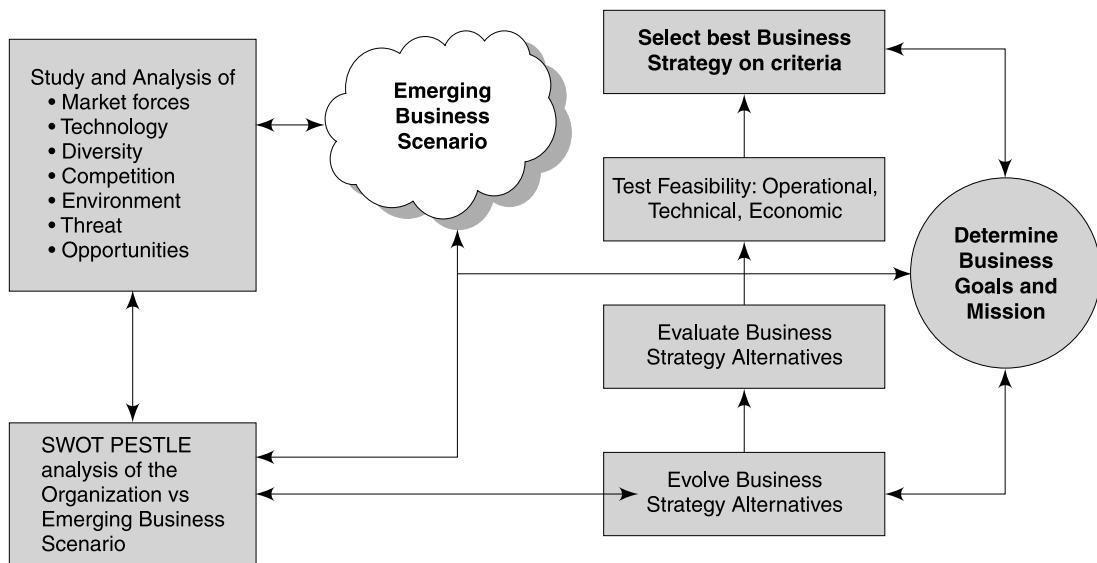
## 10.7 STRATEGIC MANAGEMENT OF BUSINESS AND SD OF MIS

In competitive business world of today strategic management of business is the main function of the top management of the organisation. The strategic management focuses on dealing with.

- Market forces and changes.
- Technology change and obsolescence.
- Complex diversity of business due to global operations.
- Competition in product, services and price.
- Environment changes offering threats, challenges and opportunities.

First and foremost requirement of strategic management is to set a goal and mission for the organisation to be pursued vigorously to attain certain image in the business world.

The strategic management process begins with determining of a business strategy based on the study and analysis of environment internal and external, Strength and weakness of the organisation, competition and trends in technology. Figure 10.4 shows the process of business strategy determination.



**Fig. 10.4** *Process of Business Strategy Determination*

## 10.8 BUSINESS STRATEGY DETERMINATION

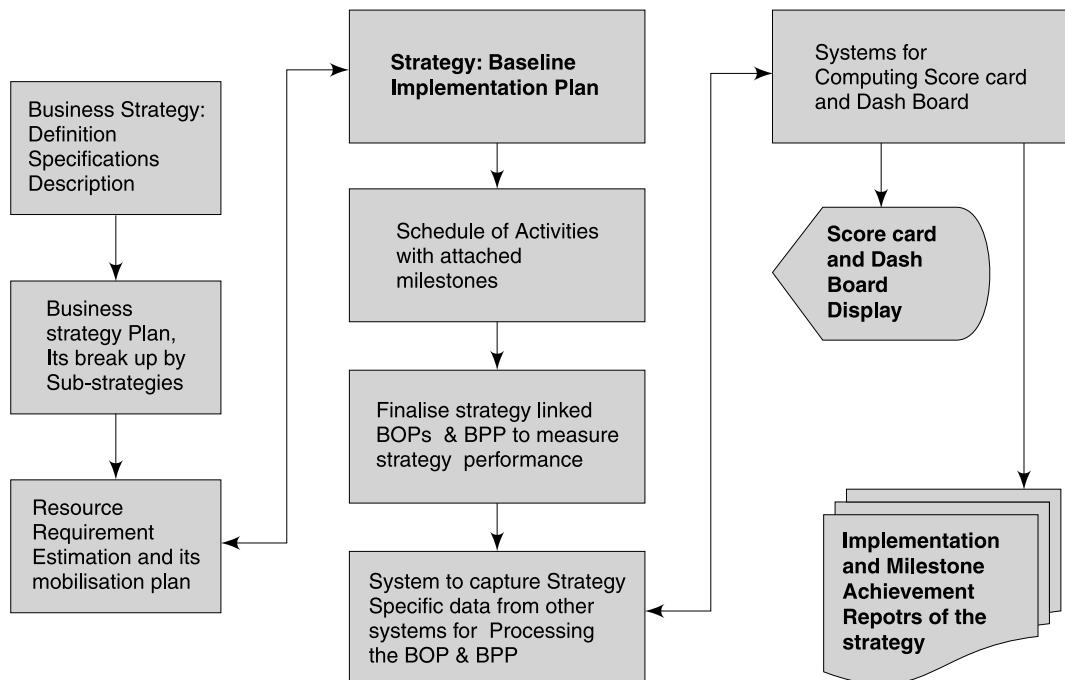
The ‘Strength, Weakness, Opportunities and Threats’ (SWOT) analysis is the second important step in the process of strategy determination. The analysis is done in context of emerging business scenario. The strength and weakness of the organisation is to be understood not in isolation but with reference to the emerging business scenario. For example, if emerging business scenario demands very strong customer centric business management but if the organisation’s current business model lacks these management skills then this is a weakness. However, if the requirement is not customer centric then this is not the weakness. The analysis also identifies new opportunities and threats.

The first step is to set the goals for the organisation in the new changed environment as seen in the emerging business scenario. Next step is to evolve number of business strategy alternatives for growth or transformation or change of the direction etc based on the opportunities and strengths and weakness and threats.

After freezing the number of alternatives, each of them is evaluated for investment and return, its impact on the business and so on. This paves the way for the third step of testing each alternative on the criteria of feasibility. Some strategy alternatives would fall out as they turn out to be infeasible for some or all reasons. The feasible alternatives are tested on economic criteria to select one for implementation. The chosen business strategy is feasible for implementation and expected to give maximum returns on the efforts and investment. The business strategy so selected becomes the driver for change, transformation and growth.

## 10.9 BUSINESS STRATEGY IMPLEMENTATION

Business strategy success depends upon how it is implemented in the larger business management process of the organization. Figure 10.5 show the strategy implementation and performance measurement model.



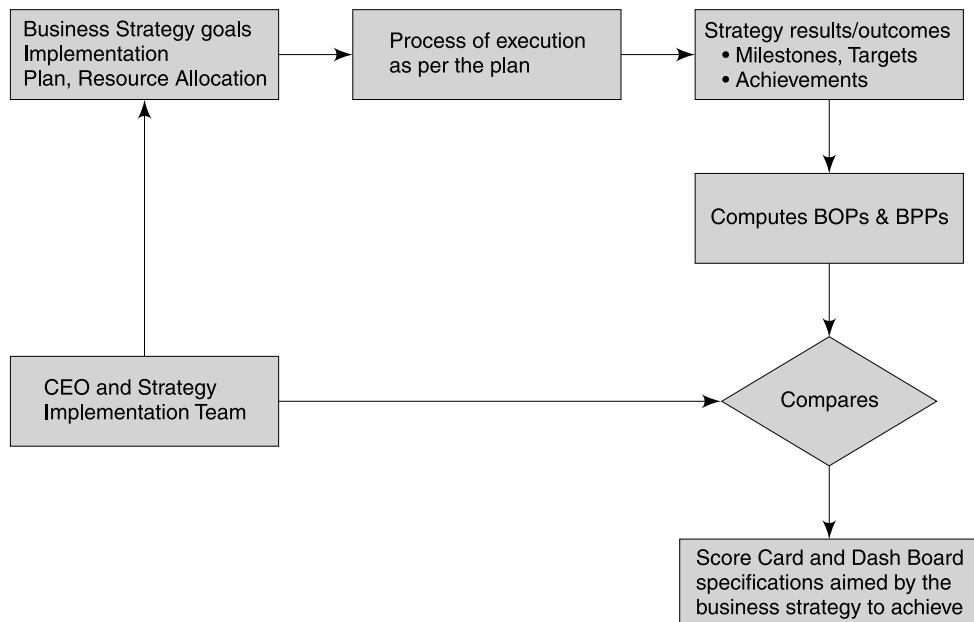
**Fig. 10.5** *Strategy Implementation and Measurement Process*

Business strategy needs to be defined with clear specifications with description for the implementer to understand for efficient execution. Every strategy needs to be factored into subsystems strategies. Such breakup helps in resource estimation and allocation while implementing the strategy. Time is the essence of strategy implementation. Business strategy success is larger if implemented successfully as per time schedule and with milestone achievement. Though strategy is successfully implemented it is necessary to find whether it impacts business and produces results and achieves business goals.

A system of capturing the relevant data and computation of BOPs and BPPs works in collaboration with implementation system. The system further computes and displays the organization's Score Card and Dash Board. The strategy managers keep the watch on strategy implementation and corresponding impact on the business operations and performance.

The SD of MIS is an aid to Manager of business strategy from its definition, successful implementation, evaluation, and review. The SD of MIS is a bridge between strategy and its implementation and impact on the business.

Figure 10.6 shows the SD of MIS as a control system to manage business performance.

**Fig. 10.6** Control System Model of SD of MIS

## KEY TERMS

- |                                     |                          |
|-------------------------------------|--------------------------|
| Five Forces Driving the Competition | Score Card               |
| SWOT Analysis                       | Dash Board               |
| Business Operations Parameters      | Balance Score Card       |
| Strategic Design of MIS             | Critical Success Factors |
| Business Performance Parameters     |                          |

## REVIEW QUESTIONS

- Identify the reasons for the organisation to develop SD of MIS.
- Identify the system components of a conventional design of MIS designed to process data and report periodically to the management.
- Identify KRAs, BOPs and BPPs for following organisations.
  - Jet Airways.
  - Life Insurance Corporation Of India.
  - Taj Group of Hotels.
- Explain the terms Balance Score Card, Score Card and Dash Board.

5. Why SD requires efficient operations of mission critical applications and monitoring and tracking of Critical Success Factors?
6. Why it is important to do feasibility analysis of strategy alternatives?
7. Explain how Internet and Web has opened the world market and how severity of the competition has increased?
8. Work out the BOPs and BPPs for Bowler in the game of cricket?  
And explain how selectors use these parameters for selecting the bowler.
9. Identify the following as a candidate for Dash Board Or Score Card
  - Whole sale Price Index (Inflation)
  - Commodity prices
  - Temperature of the patient per hour.
  - Share Price
  - Sensex, Nifty developed by SEBI, India.
  - Machine Productivity.
  - Quantity machined for the day
  - Machine capacity per day.
  - Rejections
10. What is the role of Executive Information System (EIS) in SD of MIS?
11. When a Score Card of the organisation becomes a Balance Score Card.
12. Find four perspectives of Balance Score Card for the following.
  - Central Reserve Force of India.
  - Bank of India.
  - Service Centre of LG India.

## **CONFIRM YOUR UNDERSTANDING**

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1. Internet is a global network for seamless \_\_\_\_\_ available for  $24 \times 7$  hours a week.
2. The business strategy is more influenced in the pull model by information, \_\_\_\_\_ and technology.
3. Management Information System Design when focuses on Monitoring and Tracking of \_\_\_\_\_ operations and performance, it is termed as strategic design of MIS.
4. SD of MIS scope is restricted to \_\_\_\_\_.
5. The difference between Balance Score Card and Score card is in its \_\_\_\_\_.
6. Business operations parameters measure key \_\_\_\_\_ and business performance parameters measure \_\_\_\_\_ resource management.
7. Business strategy is built using \_\_\_\_\_ of the organisation to take \_\_\_\_\_ of the opportunities in the environment.
8. The strategic Design of MIS ensures information support to \_\_\_\_\_.
9. Organisation structures have become flat, \_\_\_\_\_ and flexible.
10. In strategic management ,emphasis shifts from business measurement to \_\_\_\_\_ measurement.


**CASE STUDY**


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## 1. PUNE GENERAL HOSPITAL

Pune General Hospital (PGH) is an institution for Medicare, established in 2001, under Public Private Partnership program of the government. Its growth is steady till this year. It has turned out to be a good investment, meeting the economic and social goals. The PGH is managed by two apex boards, one board takes care of business aspect of PGH to ensure its economic viability, and the other board takes care of management aspect of the medicare to ensure high quality service to the patients and the community at large. The hospital has three hundred beds, four operation theaters, out patient department (OPD), Pathology, X-ray and Scanning, Blood bank. The hospital has following wards.

- General Medicine and Surgery
- Gynecology
- Orthopedics
- Pediatrics
- Dermatology
- Cardiology
- ICU & CCU

PGH has permanent staff of resident doctors supported by nursing staff. The senior doctors and consultants are on the panel of the hospital. These doctors have a first claim on the PGH resources. They can book the operation theater and seek the assistance from pathology, X-ray, blood bank and other departments.

Though PGH revenue is increasing certain facilities like theaters, labs, blood banks are not fully utilised. The investment in these departments is very high.

All wards and service departments are on IT network. Though patients are happy about the medical care, they are not happy about the support services. They experience delay and long servicing cycles.

PGH has Hospital Management System (HMS) comprising of following modules.

- Patient admission and Administration
- Patient Billing
- Patient medical care record building (Data Base)
- Doctor visits and consulting services accounting.
- Hospital medicines procurement system.
- Medical and lab services billing
- Financial accounting and few other applications

HMS has standard Management Information System (MIS) for reporting the patient status: Admitted and discharged, ward occupancy, theater reservations, doctor visits, billing status, revenue earnings, and so on.

The information on each ward and service centre can be seen on line by authorised persons of the hospital. The HMS is very efficient as a support to day to day administration and management of patients, wards and services.

The HMS MIS module however lacks a feature of data analysis and throwing information on the efficiency and productivity of various resources.

The executive board, responsible for running the hospital efficiently and improving the quality of service, needs more critical information on cost, time, and delay and so on. The cost of servicing the OPD patient and the admitted patient is increasing. PGH wants its image, *a hospital where care, cost and comfort are best* to be maintained. The goal is to keep PGH an affordable hospital for middle income group of the society. The problem has become acute due to general price rise in every item of hospital supplies. The rise in salaries too is a major cost component in "cost per patient".

PGH board wants up gradation of current MIS module of HMS with the objective of providing following information which they could immediately think of.

1. Cost data for business decision on pricing the services.
2. Data on various servicing cycles.
3. Ward and theater occupancy data for manning the nursing staff.
4. Material consumption data.
5. OPD patient data analysis.

The board is of the view that more systematic system study should be made to ascertain the information needs to manage the hospital efficiently with competitive rates of billing the patient. If such information is available on line.

then strategic decisions like investment decisions, pricing decisions on services and Nursing staff allocation etc could be more scientific.

To day decision making in these areas is ad hock and follows thumb rules approach. The board would like to change the image of the hospital from 'General to Specific Special Hospital' for more focused attention and care.

The board believes that they would be able make more cost effective usage of the hospital infrastructure if such change is made. This however is a strategic decision as it changes the hospital philosophy and direction of working. Before such decision is taken the board would like to assess the working of the hospital by two parameters namely Operations and Performance.

The board is looking for certain key figures to measure the hospital operations.

If this data is collected and reported regularly each week for analysis, lot of indications will be known for future planning. Along with this data, if the operation performance also is computed it will be possible to judge the efficiency and effectiveness of the hospital operations.

## Questions

1. Define the hospital goal and mission as set by the Apex board.
2. Identify the business measuring operations Parameters (BOP).
3. Identify the Business Performance measuring parameters (BPP).
4. Build Balance Scorecard, Score Card and Dash Board for organized reporting on operations and performance.
5. Identify the data needed to build the parameters and subsequently the Scorecard and Dash Board.

## LEARNING OBJECTIVES

- Business Intelligence and MIS
- What is Business Intelligence (BI)?
- Tools and Techniques of BI
- Why is BI developed?
- How is BI used?
- Process of generation of BI
- Benefits of BI

### 11.1 BUSINESS INTELLIGENCE AND MIS

In the context of development of MIS, we have discussed data, information and knowledge and decision-making concepts, and further we have illustrated how they are used in the design and development of MIS. The conventional design of MIS continues to be in use, offering periodic reports and exception reports on targets achievement.

We also discussed strategic design of MIS driven by Information and Knowledge focusing on business operations and their performance. Its focus was on evaluation of functional and business strategies implemented for a short range of period. Balance Score card, Score card, and Dash Board are used for reporting on performance achievement.

This design of MIS is sufficient and effective when a business organisation is SME or a large enterprise where business model is simple. MIS design under reference works well when business operations are not complex, business processes are not distributed at multiple locations, or there are no strategic business units (SBUs) making one business enterprise.

In the decade of 2010, however some of these organisations have become business enterprises of large size due to globalisation and liberalisation of world trade. Their business is now complex in a number of ways such as

- Numbers of operating units in the country are distributed in different states with head office at Mumbai or Chennai. Some enterprises have their business units abroad.
- Business strategies, targets are governed by market conditions and customer requirements of the country of operation.

- Transactions are designed to suite local tax, labour, import/export and company business laws.
- Each operating unit is a legal corporate entity requiring maintaining business accounts as per state accounting standards.
- Business strategies are also influenced by country specific market conditions.

Strategic design of MIS under reference, however, is effective for each business operating unit (SBU) where data is sourced from local databases and transaction servers, local DWH, and files and folders of legacy applications. But, when corporate or head office requires consolidation of data and evaluation of business and strategy performance, the design poses a number of data processing difficulties due to differences in them on various accounts. Difficulties are also faced in evolving new business strategy. The SBUs or operating units differ from each other in the following:

- Business models
- Revenue models
- Data models
- Enterprise software
- Legacy applications
- Business & market strategies, KPIs and so on.

This difficulty is resolved by developing 'Business Intelligence' (BI). Building BI for the corporate business unit or for local business operating unit, if need be, is the solution to meet the complex requirement of strategic decision-making, getting better insight into a sudden business development and so on.

BI is used to meet different information and knowledge needs of users in higher echelon of the organisation structure.

Hence, building BI becomes a natural extension to strategic design of MIS. Table 11.1 explains in brief how the strategic design of MIS uses BI for analysis of sudden developments in business and supporting problem-solving arising out of that development. More details are given in the following sections.

In a global world of business, enterprises need entire spectrum of MIS solution comprising data-driven conventional MIS to knowledge driven strategic MIS to BI-driven MIS. The entire solution suite of MIS uses 'Data, Information, Knowledge and Business Intelligence'.

## 11.2 WHAT IS BUSINESS INTELLIGENCE (BI)?

Let us explain BI with all known familiar term 'Military Intelligence' (MI).

All countries collect and store MI for use in crisis, and understanding the purpose of enemy countries troop movements, their purchases of military hardware, fighter planes and so on. The countries also collect information on Army, Air force, Navy, their base, maps, roads, landmarks and such other information. All the information is collected through spying, analysis of news papers, journals and various formal and informal sources within and outside the country. The entire process is called data acquisition. This information may be structured or unstructured, uncorrelated, incomplete and unaligned on time scale. The information being

**Table 12.1** MIS design and its progression

<i>Business Organisation</i>	<i>Character/Attributes</i>	<i>MIS Design</i>	<i>Reporting Requirements/Characteristics</i>
<i>SME &amp; large within country</i>	Single location; simple transactions; one business model; not so complex operations	Conventional design for reporting information	JIT reports, control reports on deviation from targets; periodic reports on targets & operations & achievements; accounting reports on HR finance, inventory, payroll, etc
<i>Enterprise within country, SBUs</i>	Multiple locations; multiple products; complex transactions; multiple business & processes models; different data models due to application variety	Strategic design of MIS	Same as above <b>plus</b> focus on performance, KPIs; analysis reporting through BSC, score card, dash Board & graphics; MIS application for reporting consolidation of SBUs results at enterprise level
<i>Enterprise spread in other countries as well</i>	Same as above plus country-specific laws & regulations; intense global competition; high business risk/threats from unknown quarters	Strategic design of MIS aided by BI development & use of BI warehouse for query & analysis of different scenarios	Same as above <b>plus</b> reports using BI warehouse for knowledge discovery, reports through Infocubes getting new insight

sourced from different locations needs to be integrated to form country-specific relevant information. This information is cleansed to make it more meaningful and usable in any application. The data then is analysed to create country-specific databases. Such databases are then used to build data warehouse (DWH) of the enemy country. The broad process described here is 'Extraction, Transformation and Loading' (ETL) of data in DWH.

The country specific DWH is a repository of MI. MI is more intelligent and actionable for modelling a crisis situation, decision-making and so on. The DWH is then probed through data mining tools to discover the knowledge of enemy country's intentions behind various decisions. The country uses this knowledge to develop defense strategies to counter enemy country's moves. This is possible because the country has MI & MI processing tools.

The business scenario is identical to the problems the country faces against other countries, friends or foes. The purpose and meaning of BI for the enterprise is same as that of MI for defense of the country.

BI is a 'Set of Information' an outcome of converting a raw data into an intelligent information with reference to a context of a problem by cleansing, analysing and re-arranging and presenting the information to users ready for use in any manner. This set of information is collected for strategic purpose of solving complex problems facing the enterprise. The BI is not static, but dynamic in nature changing with times consistent to the changes in the business environment.

Business intelligence is all about converting large amounts of enterprise data into useful actionable information. The term, Business Intelligence, is also used representing a data collection of processes, applications, and tools and technologies helpful to generate BI. BI means intelligent information, together with tools and technologies (ETL) needed to analyze business scenario or a problem and build its model for strategic decision making.

With the help of BI, the enterprise data is organised, analysed in a better way and then converted into a useful knowledge and actionable information needed to initiate a strategic action. BI is an outcome of converting a raw data into intelligent information by analysing and re-arranging the data according to the relationships between the data items by knowing what data to collect and to manage and in what context.

For example, BI for CRM will be different than BI for manufacturing management or for product life cycle management. BI has a specific support goal to achieve particular business result.

The power of Business Intelligence (BI) depends on the knowledge acquired through the analysis of various reports, queries and views taken using business intelligence analysis and reporting tools.

A typical BI environment is made of business models, data models, and data from sources like files, folders, servers' databases. The data sources of BI are structured and unstructured. ETL ('Extraction, Transformation and Loading) tools are needed to transform and organise the data into useful information for target data warehouse. OLAP and other tools are used for further analysis, modelling and decision making.

OLAP tools provide different views of data by rotating the data across several dimensions. For example, car sales data with its commercial and technical details can be rotated and summarised around its model or segment or distributor and so on with past periods for comparison. BI tools are capable of displaying data in several formats like, tables, charts, query results display or reports.

### 11.3 TOOLS AND TECHNIQUES OF BI

#### Online Analytical Processing (OLAP)

OLAP, an acronym for 'Online Analytical Processing' is a technique by which the data sourced from a data warehouse or data mart is visualised and summarised to provide multidimensional view across multiple domains. OLAP Tools (e.g. Cognos, Business Objects, etc.) help to accomplish these tasks. Business Objects Data Warehouse is designed taking "top-down" approach with the needs of BI of end users. It provides coverage that spans the enterprise so that query, reporting, and analysis can be performed across departments or functions.

An Information Cube, also termed as 'InfoCube' in the literature, is a self-contained data set in the form of tables for a business area such as sales, manufacturing, HR etc. An Information Cube is a set of relational tables stored physically in the star schema structure. InfoCube is made of a fact table at the centre connected by dimensional tables stored in star schema structure. It is created using business data objects from business objects data warehouse.

For example, Infocube contains large fact table about a business entity say Sales or Inventory at the centre connected by its several dimension tables. Each dimension is in the context

of data entity in the centre table. InfoCubes are filled with data from one or more sources for OLAP analysis and reporting purposes.

InfoCube of inventory of a manufacturing organisation would have in its central table Item code, item description; stock in hand, issues & receipts, inventory control levels (ROL, safety stock). This item in inventory has five dimension tables namely, Purchase order of procurement, Work order to manufacture, Material issue requisition, Material receipt note and Goods return note. Each of these dimension tables has respective data details. OLAP analytic process can develop knowledge about the item vs vendor vs value vs quantity, item vs consumption quantity vs value vs rejection and so on.

OLAP works on data or business information stored in data warehouse. DWH is a repository of data and information selected and stored for specific information support objective. OLAP tools enable aggregation of data, and partial or total view across several dimensions through InfoCube application. OLAP tools also provide options to drill-down the data from one hierarchy to another hierarchy exposing its details for insight into its generation.

COGNOS is IBM's business intelligence (BI) and performance management software suite. The software is designed to enable business users without technical knowledge to extract corporate data, analyse it and assemble reports. Cognos is composed of nearly three dozen software products. Because Cognos is built on open standards, the software products can be used with relational and multidimensional data sources from multiple vendors, including Microsoft, NCR Teradata, SAP and Oracle.

SAP Business Objects BI On Demand is a comprehensive business intelligence solution in a software-as-a-service (SaaS) model that helps you get up and running the application in minutes. The solution mainly offers

- A complete view of your business
- Supports informed decision-making
- Saves time with self-service BI

## Data Mining

Data mining tools are another important set of tools used to mine Business information in Data warehouse and analyze it to discover useful findings, which is an actionable knowledge buried under large volumes of data in DWH. SAS Institute defines data mining as the process of selecting, exploring, and modelling large amounts of data to uncover previously unknown patterns of data for relevant information advantage or knowledge.

This knowledge discovery involves finding patterns, trends or behaviours such as associations or correlation within the data that leads to some proactive action. Data mining also uses one or more of the traditional knowledge discovery techniques like Market Basket Analysis, Clustering, Memory Based Reasoning, Link Analysis, and Neural Networks and so on. Data mining requires generally large volumes of data including history data as well as current data to explore the knowledge. Data Mining Methods used in search of context specific information are

- Classification and Prediction
- Association
- Clustering
- Link Analysis

## Market Basket Analysis

The term market basket analysis refers to investigative research on buyer behaviour. The buyer behaviour may reveal group of products purchased together suggesting new promotion campaigns, relaying the store in line the items are picked to save buyers pick up time, design discount schemes on products which are bought in association, developing cross selling schemes and so on.

For example, it is observed that most buyers who buy bread, also buy cheese or butter and eggs or honey or jam or sauces and so on. It is further observed that milk is not bought by majority buyers in association with these items. Market Basket Analysis is very important in retail business for product promotion, cross-selling, product placement, discount schemes and for better inventory management.

## Clustering

A loose definition of clustering could be ‘the process of organising objects into groups whose members are similar in some way’. A cluster is, therefore, a collection of objects which are “similar” and are “dissimilar” to the objects belonging to other clusters. For example, a cluster could be of machine operators though they operate simple as well as complex machines, a cluster could be of SMEs of auto components manufactures. Each cluster has a character of common interest of the buyer.

## Reasoning Based Methodologies

- **Case-based reasoning:** Typical case-based reasoning combines cases similar in nature with general domain knowledge and uses inferences to solve the specific problem at hand. The user in this case may adopt, modify the solution to the advantage of problem in hand for resolution. Case-based reasoning is the process of solving new problems based on the solutions of similar past problems. An auto mechanic, lawyer solving the problem by recalling earlier case instances that exhibited similar symptoms in using case-based reasoning.
- **Memory-based reasoning:** Memory based reasoning focuses on memory organisation of the user and accesses and draws from a large memory of cases a solution to adapt as a solution to the problem. The memory organisation may include more than one domain of knowledge.
- **Link Analysis:** Link analysis is a data-analysis technique used to evaluate or establish relationships between nodes. Relationships may be identified among various types of nodes. Nodes could be organisations, people and transactions. One established link would suggest another probable link.

Link analysis has been used for investigation of fraud detection, counter-terrorism, and intelligence, computer security analysis, search engine optimisation, market research and medical research. Network and social network analysis are all link analysis methods of knowledge discovery. For example, the relationship among two individuals will be judged as ‘friendship’ by linking their letters of exchange, invitations, monetary transactions or exchange of goods. Customer relations can be judged as poor or good based on analysis of call record and resolution of problems. Nature, type, frequency of links suggest the quality

of relationship for user to take suitable action. The detective agencies find link analysis a powerful tool to detect hidden relationship between two individuals.

- **Artificial Neural Networks:** An Artificial Neural Network (ANN) is an information processing method on the lines the way our nervous systems processes information. It is composed of a large number of highly interconnected processing elements (neurons) working in together to solve specific problems. ANNs, of doctor develop expertise in diagnosis, and defence lawyer's ANN helps to build the defence of the accused. An ANN is configured for a specific application, such as pattern recognition or data classification or cause and effect relationship. An established ANN strengthens through a learning process. ANN of a Doctor in general practice would differ from that of a Consultant attached to a specialty hospital. Neural networks are used when the exact nature of the relationship between inputs and output is not known. When decision maker confronts a situation of problem resolution, the neural networks help to resolve the problem.
- **Business Analytics:** Business analytics (BA) refers to technologies and applications using statistical and modelling techniques for exploration and investigation to gain insight into an issue or scenario. The BA helps to surface the issue hidden in huge volume of data. Once the business goal of the analysis is determined, statistical analysis methodology is selected and data is acquired to support the analysis. Suppose the goal is to confirm whether marketing strategy and advertising strategy has impacted sales or not, then correlation regression analysis techniques are used. The relevant data is already in warehouse through ETL process. BA can be used for prediction as well as for knowledge discovery. A typical application of BA using BI process is predicting the credit risk, Loan installment failure, or any business result. SAS is the leader in business analytics software and services, and the largest independent vendor in the business intelligence market.

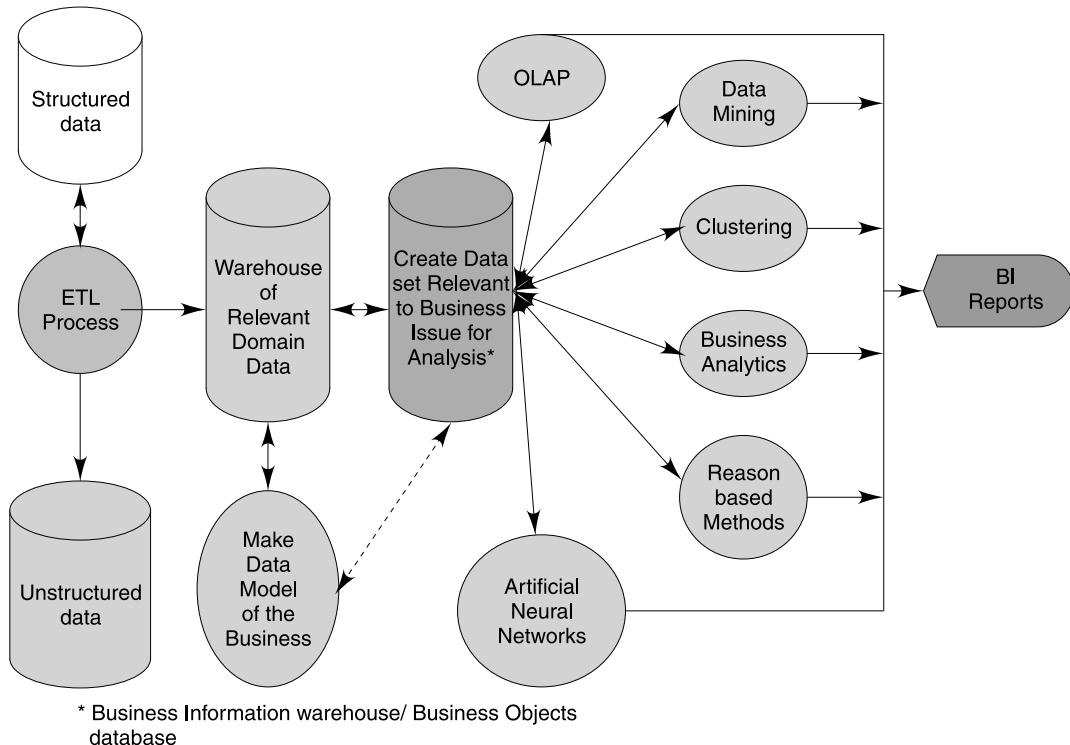
All these tools and techniques essentially are capable of handling stored data in DWH helping identification of the problem and enabling its resolution through knowledge discovery (BI) and using it for the problem resolution. The tools also provide deeper insight into the scenario which otherwise not so clear. Application of BI & BI tools open up a new vision in the business and its operation. See Figure 11.1, the process of converting data into BI.

#### 11.4 WHY IS BI DEVELOPED?

In today's technology-driven global business platform, business organisations have overload of information in various forms and from various sources. Information overload has diminishing return to the users in terms of its intelligence use. Users in general, and managers and decision makers in particular, find it difficult to search, filter, sort and analyse data well in time to develop strategies to meet competitive challenges arising out of changing market conditions.

As IT and communication technology is being used extensively, more and more users find it difficult to cope with information overload. An increasing amount of information that could have been useful is never used because of overload and complexity in handling it.

In business enterprises of the day, data and information are stored as the result of data logging and general information gathering, enterprise application processing and many



**Fig. 11.1** *The process of Converting Data into BI*

more. The contents of such stores are kept in data bases, registers, personnel files, manuals, information banks, portals, text files, e-mails etc.

Improved methods for information capturing—including active filtering and focusing of information, searching for problem-specific information, and guidance on its utilisation—are needed in order to benefit from the information ‘explosion’.

Two main problems are, first, finding problem-specific relevant information, and second, helping the user to utilise the information. The two tasks are highly interrelated and interdependent. Users want information in order to solve problems or to achieve goals. We, therefore, need a solution which will first locate and identify the problem-related information from mass of stored data (Searching & extracting), and second help to identify problem specific relevant information out of it (Filtering & downloading) for further processing for personalised summary, computing and modeling for further decision making.

So the two problems are—one how to get hold of potentially useful information on a general basis, and the other is how to find relevant information for a particular problem at hand. Technically, the two problems are relevant *information identification and extracting and then filtering and its retrieval* for processing further for problem resolution.

The problem-specific information enabling its resolution is Business Intelligence (BI) and tools & technologies enable its withdrawal and processing for specific goal are BI tools.

To appropriately utilise the rapidly growing amount of data and information is a big challenge for users and managers in the enterprise. Standard information retrieval methods, using different processing techniques combined with syntax-based indexing and access methods have not been able to adequately handle this problem. Spreadsheets, Lotus Notes, DB technologies & query handling, different information retrieval products and reporting tools also have not helped users and managers to overcome this problem.

BI repository and BI tools provide critical support to all users to design and develop personalised summary and detail views enabling them to solve immediately confronting problems, adapt to sudden changes, reengineer processes, and develop and monitor key performance indicators (KPIs) to generate objective, measurable business results and business performance.

BI enables more informed strategic decisions resulting into higher revenue, better business risk management, and operational control and creating competitive advantage. Today, it is difficult to find a successful enterprise that has not used BI technology for its competitive advantage and for business strategy formulation. Application of BI keeps enterprise ahead of the competition.

## 11.5 HOW IS BI USED?

In the new order of global business, yesterday's business organisation has become a business enterprise of SBUs handling multiple business lines spread across the country and the world. Business intelligence (BI) software solution is a collection of decision support technologies for such enterprise aimed at assisting and empowering knowledge workers and decision makers such as CEO's, CFO's, marketing strategists and business analysts to make better and faster decisions.

The past two decades due to globalisation of business, there is a explosive growth, both in the number of products and services offered to customers in different market segments world over. In the same period, there is a growth in the adoption of new technologies in data storage and management, communications, computing and analytics by industry to enhance the service quality to their customers.

The business models of these enterprises have become complex due to complexity of business transactions caused by tax laws, trade regulations, different accounting standards, multi currency transactions and trade agreements, and so on. In this scenario, data and information management must satisfy the need of local users while making a provision for the needs of corporate users overlooking world operations.

The complexity of large data is more difficult to manage as data is to be sourced from multiple locations processed on different systems and technology platforms. The source of data is not data bases or servers alone, but could be from records of e-transactions, RFID tags, email folders, Lotus notes, legacy systems, ERP/SCM/CRM applications, query logs, DWH and data marts and so on.

Enterprises are exploiting their data asset aggressively through sophisticated data analysis techniques to understand customer behaviour, their choices, and deliver new functionalities in their offer to customers. These functionalities are identified in BI-driven analysis.

BI technology is used in a number of applications where customer is treated as special, for example, in manufacturing for order shipment and customer support, (*a shipment is delivered in specific manner to suite customer convenience & support needs, a deviation from standard practice*), in retail for user profiling to target grocery coupons during checkout (*grocery coupons are sent to those identified customers who are frequent buyers of grocery*), in financial services for claims analysis and fraud detection (*Insurance claim analysis is made in specific manner based on identified customer profile of the customer to decide on claim amount*) in transportation for fleet management (*every vehicle's status and performance behaviour is compared with benchmark performance profile to decide on change of parts, or grounding for overhaul and maintenance or for that matter its disposal*), in tourism industry for proactively identifying tourists choices and offering them at least price.

On similar lines BI is used in utilities for power usage analysis to mange power distribution, and in healthcare for outcomes analysis to manage healthcare resources in an efficient manner.

In all these applications BI scenarios are developed using different tools and technologies such as:

- Online analytical processing (OLAP) to expose the multidimensional view of data to applications or users.
- Enterprise search engines support the keyword search over text and structured data in the warehouse, for example, find email messages of customer complaints, or purchase orders of a particular model, support calls related to a particular customer, product reviews and so on.
- Text analytic engines analyse text file, say CRM file to identify the frequency of specific function requirement of the product.
- Filtering, aggregation, drill-down and pivoting on data to get different views.
- Reporting tools to define user specific report and its development using text and numeric data together.
- Data warehousing provides a platform to develop various data views providing an insight which is not easy to see using normal reporting tools.
- Data mining tools enable in-depth multi-dimensional analysis of data showing patterns or giving prediction of a response through predictive models.
- Visualisation tools of data helps to see the patterns, trends or no patterns in data throwing light on hidden facts for you to respond.
- Score cards and dash board development tools help to monitor and track the KPIs of the business.

## 11.6 PROCESS OF GENERATION OF BI

To create business intelligence the data, structured and semi-structured, from different domains and sources is searched and taken through the following process using different BI processing tools:

The entire process in brief is termed as ETL (Extraction, Transformation and Loading). See Figure 11.2 ETL (Extraction, Transformation and Loading) process.

Data Acquisition → Integration → Cleanup data → Search related data  
 Analyse the data → Identify relevant data → Format data → Load in DWH

**Fig. 11.2 ETL (Extraction, Transformation and Loading) Process**

ETL, an acronym for ‘Extraction, Transformation and Loading’ is a collection of processes associated with extracting the source data, transforming the data and finally loading the transformed data into a business data warehouse. This transformation involves several processes like data cleansing, data profiling, data type conversion, validating for referential integrity, performing aggregation if needed, denormalisation and normalisation. Loading is a process of putting the data into business information warehouse for all users.

BI always has a context such as solving a problem, decision making, understanding new development to evolve a strategy, knowledge discovery and so on. BI is to be created from different sources of information stored in different locations in terms of stated context. The process is called ETL. The reply to them who decides about the information, of course the decision maker or user of the information.

The first step is acquisition of data. Data could be structured or unstructured. The structured data comes from servers and databases used in enterprise software like ERP/SCM/PLM, legacy applications, intranet applications, data warehouses and so on. Unstructured data may be sourced from e-mails, letters, product or marketing literature, memos, graphics, attachments and such other sources. The extracted information, structured and unstructured, is integrated for next process of clean up.

Since data is sourced from different domains, sources and applications, it would have different formats, models, time periods, and incompleteness and so on. Such data though integrated needs to go through process of clean up, alignment and formatting, etc. to make it ready for BI processing. The clean-up can happen before integration as well. For example, date could be in different format in different applications. But for BI, one format is required. The sales data in ERP is weekly for BI it is required monthly. The clean-up of data includes estimation, correction, achieving precision, alignment, reformatting and so on to suit the users’ requirements.

In the fourth step, what you decide and search is the related data or information as an input to your problem solving and decision-making requirement. This is very fair as the decision maker is not sure how the problem would be resolved. The related data or information could be the best guess of its use.

Analysis of related information has two purposes, one to get insight or understand the problem and then go for identification of relevant information to solve the problem. Analysis of related information is to find most relevant information which would serve the purpose of solving the problem. The user or decision-maker has some approach, a model or a DSS in mind to resolve the problem. The relevant information is the one which fits this requirement.

Having analysed the data in the context of problem resolution, the user narrows down the search to relevant information which will be an input in the problem-solving approach. Related information may include some data due to acquisition process, but it has no role in

the problem solving. For example, an organisation wants to select a manager for posting in UK with right kind of profile. HR data, being related to the problem, is extracted from HR database. For the problem in hand, competency, social skills and experience are important inputs, hence considered as relevant information, while qualification, designation and salary are not important, hence irrelevant.

Relevant information to the problem needs to be presented in a proper format as per user needs. The order in which data is extracted needs to be put in a different manner for use in the problem resolution. The format could be a Word Document, a Spread sheet, or a Table in order of experience or a Table prepared on the basis of weighted index of three requirements and so on.

Delivery is a last step in a process of BI development. Formatted data will be delivered to the users through BI warehouse. While delivering data may further be supported by graphics to highlight certain attributes of relevant data. Delivery with intelligent presentation may open new vision to the user.

## 11.7 MAIA'S 1KEY AGILE BI SUITE

For the purpose of illustrating BI & BI Tools used in ETL process, MAIA's 1KEY solution product is chosen and described as 1KEY Agile BI Suite. For more details and associated graphics, visit: [www.maia intelligence.com/agile.htm](http://www.maia intelligence.com/agile.htm).

1KEY Agile BI Suite is the only single layer, interoperable, ground-up built end-to-end BI product. Decision-making is a crucial task in any business. Business intelligence reporting supports all decision-making task or executive support system by collecting and collaborating facts and figures into a single informative report. Good reporting software can accommodate extensive users, multiple platform and has the ability to connect to various data sources. MAIA Intelligence offers multiple business reporting products/tools like 1KEY and post XBRL. These reporting software products are extremely efficient in collecting, analysing and presenting business information.

1KEY Agile BI Suite is a comprehensive business intelligence application catering to strategic, tactical & operational data analysis and reporting needs of multiple vertical industries. An integrated offering with a choice to pick and choose modules enables organisations to deploy the BI framework with minimal investments.

To succeed as an enterprise, BI solution must:

- accommodate thousands of users with ease of affordability, without prohibitive software license costs.
- provide a highly interactive interface, flexibility and intuitive reporting that improves decision making.
- access any or multiple enterprise data source.

1KEY Agile BI Suite is the only single layer, inter-operable, ground-up built, end-to-end BI product. Our customers' CXO level group have experienced these benefits with the highest adoption ratio wherein 1KEY Agile BI Suite is now used by both, expert BI analysts and operational business users en-masse.

### 1KEY Agile BI Suite features

- Scalable and adaptive SOA
- Dashboards and visually stunning reports
- Dynamic expression and query builder for adhoc reports
- Connects to multiple applications, multiple databases
- Performance to handle silos of data
- Extremely intuitive user interface a user-friendly interface
- Co-exists with existing BI tool at many customers

With 1KEY Agile BI Suite's CIOs are able to deploy an enterprise-wide, secure dynamic reporting platform in as less as 6 weeks. Irrespective of the existing applications (SAP, Oracle, Peoplesoft, JD Edwards, Ramco, Tally, Siebel, Microsoft Dynamics, Legacy, etc.)/database set-ups, 1KEY Agile BI Suite, with inbuilt drivers for multiple RDBMS and DBMS (Progress, Oracle, SQL, DB2, Sybase, etc.) platforms, can assist organisation to create single reporting structure in a heterogeneous database environment. Large enterprises are already reaping the business benefits from 1KEY deployment.

### Modules in MAIA's 1KEY Agile BI Suite

1. 1KEY VIEW provides users the flexibility of analysing the data and creating reports of great business value. 1KEY VIEW has been engineered to fully address the BI needs and reporting requirements of your organisation helping you to compete and win in the marketplace without much effort or compromise.  
1KEY VIEW provides two-dimensional tables for runtime analysis, grouping and column customisations with Parent-Child Relationships, Drill Down and Drill Back functionalities, etc. A two-dimensional and extremely intuitive report formatting and analysis tool for Business users.
2. 1KEY CUBE is a comprehensive data analysis, data mining, and multi-dimensional visual reporting solution. With its powerful data architecture, 1KEY CUBE is able to slice and dice information efficiently and provide customers with an extremely intuitive experience. Regardless of the perspective, data can be rendered to answer business questions—and best of all—it allows business users to focus on business rules rather than creating dozens and dozens of reports.  
It is a powerful tool conceived to help the business user to understand their data, to compare and contrast scenarios, and to deliver this information inside and outside of their organisation.
3. 1KEY CHART is a graphical representation and visual reporting which represents business performance via stunning and meaningful diagrams. It helps to drive organisational achievements by giving information in a much consolidated and easy to understand manner.
4. 1KEY TREE is used to drill down into a number and see the relative importance of each of its constituent parts. When you drill down into any dimension at any node in the tree, the OLAP client ranks the next level of detail from left to right by value and percentage of the total. In this way, the user can readily grasp the relative importance

of any group of products, sales regions, customers, or any other dimension of the cube.

It allows users to do further filters, displaying results in charts, setting other aggregates like %age, Min, Max, counts, etc. and also export and email. The user can save their own layouts for what they drilled from any of the model.

5. 1 KEY DASHBOARD is a reporting tool that can be defined as a user interface for organising and presenting data in a consolidated manner. Data from multiple sources are integrated and unified for display on a single platform. This makes the information easy to read and comprehend, all on the same screen. MAIA Intelligence provides the 1KEY Dashboard reporting tool for all your BI solutions.

1KEY DASHBOARD gives single window to view all types of nos., facts and figures in multiple ways, multi data presentation, etc. The CEO requires complete performance of sales, orders in hand, revenue v/s budget, its outstanding, cash flow, salesman performance, product wise stock in hand, budget & expenses, etc.

6. 1 KEY KPI is high-level snapshots of a business or organisation based on specific pre-defined measures. KPIs typically consist of any combination of multiple reports. They may include global or regional sales figures, personnel stats, real-time supply chain information, or anything else that is deemed critical to a corporation's success.

- Visualise key performance data effectively with graphical pointers
- Convey performance results quickly with visuals
- Monitor red zones and define threshold levels to set indicators and trigger alert deliveries
- Link individual KPIs to corporate goals

KPI allows goals to be observed with different warning colours that will be switched on as defined giving the user a quick view of how well or how poorly each goal is met. Business users are empowered to set the KPI values on their own without depending on the IT team.

7. 1KEY REPORTER is a generic report writer for designing compliance reports, pre printed forms, vouchers printing and viewing. It gives freedom to create a range of simple to complex reports. Thanks to intuitive reporting integrated development environment. A developer can do multiple event formatting, runtime scripting for each cell with J#,C#, VB.net. It has formula and function editors which can be embedded with reports. It has enhanced formula builder having VB Functions, Financial, Math, Conversational, String, Aggregate with advanced conditions and multiple operators.

8. 1KEY On-Line Analytical Processing (OLAP) transforms raw data to reflect the real dimensionality of the enterprise as understood by the user. It gives remarkable performance on the ever growing sizes of the databases.

It connects and synchronizes with multiple raw databases and creates OLAP database in user desired flavour. It is having a middle ware/engine, where the data can be restructured and cleansed allowing the users to create its own OLAP Data-warehouse with ETL process.

9. 1KEY AGILE has dynamic query engine with expression builder and model creator. It provides the facility to use simple graphical interface to build SQL statements and

create views in a database. It has graphical panes that displays your SQL statements visually and a text pane that displays the text of your SQL statement. You can work in either the graphical or text panes.

10. 1KEY SCHEDULER enables users to schedule their reports as per the recurrence pattern in the variety of formats like PDF, TXT, XLS, HTML, MHT and RTF to be stored on hard disk, to be emailed to respective business users, or to SharePoint. Thus, 1KEY SCHEDULER automates the complete process of reporting and avoids the cumbersome work of manually creating and/or delivering reports to respective business users on a periodic basis.
11. 1KEY FILE READER is a utility that imports data from Text files, Excel files, stores it into 1KEY CUBE or 1KEY VIEW for direct reporting and analytics.
12. 1KEY CONSOLE is a powerful enterprise administrative security system for managing the application with user rights, authentication, log writing, back-ups and permissions. It has modules like My Desk, All Managers, User Roles & Report Rights, SMTP settings, Control Center. 1KEY AGILE has active directory integration for single sign on. 1KEY AGILE has service oriented architecture with web services and also integration with third party services. It connects to multiple servers through OLEDB, ODBC, MAIA OLAP, SSAS, SAP & XML.

## 11.8 CASE ILLUSTRATIONS OF BI

The following are brief case illustrations of MAIA's 1KEY Agile BI Suite:

1. Financial services organisation, ₹ 15,000 crore group Mahindra and Mahindra Financial Services Ltd (MMFSL), which deals with over 10,00,000 customers has increasingly leveraged IT to drive operational efficiency. The current MIS solution generated scheduled periodic reports, some control reports helping management track the performance and day to day operations.

Increased transactions required a new MIS design and data analysis solution, to meet the needs of information of complex business operations dealing with 10,00,000 customers. The growth expansion created a need for improving performance at the business level enabling the management to meet the future performance targets. BI development over and above new MIS design was considered an appropriate solution to draw the required information to be observed in real time for managing M&M financial performance. ( Suresh Shanmugam, Head, Business Information Technology Solutions, MMFSL).

Implementation of BI solution resulted in 30 to 35 per cent productivity improvement at the IT level in terms of meeting the users' reporting analysis needs. Further, it is observed 20-25 per cent productivity increase at the business user level due to user-friendly interface of the solutions and its capability to provide on-the-fly ad hoc reporting analysis. Some of the other advantages were faster decision-making owing to the interactive graphics, gauges and filters and deeper insights into the business user out scenarios.

2. BI helps Brand Marketing India (BMI) respond quickly to changes in business conditions with actionable information to users. Timely availability of data in the required

format for enabling decision-making was a challenge for our operational users. Taking informed decisions is the best method of providing your sales and marketing team with the edge in any market place. (Jatin Bhatt, Head IT, Brand Marketing India)

BI solution is implemented to process current and past business transactions to know exactly what happened previously and compare with the current numbers. BI was connected to warehouse built from old Btrieve data, new Shopper data and Tally ERP 9 data. With BI, business users can now run Year on Year periodic reports which they use to prepare manually in spreadsheet and were taking days earlier. The users are now able to track changes in inventory movement by region and product category. They can also now analyse product performance by outlet, region, to enable them to more effectively manage brands towards profitability.

BI has come at a cost-effective price-point, a powerful tool in the hands of our operational users for ad-hoc MIS reporting and analysis. Timely availability of information in required reporting format and presentation has empowered business users to take pro-active and much accurate decisions.

3. Gateway Terminals India Limited (GTIL) deals with container cargo terminal services in the freight domain. The company's business mission is critical. This involves high-end and varied applications across the domains of operations, services and engineering. Since each department was adding data into different systems, consolidation of reports was a huge task and accuracy was also hard to determine. There are multiple data sources involved, as well as text-based applications making the 'timely' data analysis critical and challenging.

GTIL decided to deploy BI development solution primarily to bridge the time gap between the need for reports and the availability of the same. Today with this solution, GTIL has managed to not only provide standard reports, but also has enabled critical data analysis which was not possible earlier. The savings are myriad from time required to make the reports, the analysis to be made and faster decisions. The total implementation time for this solution was four man months.

The company currently has 25 users across various departments using the solution. GTIL estimates the it will be able to get ROI in 10 man months. The major gainer from this application is the commercial department. The productivity of the company's business users has gone up as they can now build their own reports quickly in the format they want.

The productivity of the IT team has also gone up as the team no longer needs to invest its time requesting business users to submit their reports. Team members can now use their time for productive and creative activities. ([www.informationweek.in](http://www.informationweek.in) Gateway Terminals India Project Head: Ananthakrishnan Ganesan)

4. In order to retain its status as one of India's largest chains of clinical diagnostic centres, Piramal Diagnostics Services Pvt. Ltd., is faced with the constant challenge of efficiently managing its 60 Indian locations. On this front, the company's finance team found it difficult to collate finance related information from different centres and format it further. As a result, the finance and the IT team of Piramal Diagnostics got together to evaluate business intelligence (BI) development and reporting tools that

will help in better finance reporting. (By Yuga Chaudhari, Principal Correspondent 07 May 2010 | SearchCIO.in)

Earlier, organisations used to collect information on spreadsheets from across different locations. The submissions of these finance reports used to happen in various formats. Collating information on a monthly basis and putting them in a standard format required by the management had become a major challenge for the finance team.

Apart from this, checking the accuracy of data inserted by the location representative was also a major issue. The issue of timely reporting of data also had to be resolved. "The finance team sitting at the Head Office in Mumbai is required to file all finance related documents in the first week of every month. Despite the deadlines, data kept coming at random times, which used to increase workloads and delay the entire procedure. We had to cross check the data for its comprehensiveness and error free nature.

With BI solution, the task became easier for Piramal Diagnostics. Using the BI reporting tool's 'Tally connector' feature, data entered from any location in India gets collated within the system without any hassles. Due to this automated process, timely data entry has become possible." The data automatically gets saved into MIS reporting, which helps timely delivery of monthly reports.

5. IRB Infrastructure undertakes development of various infrastructure projects in the road sector. Each project is treated as a different legal entity for better control process, cost elements, and for other accounting procedures. The company was depending largely on Tally and Excel to capture the data. IRB had the mammoth task of consolidating the entire financial data of IRB Infrastructure Developers, which had more than 15 accounting entities created as separate companies in Tally. Cracking into a closed system like Tally and consolidating the data was a challenge in itself. Moreover, IRB had to track the finance across all the entities that had accounts with multiple banks. It was becoming increasingly difficult for IRB to prepare the quarterly financial statements as the financial data was scattered across many places. The accountants and financial officers were facing increasing pressure with regard to financial consolidation branches, or the SBUs. The statutory consolidation reporting, which required the reported data to be aggregated into consolidated financial statements on a quarterly basis, was becoming a challenge.

IRB wanted financial consolidation solution across 15 accounting entities, and also capability to 'analyse' the consolidated data. IRB implemented a business intelligence solution. The difference between using an excel sheet and a BI solution for analytics was, without much hassle, accepted by the IRB.

6. The management of Asia Motor Works, the firm that manufactures trucks and auto components, need to have right reports, and that too ones that are linked to multiple data sets distributes across various systems in the organisation. The present solution couldn't provide elaborate and customised reports, hence making decision was a difficult task for the senior management. For example, they couldn't compare between two different horizons within the same dataset and also link between two dataset in a single report. The major technical challenges that they faced during the process was

consolidation of data in a meaningful way and defining a clear and concise model of user information need. Reports from BI solution are directly delivered to the company's executives and the top management for an eagle eye view of the enterprise.

After implementation of BI solution, the productivity has increased. The vendor performance report which took days earlier and used to be prepared manually can now be automatically generated within minutes. Now AMW is able to track inventory changes or movement by region and category. AMW can also analyse product performance by vendor which enables them to more effectively manage vendors toward profitability.

The business intelligent software helped in making decisions faster and more efficiently. Technology Used for BI solution: 1KEY, 1KEY SAP Connector, Windows Server 2003, SAP R3, Oracle 9i, MS SQL Server 2005 (Umesh Mehta, CIO AMW)

7. TATA Chemicals is a Tata Group company with operations in India at 3 locations at Mithapur for Soda Ash, Cement and Tata Salt, at Bagrala for Urea, and at Haldia for Phosphate Fertilizers. The company is also having operations outside India. It has a JV in Morocco and has acquired Cunomon 3 years back. The company has plants for soda ash in UK, Netherland. The challenge to Tata Chemicals management is:

- The company of this size requires actionable information & MIS at various levels in the organisation.
- Top management team requires information which is quick, analysed already and based on which action can be taken related to customers, employees, production programmes, global supply chains.
- At the middle management level, they require information related to tactical decisions and operational matters.
- At grass root level, field people, sales officers require information related to customer interfaces.

All these information which come from multiple sources such as SAP, legacy systems, customer contact or care system, lotus note based workflow system, need to be integrated.

All these enterprises get the following main benefits for their users/decision makers positioned in higher strata of the organisation.

- Get a complete view of the business with critical, up-to-the-minute business data from a single/multiple sources of data.
- Give users instant access to the right information they need to run the business.
- Enable to expand the business and customers with complete customer view across sales, distribution, and financials helps uncover new ways to serve customers faster and better.
- Take proactive control of the business through automatic AAA signals, scheduler, and response to key business events and customer needs.
- Streamlined existing MIS by seamlessly integrating key business data such as sales, purchasing, inventory, and financials, eliminating redundant spreadsheet entries and errors.

- Support changing needs of business with easy-to-use ad-hoc reporting tools to fit specific business needs and individual user preferences.

## 11.9 MIS AND BUSINESS INTELLIGENCE

In the context of development of MIS we have discussed data, information and knowledge and decision-making concepts, and further we have illustrated how they are used in design and development of MIS. We also discussed strategic design of MIS driven by information and knowledge focusing on business operations and its performance.

MIS design under reference works well when business operations are not complex, business processes are not distributed at multiple locations, or there are no strategic business units (SBUs) making one business enterprise. In the decade of 2010, however, some of these organisations have become business enterprises of large size due to globalisation and liberalisation of the world trade. Their spread is beyond the country and distributed over different SBUs.

Strategic design of MIS, however, is effective for each business operating unit, where data is sourced from local databases and transaction servers, local DWH, and files and folders of legacy applications. But when the corporate or head office requires consolidation of data and evaluation of business performance, and strategy performance it poses a number of processing difficulties due to differences in business models, data models, technology platforms, legacy applications and so on.

Building 'Business Intelligence' is the solution to meet this complex requirement of strategic decision-making, getting better insight into a sudden business development and so on.

BI is a 'Set of Information', an outcome of converting a raw data into an intelligent information with reference to a context of a problem by cleansing, analysing and re-arranging and presenting the information to users ready for use in any manner. This set of information is collected for strategic, purpose of solving complex problems facing the enterprise. This BI is not static but dynamic in nature changing with times consistent to the changes in business environment.

BI always has a context such as Solving a problem, Decision-making, Understanding new development to evolve a strategy, Knowledge discovery and so on. BI is to be created from different sources of information stored in different locations in terms of stated context.

BI is an outcome of converting the raw data into intelligent information by analysing and re-arranging the data according to the relationships between the data items by knowing what data to collect and to manage and in what context.

A typical BI environment involves business models, data models, data sources like files, folders, servers' databases, ETL ('Extraction, Transformation and Loading) tools needed to transform and organise the data into useful information for target data warehouse and data marts, OLAP analysis and reporting.

In today's technology-driven global business platform, business organisations have an overload of information in various forms and from various sources. Information overload has diminishing return to the users. Users in general, and managers and decision makers in particular find it difficult to search, filter, sort and analyse data well in time to develop strategies to meet competitive challenges arising out of changing market conditions.

BI repository and BI tools provide critical support to all users to design and develop personalised summary and detail views enabling them to solve immediately confronting problems, adapt to sudden changes, reengineer processes, and develop and monitor key performance indicators (KPIs) to generate objectives, measurable business results and business performance. BI enables more informed strategic decisions resulting into higher revenue, better business risk management, operational control and competitive advantage.

BI technology is used in a number of applications where customer is treated as special, for example, in manufacturing for order shipment and customer support, in retail for customer profiling to target grocery coupons during checkout, in financial services for claims analysis and fraud detection, in transportation for fleet management etc. On similar lines BI is used in utilities for power usage analysis to manage power distribution, and in healthcare for outcomes analysis to manage health care resources in efficient manner.

To create business intelligence, the data, structured and semi-structured, from different domains and sources is searched and taken through a process using different BI processing tools. The entire process in brief is termed as ETL.

ETL, an acronym for 'Extraction, Transformation and Loading', is a collection of processes associated with extracting the source data, transforming that data and finally loading that data into a data warehouse. This transformation involves several processes like data cleansing, data profiling, data type conversion, validating for referential integrity, performing aggregation if needed, de-normalisation and normalisation.

Loading is a process of putting the data into Business Information Warehouse for all users.

Enterprises get the following main benefits of using BI through MIS:

- Get a complete global view of the business.
- Give users an instant access to the right information required at a point of time.
- Able to expand the business and customers by discovering new ways to serve customers faster and better.
- Able to develop context-specific business strategies to make a breakthrough.
- Allow proactive control of the business through installing automatic alerts, and response to key business events.
- Streamline existing MIS by seamlessly integrating key business data.
- Support changing needs of business with easy-to-use ad hoc reporting tools.

## KEY TERMS

Business Intelligence  
Key Performance Indicator  
BI Tools  
BI Warehouse  
InfoCube

ETL  
Knowledge Discovery  
Predictive Analytics  
OLAP  
Strategic Business Unit (SBU)

Structured Data  
Case Based Reasoning  
Cluster Analysis

Unstructured Data  
Link Analysis  
Customer Profiling

## REVIEW QUESTIONS

1. Explain the progression of a decision maker's support need from 'data to information to 'Knowledge to Business Intelligence'.
2. What is the difference between Knowledge and Business Intelligence?
3. Explain the terms in ETL process:  
Data acquisition, Integration, Cleanup data, Search related data, Analyse the data, identify relevant data, Format data, Load in DWH .
4. Explain following models using any business organisation which you know best.
  - Business model, Revenue model, Data model, Data dimensional model
5. Why there is an urgent need of BI for global enterprises? Explain the characteristics of the organisation which justifies BI and BI tools implementation.
6. Explain the modules in MAIA's 1KEY Agile BI Suite: Explain with example.
7. Consider a hospital complex of Mumbai Municipal Corporation (MMC). The complex has dispensaries, local specialty hospitals, general hospitals, labs and so on. Construct following models for use in BI implementation.
  - Business model of dispensary and that of hospital.
  - Patient data model and its dimensional model.
  - Process model of treatment to patient in OPD of the hospital.
8. MMC has a responsibility of offering proactive healthcare to its citizens. It, therefore, wants to built BI whose use would enable them to judge, assess, and evolve a preventive healthcare strategy. List the business data which would form the part of BI. *For example, in case of malaria patient, address, hospital, doctor, treatment days, medicines, could be the part of BI suite.*
9. Also explain how MMC will use BI for discovering an emergence of new epidemic? Say, Swine Flue, Eye diseases. How then BI helps to evolve a strategy to control the epidemic?
10. Data mining methods used in search of context specific information are
  - Classification & prediction
  - Association
  - Clustering
  - Link analysis
 Explain how data mining methods mentioned above would be used to discover 'Knowledge' about:
  - Students of an university
  - Patients in general hospital
  - Customers of multi-brand retail mall
11. Identify the BI scope in the following cases:
  - Central bank and the branches

- University and affiliated colleges
  - Mahindra holiday resorts
12. Explain the use of the following tools in:
- Online analytic processing (OLAP)
  - Enterprise search
  - Text analytic engines
  - Filtering, aggregation, drill-down and pivoting on data
  - Reporting tools
  - Data warehousing
  - Data mining tools
  - Visualisation tools
  - Score cards and dash board



1. The client is a WHO-GMP compliant, ISO 9002 certified, leading publicly listed pharmaceuticals company with a large shareholder base. The company manufactures all major dosage forms such as Tablets, Capsules, Injectables, Syrups, Ointments, etc. They sought a Business Intelligence solution that would help them consolidate information from their ERP system and few other applications and databases within the organisation, create a central data warehouse and thus derive accurate MIS reports by integrating, transferring and accessing data scattered across different functional areas. The BI solution needed to be interoperable with existing data sources, scalable with their future requirements, and intuitive to reduce their time for training and roll out new products through the organisation.
2. A leading construction and infrastructure development company in India with a turnover of over USD 225 mn and employee strength of around 2200 located across over 50 sites and locations – had developed an in-house ERP for construction industry with in-built reporting capabilities.

To gain additional efficiency from operations and tactical managers and to lower overall operational cost, the company wanted to have a business intelligence solution that was built on an industry standard architecture, interoperable with their existing platforms (Unix, Linux, Windows, Oracle RDBMS, other small database and spreadsheets), can be rolled out to all offices and project sites in minimal time, can be hosted through their centralised IT infrastructure at HO, and a solution which is simple to use for all its managers and users.

BI has been integrated with the Oracle based ERP solution to meet the data mining & analysis needs of users across all company offices and site offices. Leveraging their own resources for deployment on production environment, client has succeeded in reducing the total cost of ownership significantly. ElegantJ BI Business Intelligence suite helped users understand operational performance, improve quality of data and reports, reduce time for generating reports, and provided intuitive, self serve analytical environment to develop insights for corporate data and performance (Source: ElegantJ).

3. The client, a leading industrial chemical marketing & distribution company having a pan-India presence, nationwide branches and a wide distribution network is engaged in import, export, marketing and distribution of industrial chemicals, petrochemicals, dyes & dye intermediates, pharmaceuticals, yarns and fibers.

As the client's business grew, their business operations became increasingly complex as a result of which they sought a consolidated BI solution that would help them leverage more value from the ERP solution. The BI solution was expected to answer critical business questions related to day to day operational as well as tactical management activities of divisions across the organisation. Built on industry standard architecture, the BI solution needed to be interoperable with existing platforms (Windows, Oracle RDBMS, other small database and spreadsheets), quick to roll out across the organisation and which would consolidate data across different divisions and companies of the organisation, thus strengthening decision support systems by answering critical business questions in a timely manner.

The versatile ElegantJ BI Business Intelligence suite was integrated into the client's customised ERP solution with great ease and helped client's users understand operational performance, improve quality of data and reports, and reduce time for taking more informed, confident decisions and generating reports. It provided an intuitive analytical environment to develop insights for corporate data and performance.

The simple, practical deployment process of ElegantJ BI Business Intelligence suite required very little training and allowed client to take control of the implementation within 8 weeks. The success of this project is a perfect example of how ElegantJ BI's simplicity of use and short implementation cycles offers the best TCO to customers.

Enhanced data quality and having a central system of record, will enable us to produce faster and accurate compliance and regulatory reporting. This will also help us to get more time to review our submissions. The BI initiative can also enable early warning signals in case of any deviation in relation to compliance.

4. Some typical applications of BI

- **Reduction in the financial write-offs:** A better data quality and also data integration linking multiple systems, will help to audit and report on end-to-end transaction flow from a single reference point. The main reason for financial write-offs (apart from credit write-offs OR capital erosion due to wrong investments OR bad risk modelling etc....), is inability to reconcile linked financial transactions across multiple systems, due to mismatching codes etc. A BI with data-integration will enable a better financial reconciliation OR at least a root-cause analysis.
- **Maximising Customer Satisfaction Index:** Customer satisfaction is the buzzword with media and the CEOs. A BI initiative, allows you to track the customer touch points across multiple systems, to have an end-to-end view of customer interaction. Secondly, by using data-warehouse for enterprise reporting, you can share a single version of truth with the customer. By using BI, you can also track the organisational performance on various customer sensitive parameters on delivery, on support call, and on customer query.
- **Enhance Sales Revenue by cross-sell and up-sell:** Along with providing a single customer view, BI can also provide the data for business modeling of customer profile and product affinity analysis. With both these enablers, the organisation can train the contact centre executives, customer service executives, sales staff and marketing staff for leads and mailing campaigns, and to go for cross-sell and up-sell.
- **Better and clear assessment of non-financial revenue and costs:** In a typical board meeting, a CEO can get many different versions of sales revenue and costs. Finally, CEO has to rely on the CFO for the costs and revenue. However, there are genuine versions of sales revenue and costs, which a CEO must know. These pipeline versions are:
  - Business ordered by the customer, but not yet processed
  - Returns done by the customer (negative revenue), but not processed
  - Costs incurred by the company, but invoice not received

The systems carrying the information on these revenue and cost pipelines are typically field and non-core systems, which are managed with lesser attention. BI enables us to integrate data across the core and non-core systems, and allows us to reconcile the financial figures and yet to hit figures. This helps the business to do better projections and take more informed decisions.

- **Exposure Management:** BI provides an end-to-end customer relationship by providing single view of the customer. This enables business to do the risk profile, de-dupe multiple customer records of the same customer, manages the exposure to the customer etc. This avoids financial loss.
- **Customer Management:** BI allows you to do various analytics and data mining tasks like churn analysis, affinity analysis, customer segmentation, and customer value and profitability analysis. This enables higher customer retention and segment-based products and service infrastructure

# PART III

## Applications of Management Information Systems to E-Business

### CHAPTERS

- 12. Applications in Manufacturing Sector
- 13. Applications in Service Sector
- 14. Decision Support Systems and Knowledge Management
- 15. Management of Global Enterprise

You have understood the purpose and role of MIS in today's e-business enterprise and the foundation on which it is built. It is necessary to strengthen this understanding through learning of its application in business and industry. Business and industry is divided in two sectors: Manufacturing and Service. This division helps to understand MIS application in precise terms to meet sector specific information and processing needs. In both sectors, DSSs play a significant role in improving the effectiveness of MIS. Having understood sectoral applications, it is necessary to take on an enterprise view to understand the enterprise applications for resource and relationship management.

Learning objective of this part is to understand the application of information technology to business and industry with a sector specific design and architecture. Then understand the role of DSS in improving the effectiveness of information technology and information systems in managing the business processes. Understanding sectoral application is not sufficient in today's competitive global business environment. It is necessary to learn to view business as E-business enterprise and use the enterprise wide integrated applications to run it effectively.

## LEARNING OBJECTIVES

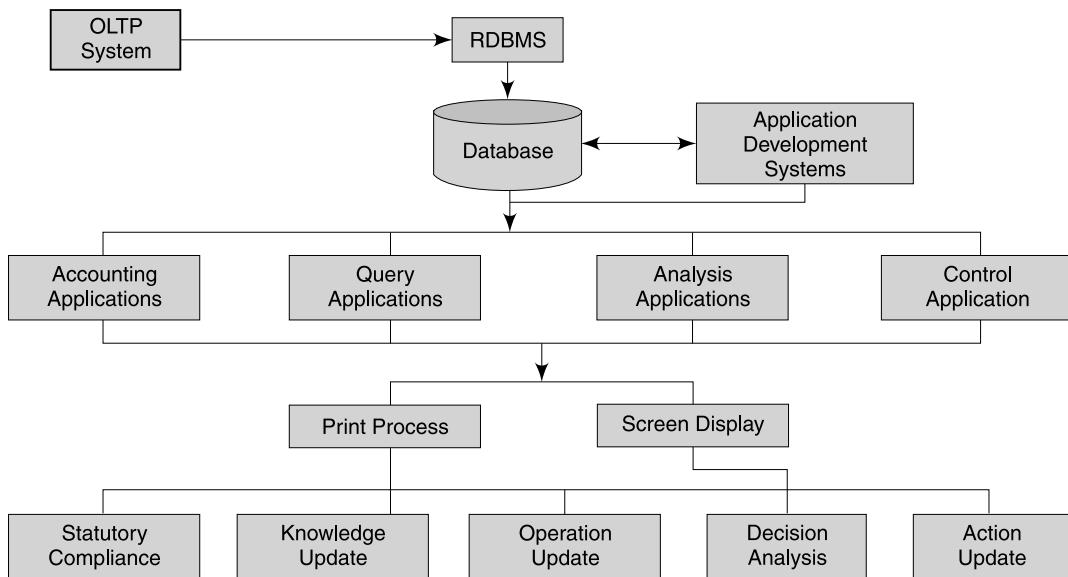
- Applications of IS and IT to Management Functions of the Industry
- Model of Information Processing System
- Application of this Model to Business Functions
- Integration of Manufacturing Applications

## 12.1 INTRODUCTION

This chapter is an introduction to the business applications of Management Information System. It gives an overview of the application and does not give small details which may be specific to a typical organisation. The approach to the application development is on the basis of data base and not conventional file system. The MIS model of an application, considers transaction processing as a basis. The online transaction processing system develops data for DBMS and the application development is based on such database. The model of information processing system is given in Fig. 12.1.

For each application, inputs, which are processed by online transaction processing (OLTP) system, are determined. The system designer develops the applications with the objective of accounting the transaction based results and providing the reports on the same. The second objective is to provide a *Query* system for assessment of the status on record, result or document. The system provides on the spot screen display showing a status, such as stock of an item, balance of an account, position of purchase order and so on. Third objective is to provide a *system of analysis* of processed data revealing certain business trends or results. It is supposed to give certain analytical assessment of the event which will throw light on the validity of decisions, policy and rules. It is also supposed to provide certain guidelines and norms for strategic and tactical planning.

The analytical information provides support for decision making in the Decision Support System (DSS). The analysis system provides fund of information at all level for planning and execution of business operations. The fourth objective is to provide control information to ensure that the business runs as per the plan, progresses in a set direction and achieves the goals.



**Fig. 12.1 Model of Information Processing System**

The control information is generated by using the standards, norms, targets and budgets. The actual results are compared with these entities and exceptions are highlighted. Whenever possible, the information is provided on the basis of feed forward control, i.e., providing early signal of probable adverse conditions or results. The designer of business application focuses the development on the aspect of accounting, querying, analysis and control.

The report generation is decided on the basis of certain business information needs. These needs are statutory compliance, Knowledge update, operation management, decision analysis, control and action. The reports are designed for screen display or for print. The contents of the reports are decided as per users of the information. The frequency, duration and coverage of the report is decided as per the user requirements.

A typical information system begins with OLTP System, uses RDBMS for creation of Database, 4 GL for application development and SQL for querying and report generation. It uses programme for complex data processing and report generation. It uses business-models, accounting and commercial principles for processing the information leading to business results. The information system is designed on the principle of open system design, providing flexibility and friendliness to the users of the system.

A typical information system primarily serves the needs at function levels such as Personnel, Finance, Production, Materials, Marketing and Corporate Business Management. These systems when integrated provide cross functional information to management highlighting the business implications of the decisions taken in one area of the business or the other. Integrated systems provide data and information for business planning at the middle management level and for strategic planning at the top management level.

## 12.2 PERSONNEL MANAGEMENT (PM)

Personnel management function has the primary objective of providing suitable manpower in number and with certain ability, skills, and knowledge, as the business organisation demands from time to time. Its goal is to control personnel cost though continuous increase in manpower productivity by resorting to the following techniques.

1. Human Resource Development through training and upgrading the skills.
2. Motivation through leadership and job enrichment.
3. Promotion and rewards through performance appraisal.
4. Grievance handling.
5. Structuring the organisation.

### **Input Transaction Documents**

The various forms or documents which serve as inputs for the personnel department are listed as follows:

1. Personnel application form
2. Appointment letter
3. Attendance and leave record
4. Biodata, self and family
5. Appraisal form
6. Production/Productivity data on the jobs
7. Wage/Salary agreement
8. Record of complaints, grievances, accidents
9. Industry data on wage/salary structure
10. Industry data on manpower, Skills, Qualifications.
11. Record of sources of manpower—University, Institution, Companies
12. Record on manpower application trend in view of mechanisation, automation, and computerisation

### **Applications**

The viewers of the database are personnel managers, heads of the human resource development department and top management.

### ***Accounting***

Following entities are accounted in the personnel management system.

- |                                       |                    |
|---------------------------------------|--------------------|
| 1. Attendance                         | 6. Accidents       |
| 2. Manpower                           | 7. Production data |
| 3. Leave                              | 8. Skills          |
| 4. Salary/wages, statutory deductions | 9. Bio Data        |
| 5. Loans and deductions               | 10. Family data    |

### **Query**

Personnel management has queries as the following:

1. Who is who?
2. Strength of section, department, division.
3. Number of persons with a particular skill.
4. Attendance, leave and absenteeism record of all employees.
5. Salary/Wage of employees.
6. Designations and number of persons holding these designations
7. Personal records of the employees.

The queries are processed with employee number, skill code, department/division code as keys.

### **Analysis**

1. Analysis of attendance by a class of employees.
2. Leave analysis by a group of employees.
3. Trend in the leave record.
4. Analysis of accidents and types thereof.
5. Analysis of salary/wages structure.
6. Analysis of overtime.

### **Control**

1. Probable absence versus workload.
2. Projection of personnel cost against manpower increase.
3. Assessment of accident records against safety measures taken.
4. Personnel cost versus Industry cost and its projection
5. Projection of manpower needs and evolving recruitment and training programmes.

### **Reports**

The reports of the system will be used mainly by the Personnel Department and the Top Management. Following is the list of reports of different categories.

#### **Statutory Reports**

There are some statutory reports which are to be prepared by the personnel department of almost all the organisation. These are as follows:

1. Attendance record (Muster).
2. Strength of the employees by category—permanent, trainees, and apprentices.
3. Provident Fund, ESI Reports, Ledgers and Returns.
4. Accident Reports
5. Income Tax Form 16, 24A
6. Strength of employees to Director General of Technical Development (DGTD)

These reports are submitted to the Provident Fund Authorities, ESI Authorities, Income Tax Department, Directorate of Industrial Safety and Health, and Labour Department.

### ***Information Updates***

1. Daily attendance report.
2. Employee strength.
3. Joining and transfers of the employees.
4. Personnel cost by department, job, product.
5. Periodical statements showing personnel cost by salary / wages, overtime.

### ***Operation Update***

1. Daily attendance to plan the workload.
2. Overtime versus work completed.
3. Projected absenteeism and distribution of workload.
4. Cost of personnel by jobs or work completed.

### ***Decision Analysis***

1. Analysis of attendance for season, festival and by skills, scheduling of the jobs accordingly.
2. Overtime analysis by department, employees and job to decide the strength of personnel.
3. Analysis of accidents and deciding on safety measures and training.
4. Cost analysis by personnel versus jobs vs skills and planning for new recruitment.

### ***Action Reports***

1. Recruitment and additional manpower or subcontracting of jobs.
2. Acceptance of orders on the basis of workload.
3. Reduction, transfer and reorganisation of employees to control costs.
4. Preparation of training and development programmes with specific needs.

Most of these reports are used by people in operations management. The information needs at the top management emerge when issues of controlling the wage bill, entering into new agreement/s, etc. come up. Most of the application development is standard and rule based, requiring very little modifications. Figure 12.2 shows Personnel HR (PHMS) Management Systems Model.

## **12.3 FINANCIAL MANAGEMENT (FM)**

Financial management function has a primary objective of meeting the financial needs of the business, from time to time, by way of providing working capital and long-term capital to run the business with the goal of containing the cost of capital at the minimum. The second objective of financial management is to meet the statutory compliance by way of declaring the audited financial results, submit all reports and returns to the Government and Tax

**Fig. 12.2 Personnel and HR (PHMS) Management System**

Authorities and fulfil the obligations to the shareholders. In meeting these objectives Financial Management uses variety of tools and techniques as under:

- |                          |   |
|--------------------------|---|
| 1. Break Even Analysis   | 5. Capital Budgeting and ROI Analysis     |
| 2. Cost Analysis         | 6. Financial Modelling                    |
| 3. Cash Flow Projections | 7. Management Accounting                  |
| 4. Ratio Analysis        | 8. Expense Analysis, Auditing and Control |

#### **Input Transaction Documents**

1. Payments: To suppliers, authorities, employees, shareholders, financial institutions and others.

2. Receipts: From customers, authorities, employees, financial institutions and others.
3. Data from Stock Exchange of the share prices, consolidated financial results of the other Companies, etc.

Transactions are payments and receipts and they are documented through journal vouchers, bills, debit notes, credit notes, receipts and transfer document. The payment and receipts are for a variety of purposes and they are documented in typical formats suiting the respective business enterprise.

### **Applications**

In financial management major application is the Financial Accounting System, which accounts for the financial transactions of the company and produces financial results for the company. It produces balance sheet for the company where the performance of the company is published in standard format prescribed by the government. There are companies where fixed deposits and share accounting are also part of financial functions. The system is made so comprehensive that it not only collects data but also collects data on different matters such as job, department, division and so on.

Due to versatility of the financial management system, it becomes a repository of financial data which can be used in the other systems of the enterprise. It forms a basis for certain reports which are required by the top management. The viewers of the financial database are, finance managers, cost controllers, auditors, materials managers, marketing managers, company secretaries and the top management.

### **Accounting**

The system accounts for all money transactions which have taken place, directly or indirectly, and which affect the company. The money transactions may affect several aspects of the business such as Sales, Production, Purchase, Travel, Shareholding, etc.

The financial management system accounts typically for the following:

- |                        |                                  |
|------------------------|----------------------------------|
| 1. Sales               | 9. Income Tax                    |
| 2. Purchase            | 10. Sales Tax                    |
| 3. Salary/Wages        | 11. Excise Duty                  |
| 4. Inventory           | 12. Customs Duty                 |
| 5. Expenses            | 13. Octroi and other Local Taxes |
| 6. Capital Purchase    | 14. Consumption                  |
| 7. Fixed Deposits      | 15. Budgets                      |
| 8. Shareholder's Funds | 16. Fixed Assets                 |

The system accounts for such main heads and then accounts for its subsidiary heads. For example, it accounts for sales and gives sales ledger and sales register. It accounts for purchase and gives creditors' ledger. It accounts for all payments to employees and gives personnel ledger and loan ledger. It accounts for expenses under different heads such as travel, entertainment, miscellaneous purchase and produces a subsidiary ledger.

Financial management accounting system provides facility to perform multidimensional accounting of financial transactions. It provides a lot of data and information which forms a valid database for other applications in the business.

### ***Query***

The query system throws light on the debit or credit balance of an account. It shows the details or transactions which have resulted into that balance. The queries are normally put to ascertain the business results by its subsidiary. For example, the query could be on sales with respect to the customer. The query could be on sales of the product.

The query is processed for the following with the respective codes as keys.

1. Main account
2. Subsidiary account
3. Location (Factory, Branch etc.)
4. Document (Bills, Credit note, Debit note, Receipt, etc.)

The query processes the transactions and shows the current status of the reference such as Account, Document, etc.

### ***Decision Analysis***

Financial management calls for a number of decisions, based on the analysis of the financial status of the company. The decisions fall in all areas of financial management. The decisions are, borrowing of short-term working capital, sources of finance, analysis of debtors and creditors, and revision of credit terms, capital budgeting and selection of investment alternatives, etc.

The applications which support the above decisions are:

1. Cash flow analysis
2. Sources and uses of funds
3. Debtors analysis and aging
4. Creditors analysis and aging
5. Budget analysis
6. Ratio analysis and management norms
7. Capital budgeting and ranking of investment alternatives
8. Cost analysis of various production inputs and alternatives

### ***Control***

The cost of running a business increases, when the business does not progress on a planned basis. The lags and leads in activities, delays in completion of tasks and non-performance of certain business functions give rise to additional costs eating away the margin in the business. The control is exercised, based on the exceptions found in the business operations. Some exceptions are mentioned as follows:

1. Accounts receivables, outstanding beyond the acceptable norms.
2. Advances to creditors and non realisation of obligations.
3. Valuation of non-moving inventory for disposal.
4. Analysis of non-moving accounts and legal actions.
5. Shortage of funds in excess of planned and rescheduling of activities, priorities.

6. Cost overruns beyond the norms and action on alternatives.
7. Performance analysis of lines of business showing adverse performance leading to the decision—whether to continue or discontinue the line of business.

The control applications lead to decision or revision of business terms, going for alternative source of financing, review of certain activities to cut down the expenses, reallocation of resources, revision of schedules, plans and priorities.

Financial control takes longer time to show the effect and hence they are to be carried out well in advance before the crisis crops up. Most of the control applications are based on the principle of feed forward control where failure is sensed earlier and action is desired immediately.

### ***Reports***

A major portion of a financial management system is devoted to the statutory compliance and operations update. The top management heavily relies on the reports source from the financial management system. The information emerging from the financial management system, is found reliable, as the basic data, is thoroughly checked, audited and validated through a computer system. Many companies rely on the financial management system for management information.

### ***Statutory Compliance***

1. Tax Returns.
2. Registers: Sale Tax, Excise, Tax deducted at source.
3. Declaration of certain results to the financial institutions.
4. Declaration of financial results to the public every six months.
5. Declaration of annual results to the Board, Shareholders and Public within a stipulated time.

### ***Information Updates***

1. Monthly Trial Balance, Balance Sheet and Profit and Loss Account.
2. Stock Valuation.
3. Accounts receivables and aging.
4. Accounts payables and aging.
5. Expenses on major accounts.
6. Cash position.
7. Payments and receipts which are statutory obligations.
8. Sales, Purchase of assets by certain classification.
9. Overall business achievements in major lines of business.

### ***Operations Update***

1. Filing of statutory returns and reports.
2. Statutory payments such as Advance Tax, Sales Tax, Octroi, Excise Duty, etc.

3. Transactions executed and accounted in the system.
4. Report on finished goods, dispatches and invoicing.
5. Reports on material receipts and payments to the suppliers.
6. Obligatory payments such as rents, insurance premium, membership fees, interest, and dividend.

If operations updates are satisfactory, the management can infer that business transactions are taking place in order. Figure 12.3 shows a Finance and Accounts (FA) System Model.

**Fig. 12.3** *Finance and Accounts (FA) System*

### ***Decision Analysis***

1. Break Even Analysis for cost and price decision.
2. Return on Investment Analysis for choice of investment.
3. Trend Analysis on price of selected commodities which play a crucial role in business performance leading to decisions of alternative material supplier, change in product design, etc.
4. Cash flow, sources and uses of funds, leading to control on expenses and selection of alternative source of financing.
5. Analysis of current and fixed assets in terms of use and decision on alternate use or disposal.
6. Analysis of current liabilities and decision on liquidation on priority basis.
7. Analysis of overdue receivables and decision on the revision of terms or commercial and legal actions.

### ***Action Update***

Though decision analysis indicates the areas of decisions, action is taken in exceptional cases. Exception reports on implementation of the decision and its impact on the business are listed as follows:

1. Overdue receivables
  - (a) Legal action.
  - (b) Termination of business association
2. Non supply of goods and services but advance paid.
  - (a) Legal action
  - (b) Revision of terms
  - (c) Termination of business association
3. Payments to creditors, where penalties are involved.
4. Poor usage of fixed assets and disposal.
5. Non-moving inventory of, say, more than two years and its disposal.
6. Evolving new systems and procedures to control expenses and implementation.

## **12.4 PRODUCTION MANAGEMENT (PM)**

The objective of Production Management (PM) function is, to provide manufacturing services to the organisation. This involves the manufacture of products of a certain specified quality and within certain costs in a stipulated time fulfilling the promises given to the customer.

The production management function is supported by other functions, viz., Production Planning and Control, Industrial Engineering, Maintenance and Quality Control. It has a very strong interface with materials Management function. The organisation of the Production Management differs according to the type of production, i.e., Jobshop or continuous. It also varies with the production policy of the organisation, viz., whether the production is initiated against a customer order or for stock. The system and methodology differs with respect to the manufacturing technology the organisation has adopted.

The functional goals of the production management are fuller utilisation of the manufacturing capacity, minimal rejections, maximum uptime of plant and equipment, and meeting the delivery promises. The function assumes key importance, when business strength is in technology and manufacturing, and the market for product and services exists. The function is pegged with the responsibility of managing high investment in plant, equipment and machinery. It also has to control the large labour force at its disposal.

### **Input Transaction Documents**

The production management is conducted through innumerable transactions. They relate to planning, issuing and controlling the various tasks involved in the course of production. The details are listed as under:

1. Production programme
2. Production schedule
3. Process planning sheet
4. Job card
5. Job status advice
6. Quality assurance rating form
7. Finished goods advice
8. Breakdown advice
9. Material requirement
10. Material requisition
11. Customer order

The production management also uses standards and norms extensively developed over a period of time as inputs in the system. These are generally known as production rate, available capacity, labour complement, material usage standards, rejection norms, etc.

The transaction documents mentioned above are indicative and may be more or less different, depending upon the type of production, nature of production and industry. The input data in each transaction would also vary from industry to industry as would the production methodology adopted by the organisation. The systems and procedures used by the organisation in performing the production function also very respectively.

### **Applications**

The production management is performed through production planning and control, bill of material processing, drawing and process planning, scheduling and monitoring systems as support systems.

### **Accounting**

Production management accounts for a number of entities in a systematic manner to fulfil the needs of production management functions in various tasks and activities. The entities are as follows:

1. Quantity of production with respect to a time period.
2. Material requirement and its usage.

3. Rejection quantity at each intermediate stage and the final stage.
4. Breakdown incidence.
5. Labour complement with respect to a period.
6. Use of power, fuel and consumables.
7. Machine and facilities utilisation.
8. Labour hours.

Accounting of the above entities is essential to build up the information base to develop norms and standards for use in planning. It also provides day to day or period by period update on the events, activities, and tasks that the production management is expected to perform.

### ***Query***

The queries in the production management relate to seeking of status of job or information on fixed entities such as machine or worker or process data.

1. Status of the job or order in terms of stage and level of completion.
2. Production programme and jobs schedules.
3. Load status on machine, group of machines.
4. Status on availability of material.
5. Standard information on machines, tools, specifications.
6. Standard information on skills and capacities of each worker.
7. Standard information on products and processes.

### ***Decision Analysis***

The production management function is required to make a number of decisions both for long-term and short-term period. The typical decisions are:

1. Make or buy
2. Make or subcontract
3. Use of alternative material
4. Use of alternative process
5. Evolving optimum product mix/job mix
6. Rescheduling and loading of jobs
7. Planning and scheduling of jobs
8. Selection of production facilities
9. Selection of alternative maintenance policies

These decision analysis applications help to make policy decisions on techno-economic basis. The decision implications are on cost, productivity, efficiency, proper utilisation of the manufacturing facility and usage of material and physical resources.

### ***Control***

These applications are developed to control production programme, production capacity and quality of production. The other issues with which the production management has to

deal, are utilisation of the production capacity and labour force. It has to ensure that plant, machines and equipment, having high investment, are fully utilised. There are always some jobs, which have to be pushed through the production programme by way of scheduling and loading the job on the machines. These are the areas where control of the production management is essential.

The exceptions which need to be highlighted are:

1. Excessive product rejection on account of material and/or process.
2. Hold up of key jobs beyond a certain limit.
3. Excessive work in process inventory.
4. Continued breakdown of the manufacturing facility beyond a certain period.
5. Utilisation of key facilities below a limit.
6. Continuous significant deviation from standards or norms of production rate.
7. Backlog of a large number of orders and failure to meet promised delivery date.

## **Reports and Screen Display**

### ***Statutory Compliance***

There are very few areas in production management which require information for reporting to authorities under the category of statutory compliance. There are some industries, which require to keep the account of raw material and finished goods and submit the report to the Government. The industries which are classified under Director General of Technical Development (DGT) are required to inform certain data on production and production hours to DGT.

### **Information Update**

For the purpose of evolving standards and norms on the various aspects of the production function, analysed information is built up in the system of subsequent use, for example, the data on the down-time of production facilities, a typical reason for rejection, output of various job versus machines and so on.

The information is kept up-to-date enabling the managers in the production function to plan the production properly by using these standards. The data on job completion time helps to give correct delivery promises to the customers. The data on breakdowns, causes of breakdowns and the down-time helps to assess the correct available capacity for production. The data on absenteeism helps to assess the available labour hours by skills and trade.

Accounting, decision analysis and control applications provide a lot of valuable key data which build the knowledge base for use in the production management.

### ***Operations Updates***

These reports provide information on day to day events. The statistics, such as the production per day, the rejections by process or job, the machines breakdowns, the jobs completed and handed over for inspection, and so on is collected and reported to the concerned operating personnel as the latest update.

The reporting of highlights—planned versus actual—on every important aspects of production function helps to take decisions in the production operations. The decisions could be extending production hours, going on second shift, rescheduling the jobs, change of tools or process, etc. The decisions and actions in the production operations are to be taken by the junior management in the production function.

### ***Decision Analysis***

The decision analysis applications provide the reports with specific key decisions in the production function. The Decision Support System (DSS) are extensively used to enable the management to take decisions. The programming models, simulation techniques, material requirement planning systems, artificial intelligence and knowledge based systems, planning and scheduling systems provide continuous analysis on many issues which affect the production function.

The analysis through DSS helps to make decisions, such as optimum product mix, alternate loading pattern, alternate assignment of jobs and machines, use of alternate material, tools and process. Some of the decisions change old practices, conventions and decision rules. They fall in the category of strategic and tactical decisions.

### ***Action Update***

These reports provide information update on the post implementation scenario of decisions. The reports inform whether the decision has resulted into expected performance as designed. The information provides knowledge whether the implemented decision is proper or not. It provides an early opportunity to the management to correct its own decision if the expected results fail to come through. These reports are termed as exception reports on the action taken by the management.

For example, a new process is evolved and implemented. The information on quantity produced, quantity rejected, quality level achieved and its comparison with the earlier process gives sufficient guidelines to confirm whether decision to switch over to a new process is correct or not. Once the action update confirms that the decision is correct, its reporting will be discontinued. Figure 12.4 Shows Model of Production Management (PM) System.

## **12.5 RAW MATERIALS MANAGEMENT (RMM)**

The objective of Materials Management (RM) is to provide material for production, maintenance and services at economical prices, in an appropriate quantity and quality with east stockouts and with no extra cost of carrying the inventory. The scope of materials management function is procurement, stocking and control of inventory.

The function of materials management is important, as it is the single largest function, which takes away large capital as working capital. Secondly, it is important from the point of view of controlling the material cost and the cost of carrying inventory.

Apart from providing material to production, maintenance and services, it has a responsibility of searching new substitutes to reduce the cost of material, reduction of inventory and disposal of non-moving and slow-moving inventory. The function deals with suppliers of all kinds and has to evolve system and procedures suitable to manage the function and reduce paperwork.

**Fig. 12.4** *Production Management (PM) System*

The managerial task revolves around a number of aspects such as balancing the cost of procuring with the cost of carrying inventory, the cost of stockouts with the cost of production hold up, the price with the quality, performance with price. In all these aspects the materials management has to search an optimum solution. The function is also controlled by corporate management, through audits and checks, to ensure the procurement of material is done at an economic price.

### **Input Transaction Document**

The materials management has the following transactions, which need to be covered in the system.

1. Purchase requisition.
2. Purchase order.
3. Receipt of goods.
4. Return of goods to supplier.
5. Issue for production.
6. Return from production.
7. Certification of bill for payment.

Apart from these basic transactions, the materials management draws data from quotations, tenders and from documents in Excise, Sales Tax, and Octroi. It also depends on the data from external sources such as Industrial Associations, Trade Journals, Research Laboratories and so on. The nature of documents is non-standard through it may become tedious and lengthy.

A typical purchase transaction will be executed only if it is processed through, at least, ten to twelve documents. The Materials Management deals with a variety of suppliers; small, medium, Government and foreign suppliers, each having typical requirement of selling the goods, which the materials management has to fulfil. Owing to the variety and complexity of transactions, its processing is a complex task, demanding high level scrutiny, checks and controls, and accounting which is time consuming and monotonous. The materials management function has to interface with finance and production while executing the functional responsibility.

### **Applications**

The materials management function is conducted through several administrative and management systems, each having different propose and focus. It has the following system.

1. Forecasting and planning.
2. Procurement.
3. Purchase ordering.
4. Goods receipt.
5. Inspection.
6. Issuing the material.
7. Processing the returns.
8. Bill passing and control.

Through these systems, different functional needs of accounting, query, analysis, decision making and controls are fulfilled.

### **Accounting**

The materials management function account for a number of things, as shown below.

1. Purchase quantity
2. Issue quantity
3. Stocks
4. Goods returns

5. Rejections
6. Performance
7. Value of purchase
8. Average or standard rate of accounting

The systems are Purchase ordering and accounting, Accounting of stocks and purchase, Consumption, stocks and performance of supplier.

Accounting is a major basic function of the materials management, which provides a lot of valuable data to other systems within materials management and also to other functional systems, viz. finance and production.

### ***Query***

Queries in the materials management largely centre around price, supplier, stock and pending aspect of purchase, returns and payments. The query may be on one key or on several keys together. The query may be on an item seeking the latest purchase price or it may be on an item seeking a price in a particular purchase order placed on a particular supplier.

The query could be a processed one seeking information on, say the number of stockouts in the last six months of a particular item. Or it could be on the items in case of which the stock is zero and supply is not due in the current month. The query applications are designed as processing routines which are often put in the system. The others are handled through SQL by the users of the system.

### ***Decision Analysis***

As materials in the single largest component of the cost, in any manufacturing organisation, a majority of the decisions centre around the cost of purchase and the cost of materials consumed.

The first major decision in the function is 'price' of an item. The prices vary from supplier to supplier and the suppliers differ from each other on a number of accounts. The price is a commercial decision influenced by reliability of supply, quality of material and dependability. The materials management is required to make multidimensional analysis to decide on price.

A DSS can be developed around the parameters requiring analysis. The second major decision the materials management has to take, is stocking of items. The stocking decision means, whether to stock or not, if to stock, what are the inventory levels, viz., minimum stock, maximum stock, reorder level, economic order quantity and so on.

The third major decision the materials management has to take, is on the system of controlling the item. There are three systems of control, viz., Fixed Order Quantity (FOQ) and Reorder Level (ROL) System, Periodic Review System, with varying order quantity and fixed period ordering with quantity not more than a fixed quantity. Several inventory control systems are available under the category of static and dynamic inventory models with finer variations suitable for varying requirements.

To make these decisions, inventory is analysed in a number of ways, viz., A-B-C Analysis, Production Holding and other, imports and indigenous, and so on. The analysis of inventory indicates the importance and criticality of an item to decide on Inventory Control Policy. The

decision analysis applications are developed to aid planning and control decisions in the Materials Management.

### ***Control***

The performance of the materials management function is evaluated on four accounts, viz., capital blocked in the inventory, number of stockouts affecting the production activity, reliability and dependability of suppliers, and cost of purchase. The management stipulates certain norms on these accounts which become the reference for control.

Inventory is valued every month to indicate whether capital blocked is above the budget. The stockouts are counted and compared with the norm. The delivery promise and quality of material supplied is rated to arrive at performance index of the supplier and compared with the norm. Lastly, the purchase cost is computed with purchase price plus taxes and duties and compared with the purchase budget.

In all these comparisons, whenever adverse results are seen, the system selects items and suppliers based on some criteria, for specific action or decision. The decisions may be to find a substitute item or another supplier. It could be that the system of inventory control is changed for the item. It may be a possibility that inventory control parameters need a revision.

There are a number of cases where inventory turns out to be non-moving or non-usable and needs to be disposed of. There could be a decision on the source of supply, where instead of imports, indigenous supply could be economical. There could be a decision on the choice of supplier based on terms and conditions of supply, payment of advance, credit terms and delivery. The control applications help in making and implementing these decisions.

### ***Reports and Display***

There are many reports and screen displays in the Materials Management System. They are largely based on accounting applications and decision analysis systems. They are produced at regular intervals, say monthly or quarterly. The report screen are developed to answer ad hoc queries on various aspects of the materials management function, viz., price, stock specifications, supplier, pending positions and valuations.

### ***Statutory Compliance***

Reporting the value of inventory in balance sheet of the company is a statutory compliance. Maintenance of registers, and filing returns in the areas of Sales Tax, Octroi, Excise Duty and Customs Duty is a statutory obligation. The essential reports are:

1. Stock ledger.
2. Valued stock statement.
3. Octroi register.
4. MODVAT register.
5. Excise duty returns and registers.
6. Customs bond register.
7. Returns on tax deduced at source.

All statutory obligations are to be fulfilled and invariably each one of them has a date of submission. The sources of these registers are required to be kept up-to-date, as they are

subject to surprise scrutiny by the concerned authorities. Hence, processing of data correctly on a regular basis is an absolute necessity. The data source for these outputs is accounting applications developed to account receipts, issues, consumptions, returns and payments to suppliers.

### ***Information Update***

A materials manager needs to build up the knowledge on a couple of aspects of the function. These aspects are:

1. Price fluctuations and trend.
2. Information on alternative materials with specification and test results.
3. New suppliers and sources of supplies.
4. Current incidence of taxes and duties.
5. Value of inventory computed at standard price.
6. Performance of suppliers.
7. Stockouts.
8. Value of non-moving inventory.
9. Materials required for the next planning period.

The reports on the knowledge base are as under:

1. Reports on price of high value and high purchaser rate items.
2. Compiled reports from trade journals on new material and sources.
3. Statements showing basic price, taxes, duties on items of high consumption value.
4. Stock ledger with value.
5. Value of stockouts versus total inventory.
6. Value of non-moving inventory versus total inventory.
7. Report on the material requirement for the next planning period in quantity and value.

### ***Operations Update***

Operations updates are useful for day to day functioning of operating departments, viz., Purchase, Stores and Workshop. It is necessary to know the arrival of material, whether inspected and taken in stock. The second update is on the issue of material for consumption. The third update is on the purchase action against a purchase requisition. These updates are provided either through screen or through report. These reports are:

1. Daily Goods Received Register.
2. Statement showing items in short supply or stockouts.
3. Reports on purchase requisitions received but not converted into purchase orders.
4. Statement on supplies due but not yet received.
5. Statement on payment due to suppliers but not yet paid.
6. Statement of supplies received and rejected.

The operations updates help to perform day to day routine operations at the junior management level in purchase, stores and workshops.

### ***Decision Analysis***

The reports of decision analysis applications are primarily exceptional in nature. For example, exception report on stockout or short supply will call for the decision of advance procurement, the information on purchase orders placed but delivery is not due. It will show the effect on the production programme and probable change in the programme or alternative choice of material to overcome the short supply.

The decision analysis report identifies the problem and provides logical relational linkage into other systems where solution can be found. The exception reports will centre around the following parameters:

1. Stockouts.
2. Cost of Purchase and Overrun.
3. Value of Inventory and Analysis.
4. Excessive delay in purchase action.
5. Excessive delay in inspection.
6. Reliability of suppliers.
7. Vendor Performance.
8. Material Performance.
9. Floor Rejections.

These reports will lead to such decisions as emergency procurement, revision of price and terms of supplies, disposal of inventory, cutting down the procedures of purchase and the inspection by streamlining the activities, and switching over to a new supplier.

### ***Action Update***

The action update comes through a control system which indicates whether the decision is implemented or not. Many a times decision is taken and delegated for action at a lower level. It is necessary to know whether action is taken and what is the impact. This will be selective reporting.

For example, if stockout is noticed, action is taken to purchase by raising a new purchase order. The update is necessary to know whether the material under new purchase order has arrived or not. The action updates, therefore, will centre around the parameters which mentioned in decision analysis applications.

Figure 12.5 Shows the model Raw Material Management (RM) System.

## **12.6 MARKETING MANAGEMENT**

The marketing management function deals with satisfying the consumer. The scope of function starts from identifying the need of consumer, evolving product concept, designing the product, positioning the product in the market and selling at appropriate price. In the process of performing the marketing function, activities such as market research, consumer survey,

**Fig. 12.5 Raw Materials Management (RM) System**

advertising, sales promotion campaign, stocking of products, developing dealer distributor network from the major tasks.

The function has a very strong interface with the production and finance department. It relies heavily on production for uninterrupted supply of goods, appropriate stock replenishments and inventory at various locations. The major source of finance in the organisation is sales, and marketing has a responsibility to obtain the orders from customers and fulfil them.

The control of sales from the point of view of sales income is a major task of marketing management. Forecasting of sales, evolving marketing strategies, pricing, product designing and launching are some of the key responsibilities of marketing management. Retaining market share, penet rating into new markets, assessing consumer responses to a new market, launch are the challenging tasks of the marketing management. In a competitive environment, the function assumes key role in the organisation. The major responsibility of the function then remains to evolve competitive strategies in all the branches of marketing management.

### **Input Transaction Documents**

The most important input transaction documents used in the marketing management function include:

1. Customer order
2. Order acceptance
3. Delivery note
4. Invoice, credit note, debit note

As a support to these transactions, data is borrowed from company literature such as price lists, product literature, etc. Marketing function needs a host of other information which is not transaction based. It draws heavily from sources such as market survey and market research studies conducted by the company. It further relies on external sources such as product journals, industry association publications, etc. for industry data.

These transactions may take place at various locations but their assimilation has to take place to conclude the marketing result. The number and the nature of transactions would vary depending upon the product, industry, marketing organisation, and infrastructure of production and warehouses.

## **Applications**

### ***Accounting***

There are several highly process-oriented accounting applications of the marketing management. The main accounting entity is sales in terms of quantity and value. The detailed entities are as follows:

- |                   |                    |
|-------------------|--------------------|
| 1. Product Sale   | 9. Zone            |
| 2. Product Family | 10. Area           |
| 3. Sales Value    | 11. Inventory      |
| 4. Sales Tax      | 12. Receivables    |
| 5. Dealer         | 13. Market Segment |
| 6. Distributor    | 14. Exports Market |
| 7. Customer       | 15. Returns        |
| 8. Excise Duty    | 16. Complaints     |

Accounting applications build a lot of basic data for the organisation, which meets the needs of statutory compliance and operations update.

### ***Query***

The queries in the marketing management are on customer, product, price, stock, sale, and certain cumulative statistics pertaining to sales. The query may be on order pending position followed by whether stock exists for allocation to the order. If the customer order is to be fulfilled by manufacturing, then whether manufacturing order is issued and if so, what is its status.

The query could be on assessment of sales performance on single dimension or multi-dimensions by comparison between two product groups, Customer Groups, Zones and Areas. The query could be on the performance of overall sales in relations to the budget.

In marketing function, a lot of importance is given to handling of customer complaints. The queries are raised on its satisfactory disposal. Many times, queries are on basic data such

as product specifications, price and discounts, quality, names and address of customer, dealers, and distributors.

### ***Decision Analysis***

In day to day functioning, the decisions required to be taken are on pricing, allocation of stocks to orders, acceptance of order, discounts and commission, deciding sales terms and so on. In most of these decision areas, decisions are rule-based and can be supported by decision support systems.

The complex decisions are price increase or decrease, deciding on a new product, packaging, distribution channels, product positioning. These decisions have far reaching effects on the marketing performance. They fall in the category of strategic and tactical decisions.

Applications are developed to support these decision building models such as the break even model, risk analysis model, distribution mode, network model, product launch model etc. The form the basis for analysing the decision alternatives and their impact on marketing performance, prospects and growth.

The organisations in consumer industry have applications which are designed to collect consumer information on preference, behaviour, response to advertising campaigns, etc. This data is collected on a routine basis to build up independent database on consumer profiles, product rating and buying decision. Some organisations collect this data from the point of sale, dealers and distributors. The database then is used for various top management and middle management decisions in business planning and execution.

### ***Control***

In marketing management, there are a number of factors, which need to be controlled for achieving business goals. These factors are Sales versus Budget, Marketing Cost versus Budgeted Cost, Product Sale versus target fixed for Market Segments—Distributor, Dealer, Branch and Marketing persons, planned sales programme versus actual sales versus competitor's sales.

The application are developed to report on these comparisons. However, a selection routine is added in each applications to bring out abnormal variations between actual versus expected. This helps to take specific decision and action in the area of shortcoming or failure.

Some control applications help to correct ongoing operational performance. Some applications help to reset the direction or trend in the development towards desired goals or objectives. Some application help to take decisions on the strategic subjects such as product positioning, pricing, choice of market segment, design and so on.

The control applications in marketing are designed with a very narrow focus for pinpointed attention, decision and action. It requires considerable understanding of behaviour of the consumer, market, product and competition. Many times corrective action is required in areas other than marketing. Marketing decisions take long time to respond and their implications are difficult to judge in short durations. The control applications required by the top and the middle management in marketing are non-standard, industry specific and are linked to business philosophy, policy and strategy.

## Reports

### *Statutory Compliance*

In marketing management, statutory compliance is mainly related to taxes and duties and filing the returns to appropriate government authorities. The main reports are sales tax register and returns and excise duty returns. In some industries like alcohol, tobacco, gold etc., the organisation is required to keep the information in a format prescribed by the government and file the returns in a prescribed format. These documents are to be kept up-to-date and are subject to surprise checks by government auditors and inspectors.

### *Information Update*

These reports are based on summaries of various entities such as orders, value, sales, stocks, budgets with reference to the past, current and future projections. They are produced regularly at equal intervals with classification on various accounts and are distributed to the concerned agencies.

The information update reports are as under:

- |                                 |                          |
|---------------------------------|--------------------------|
| 1. Product sales ledger         | 6. Aging of receivables  |
| 2. Sales summaries              | 7. Contribution analysis |
| 3. Accounts receivables         | 8. Market analysis       |
| 4. Orders received and accepted | 9. Competition analysis  |
| 5. Sales analysis               |                          |

Most of these reports are generated as functional information and they are not related to an individual's needs. It is expected that these reports will be used by all concerned by picking up relevant information suited to them. These reports have a fixed general format and they are produced in a summarised fashion in line with organisation structure, i.e., the reports will be made by Branch, Zone and Area.

There are eleven factors, viz., Customer, Class of Customer, Market Segment, Product, Product Family, Sales Representative, Branch Area and Zone, Dealer and Distributor, which are used for classification and summaries in these reports. Such factorial analysis gives valuable information and builds marketing knowledge helping to evolve the strategies in marketing.

### *Operations Update*

These reports inform the details of the marketing operations ranging from orders received, processed, accepted, executed, dispatched, billed and money recovered. These reports are processed by way of daily transaction processing and making statistical summaries for quick update. They are not analysis reports but reports informing facts on day to day operations. These are made for Junior Management personnel in marketing and related functional areas such as store and accounts.

A typical report will indicate daily order received and orders invoiced. Some more typical reports are as follows:

1. Order book
2. Despatch report

3. Inventory
4. Invoice
5. Customer complaints
6. Complaints disposed

These reports are produced with reference to a date and cumulative since beginning of the year. No high order data processing is involved. Transactions during a day are processed in document sequence and grand summaries are taken on a daily basis, such as daily sales, dispatches, inventory and invoice. These reports provide guidance to the operating personnel as to how they are performing. No external information is connected and processed along with this statistical data.

### ***Decision Analysis***

Decision analysis reports convey whether the desired/expected results are realised or not. These reports tie up the specific decision to its results. For example, a decision is taken to launch and advertising campaign in two segments to test the efficiency of the campaign. A report analysis pre- and post-sales of the campaign will indicate a good advertisement.

In marketing function, a number of such decision situations are present, where analysis or sales is necessary, to confirm whether the choice of the alternative is correct or not. The analysis may be with reference to price, choice of market, packaging, design and so on. Market research analysis reports fall in this category. These reports are unstructured and are decision specific.

There is another class of reports, which are generated using models. For example, risk analysis model throws light on the market share, given the probable conditions of the company and its competitor in price, market, design and so on. New product introduction, Break Even Analysis, Product Market Mix, Marketing expense and market Mix are the examples of decision analysis models helping the marketing management to take a correct decision.

### ***Action Update***

The action update reports will lead to such decisions as price reduction, withdrawal of product from the market, changing the product position, allocating more budget for expenses, inventory and personnel resources. Some of the action update reports are:

- Sale versus Budget.
- Expenses Versus Sales.
- Sales Growth versus Sales Objective.
- Sales versus Market Segment versus Budget.
- Stock versus Budgeted Stock Levels.
- Complaints versus Number of Complaints Serviced.

Figure 12.6 shows a Model of Marketing Management (MM) System

## **12.7 CORPORATE OVERVIEW**

The top management, in all organisations, is kept informed of the ongoing through various MIS reports, in each function and informal channels such as Notes, Inter-office Memos,

**Fig. 12.6** *Marketing Management (MM) System*

Minutes of the Meetings and so on. However, this reporting on business performance is not very systematic and it is infrequent and irregular overview. This reporting does not throw light on the inter-functional implications. The management does not get a clear picture of the totality.

For example, sales versus raw material inventory, production versus finished goods inventory, invoicing versus receivables and its aging, purchase liability versus payable and its aging, uses of fund and its resources, sales versus market segments versus products, product family, machine shop loading versus utilisation of the capacity, etc.

The management does not receive information which helps to make comparative analysis between the current and the past. It also does not receive information on the projection in totality. The top management always like to have an overview of the business at equal time intervals to bring visibility in the business operations.

Such reporting is normally done monthly, on a fixed date, on key parameters of the business. It uses budget, norms, ratios, targets as a reference for comparison. It provides same information for the corresponding period in the previous years. It also provides the information on the next planned period in each case of reporting parameters.

Along with statistical, comparative analytical information is reported in graphics to create visual impact on the management. The graphics further give some idea of the trend and direction a parameter is setting in. The trend information evokes response to correct the policy, guidelines, and strategic decisions that the management has already taken. It forces a critical review of the business operations, leading to corrective action if necessary. It identifies clearly the strength and weakness in the present operations. The corporate overview system helps to make such a review easily and conveniently. Many organisations review key business parameters along with reporting on special projects or subjects. For example, management would like to have a separate report on new product performance, progress on certain design and development of a new product or an event in the industry, introduction of new product by the competitor, policy change and its implications on the business and so on.

The corporate overview system provides comprehensive reporting of the information touching key sensitive areas of the business. A typical corporate overview report is shown in Table 12.1. Variations are possible in it with respect to the specific organisation and the industry.

**Table 12.1** Corporate Overview Report for the Month (A Model)

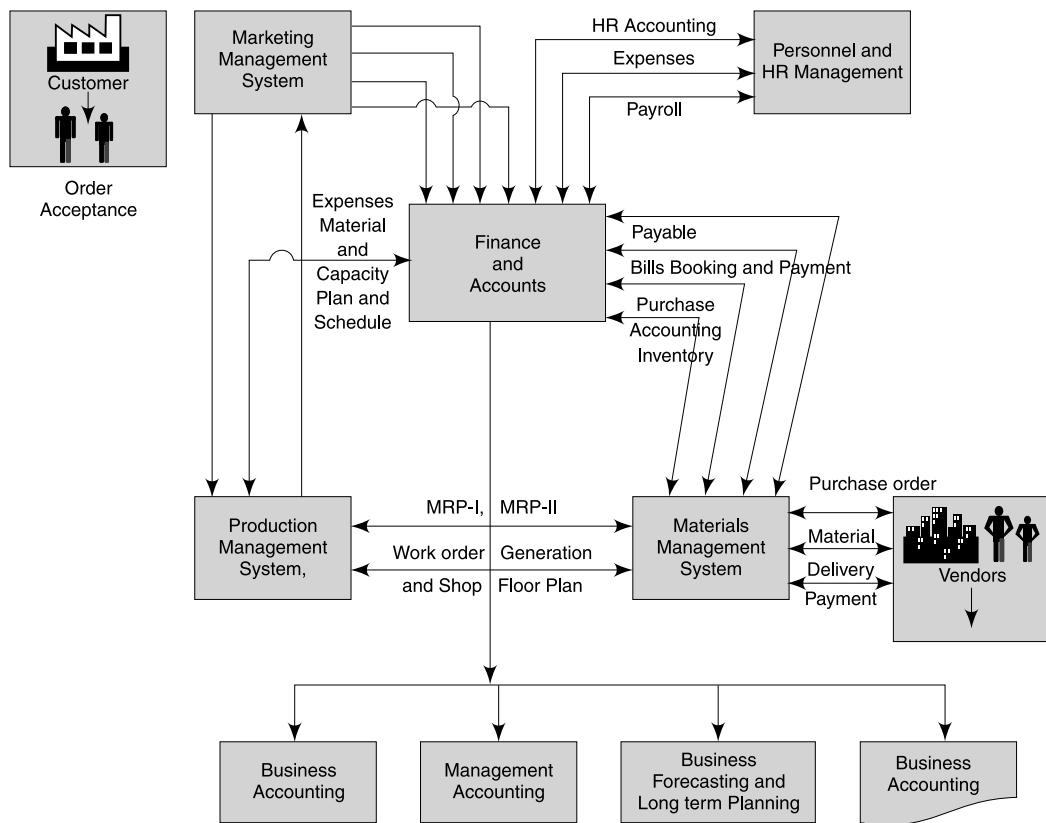
<i>Marketing</i>	<i>Production</i>	<i>Finance</i>	<i>Expenses</i>
Orders	Planned production	Current assets	Revenue expense
Sales	Actual production	Current liabilities	Capital expenditure
Cost of goods sold	Cost of production	Current ratio	Payment to employees
Finished goods inventory	Raw materials inventory	Accounts receivables to turnover	Marketing expense
Receivables	Payables	Inventory turnover	Travelling expenses
- Due	- Due	- Net sales	Hotel expenses
- Overdue	- Overdue	- Net sales to total Assets	Miscellaneous expense

The overview is built on the basis of information provided by the functional systems. It gives information at equal intervals enabling the management to take critical view of the performance. It provides trends among the entities. It also shows the financial health of the company by relating assets and liabilities. It highlights major expense heads which are controllable. The overview report indicates the assessment of the business performance in the current year and the trend of business direction in future.

In addition to such reports, there is a practice in a number of companies to collect regularly the information from external sources, which are critical to the business of the organisation. This includes competition, policy, projections and forecasts, developments, which may affect business such as new product, process, technology. Such information is used to develop

business models for strategic growth, planning and control. The decisions on new product, diversifications or starting Strategic Business Unit (SBU) are taken after mixing external information with internal information from within the company.

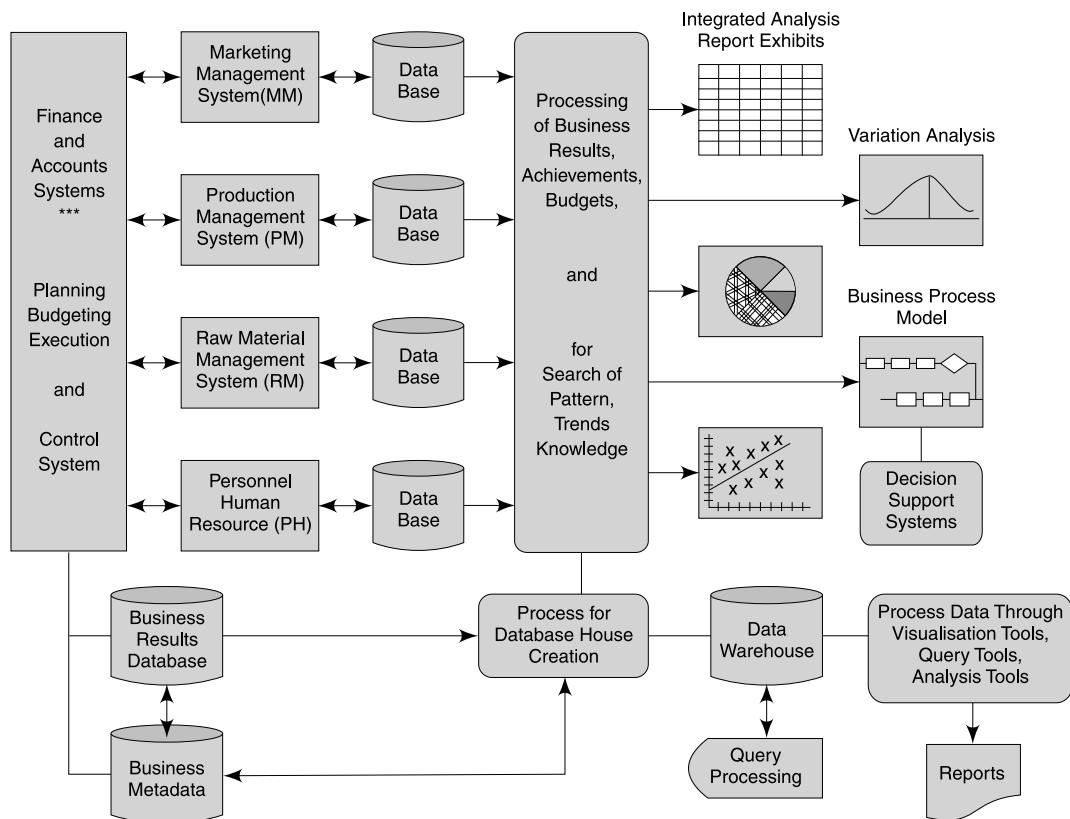
The information so collected from internal and external sources is used to develop business development models for testing and stimulating different conditions of business. Such models help in developing corporate plans on implementation of products, process, technology and investment strategy. Figure 12.7 shows a Model of Business Integration System designed to take corporate business reviews.



**Scope:** Integration of business functions and Supply Chain Management

**Fig. 12.7 Business System Integration**

Figure 12.8 shows a Model of Executive Information System designed to provide strategic, analytical information for executive business design.



**Scope:** Performance Analysis – Projections – Strategy Building

**Fig. 12.8 Executive Information System (EIS)**

## KEY TERMS

OLTP System  
Control Applications  
Action Update  
Analysis Application  
Operation Update

Query Applications  
Information Update  
Application Development  
Query Response Display  
Exception Reports

## REVIEW QUESTIONS

- Identify the master data in the following applications—Personnel, Finance, Production, Materials and Marketing.

2. Draw report format for Payslip, Goods return note, Stores ledger, Trial Balance and Balance Sheet.
3. Which applications in these functional areas should be online and real time?
4. Draw an interface matrix between following application areas after establishing all submodules in that application: Personnel, Finance and Production.
5. Which data items are common across the functions? For example, employee number is common to Personnel, Finance, Marketing and Materials. How would you exploit this factor in the variety of application development?
6. Suggest one exception report in each function which is not mentioned in the text.
7. For each function, design an MIS report for the chief of the function. Then design one MIS report for the top management for the month.
8. Based on the outputs listed and information available therein, develop performance indices on critical areas of business as a standard requirement.
9. Model one decision support system of your choice in Production and Materials function.
10. In the list of applications under each function, identify critical applications. What is a mission critical application?



## SUNRISE CONSTRUCTIONS LTD. (SCL-II)

SCL is a civil engineering firm engaged in the construction of bungalows, apartments, club houses, row houses and large apartment complexes. The sales turnover is over ₹ 5000 million. The business core competency of SCL is mainly design and construction as per the customer requirement. SCL does engineering and design of the construction to ensure that design is attractive and cost effective for the customer.

The customer accepts the design and agrees to pay by rate per square metre. Generally the agreement is signed with the customer for all deliverables of the construction, and the changes if any to be paid for. SCL sales revenue in this arrangement is fixed, as the business model is 'sell though contract and construct' and therefore it is a challenge to construct the house at the lowest cost and within budget, so that estimated profit margin is not affected.

When design and construction specifications are finalised, the cost of various construction activities are estimated and activity cost is budgeted. Material budget is also estimated and finalised for execution and control. All major material items are budgeted for procurement planning and cost control. The construction activity is managed through Project Management System (PMS) and project and material cost is controlled to remain within the budget.

Project is budgeted for quantity and value by activities grouped into budget head, material head and materials required into construction. For example, Construction of Security tower and gate is a budget head with activities such as security tower foundation, RCC frame, brick wall construction, flooring, erecting windows, painting and each having activity budget and material budget.

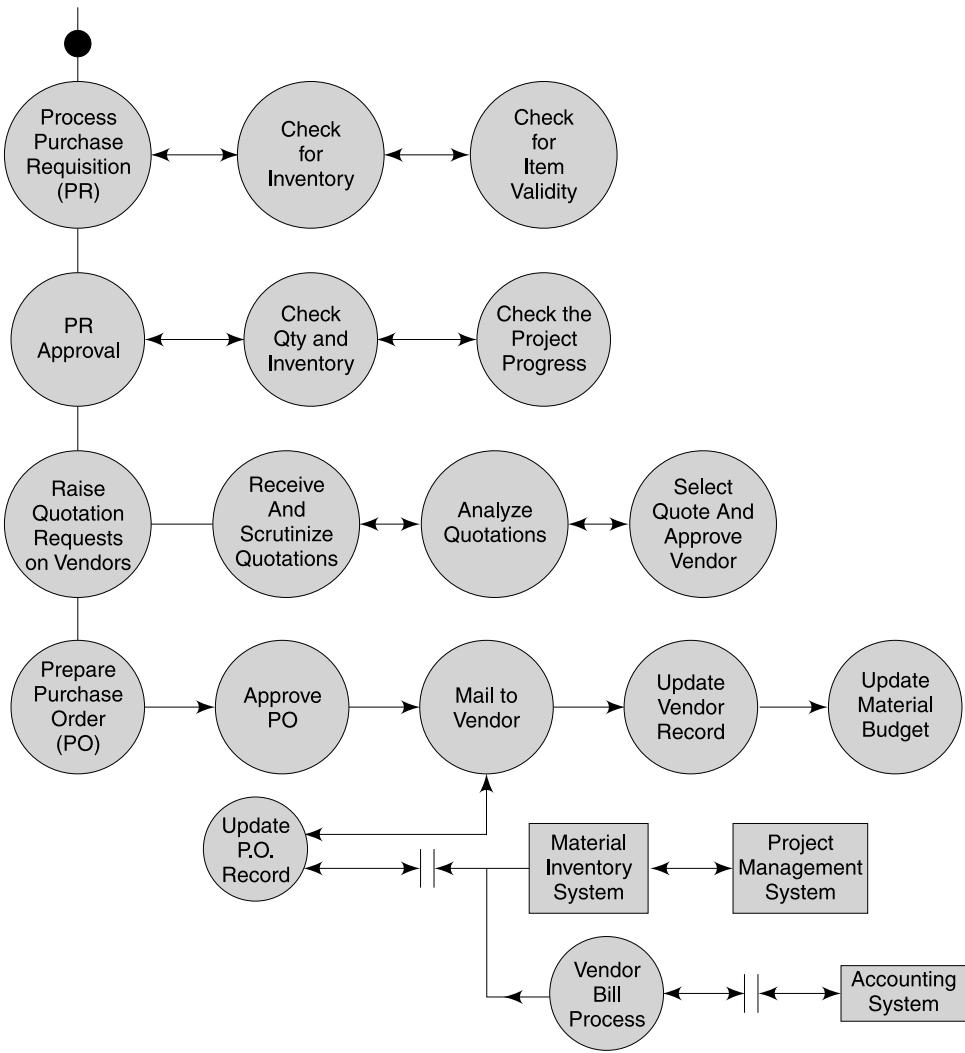
Each construction project has two budget heads, one is Activity and second is Material. Typical activities are flooring, tiling, painting, RCC casting, and plumbing. The material cost contributes over 60 per cent to the total cost of the project. Material cost is controlled through the appropriate use of material as per specifications and attempt is made to purchase the material at the rate, used for estimation and budget. SCL has standard material list for use in planning, estimation and construction. Since, purchases are project specific, once the material is purchased and received, it is treated as consumed and material cost budget is updated for the value of the material received at project site.

All time in material list are purchased on purchase requisition, raised by the Site Manager and approved by the Project Manager. Presently, the entire system from requisition to ordering is manual. The new purchase order application system is to be developed with latest technologies. The system should be Internet/web enabled in its entire scope from raising requisition, its processing and approval, demanding quotations, quotation analysis, selection of vendor, price approval, purchase order preparation, approval, and mailing to the vendor. The existing system flow of the 'purchase order application' proposed for development is shown in Fig. 12.9.

Present formats of Purchase Requisition and Purchase order are given in Table 12.2 and Table 12.3.

While preparing purchase requisition, Site Manager has to mention all the details, which includes information about present inventory at site and required delivery date.

In the manual system, delays occur extending to two to three weeks in preparation, communication and approval at each stage. This delay affects the construction progress. If the delivery is not received on time, project is delayed further. The average delay of two to three weeks raises inventory provision, blocking additional working capital in the inventory.



**Fig. 12.9 Purchase Order Application Flow**

Management of SCL is looking for a radical improvement in the procurement application which would reduce PO process time, cut down inventory, and faster bill processing to improve vendor relations.

### Integration in Project Management System (PMS)

SCL has strong Project Management System (PMS) to control the construction project on three dimensions, Time, Cost and Quality. Major component of cost is material which is a controllable factor and control needs to be exercised from material requisition stage till material is consumed. It is the practice of SCL that all project specific materials are considered as consumed

**Table 12.2** Purchase Requisition Form

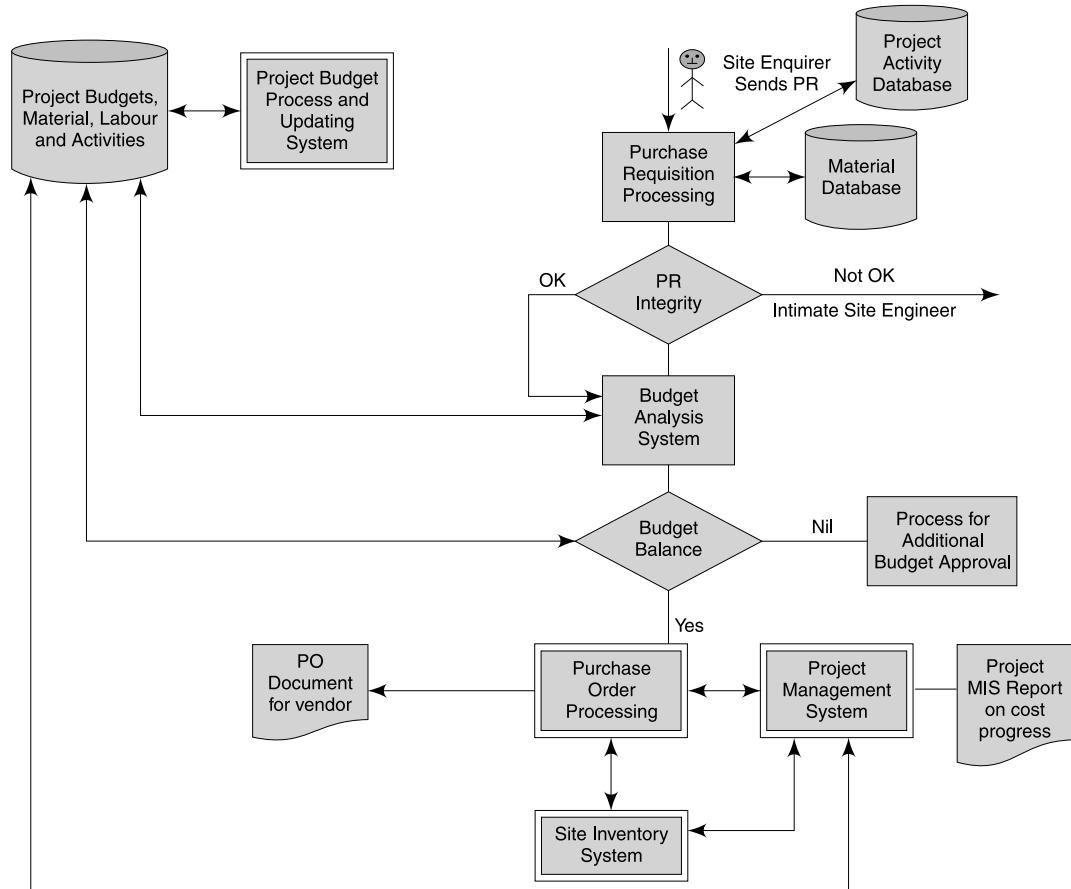
SCL PURCHASE REQUISITION						
Project Code	Project Name	Site/Location	PR Date	PR. No.		
Item Group: General				Budget head: Security tower and gate		
Code	Description	Specification	Qty	Unit of	Stock	Delivery Date-2005
G/01	Roof Sheets	8'× 4'	20	No	Nil	1-6-05
G/02	Roof Tiles	SCL Stand	1000	No	Nil	1-6-05
W 303	Windows	As per Drawing	6	No	Nil	10-5-05
D 499	Door	As per Drawing 10" × 10" white 3" thick mable	3 1000	No No	Nil 200	1-6-05 1-6-05
G/12	Floor tiles	SCL Standard	1000	Bags	100	1-4-05
369	Cement	SCL Standard	1	Truck	Nil	1-4-05
	Sand			Load		
G 999	Gate	As per drawing	1	No	Nil	1-6-05

**Table 12.3** Purchase Order Form

SCL J.M. Road, Century Towers, IIIrd Floor, Ph. No.: 020-25654888.			PURCHASE ORDER No. _____ PURCHASE REQUISITION No. _____ P.O. Date: _____			
To _____ Address: _____		Project Code: Budget Head:		Project Name: Site Location:		
Item Code	Item Description	Qty.	UM	Rate (₹)	Quote No. PR No.	Req. Delivery Date
	Specification					
Instruction:			Terms:			
Delivery at: _____ Mode of transport: _____ Packing Instruction: _____ Loading/unloading: _____ Other: _____			Credit: _____ Tax: _____ Payment: _____ Octrol: _____ Insurance: _____ Advance: _____ Other Charges: _____ Excise: _____ Turnover Tax: _____			
Prepared by:		Checked by:		Purchase Approval	Project Manager Approval	

once purchased. This means the cost of material is loaded as direct cost on the project. Most of the materials being of special kind of special category are rarely usable in other projects.

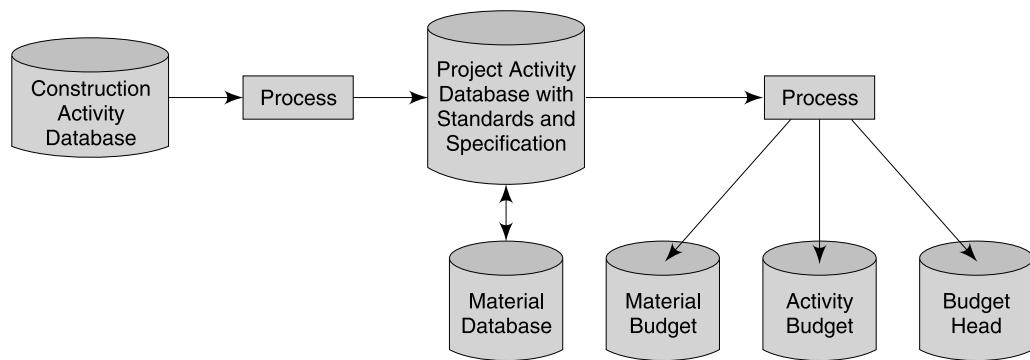
Approving authority and Project Manager needs up-to-date precise information on budgets, current expenses and variances so that next requisition can be approved with the knowledge of budget performance. Figure 12.10 shows proposed application of PO system, and its integration in Material Project Management System.



**Fig. 12.10** *Integration of PR, PO, Inventory and PMS*

SCL maintains two databases: construction and project. In construction, database construction activities are listed as standards with specifications which then are used for creating 'Project Database.' The project database is used to develop material budget, activity budget and budget for budget head. Figure 12.11 shows relationship between databases.

In Project Management System (PMS), MS – Project is used for activity planning, scheduling, monitoring and tracking of progress towards completion along with costs and budget. PMS uses MS - Project for progress reporting as a part of project MIS reporting.



**Fig. 12.11 Relationship of Databases**

Integration in PMS is necessary to control cost by budget heads and material heads. Prior to integration in PMS, the processing goes through three system layers.

- Purchase Requisition (PR) Processing System
  - Items in PR checked against material master.
  - Items in PR checked against project master.
  - Item quantity computed using SCL material standards rule and requisitioned quantity is validated against the estimated quantity.
  - Quantity valued by standard rate is used in the budget.
  - Item quantity and value subjected to budget check for control.
  - Budget analysis indicates balance for future uses.
  - PR processed for PO processing.
- Purchase Order (PO) Process System
  - Call for quotations.
  - Process quotations for analysis.
  - Select vendor on: Price rating performance/A or B X or Y/QA rating.
  - Raise P.O. with approvals.
  - Update project record and inventory record.
  - Update payable forecast in cash flow projection system.
- Integration in Project Management System (PMS)
  - Project Activity schedule is posted.
  - Update budget balance of budget heads and project budget head.
  - Produce budget analysis and variance reports.

SCL, at anytime, has six or more sites, where project construction is in progress. Each project of SCL lasts minimum three to four years. The present communication between site and head office is through mobile phone, fax and courier. All sites have local LAN of at least 8-10 computers. Head office has a network of 40 computers with database servers, and application servers and mail servers. SCL has website: [www.SCL.com](http://www.SCL.com), which is used for sharing information about sites, company history, company management and so on. The coding system for projects, material, accounts is already in place and is in use in the present system. All critical processes are controlled through three-layer process approving structure: 'Prepared by,' 'Checked by' and 'Approved by.'

## Questions

1. Draw a system flow chart of your proposed software system solution for this application in following order.
  - (a) Data Processing of PR (DPS)
  - (b) PR transaction processing (TPS)
  - (c) Quotation raising and processing application (APS)
  - (d) PO, Inventory Application integration (AIS)
  - (e) System Integration PO + PMS + Accounting
2. How would you integrate this system in organisation's other application systems, mainly.
  - (a) Project Management
  - (b) Account and Bill processing
  - (c) Inventory Management
  - (d) Cost and Budget control application for Project, Material and Activity.
3. Suggest MIS reports and their formats for (a) Control costs and budgets; (b) Bill tracking for non payment; (c) Assessment of vendor performance on timely delivery, quality, and acceptance and rejection of material.
4. Draw E-business model of SCL business organisation under the new technology platform suggested by you.
5. Draw a Groupware system application diagram for:
  - (a) PR Processing
  - (b) PO Processing

## LEARNING OBJECTIVES

- Understanding of Service Industry Features
- Information Need to Generate Distinctive Service
- Nature of Mission Critical Application
- MIS Role in Service Industry
- Service Quality Model
- Service Process Cycle and Analysis
- Customer Service Design
- Service Management System (SMS)
- SMS Architecture

### 13.1 INTRODUCTION TO SERVICE SECTOR

Unlike the manufacturing sector, the service sector does not have physical goods to be manufactured for the customer. Hence, the MIS normally found in a manufacturing and selling organisation will not be suitable in the service sector. The data processing applications like Payroll, Accounting and Inventory are required in the service industry too, but they may not be all critical to the service industry. The mission in a service industry is of providing the most satisfying service of the customer, while in a manufacturing industry, it could differ from industry to industry and from organisation to organisation.

There are certain mission critical applications in the service industry which need to be managed best. These applications make a service organisation efficient and effective in providing the best service to the customer. In a competitive situation, this industry requires service distinction to create an identity, a position and a growth, to remain ahead of the competition. In a service industry, therefore, a sensitive market and consumer research is necessary to identify the segment to be served and to study its service requirements, expectations and perceptions. Since, the service demands are more dynamic than that of a product, a continuous search on the requirements, expectations and perceptions, it to be conducted to upgrade and enhance the service facilities.

The socio-economic status of customer has changed leading to changes in expectations and perceptions about the service and its outcome. The service, may remain the same but the process or the manner of offering the service needs a change. Depending on the service industry the mission critical applications would change from time to time, but the focus in all the cases and at all the times is to offer a service which satisfies the customer. Since the service is essentially a process of human interaction.

Most of the service industries have front end facilities to serve the customer to clear his immediate needs and make him comfortable for the rest of service demands. Any human interaction is knowledge based, hence information based. All the systems which make human interactions effective and comfortable are mission critical applications and a service industry has to provide these to offer the most satisfying service. The mission critical applications are built around the business strategy. The strategy formulation and implementation depends a lot on the information on the socio-economic changes, the new demands arising out of these changes, and the technology to meet the changing needs effectively.

The service organisations undergo changes more rapidly than the manufacturing sector. The returns in the service industry are immediate compared to the manufacturing sector. The entire managerial effort in a service industry is to create a Distinctive Service to remain competitive.

Tom Peters in 'The Service Edge' states five principles of a distinctive service.

1. Listen, Understand, and Respond to the customers.
2. Define a Superior Service and establish a Service Strategy.
3. Set standards and measure and performance.
4. Select, Train and Empower the employees to work for the customers.
5. Recognise and reward the accomplishments.

Before going into the details of these, one should understand the meaning of the distinctive service in the service industry and how it differs from the manufacturing sector. This would help us to evolve and understand the specific mission critical application in the service and hospitality industry.

## 13.2 CREATING A DISTINCTIVE SERVICE

Creating a distinctive service is a willful management act. The management of a service business calls for such a willful act to create a distinctive service and hence, to remain in the business. To manage a service effectively, it is necessary to understand the distinctive characters between the product and the service, the customer expectation and the perception.

### Service vs Product

A product is tangible, but a service is not. A product consumes a shelf space, has a shelf life and has a physical unit of measure such as kgs, sq. metre, volume, etc. The product can be offered on payment, while services are offered on demand. The quality control of the product is possible with reference to the determined standards, while the quality control of a service is difficult due to its reference to the customer's expectations which are difficult to judge and control.

The product can be demonstrated before the actual sale, while the service cannot be demonstrated. The product can be produced, sold and consumed in stages while the service has to be produced, sold and consumed simultaneously. The receiver and provider of the service are very close to each other.

The quality of service results in the satisfaction or dissatisfaction of the customer. The satisfaction is related to the customer's expectations and perceptions of the service and its outcome which are integral to his needs, could be specific or vague. The customer is dissatisfied if the service received is below his expectations and not as perceived by him.

The satisfaction is also based on the manner in which the service is being offered or perceived. If the servicing process is not enjoyable though it gives what is asked for, then dissatisfaction results. The service expectations are dynamic and not static. The expectations are about the service process and the outcome, and a satisfaction relates to both. Hence, to create a distinctive service, the management of a service business must understand the customer expectations, and if the customer expectations and perceptions are not rational and are generated out of knowledge, then customer awareness and education is absolutely necessary.

The customer education would create realistic expectations and a meaningful perception reducing the gap between the actual and the expected service experience. While achieving this, it is necessary to control the diversity in the customer expectations and perceptions. It is necessary to control this diversity through management action by concentrating on the customer/market segment where customer diversity is not significant.

To summarise, the service conscious management would create service focused organisation, where:

- the organisation listens, understands and responds swiftly to the changing character of the customer wants, needs and expectations.
- the organisation develops and maintains a 'customer-friendly' service delivery system.
- organisation employs, inspires and develops a customer-oriented frontline personnel.

The service function essentially is a human interaction between the service receiver and the provider. The service focused organisation manages this human interaction at its best through a well defined customer-oriented service strategy designed for an excellent distinctive service.

Let us take an example of a Medical Service Centre, where the service of health check-up is offered to all kinds of patients. Being a service centre, a customer could be young or old, a child or an adult, a man or a woman, and coming from a variety of socio-economic groups. Hence, there are customers from several service segments who would call upon the medical centre for servicing some health related problem.

The service expectations and perceptions would differ from segment to segment, and if those are met then the receiver will be satisfied as mentioned in Table 13.1.

So if a distinctive service is to be offered at the medical centre, the management of the hospital has to understand the expectations and perceptions of the visiting people and the patients, and make decisions related to the resources, facilities and medical assistance which would meet the service expectations. If these decisions are to be correct, then a proper MIS

**Table 13.1** Service Expectation and Perceptions

Purpose	Expectation	Perception
Annual health checkup	Quick service and total coverage at a single location with proper guidance and advice.	Depends on the socioeconomic status.
Normal treatment	Proper guidance, and very less waiting time.	Less paper work and infrequent visits.
Emergency	Immediate attention, necessary resources and services are immediately available.	Doctor's choice and a norm of immediate attention.
Hospitalisation	Clean and quiet surrounding. Pleasant stay and fast recovery.	Star hotel cleanliness and a service with a smile.
Old patient	Expects help to conduct in the hospital, affectionate service, rest facilities and faster service at least cost.	Good layout and help to read, write and to be mobile.
Child patient care	Expectations of parents are relevant.	Interactions reduces parents anxiety.

would be necessary to support these decisions leading to the establishment of an appropriate medical facilities in the centre. We now discuss the specific MIS application in the service industry.

### 13.3 SERVICE CONCEPT

Service is an identifiable, intangible activity or a process designed to fulfill certain expectations of the customer/consumer. Kotler defines it as 'service is an activity or a benefit that one part can offer to another which is essentially intangible and does not result in the ownership of anything. Its production may not be tied to a physical product. To understand the service better, it is necessary to understand its character or attributes. They are described below:

#### Intangibility

All services are fully intangible i.e. they lack 'physical existence.' They can be seen being delivered and being received by the customer but cannot be displayed. Intangible service may have an association with physical goods. For example, when teacher teaches in the class, textbook, notebook, chalk or transparencies are the goods associated with 'teaching,' a service where customer is a student. The customer receiving a service is in dilemma as the process lacks physical evidence. In view of this customer perceives high risk in demanding service.

#### Inseparability of Receiver & Provider

In case of service, receiver and provider must be present. Service process cannot be executed unless both are present at the site of service delivery. It is a live consumption of service experience. The production of service and its consumption is simultaneous. In other words, receiver and provider are inseparable, when service is on.

## Storage

Service being intangible cannot be stored like goods, which can be stored in the warehouse and can be used at a later date. For example, a consultant physician offers everyday three hours consultancy in the morning. Suppose, no patient comes for two hours then the physician is idle and consulting service potential cannot be stored and made available next day.

## Inconsistency

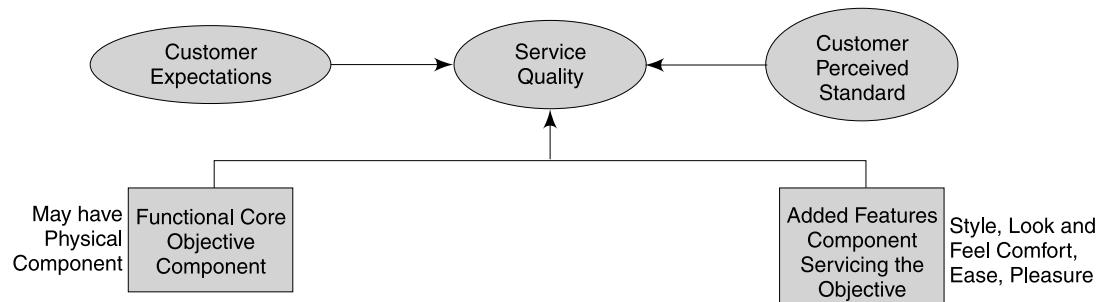
Service process being intangible, can vary from one service incident to the other service incident. This being the case, it is difficult to standardise the process. At the most service scope can be defined but its delivery process cannot be standardised. Every service experience is different. The inconsistency occurs due to different service providers performing at different times.

Though service process is the same, service experience varies from incident to incident. Every customer has different service expectations. For example in Air travel, in-flight service scope to passenger is same but its experience varies from flight to flight due to different crew in each flight. This is not true where services are automated. For example, Bank's ATM service is consistent and is also standard when compared with other banks. However, a service is remembered by its quality.

Service quality parameters are Reliability, Assurance of delivery, Degree of tangibleness, Empathy and Level of responsiveness. The quality of service has two dimensions, namely:

- quality of resources used: service inputs, equipments, facilities, tools, designs and so on.
- functional quality of the process: Empathy, level of responsiveness, and process design quality.

All services have two components, one basic core and second its features. Basic core service offers original functional content of the service, like quick solution to the problem, serving dinner at the table, getting airline ticket and so on. The core process may or may not have a physical component. The second component generally deals with the manner in which a service is provided. The second component provides style, comfort, pleasure, and consistent look and feel of the service. The service quality model incorporating two components is shown in Fig. 13.1.



**Fig. 13.1** Service Quality Model

### 13.4 SERVICE PROCESS CYCLE AND ANALYSIS

All services are bound by process steps and each step adds value in the service. All the steps can be classified in stages based on the role played in the process. These stages together build a service process cycle. The stages in the cycle are

- Initiation of service
- Transition to service
- Pre-service
- Service
- Post-service

Table 13.2 Illustrates a model of Service Process Cycle for Airlines passenger

**Table 13.2** Model of Service Process Cycle.

<i>Stage in Service Cycle</i>	<i>Steps in Stage</i>	<i>Example of Airlines: Passenger Service</i>
1. Initiation of service	Enquiry, Information Seeking Checking, Assessing.	Seeking information on Flights, Fare, Services, Timings, and Facilities.
2. Transition to service	Steps towards or prior to effecting the service	Issue of ticket and instructions about check in of baggage. pre-boarding service.
3. Pre-service	Check and cross check of documents, Records, vouchers Proving guidance, Exchange of documents; Creation of confidence; Assurance of quality	Ticket Inspection at the counter. Issue of boarding pass. Movement guidance for security check.
4. Service	Effecting the service delivery with goods, Physical Assistance	Finding Seat. Provide in-flight assistance and services like offer of soft drink gifts and announcements.
5. Post-service	Concluding the service, providing exiting assistance. Service Recovery	Baggage arrival and reclaiming, Exit guidance. Next flight information. Transport assistance.

All service stages are applicable in every kind of service in every environment. The customer satisfaction is best achieved completing these steps in the most effective and efficient manner. The people who drive the service are to be supported by tools, information, and system assistance so that the customer interaction is quick, responsive, and pleasant, and leave a feeling of comfort and confidence of service delivery.

The service can be quick if the steps are mechanised and/or automated with the help of technology. The service can be highly responsive, if at each stage the information support is available in shortest possible time. The responsiveness of the service would increase with:

- faster data capture and processing in every interaction;
- access to various databases and services;
- error free transaction processing and updating;
- and application processing at each stage of service cycle.

Industry specific solutions comprising of front-end and back-end applications, Data warehousing and knowledge building applications, Networking of all internal and external partners in the service, and also provision of self service through on site terminals, Kiosks are the keys to customer satisfaction and good customer relationship.

### 13.5 CUSTOMER SERVICE DESIGN

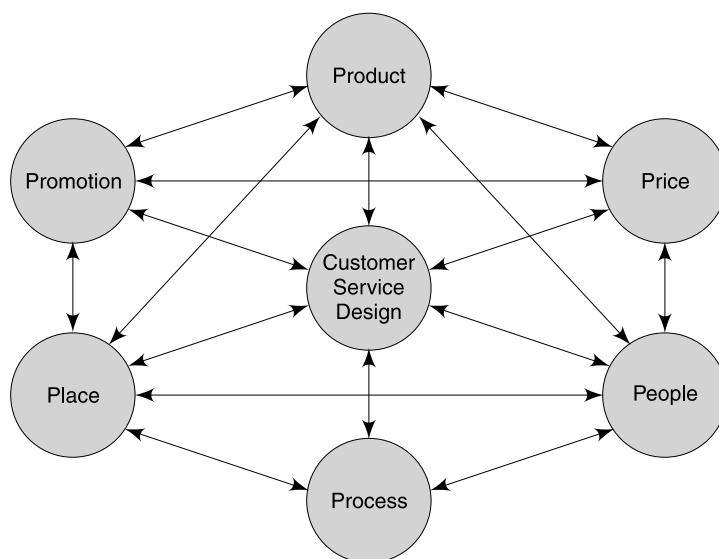
The customer, who initiates the service trigger to avail the service, is influenced by the:

- Assessment of Service, Scope, Quality.
- Assessment of price of offer and willingness to pay that price.
- Perception of ease of availing service delivery.
- Perception of service standard.
- Extend of knowledge about the service.
- Impact of promotion campaign.

Service process designer designs the ‘customer service’ based on the assessment and analysis of customer’s choices, preferences, quality expectations, willingness to pay the price and so on. Following factors influences the customer service design.

- |             |             |                            |
|-------------|-------------|----------------------------|
| • Promotion | • Product   | • Price                    |
| • Place     | • Processes | • People (Process drivers) |

The factors influencing customer service design are linked to each other as shown in Fig. 13.2.



**Fig. 13.2 Factors Influencing Customer Service Design**

All these factors are cross-linked to each other. For example, service product formation will decide the nature of promotion, layout of the place and facilities where service product will be delivered. Similarly, the process which delivers the service will be decided based on the capacity and capability of people and also by the layout of place and facilities. The process could be a mechanised, or automated one supported by other value adding services.

Customer service design addresses primarily the ‘service product formulation,’ which states:

- Who is the customer?
- What is the service scope?
- How it is delivered?
- What is the quality level?
- What additional features to provide?
- What should be the price of service?
- Where it should be offered and what facilities to provide?
- Who would drive the service process?
- What kind of promotion would entice customers to avail the service?
- And finally, what process design would deliver the scope?

Customer service design is crucial for customer satisfaction. It is strategic and also governed by the cost of service to the customer. Cost of service is linked to customer service level decision of the management. Higher the service, higher is the cost of service. In service oriented business, cost of service, quality of service, and customer service design are critical success factors. The companies who score high on these factors have a strategic competitive advantage. The customer service design is also a key business differentiator.

Information technology can be used extensively to automate various processes to reduce cycle times, and cost of service. Information technology can be used through information systems applications to assess the customer requirements, customer behaviour, and customer's buying cycle.

### 13.6 SERVICE MANAGEMENT SYSTEM

We have seen that service process scope is 'Initiation to Delivery to Post service evaluation.' This cycle is a basis for designing all service delivery processes. Once the service process design is finalised, its launch and implementation is a system by itself. The process is best managed through a well-designed system, termed as Service Management System (SMS). SMS is shown in Fig. 13.3.

We now discuss each module of SMS, its scope and objective in SMS.

- **Initiation for Service (Front End)**

**Scope:**

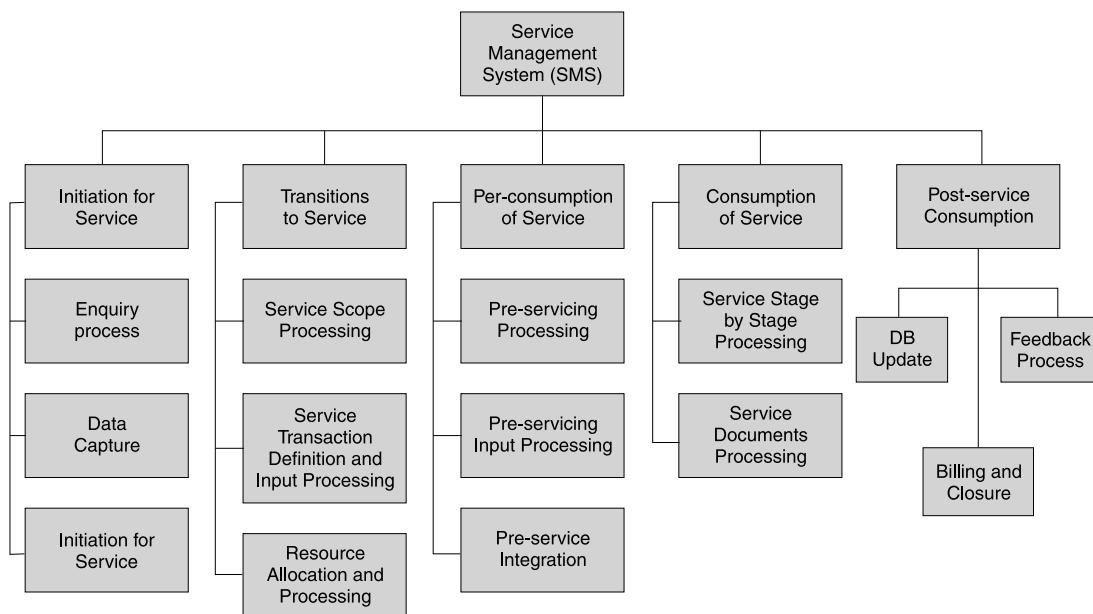
- Answer queries, standard and non-standard. Record the query details and seek for agreement to avail the service.
- Capture the data in standard format to initiate service action.
- Ascertain the service requirement. Create a bill of service offer.
- Give a Service Job Number. Put the service job in a queue.

**Objective:** Win the customer for availing the service.

- **Transition to Service (Front End)**

**Scope:**

- Check, Assess, Validate the service requirement.
- Ascertain commercial and technical viability, and operational feasibility.



**Fig. 13.3 Service Management System**

- Check for submission of any document, or goods, which may be mandatory for service.
- Obtain formal acceptance for beginning the service.
- Issue acknowledgement, acceptance card, voucher, and so on.

**Objective:** Establish technical, commercial feasibility and obtain customer acceptance.

• **Pre-Service: (Back End)**

**Scope:**

- Inspect all submissions from all points of view.
- In doubt, clarify and ascertain.
- Issue service job identity for record, communication, and for reference at a later date.
- Update customer database with this service job identity.

**Objective:** Enlist the service offer with identity.

• **Service: (Back End)**

**Scope:**

- Conducting the customer and/or the goods for service after execution.
- Execute all necessary transactions, which are part of service process.
- Collect transaction results and update the records for reporting.
- Produce and/or display documents.

- Collect relevant data for computing cost of service.
  - Close the service process and obtain an acknowledgment of service completion.

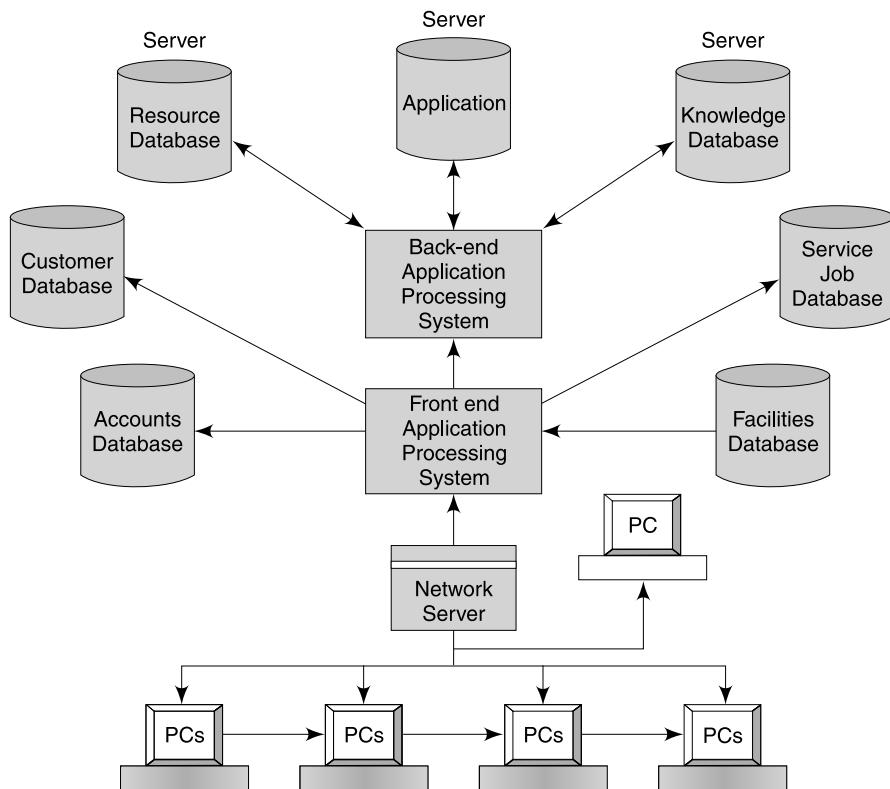
**Objective:** Complete the service execution process efficiently and effectively to the satisfaction of the customer.

- **Post-Service: (Front End)**

## Scope:

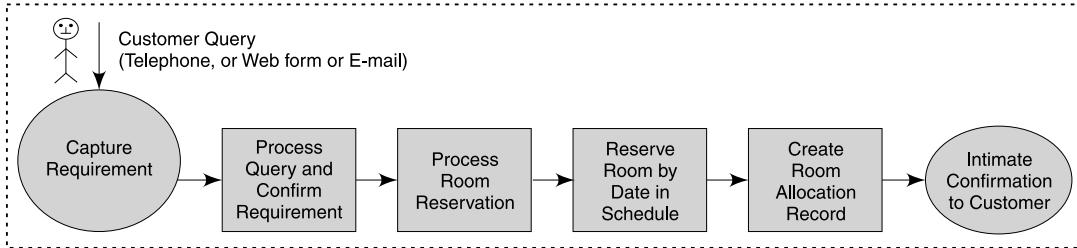
- Collect feedback on service experience, suggestions if any.
  - Bill the customer for services availed.
  - Process payment as per terms of services.
  - Up-date customer record, job record, and other information databases.
  - Generate a report for examination to close the service offer.

**Objective:** Collect data and information about service for decision-making and improvement. Figure 13.4 shows conceptual SMS architecture model.



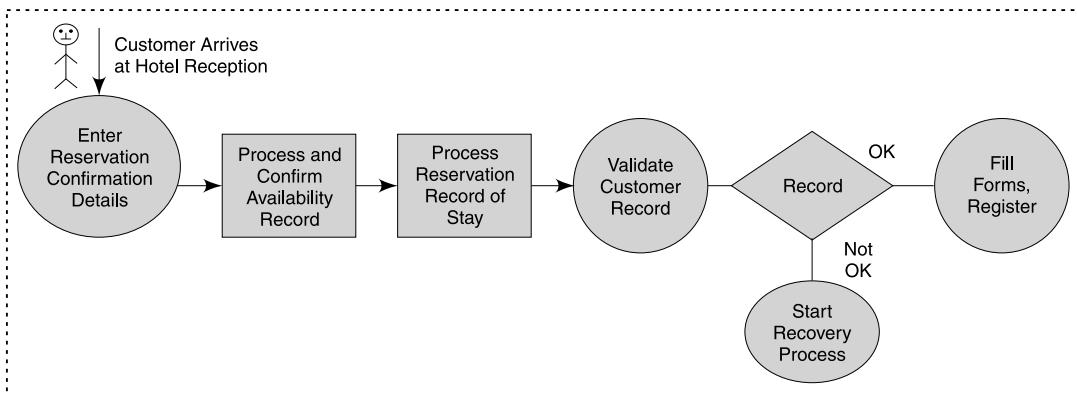
**Fig. 13.4** Conceptual SMS Architecture Model

To strengthen the understanding of SMS let us take a 'Hotel' case where customer wants to stay for four days and needs reservation of a room and certain facilities and other supports like transport, laptop and so on. Let us use SMS model to analyse the Hotel Case. Figure 13.5 (a, b, c, d, e) shows details of SMS system flow.



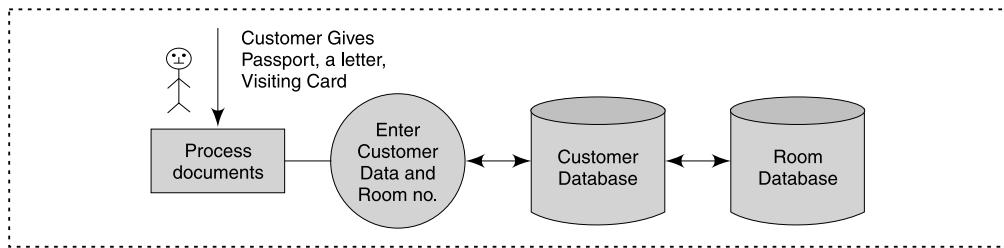
**Fig. 13.5 (a) Initiation for Service**

- (a) Customer contacts hotel on phone, e-mail or submits reservation request through hotel website. This interaction solves customer queries, and provides information for customer to decide. If customer accepts the service offer including the reservation, the customer call is coded for putting in the queue to be used when customer actually arrives at the reception desk.



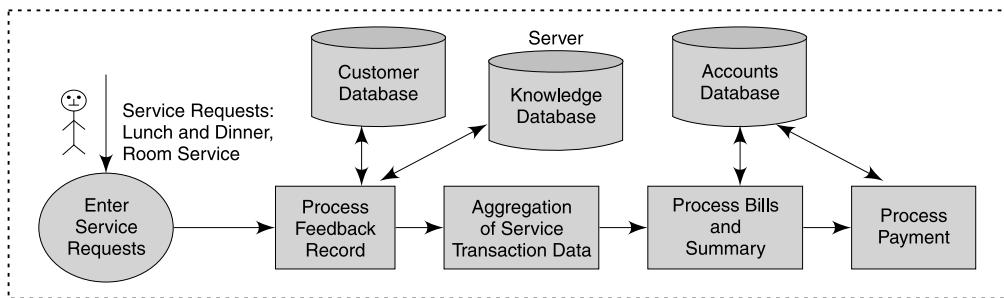
**Fig. 13.5 (b) Transition to Service**

- (b) When customer arrives on the date, transition to service process begins. The customer identifies prior contact with voucher, reservation number or E-mail copy. The receptionist at the desk checks the reservation record and confirms, and acknowledges the room reservation. The customer is requested to submit visiting card, a letter from the company or any other valid document to confirm the person's identity. Customer is given hotel brochure, and other information. Customer is also asked to fill forms, enter name and other details in hotel register. This process concludes with confirmation of customer identity, selection of room, mode of payment and so on.



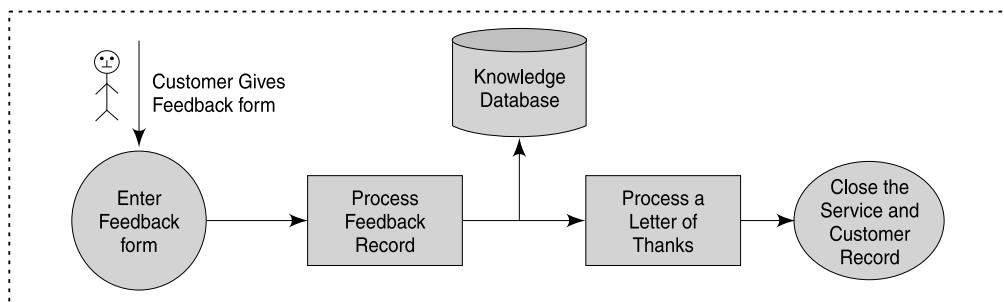
**Fig. 13.5 (c) Pre-Service**

- (c) In pre-service process, customer is handed over room keys, discount coupons, city map and other documents. Assistance is given to move over the room.



**Fig. 13.5 (d) Service**

- (d) In the service phase actual live service process begins. In this phase all secondary service demands such as room service, STD calls, lunch and dinner, laundry and so on are fulfilled. These service transactions are processed in frontend and backend system in real time mode. All transactions are managed through SMS.



**Fig. 13.5 (e) Post-Service**

- (e) In this phase, service scope is completed and customer transactions are processed for billing and payments. Bills are checked and purchased for payments. Customer is requested to fill a feedback form.

A good SMS designed for excellent customer service serves number of other objectives of the business. It is a strategic information system designed with customer focus to fulfill the service expectations. It is a decision support system to decide on service offer, confirmation of service eligibility, checking and providing the resource for service execution and so on. The DSS is supported by customer database, knowledge database to improve the quality to the service and the process of delivery.

It is also a Customer Relationship Management (CRM) system when business is competitive and customer driven, and customer satisfaction and relationships are the keys for growth of the business. The SMS is capable of providing operational, behavioural and commercial information about the customer, services sought to improve the customer relationship. It is a major data source for building customer intelligence using data warehouse applications. SMS therefore is a mission critical application in all business and industries where quality of service is a key driver of the business.

### 13.7 MIS APPLICATIONS IN SERVICE INDUSTRY

We will discuss MIS applications in major service and hospitality industries. We shall not discuss the normal data processing applications, such as basic accounting of business operations, payroll, personnel, inventory, etc. We shall concentrate only on the mission critical applications of the business where the issue of a distinctive service is a focus. These applications are critical to the industry's performance.

#### Airlines

The operative functions of Airlines is to move people and goods from one location to the other safely on time. The expectations and perceptions about the distinctive service is beyond the operative function of carrying people and goods on time. The perceptions about good service are schedule, convenience, prices, seat comfort, meal quality, treatment by the crew and the ground staff, the facilities at the airport, etc. Another set of people have a perception of the distinctive service which falls into pre-and post-travel period. A distinctive service means an assistance in the travel arrangements, arranging the hotel accommodation, surface transport to and fro to the airport, etc.

The third set of people believe that a distinctive service means solving the passengers' problems immediately at the front desk with no hassle of moving from counter to counter or entering into correspondence.

The MIS applications in the Airlines industry would be towards supporting all decisions which affect the objective of offering a distinctive service to the customers having different expectations and perceptions. They concentrate on the process and the outcome of the service.

The service goals could be:

- (a) One complaint per 100,000 passengers.
- (b) 95 per cent occupancy to conclude that the schedules are convenient.
- (c) Throughput time, check in to check out, is less than 10 minutes.

The MIS, therefore, will concentrate on the following information to make the managerial and the operative decisions to achieve the service goals.

### **1. Passenger Information**

- The type, class and purpose of travel.
- The socio-economic group.
- The duration of stay at the destination.
- The food and eating habits.
- The language and communication needs.
- The expectations on the service before and after the journey.
- The traffic flow between the towns, cities and countries.

The MIS in the Airlines industry should focus on collecting this information. This will help to service the schedules frequently to suit the passenger needs. It would help to build the passenger profile and make decisions to meet the expectations and perceptions of maximum passengers. For example, the passenger profile will be different for the Tourists and Non-tourists, a Domestic traveller and an International traveller, a family and an individual, etc. Hence, each passenger profile will have a different service expectation. It is, therefore, necessary to collect this information and build the service package around this profile. Such an information would help to build and modify the service package, satisfying the changing profile of the passenger.

The information on the traffic flow and the type and class of passengers, would help to design different fares affordable to the passengers. The different types of fares can be offered for off season, off time travel, individuals and family, business routes and tourist sites, etc. It is also possible to build packages where passengers pay for all services, and airline takes care of all the requirements in pre-and post-travel total service.

### **2. Information on the Aviation Industry**

The best service package for a distinctive service would fail in implementation, if the safety, security and availability of planes is doubtful. It is necessary to have a dedicated MIS to manage this aspect of the airline industry, where the decisions related to new purchases, planned replacement, investment in the infrastructural facilities to keep the planes in a good shape for flying, the critical spares in the inventory, manpower training, etc. are taken with confidence.

The MIS in this area would heavily rely on the business and operations research models to solve the complex problem of planning and control. The MIS would help in the perspective planning, and strategy formulations which would support the implementation of the plan framed for offering a distinctive service.

### **Hotels**

Hotel is a place where people look for a distinctive service. Traditionally hotels are meant for those who do not have home or place to stay, when they are away from home. It is viewed as a place for convenience. However, the concept of hotel as a place of stay, when you are out station has undergone a change due to number of reasons.

The transition has taken place from convenience to comfort, comfort to enjoyment, enjoyment to total service. The transition has taken place as the hotels are used by different people

whose profile have undergone change. The hotels were designed for individual's stay, then came the business executive followed by the family, and followed by the tourist groups. Every time the hotel designs undergo change to meet the changed needs of the occupants. The concept of the star hotels emerged to service these needs of the different customer segments according to their budgets.

The hotel management always faces the problems of providing the best distinctive service to the customer. The operative function of the hotel is to provide a room to stay with the basic amenities and facilities so that the stay is comfortable. The success of the hotel business lies in ensuring that the hotel occupancy is high and the occupant uses the services which are separately charged. A higher customer turnover with a higher occupancy is better for the business performance.

The MIS for the hotel management addresses the issue of assessing the customer expectations and their perceptions and fulfilling them in the best possible manner. The MIS, therefore, has the following responsibilities to provide the best information support.

### ***1. Keep Track of the Customer Profile***

The following information is to be kept in the customer database.

- Type of the customer.
- The nature or purpose of visit.
- The duration of stay.
- The service demanded.
- The socio-economic class of the customer.
- The religion, the language, and the culture of the religion.

This information will help to anticipate the expectations and perceptions about the service and the process of offering the service and its outcome.

This will enable the hotel management to make the investment decisions to offer different service-based infrastructure, i.e., swimming pool, shopping arcade, different restaurants, travel related information counters, transport facilities, office and secretarial service, etc.

### ***2. Monitoring Occupancy Level***

It is necessary to control the occupancy at a high level. The MIS should provide the information on a high or low, and the reasons thereof.

This would help the hotel management to take actions by evolving different tariff schemes, attractive gift and discount schemes, more personalised service and so on which make the difference to the customer. Such decisions will ensure high occupancy and revenue to the management.

### ***3. Project Future Needs***

The MIS should provide information on new needs which are emerging in the foreseeable future. For example, the hotels were originally conceptualised as a place of stay, but the role has now changed. It is now a place for business meetings, conferences, exhibitions, marriage parties and entertainment shows also. The management then has to provide the necessary infrastructure at all levels to meet such needs.

#### **4. Monitor the Level of Expectations**

The customer expectations on the service level norm differs from class to class and service to service. Besides the perceptions about fast and slow service, the customers have expectations about the manner or process of offering the service. The efficient and effective process is a function of training, understanding and knowledge of manpower, while the speed of the process would depend on the strength and competence of manpower. It is, therefore, necessary to build a proper manpower grid to take care of the quality of service. Generally, the norm is the number of employees per room offering certain level of service.

If the service level expectations have changed, the norm should be changed. The MIS should certainly monitor the expectations and the manpower needs. This would help the hotel management in the HRD function.

#### **5. Monitor the Communication Needs**

The communication makes interaction with the customer a comfortable exercise. It is necessary to upgrade the knowledge and skills of all employees to fulfill the changing needs of the customer.

For example, the employees at the reception should be well informed to answer the queries from the tariff to the facilities in the hotel, the service offered by various hotel agencies, the information on sight-seeing places, other hotels, important locations, a different way of greeting to the different customers, speaking the language of the customer at his wavelength, and so on.

The MIS should monitor such communication needs helping the management to improve the knowledge and skills of the employees whose interaction with the customer is high. The MIS, in short, should, assess training needs to the service group employees to run the programmes of training to improve the quality of the distinctive service.

#### **6. Customer Database**

Most of the good hotels create a customer database for handling a variety of applications. Such database handles a personal information about the customers. It keeps the data about their room choice, food habits, special likings, record of contacts and so on. The data on the organisations which prefer the hotel is also kept. The data is used by the management to build a good organisational relationship, to create a sense of care and concern.

Most of the MIS systems in a hotel are managed as front end and back office systems. Front end systems handle customer interaction and back office systems handle processing of commercial data such as billing, accounting, correspondence, inventory and general administration. The systems are support systems to the main MIS of the hotel.

#### **Hospital**

The role of a hospital in today's world has changed from the medical and clinical assistances to health care with a concern for the people who need it. It is a missionary organisation established to provide health care services to the needy with the motto—*Don't make them sick while they are trying to get well*. The hospitals are required to run as business institutions with the mission of the best health care for the people. The scope of services now includes health care

guidance, preventive care, post clinical attention, care and advice. The hospitals may handle a person who is not a patient and hence we call a person visiting a hospital a 'Customer' and not a 'Patient.' Hence, the customer profile would include besides a patient, an associate of a patient, a doctor, consultant, a paramedical personnel, a medicine supplier and so on.

The management of the hospital is to provide distinctive service to a wide range of customers whose service expectations and perceptions are varied. The customers can easily discriminate between *the quality of care and quality of caring*, between *being treated medically and being treated personally*, between *being served at least cost and served with efficiency and effectiveness*. The customer aims at the terminal result of the service and evaluates the management on the quality of the service process.

Unlike any other service business, in the hospitals the server, is a highly knowledgeable resource while the customer is a no knowledge person with high demands on the service expectations. The risk management in hospitals is highly punitive but not necessarily highly rewarding. It is the management of a customer through a high level human resource management.

Like any other business, the management of hospitals has changed from an art to a science and then to a technology. Today's hospitals use a lot of medical hardware and software in health care activity. Health care decisions are based on diagnostic aids and assistance through an X-ray, scanning, pathological tests, and knowledge base of case history, etc. The operational aspect of the health care is supported by a lot of equipment and instrument specially developed for the purpose. The role played by these aids is so vital and important that it is called *Medical Engineering*. The medical engineering has helped the medical professionals to reduce the drudgery of health care and concentrate on diagnosis, prescriptions and treatment. The management of the infrastructure of equipment, instruments, etc. is very important management function supporting the effect of offering a distinctive service to the customer.

In hospitals there are critical resources such as an operation theater, an X-ray lab, hospital beds, etc. These resources are to be managed efficiently and to be used effectively by planning and control by the other associate resources such as the surgeon, anesthetist, physician, and nursing staff. The scope includes a provision these critical resources. More than any other service industry, handling of emergency in the hospital is highly critical and hence detrimental to the distinctive service. The resource planning must consider the emergency requirement of the customers which are difficult to predict and control. With this backdrop, we can discuss the mission critical applications in the hospital industry.

## Front End Applications

### **1. Patient Database**

- To handle the queries on the existing patients and the patients treated and discharged. The queries may come from a visitor, a doctor or any other staff of the hospital.

### **2. Medical Server Database**

- Name, addresses, telephones, etc. of all medical staff including Doctors, Nurses, Technicians. Holidays, work times, and locations on weekdays for contact.

- Important service centers in the town where support services can be obtained in emergency. These are the laboratories, the blood banks, the special clinics and the special facility centers.

### **3. Resource Planning and Control**

- An online query facility to answer the number of queries on the availability, scheduling and rescheduling of the resources and the facilities.
- For judging the usage of the facilities and to put them in proper use.

### **4. Medical Case History Database**

- Knowledge database on the case history for the guidance and research.
- Monitoring the effect of drugs to judge the efficacy in terms of the patient's response.
- Analyse the health care demand and make planning for the health service strategy.

## **Back Office Applications**

### **1. Core Applications**

- Manpower and personnel planning.
- Payroll and the employee related applications.
- Hospital billing and recovery.
- An inventory control-procurement, planning and control. The expiry data management.
- Financial accounting. Capital budgeting and expense control.
- Maintenance of the service facilities.
- Resource utilisation and analysis.

### **2. Critical Control Applications**

Evolve the basic standards for control and provide exception reports to the management for forward planning and control.

- Patients waiting time and service cycle.
- Non use of critical resources.
- Stockouts of the critical drugs, and the time taken to restore supply.
- The number of patients admitted, treated and cured. Length of the stay, cost and revenue to the hospital.
- New trends in the service demands and the service performance in such cases.
- Analysis of the delays in terms of duration and causes.
- The number of patients turned down or sent to the other hospitals for want of facilities—analysis and causes.

Unlike a manufacturing industry, it is not possible to have a mechanisation and an automation in the hospital services. They could be, at the most, aids. The service quality depends on the people who provide it. Most of the management issues are related to the manpower and human resource planning. The MIS largely revolves around this aspect in the industry.

If this aspect is not taken care of, the service would suffer badly in spite of the best physical resources available.

The hospital management is a high risk business, both for the server and the customer and the risk spreads from business risk to the survival of the patient. It is a business of non standard activity where every customer needs a unique approach. The steps of service may be common but the process may differ putting strain on the facilities. The MIS in hospital management plays more of a support role in forward planning than the present control needs. The MIS plays a support role for a strategic decision making for expansion, upgradation and training of human resource. The MIS plays a role of crisis management through information support.

### **Banking**

Banking is generally understood as a place where the financial services are offered, viz., checking, savings and providing credit to the customers. The scope of this service in today's world is expanded where the banks have become an instrument in providing financial assistance to a number of activities as a policy or by regulation or for meeting socio-economic obligations. In banking also the concept of financial product has come in.

The customers choose the bank mainly on the following three factors.

- The ease of doing business.
- The quality of personnel and service.
- The range of the financial services.

These factors outrank the factors such as the location, the interest rates, the lay-out, the banking hours, etc.

The bank has a wide range of customers like individuals, institutions, trusts, business organisations, Government and local bodies.

The banks deal with a number of transactions which also vary widely in terms of length and complexity. The bank customer, like any other service industry, is interested in getting terminal results quickly. The distinctive service in banking mostly means solving the customer's problems in the financial matters, and the single, most widely used measure of quick service is the elapsed time of transaction execution. For example, the time taken for crediting the amount, withdrawal of cash, the sanction of a loan or credit facility, etc. are the norms of deciding a good service. The MIS in banking industry revolves around this aspect. The customer of the bank would like to know the states of the account very fast to make decisions on withdrawals or payments. He is interested in obtaining the loan assistance for his specific need with a reasonable rate of interest. Some customers would be interested in tax consulting and tax planning. Another group of customers would be interested in investment guidance for investing in stocks and securities.

To avoid the inconvenience of going to a number of places for payment of small amounts, customers need service at the counter to pay electricity bills, telephone bills, taxes and duties to the local bodies and the Government. Hence, the MIS is to be designed to identify, decide and design a service strategy for offering a distinctive service to the wide range of customers seeking a variety of service demands. The following points should be taken care of while designing an MIS for a bank.

### **1. Customer Database**

The service expectations and perceptions revolve around the following factors:

1. *Customer* — individuals, company, institutions, etc.
2. *Operator* — housewife, employee, officer of the organisation.
3. *Range of service* — savings, credit checking and payment, the other financial services.
4. *Class of customers* — income group, corporate bodies, etc.
5. *Working hours* — morning, afternoon, evening, etc.

The management of the bank create a customer database and analyse the needs of the customers from time to time to create suitable service packages.

### **2. Service to the Account Holders**

The customers (Accounts holders) need constant advising on the status and its operations. Most of the customers use their account for routine payments affecting the balances. Many a times the account holds a large amount and it is not transacted for any purpose. The MIS should give following reports to the management.

1. The non-moving account.
2. The account having balance more than say ₹ 50,000.
3. The account going down below minimum balance.
4. The routine payments not made.
5. The routine credits not arrived.
6. The defaults on loan repayment.
7. The delays on crediting cheques amounts.
8. A sudden rise and fall in the account movement.
9. The account holders giving 80 per cent business to take personal care of their service expectations and perceptions.

Based on these reports, the management of the bank should alert or warn the customer to act on his account to correct the situation. The personal and individual account holders need such a service badly as they have to manage their domestic or business activities in a tight money situation. The MIS built around such demands would help not only the bank manager but also the account holder.

### **3. Service for Business Promotions**

The bank finances can be utilised in a number of ways to increase the banking operations by offering credit to the right kind of customers. It is, therefore, necessary to study the trend in the business industry and solicit the customers from the upcoming and growing business sector.

The MIS should concentrate on data collection from the various sources to analyse and conclude the future business strategy. Such information will help the banker to move out to talk to the customer to obtain business for the bank. Such support will also reduce the risk of account going into the red and the bad debt.

#### **4. The Index Monitoring System**

One more feature of the MIS is to monitor the variety of indices and ratios related to banking operations which are internal to the banking business. Some of these ratios fulfill the statutory needs, some meet the policy needs and so on. It is necessary to build the MIS applications to support the bank manager in making decisions to keep a different index, norms and ratios within the acceptable limits. He should also get support through DSS to handle the problem of not meeting these statutory standards.

#### **5. Human Resource Upgrade**

There is a lot of human aspect in the banking operations. Any amount of mechanisation and computerisation is not a substitute to a *service with a smile*. The service may become faster or quicker but still it requires a human touch and skill. It is, therefore, necessary to upgrade the skills and knowledge of the bank employees to offer a proper service to the customers.

The financial world changes so fast that retaining a customer base is a challenge. The financial service business is becoming competitive and offering a good distinctive service is the only solution to improve the business prospects. The service has to be more aggressive for specific problem solving of the customers. The MIS should identify such needs and offer help to the management in designing training courses for the employees to improve their knowledge about banking and the financial world.

In the banking industry, the traditional methods of good performance are at odds, with good service. A good financial performance may not necessarily mean a good service quality.

The customer of the bank expect the service to be delivered in a smooth, problem-free, efficient and timely manner. The managers in the bank have the service as well as the financial goals to achieve. It is, therefore, necessary to set the internal standards on the art, the accuracy, the responsiveness and the timeliness. The systems and the resources provided to achieve these standards need monitoring and the MIS will provide a feedback on these standards so they can be regulated and controlled.

For example, a multinational bank has set standards on satisfying the queries in the first phone call, cheque clearance time, waiting time, etc. It has set eighty-one separate 'Quality Indicators' for the Bank Card Business and so on. The MIS measures these standards and gives a feedback on achievement or non-achievement.

#### **Insurance**

The other name for insurance business is Risk Management. The insurance covers the risk of the customer. The risk may cover 'life' through a life insurance, 'liability' through a liability insurance, 'accident' through an accident insurance, 'breakdown' of the equipment through a breakdown insurance, etc. An insurance is taken by the customer to cover the risk which may be faced in the event a mishap happens such as a death, an accident, a break down, a loss, a theft, etc. The risk in such cases is large both in the financial terms as well as in the business terms. Hence, its appropriate insurance cover is most necessary. The customer expectations are around the quality of the risk coverage and the process through which it is settled, if the insurance claim is lodged. The expectations and the perceptions of the customer differ from the type of insurance cover the customer has opted for.

In any insurance business the main task is to evolve a new product (Policy) covering different risks of the customers. The product features include the cost of the insurance cover, the conditions of covering the causes and exclusions under which the claim will not be honoured. The service feature includes the process and the pace at which the claim is settled.

The MIS in the insurance business revolves around the information needs which would generate out of desire to provide a distinctive service to the customer by way of risk coverage, risk handling, and claim settlement. There are four basic principles of the insurance business — simple products (different insurance policies), low premiums, high risk standards and cautious investments. The success of the insurance business lies in how efficiently and effectively the claims are settled, an accurate billing and record keeping, and an accurate representation of product features.

The insurance business is conducted through the agents, brokers, and appraisers. A considerable amount of success depends on how good these bodies are. An up-to-date knowledge of different products of the insurance company, an understanding of the customer's risk coverage needs and an ability of offer the right policies, and the knowledge of handling the risk incidence by proper appraisal, are necessary for a good growth oriented insurance business.

The growth of the business depends on the ability to develop new insurance products and expand the scope of the risk coverage. In the history of insurance business, it can be observed that a car, a life, a breakdown, a theft and a burglary are the routine old insurance products. However, as the business and the industry has grown four fold with all the complexities, the insurance business now offers a number of non-standard products serving the distinctive service needs of the customer. The MIS in insurance handles following main areas:

- The information for development of new insurance products through different policies.
- The settlement of claims, in terms of time, value and fairness.
- The administration and management of the existing policies.

### ***1. Information for New Products***

It is necessary to conduct a survey of new needs through regular contacts with the business and industry. The study relates to finding out the risk incidence, the cost of risk management, identifying the conditionalities for giving the insurance offer (procedures, facilities, guarantees, etc.), and the assessment of insurance premium.

Normally, the insurance products are designed by evolving Risk Model of the risk incidence, the market for such risk coverage and value of risk coverage to the customer. Different products are evolved with a difference in the coverage, the premium, and the exclusions. The skill lies in evolving an attractive insurance risk coverage products.

The study should, therefore, focus on the trend in the business and industry, the process of conducting the business, the new technologies in all fields of business and industry and identifying the risk possibilities and covering them by an appropriate insurance policy. To illustrate the point, computer breakdown and the resulting loss of data, old age health care, consignment insurance, export credit insurance, farm insurance, etc. are examples of the new insurance products emerging out of new trends in the business, commerce, and industry.

## ***2. The Settlement of Claims***

Apart from the risk cover and its cost, the distinctive service depends upon how soon the claim is settled. Many a times the conditions prevailing at the time of incidence, and the commercial aspects of the claim are the main issues which take a lot of time leading to customer dissatisfaction.

Claim settlement becomes a critical applications in the MIS and it should be designed effectively so that the management attention is brought in for a quick decision for a break through. The processing of the claim fast helps the customer to start the process of revival at his end and come to a normal functioning at the earliest. His perceptions are built around this requirement. The MIS should deal with the claim processing as a critical system. It is necessary to build different indices of the claim processing and keep the track of claim settlement.

The MIS should bring out exception report on the claims pending, in dispute, not settled and rejected. It also should use this information to improve the policy profile and change the premium structure to accommodate even one in million chance of rejection, exclusion and inclusion. This is a non-standard application to meet new needs of the insurance policy manager, magents, brokers, and surveyors.

The MIS application of claim processing should provide information of the risk incidence, the revenue under that policy and the value of claims settled. Such information will help to calibrate the policy in terms of the conditions, the premium charged and the percentage of claim value to be settled.

## ***3. Management of the Policies***

Another critical application in the insurance business is the management of existing policies by offering help to the policy holders. Issues are as under:

- Renewal of a policy
- Revision of a policy

The application is handled through a series of mailings such as a reminder, policy documents, obtaining the premium, etc. This application includes the following systems:

- Customer data management system
- Commission, billing and claim settlement
- Premium accounting and policy analysis

## **Utilities**

The application of Information Technology in utilities is very old. It has typical nature in contrast to the manufacturing or the service sectors. Most of the utility businesses are in supply of the basic amenities like water, power, telephones, gas, credit cards, paging, etc., and also in the areas of insurance, license, etc. All these applications have a large volume input, because of shear numbers of beneficiaries of the services. The input is standard and after processing, the output also is standard.

The input to the system is the name and addresses, its code, the code of measuring units, i.e., the meter number, the telephone number, the policy number, the license number, and the

quantity of supply, i.e., the number of calls in case of telephones, the number of units in case of power supply, the quantity of water consumed and the period for which data is collected.

The output could be a bill, a notice, or a claim. Both the inputs and outputs are standard in nature in all the utility businesses and hence, it is a standard application.

The system scope covers data collection on consumption between the last date and the current date. Then the data of consumption units is processed for accounting and billing. The bill, then, is printed and mailed to the holder of the facility, viz., the telephone, the electric meter, the water meter, and the credit card, etc.

The system also validates the usual references with the master, such as the name, the mater, the area code, etc. A good system also validates the consumption, based on the pattern established so far, and points out the same to the subscriber of the facility. The typical system flow is as follows:

1. Data gathering
2. Data entry
3. Data validation
4. Data processing for current billing, add the unpaid bill amount, charge penalty, if any, deduct extra amount paid, charge fixed amount for the period such as the rent, the service charges and so on.
5. Total the amount
6. Verify the process and print the bill. Alternatively, process the notice for discontinuing the service due to contractual non-compliance.
7. Data analysis, reconciliations and reporting.
8. Collection centre accounting and handle reconciliations, i.e., account reconciliation, bill reconciliation, bank reconciliation.

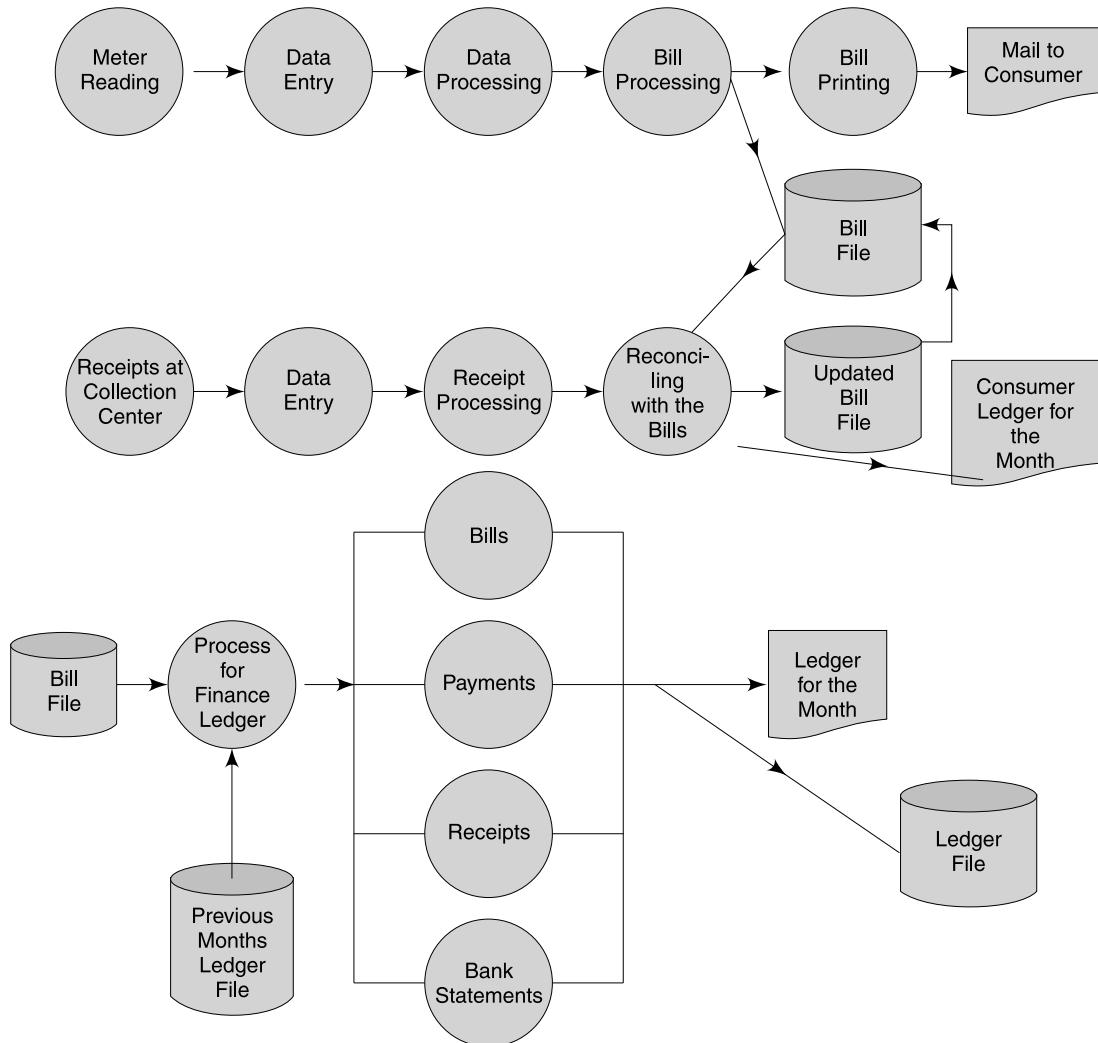
The billing application is the largest in the utility business. It is processed as a dedicated application on main or mini systems configured for large data storage and faster processing.

These applications are developed with a life cycle approach with a strong validation focus to ensure the completion and correctness of all kinds of data. The Management Information System reports in utilities business are the following:

1. The amount of consumption and its value and the bill amount.
2. Amount billed and recovered.
3. Amount billed, not paid and its aging.
4. Consumption pattern by period, season, area (industrial, domestic, etc.) and holders.
5. Number of units (meters) installed — working and not working.
6. Complaint Register, complaint analysis and the performance rating of various key facilities.
7. Asset register of the service facilities such as the telephone exchange equipment, the sub-stations and the transformers, the pumping systems, the cable or the pipelines and so on.

8. Maintenance report on breakdowns, uptime, planned maintenance and its compliance, conditions monitoring and the preventive maintenance reports.
9. The stores and inventory application with standard reports on holding, ABC analysis, moving and non-moving inventory, and stock-outs, etc.

A system flow chart for generic billing and accounting application is given in Fig. 13.6.



**Fig. 13.6 General Billing and Accounting Application Model**

The billing application is critical from the revenue view point while the maintenance application is critical for sustaining and improving the business performance through excellent

service. All the utility companies have maintenance applications specially designed to keep the uptime of service facility at hundred per cent.

The application deals with the following aspects:

1. Facility Register : Code, location, specification, features.
2. Planned Maintenance : Periodic stoppage, cleaning, overhauling, replacements, testing, tuning and setting.
3. Preventive Maintenance : Based on the performance trend judged on cost, consumption and productivity.
4. Break-down Maintenance : On-call as and when occurs.
5. Facility Planning : Purchases for replacement expansion and improvement.
6. Costing of service offered and its analysis for improvement and replacement.

Both these applications namely billing and maintenance, are then integrated in finance and accounting application for reporting to the Top Management on business performance.

With electronics, computer and other communication technologies, processing has converged to point where cycle time of recording the service details and billing is reduced considerably. The utility companies are switching over to digital and bar code technology for data capture and its communications to the processing centre. With the advent of network communications and credit card payment facilities, these applications are undergoing structural changes, whereby the data capture, processing, communications payment and accounting are becoming faster than ever before, giving business benefits to the company. It is now, therefore, possible to monitor the payment, service level better than ever before. The cost of service is reducing due to the reduced overheads in the non-productive areas like data capture, data entry, etc. The paper work is considerably reduced as the processes are getting redesigned through the work flow automation technologies.

## **Finance**

Raising funds from various sources for the business operations is a standard application requirement of many organisations. These organisations are the Financial Institutions like Banks, Unit Trusts, Finance and Leasing Companies and the Companies themselves which are in need of funds for their own operations.

The source of funds is through public and institutional savings. The amount of funds to be raised is governed by the law and the rules and regulation introduced by the central organisations, like the Reserve Bank of India, the Finance Ministry and the Stock Exchanges. The processes, the procedures and the guidelines are issued by these bodies, and the fund raising company is required, by obligation, to comply certain stipulated requirements.

The typical applications in sourcing the funds is the Shares, the Fixed Deposits, and the Bonds, etc. These sources have their own specific nature and the choice of the source could be based on eligibility, cost and profitability of the source. However, the core process of raising the funds, and servicing them is fairly common for all the sources of funds raising alternatives.

The common characteristics of these sources of raising funds are given in Table 13.3.

**Table 13.3** Characteristics of Fund Raising Sources

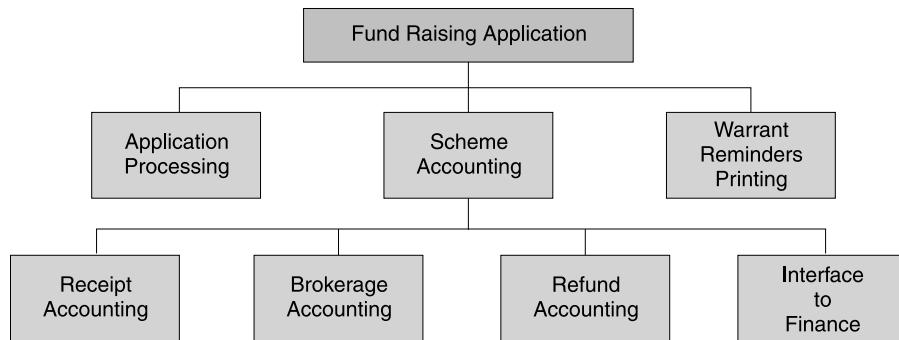
Particulars	Shares	Fixed deposits	Bonds
Source	Public	Public	Public
Demand of funds	Application, advertisement	Application, advertisement	Application, adver
Beneficiaries	Multiple holders	Multiple holders	Multiple holders
Limit of investment	Yes/No	Yes/No	Yes/No
Period	Unlimited	Fixed	Fixed
Return of funds	Yes, when sold or called	Yes, on maturity	Yes, on maturity
Transfer of funds	Yes, any time	Yes, on maturity	Yes, on maturity
Benefits to Investors	Dividend amount	Interest amount	Interest amount
Method of payment	Dividend warrant	Interest warrant	Interest warrant
Period of payment	Annual	As per choice within the scheme	As per choice within the scheme
Data inputs	Same fields	Same fields	Same fields
Outputs	Dividend warrant	Interest warrant	Interest warrant

One can develop a generalised, parameterised software application to handle the shares, the fixed deposits, the bonds, etc. However, the shares' application is a little more specific and different from the fixed deposits and the bonds. For shares, the Corporate law requires maintenance of certain records and registers. For all these three sources, the records like the ledger, the registers and the returns to the government are common in nature. All these three applications are auditable and have place in the balance sheet schedule.

The general procedure for raising funds through the shares, the fixed deposits, and bonds is the same. A public announcement is to be made for raising the funds through one of these sources. The application form is designed for the said purpose with sufficient details about the company and that of the issue or the scheme.

The application form is identical in the contents, whichever be the source. The name of the applicant, and the name of the second and the third joint holders, their addresses, signatures, name of the banks, branches, the details of cheques, such as, number, amount etc., the name of the broker and the code number, the amount in figures and in words, the class of investors, i.e., whether individual, NRI, or Trust and so on. Hence, the application data entry processing and its acceptance is common for all these three sources. In each case, a small programme change is necessary to identify either the scheme, or the issue and so on.

All the three kinds of applications need documents control in detail. The documents are the shares, the fixed deposit receipts and the bonds. They are to be watched for the numbers, the transfers and the refunds. Hence, each application is required to process for a register/ledger by folio, the number of documents and the issue or the scheme code for administration and management of funds. The system of funds raising has sub-modules as shown in Fig. 13.7.

**Fig. 13.7** Funds Raising Application

A one time system application, in each case, is of processing the applications for brokerage and the bank charges or commission. The administration and execution of the public issue, the fixed deposit and the Bond issue is done through the Brokers, the Bankers and the underwriters. They are an important link between the organisation and the investors. They distribute the forms, guide the investors, collect the applications duly filled along with cheques and hand them over to the authorised bankers for the transaction processing. The brokers, bankers and underwriters also inform the organisation, the status, the funds position, and the response to the issue for management action. All these services offered by these agencies are compensated by brokerage or commission at a fixed rate of half per cent on the amounts given by the agencies. The rate could vary from the agency to agency, and from one issue to the other.

The reports in the system are, again, fairly standard in nature as follows:

1. Statement with the amount for each source and scheme.
2. Analysis of investment by the type of applications and investors.
3. Statement showing refunds by month for cash planning.
4. Statement showing the refunds that are due but not confirmed by the investors.
5. Balance sheet schedule on various sources of funds, showing the opening balance, the transactions during the period and the closing balance.
6. The returns to the Registrar of Companies, and the Reserve Bank of India on the sources of funds and its utilisation.
7. The statement of brokerage, commission, the charges for audit and accounting.
8. Query reports on the document number or the code, the name, the date of maturity for quick search to satisfy the queries from the investors.

All the three applications are rule driven, deterministic, closed system and can be designed as a stand-alone application on a small LAN system with the data transfer or interface to the finance system. The system also can be designed to suit multiple locations and transferring valid date to the main system for further processing.

Some of the Companies which are in the finance and leasing business have another set of applications, where the funds are reinvested by these companies in the other Companies by way of loans, trade credit finance, or lease finance, etc.

One standard application in all such companies is that of the loan application scrutiny, loan sanctioning, monitoring loan utilisation, and refund of loan as per the agreed schedule between the company and the loanee. The reports in the system are as under:

1. The loan applications received, processed and disbursed.
2. Analysis of loan disbursement by the industry, business and companies.
3. The funds forecasting and the funds management for new sanctions and disbursements.
4. Receivables statement and aging.
5. Bad debts.
6. The MIS reports for marketing and management.
7. Management of the bank guarantees.

### **13.8 MIS: SERVICE INDUSTRY**

The mission critical application in any service industry deals with people or customers in that industry. The success of the MIS lies in how service is managed through its support. There are three sides to the service business; People, Process and Technology.

The MIS in the service industry should focus; on the evaluation of service needs of the people. The needs should be continuously scrutinised to ascertain the change in the service demand in terms of scope and level. Unless this is monitored, it will not be possible to revise the service strategy. The perception of good service also needs frequent scrutiny, and the strategy should then include the processes which will take care of the customer perception of good service. Many a times the perceptions are not directly related to satisfaction of basic service need, but they are related to the peripheral processes which makes servicing process a comfortable experience.

For example, getting a seat on a flight is one demand but how quickly the reservation is made without a delay gives more satisfaction. The MIS should provide an understanding to the management about such needs which would help them to modify the physical, communication and human related processes to keep the distinctive service offer at the highest level.

The second dimension of the business is the service process. The MIS should evaluate the process efficiency and effectiveness by fixing operating standards.

The third dimension of the service business is the service technology. The efficiency and effectiveness improves with an appropriate choice of technology. The technology in the service industry deals with communications, data and information search, real time decisions and movement of matter such as Customer, Paper and Documents. If the technology chosen handles these four factors effectively, the throughput of the system improves. Otherwise there would be delay, confusion, and a loss of resource. The management in the service industry relies heavily on the appropriate technology such as automation, computerisation and mechanisation to upgrade the basic service process.

Use of computers in the reservation system has improved the passenger satisfaction considerably. Similarly use of the high end telecommunication system has helped the courier industry to keep track of mail packages. The computer and communication technology has helped newspaper industry bring out editions from different locations simultaneously with the latest news.

The choice of technology makes a significant difference in the service quality to the customer. The distinctive service strategy means in the most of the cases the appropriate choice of technology.

While designing the MIS for any service industry, the people, process and technology to be used should be identified and an information support on these key factors should be provided to the management to make decisions to design the service strategy. Table 13.4 shows where the focus area is in the MIS for these key factors.

**Table 13.4** MIS Focus on the Key Factors

Factor	MIS focus
People	Understanding the expectations and the perceptions of the customer.
Process	Evaluating and controlling the process output standards of the service operations.
Technology	Evaluating the efficiency and the effectiveness to make the technology decisions.

## KEY TERMS

Distinctive Service  
Service Quality  
Customer Service Design  
Service Management System

Service Concept  
Service Processing Cycle  
Factors of Influence  
Service Process Efficiency

## REVIEW QUESTIONS

1. Distinguish between the manufacturing sector and service sector in terms of character, focus and deliverables.
2. What is the difference between product management and service management?
3. What is a distinctive service in the following service business?
  - (a) Fast food joint.
  - (b) Railway ticket counter.
  - (c) Inflight passenger service.
  - (d) Hospital Reception Centre.
4. What are the expectations and perceptions of good service in each case mentioned in Problem three above?
5. Most of the service applications have heavy dependence on database (s) and they are transaction intensive. Explain.
6. Applications in service industry will be efficient and effective, if appropriate IT is chosen. Explain with reasons.
7. In following service businesses, identify mission critical applications.

1. Milk and newspaper distribution.
2. Blood bank.
3. Courier.
8. What care should be taken while configuring the hardware and software platform in service application?
9. Identify distinguishing features of MIS in service industry as against manufacturing industry.
10. How would you control quality of service through MIS support? Explain with example of any one service industry.
11. Discuss the distinguishing characteristics of services and what problems do these characteristics present in offering the service?
12. Explain, how quality of resources used in service offer and functional quality of offer affects customer satisfaction?
13. In following industries rank six factors in order of its importance influencing customer service design.

• Airlines	• Hotels	• Hospital
• University	• Software Support	• Railways
• Shopping Mall		
14. What steps should be taken by the organisation to ensure that people deliver satisfactory service?
15. Explain the importance of IT in today's SMM. Identify technologies and their major contribution towards efficient and effective SMS.


**CASE STUDY**


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## SEMINARS, CONFERENCES AND CONVENTIONS (SCC) SERVICES LTD

### Introduction

SCC Services Ltd. (SCCL) offers services to organise and implement seminars, conferences and conventions for clients from business and industry. The client base is universities and Institutes, bodies like CSI, ICWA, government bodies and so on. Seminars, conferences, conventions are essentially for people of common interest who would like to come together to share ideas, listen and learn. In the last three years demand for such services is increasing and SCCL finds that it is not able to fulfill clients expectations fully. Though business is showing good results, management believes that there is a loss of opportunity due to not able to plan and manage the event properly. This results in cost overruns leading to loss in profit. All client requests finally are contracted where conditions, constraints, assumptions, requirements, roles and responsibilities with time line plan are stated and signed by both the parties.

SSCL observes that though it is essentially an 'all people event,' the requirements differ to a great extend in scope, content and delivery with different specifications. The event differs in duration as well, asking for more resource requirements. Organising such events mean researching, defining event concept, scope determination, finalising deliverables, planning and execution. Many tasks however are common for Seminar, Conference, Convention. But they differ in detail specification from event to event.

The tasks in events includes, to name a few, selection of venue, layout and arrangements at the hall, provision for event office, arranging communication, projection and telecast services, and finalisation of lunch/dinner, tea break arrangement; interior decoration, discussion rooms, room reservation for the participants and so on.

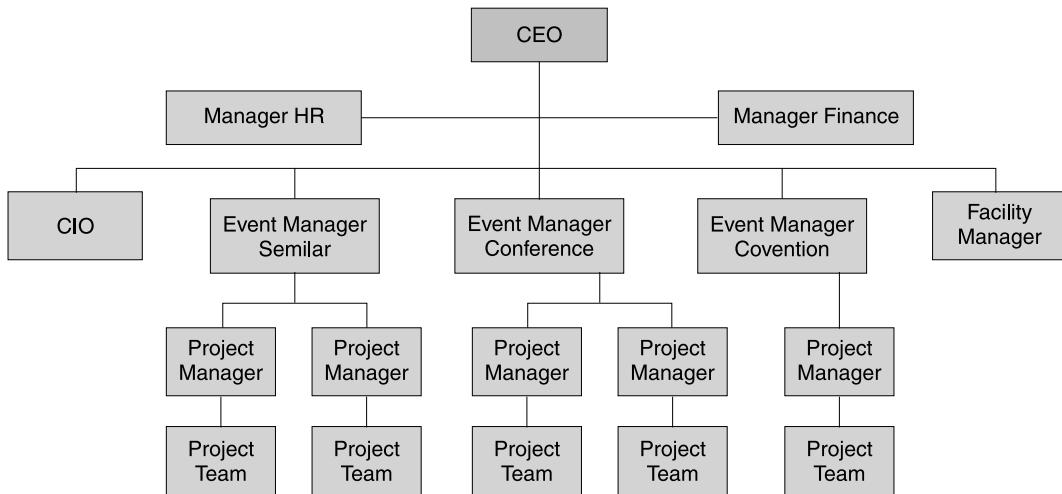
Essentially SSCL offers services in the area of infrastructure and supports them during the performance of the event. It also undertakes other allied services like advertising the event, processing nominations, printing souvenirs, compilation and duplication of the print material and so on.

Normally, a client comes up with the event idea and discusses broad requirements with SCCL. SCCL then prepares a bid proposal based on initial requirement study. It is a practice of SCCL to make a corporate bid presentation. It is observed that every enquiry is worked upon from scratch taking longer time for bid preparation and submission.

### Business Operations and Organisation

SCCL views and treats Seminars, Conferences and Conventions differently though they are events for the people having similar tasks to perform. The organisation model of SCCL is shown in Fig. 13.8.

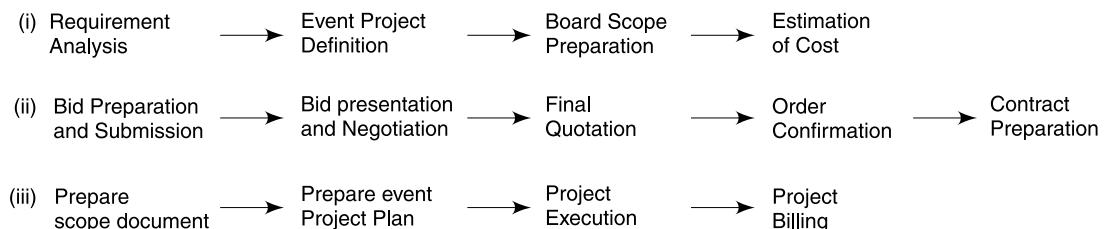
SCCL organisation is structured as a project organisation wherein once the event/project is approved; performing all techno-commercial activities is the responsibility of an event manager and Project manager supported by the project team. SCCL has employed knowledge workers such as managers, specialists, experts and have minimum operation staff. Additional HR requirement is estimated and requisitioned from manpower agencies on contract basis for the event management. The profitability of an event depends on how best HR is estimated and utilised. The cost incurred for infrastructure is paid at actual based on the market rate. SCCL performance depends upon how best is an event planned and executed. All these events are like festival, and client looks at style and manner in which the event is performed. The client views these aspects in high value and is willing to pay to meet high standards.

**Fig. 13.8 SCCL Organisation**

CIO provides information support to event manager and provides system support for event's transaction processing for corporate requirement. SCCL has a local area network and internet support for local processing and communication. Event Managers and Project Managers have desktops to work upon to meet their planning and execution requirements. Facilities Manager is responsible for all hardware such as cars, projection equipments, audio visual equipments, tables and chairs. They are charged on per day basis. The charge includes on site support and operations.

## Events Processing Cycle

A typical event processing cycle is made of following three phases:



The present practice is to treat every enquiry as unique, and process from scratch to finish. This practice is riddled with problems, namely,

- Delay in bid submission
- Incomplete in scope and delivery
- Erroneous resources, cost and time estimates
- Inefficient planning and scheduling
- Loss of opportunity and also orders
- Adverse impact on planned profits

## Expectations

CEO believes that SCC has event/project planning and execution experience. And continuous improvement in performance is possible, if SCCL can use effectively what is learned out of experience. Recently, he attended a seminar on Project Management and came back with additional strength in this belief. In a weekly meeting on Monday he raised this subject and appointed a taskforce of CIO, Event Manager and Facility Manager with the objective of raising the efficiency of event processing cycle, concept to delivery. CEO is of the view that SCCL business is highly competitive and competitive advantage is possible unless the business is treated as 'service.'

CEO is looking for a more sophisticated Project Management System (PMS) which helps build a very efficient 'Project Plan' using SCCL experience, knowledge and information in this business. In this regard he asked team members to study PM Seminar material. He considers PMS a tool to improve quality of service to client to create a image of differentiation.

He is looking for a 'Model' of project plan whether it is Seminar, Conference or Conventions. He wants PM system which will first automate Project Plan preparation and processing reducing the bid submission time of two to three weeks. CEO conveyed that he is convinced if the process of Progressive Elaboration from 'Project concept to Project Plan' is followed, an effective model can be built which then can be used for fitting client specific event/project requirement. He strongly recommended exhaustive efforts by initialisation and planning group in this regard. He also advised to give a thought on viewing the model in terms of 'Umbrella Activities' required for all projects and all pervasive project activities from where client specific project scope can be built. He suggested organisation of the event scope by Tasks/Activities/Processes with other relevant details. This would help in PM system, planning and processing, and execution. He invited ideas on structuring SCC organisation by Project Process Groups and Product Process Groups. He also suggested a task level project Master Plan and Network for model project plan for participants to understand and appreciate.

He asked CIO to make a presentation on the Model Project Plan for SCCL. He assumes that CIO will support this task through information support on SCCL standards on resources and time estimates to make the plan more useful and effective. CIO wants SCCL business process to be modelled in three systems PMS, Service Management System (SCM) and project transaction and accounting system. A presentation of Model Project Plan is scheduled in first week of January 2005.

## Questions

1. Suggest a conceptual model of PMS where knowledge database is created and used for developing project specific PMS model.
2. Break the service cycle of three phases in five parts for efficient and effective execution of the project.
3. Enlist DSSS SCCL should use to improve the quality of service.
4. How would you integrate PMS, Service Management System (SCM) and Accounting of transactions and billing. Draw a system model of integrated system.

# Decision Support Systems and Knowledge Management

## LEARNING OBJECTIVES

- Understanding of DSS
- Types of DSS
- Operations Research Models
- Management Science Models
- Expert Systems
- IA Systems
- Knowledge Based DSS Systems

### 14.1 DECISION SUPPORT SYSTEMS (DSS): CONCEPT AND PHILOSOPHY

Decision Support Systems are an application of Herbert Simon Model. As explained earlier, the model has three phases, viz. Intelligence, Design and Choice. The decision support system basically helps the information system in the intelligence phase where the objective is to identify the problem and then go to the design phase for solution. The choice of selection criterion varies from problem to problem. It is, therefore, required to go through these phases again and again till a satisfactory solution is found. In the use of three phase cycle, you may use either inquiry, analysis, and models or accounting systems to come to a rational solution.

The decision support system helps in making a decision and also in its performance evaluation. These systems can be used to validate the decision by performing sensitivity analysis on various parameters of the problem.

In decision-making, we know that there are two types of decisions—Programmable and Non-programmable. The programmable decision, because of its rule base structure, can be computerised, as inputs, processing methodology, analysis and choice of decision-making are predetermined. Decision support systems can be built around the rule in case of programmable decision situation. While in non-programmable decisions, the rules are not fixed or predetermined, and requires every time the user to go through the decision-making cycle as indicated in the Herbert Simon Model.

The decision support system refers to a class of system which support in the process of decision making and does not always give a decision itself. The nature of the decision is such

that the decision makers need a variety of information, when same or similar types of decisions are to be made. These needs are such that wider additional demands on information would be made, the moment a piece of information is received. The calls on the information are continuously made till the decision maker is fully satisfied. The reason for changing the demands is also because the methods of decision making undergo a change from time to time. The quantum and the scope of information also changes depending upon the risk in decision making. The higher the risk, more information may be sought.

## **Types of Decision Support System**

### **1. Status Inquiry Systems**

The number of decisions in the operational management and some at the middle management are such that they are based on one or two aspects of a decision-making situation. It does not call for any elaborate computations, analysis, choice, etc. for decision-making. If the status is known, the decision is automatic, i.e., the status and solution is unique relation.

### **2. Data Analysis Systems**

These decision systems are based on comparative analysis, and use of a formula or an algorithm. But, these processes are not structured and, therefore, vary. The cashflow analysis, the inventory analysis and the personal inventory systems are examples of the analysis systems. The use of simple data processing tools and business rules are required to develop this system.

### **3. Information Analysis Systems**

In this system, the data is analysed and information reports are generated. The reports might be having exceptions as a feature. The decision makers use these reports for assessment of the situation for decision-making. The sales analysis, the accounts receivable systems, the market research analysis, the MRP systems are examples of this system.

### **4. Accounting Systems**

These systems are not necessarily for decision-making but they are desirable to keep track of the major aspects of the business or a function. The contents of these systems is more data processing leading to formal reporting, with exceptions, if necessary. These systems account items such as cash, inventory, personnel and so on and relate it to a norm or norms developed by the management, for control and decision.

### **5. Model Based Systems**

These systems are simulation models or optimisation models for decision making. These decisions, generally, are one time and infrequent and provide general guidelines for operation or management. The product mix decision, the material mix, the job scheduling rules, and the resource or asset or facilities planning system are the examples.

In order to illustrate these decision support systems, let us take the example of Materials Management function and the variety of the decision and the type of systems used therein to support and evaluate the decision.

<i>Decision</i>	<i>Type of system required</i>
Finding and Selection of vendor	Inquiry system
Procurement	Performance Analyses system
Pricing	Data analysis
Selections of vendor based on price, quality, performance	Information analysis system
Selection of order quantity	Model based system
Inventory rationalisation	Valuation of inventory and accounting system
Management of inventory within various financial and stocking constraints	Inventory optimisation model

We can further analyse these systems in terms of the input source, the system, the hardware and the type of user as shown in Table 14.1.

**Table 14.1** Types of DSS

<i>System</i>	<i>Input source</i>	<i>System</i>	<i>Hardware*</i>	<i>User</i>
1. Inquiry	(a) Database (b) Conventional files	Query System	PC, Servers and clients	Clerks, Assistants
2. Data Analysis other files	Database and Systems	Packages of DP Servers, PCs	Mainframe or Managers	Operations
3. Information Analysis	Processed data files	Analysis Programmes and use of simple models	Mainframe, Mini, Super Mini, Servers, Client PCs	Middle level Managers
4. Accounting ROI Database	Transactions Master files and	Transactions processing system	Mini, Mainframe, Client/Server	Middle and Top Management
5. Model Based Control	Inventory database and External data	Development of OR or Business Models	Mainframe, Mini, Client/Server	Middle and Top Management

\* Hardware will be configured under client/server architecture.

Some more facts about decision support systems are,

1. The decision support systems are developed by the users and system analysts jointly.
2. The decision support system uses the principles of economics, science and engineering, and also the tools and techniques of management.
3. The data used in the decision support system is drawn from the information systems developed in the company.
4. The decision support systems are developed in isolation and form an independent system subset of the management information system.
5. The most common use of the decision support system is to test the decision alternatives and also to test the sensitivity of the result to the change in the system and assumptions.

6. The data and information for the decision support system are used from the internal sources such as the database and the conventional files, and from the external sources.

### DSS: Deterministic Systems

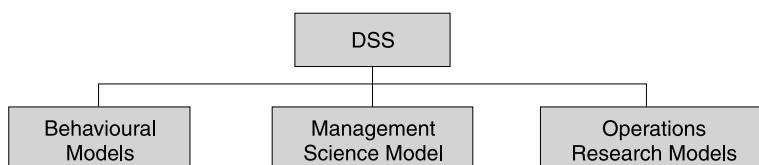
There are a number of situations, where the management has to make a decision based on the analysis of business statistics. Since, the organisation would have the database information, these decision situations draw data from the database(s). Most of these decision situations are fairly structured and, therefore, can be put in the form of the business models. A fair assumption is made that the model has business and decision-making validity.

If the management can design such models duly tested, they can be used by the decision makers, whenever the need arises. All such tools and models act as the support systems for decision making. The tools and the models are generally standard but have to have a custom design to suit the organisation's specific needs in the specific situation. The decision support systems based on such tools or models have found extensive use, as a number of computer based software tools and packages are available at a very reasonable price. These packages are hardware independent and have proven the application areas. The range of packages are available from the PC to main frame computer systems. The packages are also available for popular network systems, as well.

The origins of these tools and models lie in the Business Management, the Management Science and the Operations Research. Some are universally known and proven tools and have application in the Business Management. While designing the models, a flexible approach is taken to solve varied decision-making problems. They undergo a change over a period of time. The most significant advantage of the decision support system is its use in sensitising the decisions and assessing its implications on the result or business performance. The second advantage of such system is in focusing on the critical issues in business. The third advantage of the decision support system is that it provides higher management ability to delegate decision making to the lower level once the tools and the models are tested.

## 14.2 DSS MODELS: BEHAVIOURAL, MANAGEMENT SCIENCE AND OPERATIONS RESEARCH MODELS

The decision support system can be based on three different approaches. They are as given in Fig. 14.1.



**Fig. 14.1** Types of Tools/Models

### 1. Behavioural Models

These models are useful in understanding the behaviour amongst the business variables. The decision maker can then make decisions giving due regard to such behavioural relationships.

The trend analysis, forecasting, and the statistical analysis models belong to this category. The trend analysis indicates how different variables behave in trend setting in the past and hence in the future. A regression model shows the correlation between one or more variables. It also helps in identifying the influence of one variable on the other. These types of models are largely used in process control, manufacturing, agricultural sciences, medicines, psychology and marketing. The behavioural analysis can be used to set the points for alert, alarm and action for the decision maker.

## **2. Management Science Models**

These models are developed on the principles of business management, accounting and econometrics. In many areas of management, the proven methods of management control are available which can be used for the management decision. There are also several management systems, which can be converted into the decision support system models.

For example, the budgetary systems, the cost accounting systems, the system of capital budgeting for better return on the investment, the ABC analysis, the control of inventory through the maximum-minimum levels, the MRP systems, etc., are the examples of the use of the management science in the materials management. Production planning and control, scheduling and loading systems are the examples in Production Management. Manpower planning and forecasting is the example in Personnel Management.

Some of these models can be used straight away in the design of the decision support system. While some others require the use of management principles and practices, most of the procedure based decision-making models belong to this category. One can develop a model for selection of vendor for procurement of an item, based on the complex logical information scrutiny. Such models take away the personal bias of the decision maker.

## **3. Operations Research (OR) Models**

The Operations Research (OR) models are mathematical models. These models represent a real life problem situation in terms of the variables, constants and parameters expressed in algebraic equations. Since, the models are mathematical, there are solutions to these problems. In arriving the solution, methods of calculus, matrix algebra, probability, and set theory are used. These models have a clarity to the extent that each of them has a set of assumptions which must be true in real life. Further, if the assumptions are valid, the solutions offered are realistic and practical, the model represents the real life problem situations.

The OR models address themselves to the resource usage optimisation, by balancing two or more aspects of the decision situation. The efforts are made to find the optimum solution. In business and industry, there are a number of situations where one type of cost is controlled, the other cost goes up. This play between the two costs has to be balanced at a point, which is known as an optimum point. The OR models generally try to find a solution which maximises or minimises certain aspects of business, under the conditions of constraints.

In manufacturing business, the maximisation of profit with an appropriate product mix, within the capacity and the market constraint, is a common problem. The allocation of an inventory to the various destinations with the least transportation costs is another well known problem. The minimisation of capital blocked in the inventory and simultaneously meeting the market demand or the production requirement is also a problem constantly met with. The

inventory control models offer an optimum solution, where the cost of inventory and the cost of ordering or set up is balanced.

In facility designing problem, the cost of facility, its running cost, the idle time of the facility, and the waiting time of the customer are considered. These problems are solved by application of the Queuing Theory. The theory considers two costs, viz., the cost of waiting time to customer and the cost of idle time of the facility and decides on the facility design with a predetermined service standard.

Some problems do not precisely fall in the category of the standard OR models. In such cases, the problems are solved by using a simulation approach. This approach uses a random occurrence of a large number of events, determines the status of the system and evaluates its cost of operations. The simulation techniques helps to assess the quality of the facility design before the investment is made in building such facility.

### **Examples of Behavioural Models**

#### ***Forecasting: Regression Models***

In the regression models, we are trying to find the relational impact of one variable on the other\*. For example, bodyweight can be estimated with the help of food in-take, since they show a strong relationship. Or the sale of two wheelers can be forecasted with the following regression model:

$$Y = 600 + 0.6x.$$

Where  $Y$  = Sale of two wheelers

$X$  = Surplus disposable income

The statistical packages are available for variety of regression models which can be used for developing and testing the regression model,

#### ***Forecasting: Time Series Analysis and Exponential Smoothing***

It is possible to generate a forecast for the next period demand with the help of a simple average of two previous periods. However, the simple average of past two periods to forecast the next period may not be correct. In such cases, exponential average is used; where more weight is given to the latest period and less weight to the older period. If three period model is constructed, it would be as under:

$$\text{Sale for period } \rightarrow t + 1 = St + 1$$

$$S_{t+1} = aD_t + (1 - a)aD_{t-1} + (1 - a)^2 aD_{t-2} + (1 - a)^3 a D_{t-3}$$

' $a$ ' is a weight expressed in a fraction and  $D$  is the actual demand at period  $t$ . The larger value of ' $a$ ' means the new average will be more influenced by the demand of the latest period and less by the old period.

The forecasting model is a Decision Support System, and there are many models to choose from. The most important decisions are based on forecasts. A forecasting model needs continuous scrutiny and, built-up on the accurate data on the variables and the parameters to be derived from the other information systems developed in the organisation.

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\*A typical two variable regressions model is  $Y = C + R \cdot X$ , where  $C$  is constant and  $R$  is regression coefficient.

### **Market Research Methods**

Several methods are available, whereby you can forecast or judge the behaviour of the consumers in respect of their buying decisions. The questionnaires are designed and computerised to assess these aspects of the buying behaviour.

For example, through a survey, the marketing manager can forecast the response rate, the recall rate on the various advertising campaigns and its influence on the buying decision. The survey methods are used to find the influencing factors in the buying decisions.

### **Ratio Analysis for Financial Assessment**

The ratio analysis is a standard method of assessing the financial status of the organisation. A model of these ratios can be computerised and be readily used to assess the status, if certain changes are expected. There are some ratio norms prescribed by the financial institutions to judge the financial condition of the organisation. There are also used while decision-making for advancing loans to the companies. There are more than a dozen ratios which deal with all aspects of business. They are the current ratio, the quick ratio, the assets to liabilities, and the inventory turnover and so on.

## **Management Science Models**

### **Budgeting Models**

Controlling the business performance through the budget system, is an accepted management practice. In this approach, various budgets are prepared, viz., the Sales Budget, the Production Budget, the Capacity Budget, the Manpower Budget, the Expense Budget, and the Inventory Budget, etc. Using these budgets the profits are estimated.

Budgets are also used for planning and control. The system is used to find out whether the performance is under the budget or over the budget. This gives the manager a self evaluation tool for assessing the current status and also provides some insight into the operations of the company.

The use of spread sheet, Lotus-1-2-3, Visicalc, Framework and many others, are a standard tool for these applications, where the planning, budgeting and analysis is required. All these systems are based on the worksheet which has columns and rows with labels on each. The package helps in arriving at the row totals and the column totals. It not only provides the totals but also summaries at the sub-heads. It has also a facility that if one row or column changes, it computes the changes in the rest of the worksheet, where it is affected. For example, the spread sheet of Sales-Profit model is given in Table 14.2.

**Table 14.2** Spread Sheet of Sales-Profit Model

<i>Particulars</i>	<i>Quarter</i>				
	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	<i>Total</i>
Unit Sales	10	15	12	20	57
Price/Unit	10	10	15	18	—
Sales (₹)	100	150	180	360	790

*Contd...*

*Contd...*

Cost of Sales	50	75	90	180	395
Gross Margin	50	75	90	180	395
Mkt. Expenses	10	15	20	40	85
Other Overheads	10	10	20	20	60
Profit (000)	30	50	50	120	250
Profit% to Sales	30	33	28	3	31

The spread sheet packages can handle hundreds of rows and columns and provide the analysis on the percentage basis. Each manager can prepare, simple spread sheet for his areas of operations, where the data is drawn from a computerised Mini or Mainframe Systems. These packages provide a graphical presentation in the form of line charts, Bar charts and Histogram, etc. for visual impact.

### ***Break-even Analysis Model***

This model is simple but very useful for determining the volume of business activity at which there is no loss or profit. The model is used to decide the alternatives based on the cost, volume and price. The break-even model, as expressed in the mathematical form, is as under:

$$\text{BEP} = \frac{FC}{REV - VC} = \frac{1,00,000}{200 - 100} = 1000$$

*FC* = Fixed Cost

*VC* = Variable Cost/Unit

*REV* = Revenue Per Unit

*N* = Number of units demanded

Break-even Point = BEP

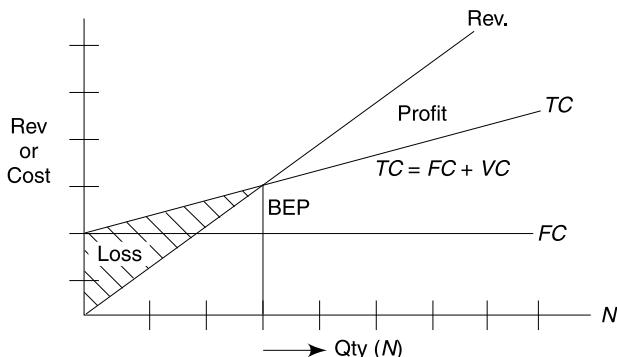
Suppose, *FC* = 1,00,000

*TC* = Total cost

*VC*/Unit = 100.

*REV* = 200

The graphical picture of the break-even model is given in Fig. 14.2.



**Fig. 14.2 Break-even Model**

This model can be built for the company, for the product groups or for any activity, where you can identify the fixed cost, the variable cost and the revenue at each activity level in terms of the units demanded. The advantages of this model is that it tells you as to what the break-even point for the given level of costs and revenue is. If there are possibilities of altering the costs, it would tell its impact on the break-even point, i.e., if the price is reduced, the revenue will come down and the break-even point will further go up.

The cost are generally not linear over the entire range of activity. The cost would go up after a certain range and would remain steady till some level and further increase is then expected. A break-even model can be built for the multiple activities and for the non-linear costs. The computerised model helps in assessing the various parameters of business and its sensitivity towards the profit/loss. The model is very popular when the costs are known and are controllable. It is very handy tool for a quick decision on the price, cost considerations, etc. and can be used very effectively for commercial negotiations.

### ***Return on Investment Analysis***

The investment decisions are very common in the business organisations and they are of two types. First, one has to invest in one among the several alternatives which are competing with each other. For example, you want to buy a machine for which three alternatives are available, and each alternative has a different investment amount and a different flow of gains or savings. Then, the second decision the management has to take is how to allocate the total funds to the various investment projects. For example, the organisation may have ₹ 100 million and the investment projects are worth ₹ 150 million. The management, therefore, has to take a decision as to how to allocate Rs 100 million to these projects?

Therefore, in the investment decisions, the investments are evaluated on the basis of discounting the value of the money of the further cash flow to the current period and net gains are compared.

For example, you are going to receive one rupee next year. This flow of money, if it is to be evaluated as on today and discount rate is say 10 per cent, then this one rupee of the next year is worth ₹ 0.90 this year. The ₹ 0.90 is the net present value of one rupee expected in the next year.

In investment analysis, the Net Present Value (NPV) is calculated and compared with all the investment alternatives.

$$\text{NPV} = (\text{PV of further cash flow}) - \text{Investment} = PV - I$$

The formula used for the present value ( $PV$ ) is

$$PV = S \left[ \frac{1 - [1 + i]^{-T}}{i} \right]$$

where  $T$  is a number of period, in which an amount  $S$  for each period is going to be received and  $i$  is a discount rate.

If the stream of cash inflow (savings or gains) are unequal each 'S' will be evaluated separately to compute the NPV.

Let us consider the following problem of selecting an investment plan

	<i>Plan A</i>	<i>Plan B</i>
Investment in ₹ Million.	1.4	2.1
Saving/gain per year/in ₹ Million	0.475	0.55
Number of years savings or gain would occur	10	10
Discount rate	18%	18%

#### *Plan A*

$$NPV = 0.475 \left[ \frac{1 - (1.18)^{-10}}{0.18} \right] - 1.4 \\ = 0.734$$

#### *Plan B*

$$NPV = 0.559 \left[ \frac{1 - (1.18)^{-10}}{0.18} \right] - 2.1 \\ = 0.371$$

Since Plan A has more NPV we should select Plan A.

Using these concepts of the present value of future cash flow a decision support system model can be built considering the following factors.

- The number of investment proposals.
- Differential investments.
- Different cash inflows of savings.
- Different criterion for selection, i.e., the payback period, the rate of return and the internal rate of return.
- Maximising the return by allocating limited funds to the several investment proposals.

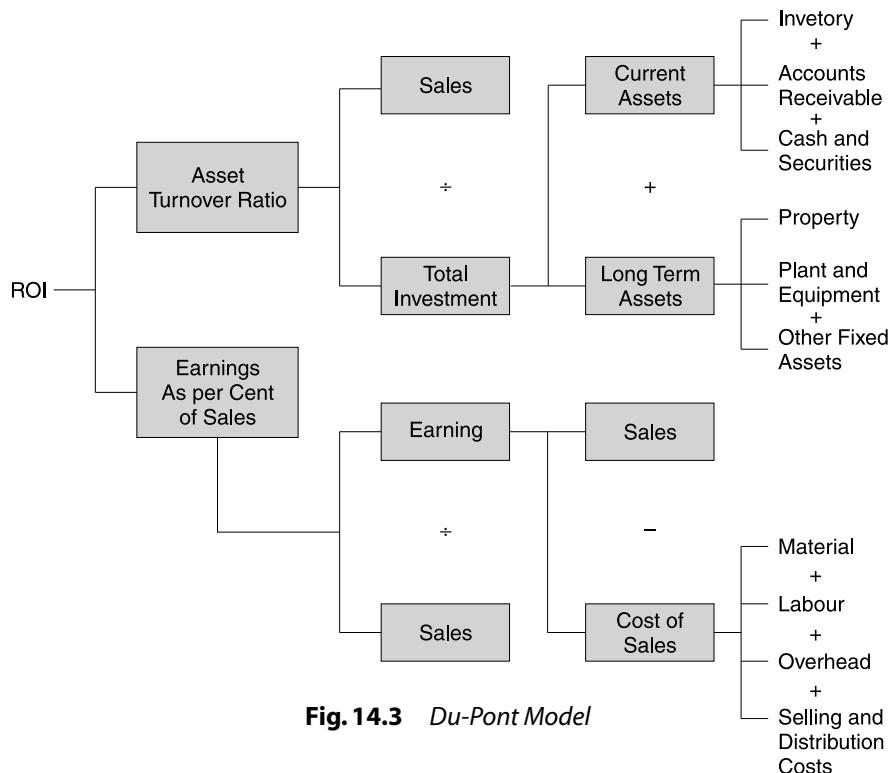
#### ***Corporate Model of Return on Investment***

This model is popularly known as Du-Pont Model where the composition and the analysis of the Return on Investment is shown. This model is better than the above discussed individual ratio model and its analysis as this model provides an insight into the relationships of the various factors affecting the return on investment. The Du-Pont Model is shown in Fig. 14.3.

Suppose, you have to make a decision on buying a business. In such an event this model will be useful. This model also gives the decision alternatives to improve the return on investment in the current business.

#### ***Model for Cash Budgeting***

Cash budgeting is a continuous process. With careful cash planning, a company should be able to maintain sufficient cash balance for its needs, yet not be in a position where it is holding excessive cash. This kind of planning will help to raise the short-term loans and simultaneously focus on the issues which is affecting the financial management. A typical statement of cash budgeting is given in Table 14.3.

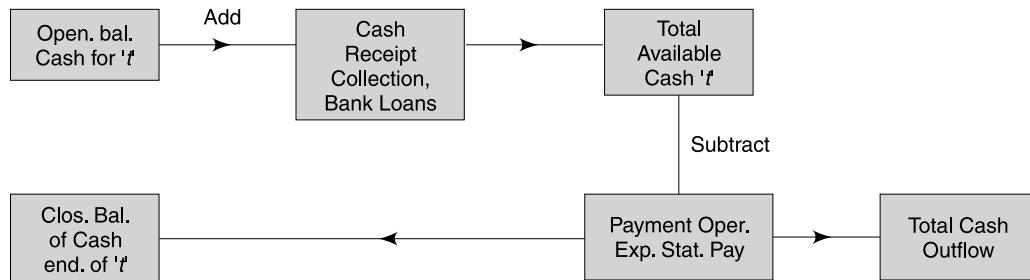

**Fig. 14.3** Du-Pont Model

**Table 14.3** Statement of Cash Budget Forecast

	<i>(Figures are in rupees million)</i>			
	<i>January</i>	<i>February</i>	<i>March</i>	<i>April</i>
Cash Balance	42	46	40	48
Cash Inflow Cash Sales	23	93	28	21
Collections	60	200	166	130
Loans	110	0	0	0
Total Inflow	193	293	194	151
Cash Outflow Pay Suppliers	173	264	62	168
Operating Expenses	14	33	27	13
Statutory Payments	2	2	2	2
Misc. Outflow	0	0	191	70
Total Outflow	189	299	282	253
Cash Balance (+/-)	+46	+40	-48	150

This shows that in the month of March and April, additional funds raising through external sources will be needed.

With the use of computer, a model can be built with all the details of cash inflows and outflows as shown in Fig. 14.4.



**Fig. 14.4** Model for Working Capital Management

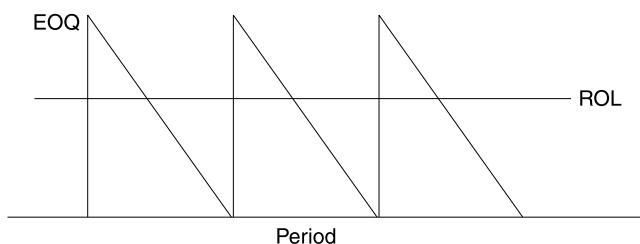
### Procedural Models

There are a number of decisions which are made on the basis of well defined rules and procedures. Unless certain conditions are satisfied the decision rules will not be applied.

The use of rules, formula or mathematical expressions is the basis for the model. For example, the reordering procedure for an inventory item is as under.

If the stock level  $\leq$  the Recorder level, then draw a purchase order of the quality equal to the Economic Order Quality (EOQ).

This ordering rule is developed on the model of the Economic Order Quantity (EOQ)—Required Order Level (ROL) system as shown in Fig. 14.5.



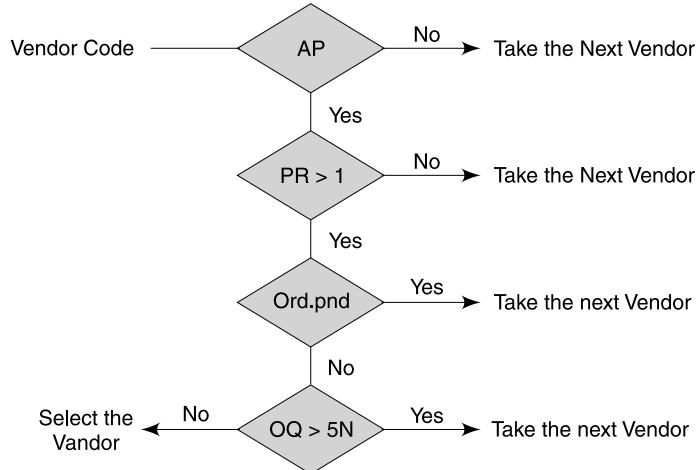
**Fig. 14.5** EOQ Model

It is possible to control the inventory of some items based on such models. These models can be computerised and be made a part of the Decision Support System. The decision models can be developed by using the non-mathematical expressions or a formula. If the conditions are satisfied the decision is automatic.

Let us take a decision problem of selecting a vendor by using the non-mathematical expressions. The selection of vendor is based on the following conditions:

- |        |   |  |
|--------|---|--|
| Vendor | : | Is he approved (AP)?                           |
|        | : | What is the performance rating (PR)?           |
|        | : | How many orders are pending on him (ORD. PEN)? |
|        | : | What is the level of order quantity (OQ)?      |

These conditions can be put in a model as shows Fig. 14.6.



**Fig. 14.6** Vendor Selection Process Model

### Project Planning and Control Models

The PERT (Programme Evaluation and Review Technique) and the CPM (Critical Path Method) techniques have emerged as very powerful tools for planning and control on one time tasks or projects. Against the conventional systems of GANTT charts, these techniques provide better facilities in terms of understanding of the project as they show the inter-dependencies of each activity in the project. Several computer software packages are available which can be used effectively for planning, monitoring and control of task and projects of the large number of activities.

Apart from planning, the model also manages to helps three aspects of the project, i.e., the completion time, the cost and the resource. The techniques provide a ready help in assessing the impact on the project completion time, if the activities are delayed. It provides the facilities to schedule the resources for the various activities. The most important advantage which these techniques provide, is the information on trade off, in each activity, for cutting down the activity completion time. It helps the Project Manager to select an activity for resource scheduling.

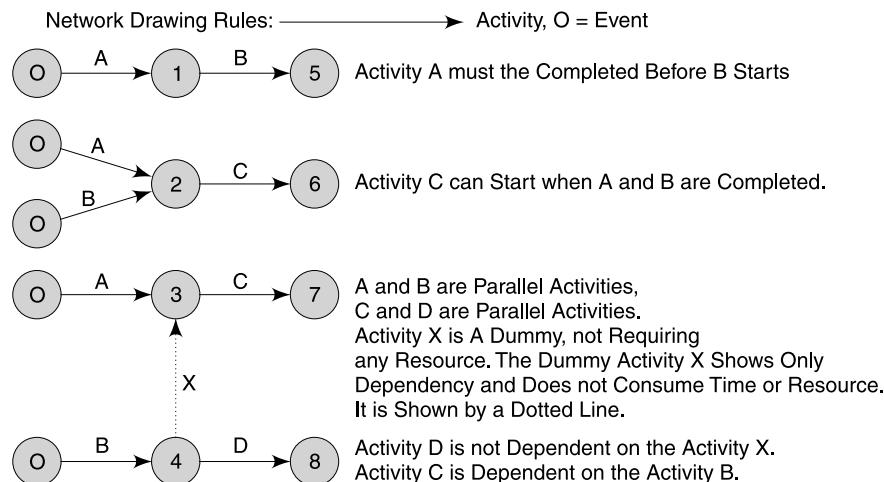
#### **Management Considerations of PERT/CPM**

1. The project manager considers the sequencing of activities before implementation of the project.
2. Inter-dependencies between the activities are described more clearly showing the possible bottlenecks in future.
3. Attention is focused on selected activities which are critical for the project completion.

4. It provides an easy method of planning the project in a different manner, within available resources.
5. A running estimate is provided, of the most probable time in which a project will be completed and also the probability of its being completed in time.
6. Any activity which is entering into cost and time over-runs is quickly identified.

### ***Network Drawing and PERT/CPM Statistics***

Figure 14.7 explains the rules of network drawing



**Fig. 14.7 Network Drawing**

### ***Estimating Activity Time***

When the network is completed, every event is assigned a number for reference and identity. Then, the next step is to estimate the completion time of each activity. Two time estimates are suggested:

- (a) The most likely time of completion of the activity.
- (b) The time estimate ( $te$ ) based on "three" time estimates:

The optimistic, the most likely and pessimistic

$to$  = The optimistic time estimate.

$tm$  = The most likely time estimate.

$tp$  = The pessimistic time estimate.

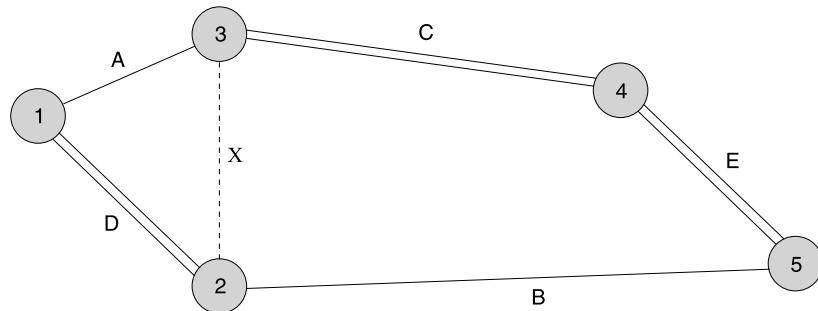
Then, the activity time estimate,  $te = \frac{to + 4tm + tp}{6}$

### ***Drawing the PERT Network***

The next step is to draw a network of the project from start to finish.

The critical path is that path which takes the longest time for start to end. Let us take a sample project as under:

Activity	Most likely duration (Days)	Immediate predecessors to activity
A	5	-
B	8	D
C	6	A,D
D	11	-
E	7	A,C



**Fig. 14.8 Critical Path**

Activity	Early start (ES)	Early finish (EF)	Late start (LS)	Late finish (LF)	SLACK
A	0	5	6	11	6
B	11	19	16	24	5
C	11	17	11	17	0
D	0	11	0	11	0
E	17	24	17	24	0

$$\text{SLACK} = \text{LS} - \text{ES} \text{ or } \text{LF} - \text{EF}$$

Critical activities are those where the slack is zero. In the network D, X, C, E are the critical activities: While A and B are non-critical. The slack is a time resource which a project manager can use for manipulating the resource and start and finish of the activity.

$$\begin{aligned}
 \text{Project Completion Time} &= \text{Sum of activity times on a critical path} \\
 &= D + X + C + E \\
 &= 6 + 0 + 11 + 7 = 24 \text{ days}
 \end{aligned}$$

### Probability of Completing the Project

Suppose the project is scheduled for completion in 24 days. We can estimate the probability of completion in 24 days in the following manner.

<i>Optimistic Dessimble</i>				
<i>Activity</i>	<i>Time to</i>	<i>Time tp</i>	$\sigma = \frac{tp - to}{6}$	$\sigma^2$
A	-	-	-	-
B	-	-	-	-
C	3	8	0.83	0.69
D	7	20	2.16	4.66
E	4	10	1.0	1.00
				6.35

Sum  $\sigma^2 = 6.35$ , therefore,  $\sigma = 2.35$

$$Z = \frac{25.0 - 24.0}{2.35} = \frac{1.0}{2.35} = 0.43$$

A normal probability curve table indicates against 0.43, that is, the project will be completed in 24 days with 67 per cent probability. (See these tables in any textbook of statistics).

### ***Activity Crashing for Control of Time***

<i>Activity</i>	<i>Normal duration</i>	<i>Cost for normal duration</i>	<i>Crash duration</i>	<i>Crash cost ₹</i>
A	5	500	3	1000
B	8	800	-	-
C	6	900	-	-
D	11	1200	7	1600
E	7	1000	5	2000

Activity B and C cannot be crashed. Activity A can be crashed to 3 days and it will cost ₹ 1000 as against ₹ 500. If the project is to be controlled in time, it is necessary to crash the activities which are on the critical path.

<i>Critical Activity</i>	<i>Reduction in duration</i>	<i>Cost increase</i>	<i>Cost slope</i>
C	-	-	-
D	4	400	100
E	2	1000	500

So if the project is to be completed in 20 days as against 24 days, it is economical to crash the activity D and E as the cost increase per day in case of D is ₹ 100 and as that of E is ₹ 500. MS Project and PRIMA VERA are the standard packages for Project Management.

### ***Cost Accounting Systems***

The cost data is an important data which is used in many business decisions, such as pricing, make or buy, purchasing, allocation of overheads, etc. Most of the companies which are in

competitive business, rely on the formal cost accounting systems used for business decisions and also for the cost control. There are three cost accounting systems:

- Job order cost system
- Process cost system
- Period cost system

The companies install these systems as the case may be and build a cost database for support in decision-making.

### **1. Job Order Cost System**

In this system the costs are assigned to the jobs passing through the plant and are accumulated by recording the basic job statistics on the job card. The order is broken into three sections—materials, labour and overhead.

The direct materials are accounted through the material issues and the direct labour through labour booking on the card. Direct overheads are also booked through transactions. The indirect overheads are allocated, on some agreed basis such as man-hours or machine-hours. All the costs are accumulated and the unit cost of the job is computed.

These systems give due consideration to work in process (WIP) and the rejections, etc. for costs for the three inputs mentioned above. Using these the standards for costs for the three inputs mentioned above are determined and the job cost is budgeted. The costs are then used to find whether the actual cost is more than the budgeted cost. All such over-runs are investigated with the purpose of cost control and in few cases the standards may be modified.

### **2. Process Cost System**

In this system, the costs are accumulated by a department or an operation. In other words, the emphasis is placed upon the department of manufacture. The number of units of product completed in the department is used in the computation of a unit cost. The unit costs are then applied to the number of units transferred in the manufacturing process and ultimately identified with units completed and sold.

### **3. Period Cost System**

In this system, no distinction is made between direct materials and indirect materials with respect to product. Materials are not requisitioned for a particular order or a product. Instead, the direct material and the indirect material are identified with the department or the process. The material consumed is accounted over a period for cost considerations. The labour costs are also accumulated by the department or process with no distinction made between the direct and the indirect labour.

The wages paid to the employees in the department are fully accounted. Manufacturing over-heads are assigned to the departments or the processes directly, wherever possible, and if they cannot be directly identified with the departments, they are allocated by using the various methods of allocation. The cost so computed are then transferred to the final product on unit basis giving due regard to the work in progress (WIP).

The variation in the product cost is not caused by any basic change in the type of product manufactured or by any change in the cost structure, it merely results from the variations in

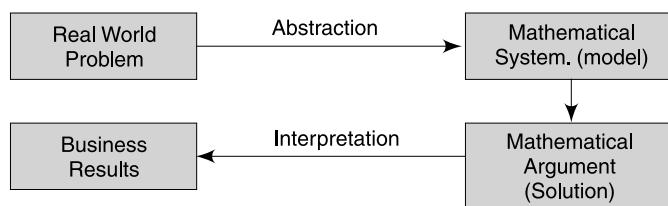
the quantities produced at different times during the year and from the variations in manufacturing overheads. When the product completion time is very large, the application of the job costing or the process costing is not possible. In such cases the cost data is accumulated on the basis of the period against the job and summed up to arrive at the actual cost when the job is completed.

All the three systems can be computerised for cost control by using the cost budgeting systems.

### **Operations Research Models**

#### ***Mathematical Programming Techniques***

Mathematical Programming Technique is a vast area of application. The programming techniques are applicable when certain conditions are met and the problem can be expressed in a mathematical form in terms of the decision variables. The programming techniques are based on such mathematical models which give unique feasible solutions satisfying the constraints on resource, capacity, demand, etc. The process of mathematical programming is given in Fig. 14.9.



**Fig. 14.9** *Mathematical Programming Model*

#### ***Linear Programming Model (LP)***

Linear programming is a special mathematical model. This model is applicable where the decision variables assume the values which are non-zero, and the relationship among the various variables is linear. There are limitations, called constraints to use the variables or a combination thereof.

Suppose a company makes two products P1 and P2 from two types of raw materials R1 and R2. The product P1 requires 2 units of R1 and 1 unit of R2 and the product P2 requires 1 unit of R1 and 2 units of R2. The Company has 500 units of R1 and 750 units of R2. The products P1 and P2 are to be produced to maximise the profit. The contribution to overhead and profit is Rs 5 for the product P1 and Rs 4 for the product P2.

Let us define the decision variables for the products P1 and P2 and X1 and X2, i.e. X1 and X2 are the quantities to be produced of P1 and P2 respectively. Then decision problem can be expressed in the form given below.

$$Z = \text{Profit} = 5X_1 + X_2 = \text{Maximum}$$

Within the raw material constraint.

$$2X_1 + X_2 < 500$$

$$X_1 + 2X_2 < 750$$

$$X_1 > 0, X_2 > 0$$

This problem has a solution which is optimum. The problem is solved by the Simplex Technique. The solution to this problem is:

$$X_1 = 83.1/3 \text{ and } X_2 = 333.1/3, \text{ Profit} = 1750$$

Computer based LP software packages are available almost on all the computer systems. Besides, solving linear programming problems, the solution provides a variety of management information through sensitivity analysis. For example, in this problem, it would provide the information on the following.

- (a) If profit of P2 is increased to Rs 6 what would be the product mix of P1 and P2?
- (b) If raw material constraint of R1 is improved to 800 and of R2 to 1000, what would be the product mix and profit?
- (c) If instead of 2 units of R2 in P2 and 1 unit of R2 in P1, we succeed in reducing this use by 20 per cent, what would be the product mix and the profit?
- (d) Suppose if only P2 is to what action should be taken?

Quadratic programming, integer programming and dynamic programming are all special cases of the mathematical programming model. These models can be used as Decision Support System in business decisions.

The typical mathematical programming problems which can be solved by applying the optimisation techniques are listed as follow:

1. The design of aircraft and aerospace structures for minimum weight.
2. The design of water resources systems for maximum benefit.
3. The shortest route of travel.
4. The optimum product mix.
5. The minimisation of cost by raw material mix.
6. Assigning jobs to workers.
7. The selection of site for an industry.

### **Inventory Control Models**

Materials management is an important function in Business Management. Apart from the commercial aspect of the Materials Management, its major objective is to control inventory in such a manner that the capital blocked in the inventory is minimum and the demand on the inventory is met without any time loss. The inventory control models are developed for each kind of conceivable situation in business.

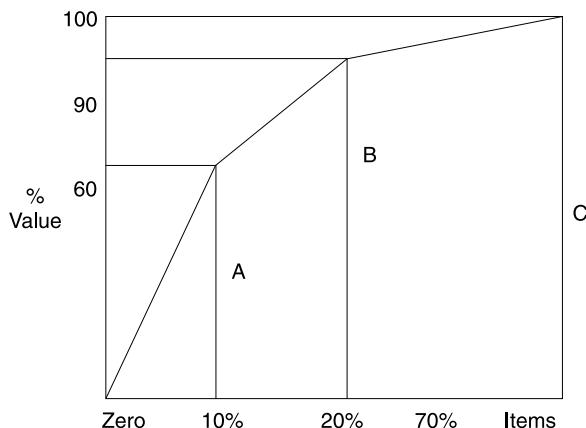
#### **A-B-C Analysis**

The inventory items are analysed in a number of ways by some aspects of the inventory. One of the classification is the A-B-C analysis based on the capital blocked in the inventory.

It means that when the inventory, it will be observed that 10 per cent items of the inventory contribute to 60 per cent inventory capital, 20 per cent contribute to 30 per cent inventory

capital, and 70 per cent items contribute only to 10 per cent capital. This immediately suggests the management control focus on '10 per cent A' category items. Figure 14.10 shows A-B-C analysis in graphical form.

The system of control for these items is normally as shown in Table 14.4.



**Fig. 14.10** A-B-C Analysis

**Table 14.4**

Category of item	Control system
A	ROL system or ordering in smaller quantities on review of the inventory.
B	Fixed period ordering system. Maximum-Minimum System.
C	Annual review and ordering system.

All these items can be brought under a computerised system. Such system will compute the inventory control parameters for each item and make suitable decisions. In all the three systems, the cost of order or manufacture is balanced with the inventory carrying cost.

The inventory can be classified in other ways also. For example, the inventory is classified from the manufacturing point of view taking ease of procurement as a basis. The classification could be critical, semi-critical, and not critical from the production point of view. The inventory control system recommended for this classification is as shown in Table 14.5.

**Table 14.5**

Category of item	System of control based on ease of procurement
Critical (A)	Bulk procurement and control on stock variations.
Semi-critical (B)	Periodic ordering.
Non-critical (C)	But very frequently, keep minimum stock.

The management control focus is on undisturbed supply of raw material to manufacturing.

Each time in the inventory is planned, monitored and controlled through one system or the other, based on the category of the item.

Periodically the parameters of the control change; but by and large the system of control remains the same because the objective is to control the capital blocked in the inventory. The main issue is how to allocate the capital amongst thousands of items without affecting the demand of the items. In such cases the ordering cost, the inventory carrying cost, and the cost of stock-out are considered in the system of control mentioned above.

### ***Material Requirement Planning (MRP) System***

When the company is following a fixed period production programming to maximise the use of production capacity, the Material Requirement Planning systems are used to minimise the inventory and simultaneously ensure the availability of the material. The MRP system is feasible only when the company produces standard products for which the Bill of Material or the Part List enumerating the items which go into the products, is available.

The bill of material is exploded and summarised for the items disregarding where it is used. Then it is compared with the stock available, the order placed and due for delivery in the production period. The comparison will show the shortage which would be faced in the execution of the production programme.

MRP system is also used when the production requirement is fluctuating from period to period and also where the changes in the production programme are frequent. It provides an excellent tool for planning, procurement, monitoring and control of the inventory as well as the production programme.

## **14.3 GROUP DECISION SUPPORT SYSTEM (GDSS)**

Decision Support Systems which we discussed so far are designed for a manager who is a sole decision maker. However, many decision-making situations call for involvement of a number of persons, each contributing towards the decision process. Information technology supports such decision-making where there is a group participation. Such decision support system is termed as Group Decision Support Systems (GDSS).

GDSS has also same components as in DSS, namely Database, Models, DSS Tools (Query, OLAP, Spreadsheet, Statistical Analysis) and something more which group needs to work together. If GDSS is a group responsibility then the group needs a platform to conduct the process. Four configurations of group members are possible as listed below.

- (a) Group members in one room operating on network with common display screen to share the display for all members. GDSS process is transparent.
- (b) Group members sit at their respective locations and use their desktop and LAN to interact with other members. GDSS process is not as transparent as in case of 'a'.
- (c) Group members are in different cities and they come together through teleconferencing or video conferencing with prior planning for GDSS operations.
- (d) Group members are at remote locations may be in different countries and they come together through long distance telecommunications network.

In all four configurations, GDSS support software is available on server for members to use. Disregarding the configuration model of the group and the type of network they use, following activities are common.

- Sending and receiving information in all forms, types across the network.
- Display of notes, graphic, drawings, pictures.
- Sharing ideas, choices, and indicating preferences.
- Participate in decision-making process with inputs, help and so on.

In all configuration models, the group members work together in a collaborative manner. Collaborative work management tools support GDSS. Also GroupWare software is used to accomplish a set of group activities. These GDSS support tools help in calendaring and scheduling, project management, workflow and workgroup activities and knowledge management.

In GDSS, group members interact, debate, communicate and conclude using different tools and techniques. This process may not happen in real time in continuous manner. The process may run for sometime online, then stop and wait for response(s), then react on response till the problem is solved. Group members are drawn from different fields having a specific knowledge and application skills. They pitch in voluntarily or when called for to take GDSS process ahead to conclusion.

GDSS is "an interactive computer-based system to facilitate the solution of semi-structured or unstructured tasks undertaken by a group and its leader. GDSS provides the hardware, software, databases and procedures for effective decision-making. It has computing, communication and storage capabilities. A rule based procedural task like loan processing is a structured task. Drafting and signing a legal contract is unstructured as contents of the contract vary with the requirement of the contract, legal and other.

The goal of GDSSs is to improve the productivity of decision makers, either by speeding up the decision-making process or by improving the quality of the resulting decisions, or both. This is accomplished by providing the support for the exchange of ideas, opinions, and preferences within the group.

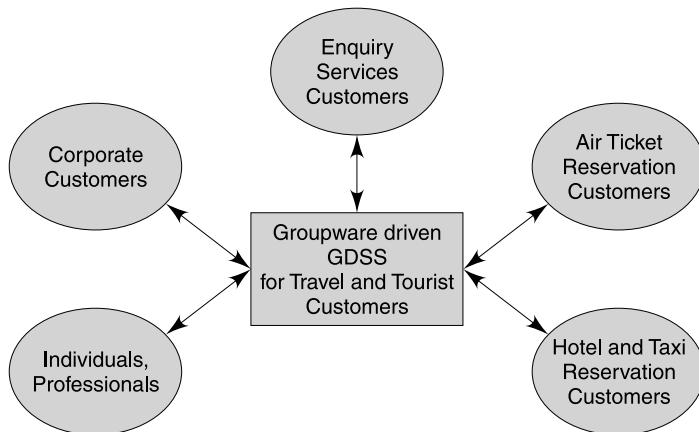
The GDSS accommodates users with varying levels of knowledge regarding computing and decision support. It can be designed for one type of problem which is handled by the group. It facilitates and encourages generation of ideas, resolution of conflicts, and communication in the group making the group more cohesive and collaborative.

Groupware is the hardware, software platform of GDSS which supports group work. Groupware applications make group members more efficient and smart in decision-making. Groupware and GDSS have the following features and service capabilities:

- Supports parallel processing of information
- Empowers group members to participate in the meeting with more complete information
- Permits the group or individual members to use tools, techniques or models of decision-making of their choice
- Offers rapid and easy access to external information
- Allows computer based discussion like oral discussions

- Produces instant, anonymous voting results
- Enables several users to interact simultaneously
- Automatically records all information that passes through the system for future analysis
- Develops organisation memory for subsequent use by all

All what is stated above as features, functions and services of GDSS are illustrated in Travel & Tourist services system shown in Fig. 14.11. It can handle a class of customers, offer single or multiple services, including commercial and financial transactions. Customer behaviours like negotiations, keeping some matter under hold, partial processing, and credit issues are also taken care of. The system can operate in synchronous mode as well as asynchronous mode, i.e same time, different place; different time, same place; different time, different place.



**Fig. 14.11** Groupware Driven GDSS for Travel & Tourist customers

Other examples of GDSS in the e- business enterprises are

- Leave application processing
- Requisition processing
- Credit rating approval
- Pricing negotiations and order processing
- Work order processing: Acknowledgement to delivery and billing
- Group interviewing of candidate
- Contract document processing for multiple signatories

There is a lot of similarity between DSS and GDSS. It mainly differs in one thing i.e., DSS is for individual decision maker and GDSS is for the group, formal or informal. Otherwise, they are similar in capabilities such as

- Use models, programs, algorithms stored for use
- Use interactive “what-if” capabilities
- Use internal and external data in secured conditions

- Graphical output like score card or dashboard
- Can communicate to any body
- Uses business analytics for prediction and decision-making
- Can handle AI-based expert systems

### **GDSS Time/Place Models**

GDSS can function in four different models based on time of interaction and place of working. It can function independent of time and location or place of work of group members.

- *Same Time/Same Place:* Synchronous groupware activity.  
Group members sit in a room together and use laptops, projecting equipment and other information sharing tools and make decisions.
- *Same Time/Different Place:* Synchronous groupware activity.  
Group members don't leave their seats, but work on GDSS using information sharing and communication tools, audio conferencing, screen sharing and chat, to make decisions.
- *Different Time/Same Place:* Asynchronous groupware activity.  
Group members do not come together but they attend to the input received or document shared by other member and respond to the requirement. While attending to the document shared they may use audio or video conferencing and document sharing tools. With a couple of such interactions, the group decides and acts on the problem.
- *Different Time/Different Place:* Asynchronous groupware activity.  
Group members do not interact or exchange any verbal communication, but interact through voice mail, e-mail, and bulletin boards to make a decision.

Same Time/Same Place model is the fastest in making a decision, while Different Time/Different Place is the slowest. Groupware is often broken down into categories describing whether or not work group members collaborate in real time or same time. The categories are synchronous groupware and asynchronous groupware. When GDSS functions in real time, the group members are working in synchronous manner. If not, then the work is done in asynchronous manner.

GDSS works on groupware technology supported by software products. Groupware provides collaboration capability to members. The leading software products are Lotus Notes, Microsoft Exchange.

### **Lotus Notes**

- Lotus Notes is an easy-to-use, desktop client for social business that delivers the people and business applications that help you get the work done fast.
- Provides an easy-to-use, single point of access to everything you need to get your work done quickly, including business applications, email, calendars, feeds, and more.
- Lets you tailor your work environment with widgets that bring social communities that are important to your job, both within the enterprise and across the Internet, right into your peripheral view.

- Enables you to work with people right at the point of context with social tools weaved into the work experience, allowing you to pivot to the tool you need, such as business cards, presence awareness, instant messaging, and more.
- Helps you quickly locate the people and content you need through integrated access to social tools from IBM Connections and IBM Lotus Quickr® software, including profiles, activities, team places, and content libraries.
- Offers advanced replication technology to enable you to work with email and applications even when disconnected from the network. (Source: [www.ibm.com/software/lotus/products/notes/](http://www.ibm.com/software/lotus/products/notes/))

## **Microsoft Exchange**

The Microsoft Exchange server is one of the most popular collaborative server today. The Microsoft exchange has the following two jobs:

- The exchange supports IMAP, POP and web email clients including Microsoft Outlook.
- The exchange lets users share information using either Outlook Web Access or Outlook.

Let's have a look at some of the features of Microsoft Exchange:

- Improved Assistant: Allows users to schedule messages by fixing the start and end points. Separate messages for people inside and outside the organisation can be created.
- Instant Search Feature: The search lets you find information from any corner of the inbox using keywords.
- New Features: RSS feed supporter, email scheduler, better preview pane and an option to view attachment.

The best advantage of using Microsoft Exchange server is the high-level of security features of the software package. The server neutralises security threats and thus, the users are protected against viruses, spam and hackers. The emails are also protected against outside sources. The security feature allows users to use the system to its maximum potential. Employees of companies that use the Microsoft Exchange server can access their email from any location in the world. They can communicate irrespective of whether they are in an office or on the go.

Microsoft exchange server is compatible with additional features such as voice mail storage, calendar, and contact organising application and scheduling. Microsoft Exchange uses the Microsoft Office Outlook as its email platform.

With so many applications, Microsoft Exchange makes businesses very efficient. It is also very easy to fix problems. In addition, it has enhanced monitoring abilities. Thus, a fault can be detected before it turns into a big problem. Several essential processes that are required for the smooth operation of Microsoft Exchange have been automated. Thus, the administrators have more free time to deal with more important issues. With its various advantages, more and more companies are realising the importance of using Microsoft Exchange. (Source: [mail2web.com/blog/2010/04/microsoft-exchange-3/](http://mail2web.com/blog/2010/04/microsoft-exchange-3/))

Groupware can allow both geographically dispersed team members in head office and in branches, and on-site workers at project location to collaborate with each other through the use of computer networking technologies. Collaboration means working together in a coordinated fashion, towards a common goal. Collaborative software, Groupware and GDSS, help group members to work together.

Main groupware capabilities which enable effective collaboration are:

- Document version management and change management
- Shared calendars and task management
- Web conferencing, instant messaging message boards, whiteboards
- Access to corporate DWH and databases
- Access to knowledge portal of the organisation
- Access to centralised repository for documents and files that users can access and save to

Groupware technology helps GDSS to solve structured and unstructured problems. The structured problems are those 'where problem is defined and solution alternatives are deterministic in nature. The data and information needed to resolve are also available on access. In case of unstructured problem, this comfort is not there. Rules of decision-making and models are in place. Data and information needs to be obtained from other sources. The parameters and variables involved in problem neither are clear due to unclear definition of the problem.

It is capable of providing decision-making service to operations management for day to day decisions, middle management for planning and control decisions and for top management for strategy planning and implementation followed by periodical reviews.

#### 14.4 ARTIFICIAL INTELLIGENCE (AI) SYSTEM

All human beings have intelligence, which they use for problem solving. Intelligence when supported by knowledge and reasoning abilities becomes an artificial intelligence. When such an artificial intelligence is packed into a database as a system, then what we have is AI system.

AI systems fall into three basic categories, viz., the Expert Systems (knowledge based), the Natural Language (Native languages) Systems, and the Perception System (vision, speech, touch). Figure 14.11 shows the structure of AI systems.

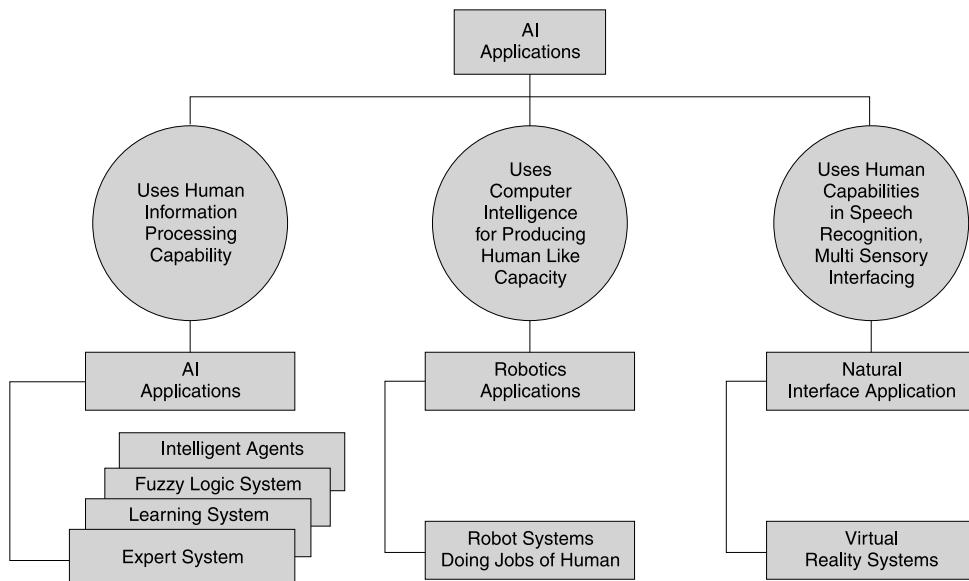
Artificial intelligence is a software technique applied to the non-numeric data expressed in terms of symbols, statements and patterns. It uses the methods of symbolic processing, social and scientific reasoning and conceptual modelling for solving the problems. The AI systems are finding applications in configurations, design, diagnosis, interpretation, analysis, planning, scheduling, training, testing and forecasting.

The AI systems do not replace people. They liberate experts from solving common/simple problems, leaving the experts to solve complex problems. Artificial intelligence systems help to avoid making same mistakes, and to respond quickly and effectively to a new problem situation.

The Knowledge-based Expert System is a special AI System. It has wide applications in business and industry.

AI systems thrive on artificial intelligence. AI is a field of science and technology where knowledge from other disciplines such as computer science, biology, psychology, mathematics, statistics and engineering is blended together. The goal of AI is to develop computer functions and features as close to human intelligence, described as reasoning, learning, problem solving, exhibiting creativity, respond quickly, sort quickly ambiguous and incomplete and or erroneous information or situation.

AI domain is very large and its application spreads in wide areas of business and industry. Fig. 14.12 shows major application areas of Artificial Intelligence.



**Fig. 14.12 Application Areas of Artificial Intelligence**

Cognitive science application uses knowledge and human information processing capabilities to produce major application as expert systems. The server provides intelligent information sets, knowledge database, rule base and goal driven reasoning capability to solve the problem. Expert systems are designed to make humanlike inferences leading to an advice to decision maker.

Robotics application uses AI, engineering science, and physiology to produce computer intelligence to guide a 'computer driven machine' to perform like human being, having capabilities of perception, touch, manipulation, locomotion, navigation and so on. Robotics applications are found useful in manufacturing, material handling, and transportation.

Natural interface application uses AI to build natural, realistic, multi sensory human – computer interface. This interface enables you to build a 'Virtual Reality'. Virtual reality becomes very handy support to test, feel or experience the 'reality' before it is actually created. When an architect rotates the model of house for different views, it provides views of the house in virtual reality before building the house. Walk through is a simulated virtual experience of walking through house. VRML (Virtual reality modeling language) is a language

tool to develop 3-D hypermedia graphics and animation products to provide virtual reality experience. Virtual reality applications are very useful to save investment from being put to wrong use.

### **Expert Systems**

Expert systems are computerised application systems driven by 'Artificial Intelligence'.

It stores human intelligence made out of expert's experience, knowledge and model of solving the problem. Expert system includes a knowledge base containing various accumulated experience and a set of rules for applying the knowledge to each particular situation. Since, human expertise is stored in computer as software programs; it is called Artificial Intelligence (AI). Some call it machine intelligence. Being a stored intelligence, its efficacy to solve a problem is limited to AI stored. Expert systems attempt to use AI in solving specific problem. Expert systems using AI relieves experts from advisory work and permit non experts to work better independently on expert systems. Non-experts are empowered by AI systems.

- **Neural Networks:**

A *neural network* is a category of AI system that attempts to emulate the way the human brain works. Neural networks analyse large quantities of information to establish patterns and characteristics in situations where the logic or rules are unknown. These patterns with characteristics are an AI for decision maker to use in analysing the situation for decision analysis.

The types of decisions for which neural networks are most useful are those that involve pattern or image recognition, because a neural network can learn from the information it processes looking at the pattern.

The banking and finance, healthcare hospitals are extensive users of *neural networks in their customer management situations*. Banks use neural networks to review loan proposals first by segment and within segment applying pattern of customer behaviour to accept, reject the proposal or seek more assurances, guarantees to grant the loan. AI in this case is a pattern of customer behaviour built on customer experiences coming from a particular segment.

Specialty hospitals based on experiences after a long treatment to a variety of patients develop a pattern on how patient will perform or behave and what developments would take place and what follow-up treatment is to be given. The pattern, a 'Patient profile' is a result of neural networks based on number of doctor's experience in treating the patients.

Police and investigative agencies use neural networks to judge nature of a crime.

With crime reports as input, neural network systems can detect and map local crime patterns. The police would judge using the pattern (AI) makes judgment on

- What will happen?
- When will it happen?
- Where will it happen?

and the kind of deployment of force necessary to prevent the crime.

Neural networks help to prejudge the situation and allow taking proactive action.

- Mail-order companies use neural networks to determine which customers are likely, or not likely, to order from their catalogues.

- Fraud detection agencies widely use neural networks. Visa, Master Card, and many other credit card companies, use neural networks to spot peculiarities in individual accounts. They develop overview strategies to manage customers.
- Many insurance companies use neural network software to identify fraud. These neural network systems search for patterns in customer insurance claims and look for unusual combinations and decide on how to handle the claim. For example, two wheeler drivers not owning a vehicle is most likely not in possession of driving license; two wheeler drivers not having a driving license and not owning a vehicle is not likely to report the accident to police.

Neural networks are a strong AI system because of the following features. Neural networks

- Continuously learn, adjust and modify to become more efficient to handle new situations
- Lend themselves to parallel processing
- Function without complete or well-structured information to find its way
- Analyses non-linear relationships, multiple variable relationships

Neural networks work with fuzzy logic when information input is not complete and imprecise. *Fuzzy logic* is a mathematical method of handling imprecise or subjective information. The visibility at an air port is very poor, cannot be evaluated as strictly true or false rather we accept this statement having certain ambiguities. Thus, the mathematical theory of fuzzy logic was developed to handle ambiguities. The basic approach is to assign values between zero and one to vague or ambiguous information. The higher the value towards one, the closer it is to one, suggesting that the information is unambiguous. In such cases, neural networks draw upon another set of information to make an assessment of the situation to make a better decision.

For example, in case of a patient based on clinical examination and pathology reports, it is difficult to associate the case to a pattern to make a diagnosis, as information is incomplete and also imprecise, ambiguous. The doctors give a 'value' between 0 and 1 to patient information and make the whole assessment. So, doctors seek other information such as family history, food habits, and life style and so on of the patient to firm up the diagnosis by removing ambiguities in initial information set.

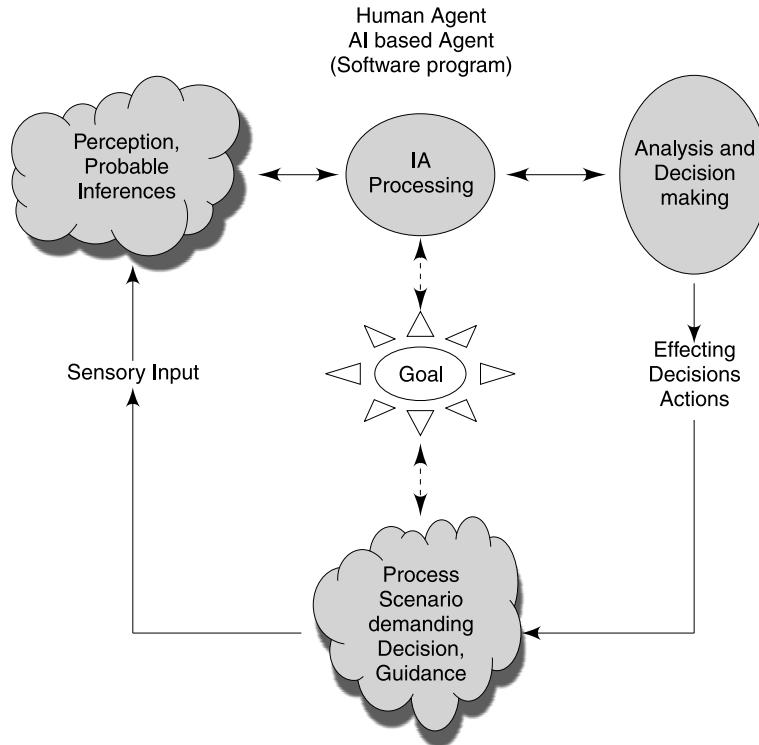
**Genetic Algorithms and Models:** A *genetic algorithm* is an artificial intelligence system that mimics the evolutionary process to generate increasingly better solutions to a problem.

Algorithms and models are built when there are innumerable solutions possible to a given problem. Further, Genetic Algorithm is built when a problem is not amenable to solution by known methods of resolution and needs an evolution of solution. The term generic is due to evolution of solution. In such situations, the approach is to find a best solution which optimises use of resources within the domain influence of conditions and constraints.

Investment in assets, investment in stocks, building an effective team, developing a mix of competencies are the problems which can be decided using a genetic algorithm, as many of them are not amenable to known solution models or algorithm.

**Intelligent Agents:** An agent is a program that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors. The effectors could be

an instruction, decision, signal and action prompt. It also has an ability to implement the decision of its own to achieve the desired goal.



**Fig. 14.13** IA driven Expert System

An *intelligent agent* is a special-purpose AI based knowledge-based information system that accomplishes specific tasks on behalf of its users. Intelligent agents are software programs written to carry out tasks on behalf of the users. The capability of agents is wide ranging from automating straightforward routine tasks to adapt user routines and preferences.

IA driven system has five components: Agent, Percept Points, Actions designed, Goals to achieve, Environment.

Agent	Percepts Points	Actions designed	Goals to achieve	Environment
Medical diagnosis System	Symptoms, Findings, Patients answers	Tests, Treatment, Follow-up feedback	Healthy Patient Healthcare at Minimum cost	Hospital Healthcare Services
Continuous Process Controller.	Temperature, Pressure Flow	Open, Close Valve Adjust Pressure Control Flow	Quality, Safety, Performance	Continuous Process Plant

Intelligent agents use their knowledge base to assess the situation to make decisions and accomplish tasks in that fulfills the intentions of a user.

IA is autonomous by design with capacity to act within the limitation of knowledge packed into it. The scope of IA services can vary from taking proactive action assessing the situation to making a decision based on rules, models and algorithms. IA can be programmed to cross the boundary and communicate at other locations to seek information or to share information.

The feature which distinguishes intelligent agents (software program) from other software programs is its ability to automatically understand, respond and adapt their behaviours to the conditions encountered and make decisions based on a set of in-built rules and criteria, without involvement of the user.

- Sample Applications of AI and ( AI system):

- **Establishing sales quotas (Genetic algorithm)**

*Establishing sales quota to the agency is governed by a number of restrictions, conditions and limitations. The quota allocation solutions are many to select one which is an optimum one. Genetic algorithm is the DSS for solving the problem of quota allocation.*

- **Generating project proposals ( Expert Systems)**

*It is a task which requires knowledge of Project strategy, Project management, Project evaluation and estimation, Team building and application of PM tools and technologies. This is available with several experts in the organisation. An expert's knowledge base is built for users to access it and solve the problem of generating the project proposals.*

- **Planning advertising spot layouts (Neural Networks)**

*Decision on advertising spot layout is influenced by number of factors, timing, medium, TRP rating, programs and so on. Neural network based AI system will be able to select those spots to ensure that the customer recall index is very high.*

- **Determining credit limits (Genetic Algorithm)**

Credit limit options are many. One has to settle with that option where the customer is satisfied and makes payment regularly, and becomes a loyal customer. This is a problem of optimising the use of credit offer capacity of the organisation to maximise customer satisfaction and sales revenue.

- **Selecting transport routes (Expert System)**

This is a classic problem in OR and application of OR models. Being a OR model, it has its own limitations to give the best solution. Expert system will improve this solution by linking the factors which the OR model has not considered.

- **Analysing market timing situations (Intelligent Agent)**

*This is the problem of finding the 'Right Timing' to launch a product in the market. Market timing situations are many and have many factors to consider. An organisation would design an IA capable of selecting that timing which maximises the impact on the market.*

- **Performance evaluation (Expert Systems)**

To judge the performance of a product or a manager, requires are assessment of facts about the achievement and the resources consumed. The performance

evaluation is about output and outcome, i.e efficiency and effectiveness. While facts will reveal quantitative aspects of achievement, its effectiveness can be judged by experts only. The performance evaluation and determination is an application of explicit knowledge generated through the evaluation system and tacit knowledge contributed by the expert.

◦ **Requirements planning ( Expert Systems)**

*Requirements' planning is an important management function in all businesses.*

Be it manufacturing, services, software development, construction and all kinds of project situations, requirements planning is the beginning of the task.

Requirements planning has two components: Requirements analysis for assessing the requirement and requirements management to deliver it.

*Requirements are the best when experts and knowledge base created by them is available to the planner.*

Here are some illustrations from business and industry on applications AI based systems:

### ***Interpretation Systems***

- Seismic Interpretation System with Advanced Mapping (IsoMap™, GeoAtlas™) is a software suite.
- The Advanced Mapping version of the Seismic Interpretation System adds the powerful gridding and contouring capabilities as well as the superior display capabilities.
- Empowers geoscientists to work on the same project with GeoGraphix's unique data management tools and common database.

### ***Prediction Systems***

Prediction systems have two components, one input and two, process the input falling back into experts knowledge base and predicting a probable event. Monsoon forecasting to consumer behaviour forecasting are the examples of Prediction systems.

### ***Diagnostic systems (DS)***

1. BD Diagnostics is the global leader of products and instruments used for diagnosing infectious diseases.
  - Products are used in the clinical market to screen for microbial presence, grow and identify organisms, and test for antibiotic susceptibility.
  - In the industrial market, Diagnostic Systems' products are used for the testing of sterile and non-sterile pharmaceuticals and medical devices, for environmental monitoring and to detect food pathogens.
2. A DS is developed for a tile manufacturing company to diagnose tile defects and to recommend actions for improvement.
  - This system consists of two main components, the knowledge base and the inference engine.
  - The knowledge base has been developed by capturing data and information that are related to tile defects, such as symptoms, probable causes, types of defects, processes, sub-processes, tile classifications, etc.

- The inference engine has been built to identify probable defects.
- The DS helps the site manager to diagnose tile defects before they are used in the construction.

### ***Design Systems***

- Computer-aided software engineering (CASE) tools assist software engineering managers and practitioners in every activity associated with the software process.
- They automate project management activities; manage all work products produced throughout the process, and assist engineers in their analysis, design, coding and testing work.
- CASE tools can be integrated within a sophisticated IT environment.

### ***Monitoring & Control Systems***

The purpose of monitoring and control system is to keep the sensitive equipment up and running without breakdown or loss of efficiency. It is a critical support to main business system. The system has information and knowledge database which acts as an agent in monitoring the performance of the system. It has a provision of variety of messaging system, which includes warning, alert and finally stopping the system. Such systems are all over around in your vehicle, cinema theatre you visit, electronics system in the house, and so on.

Airport Monitoring & Control System (AMS) is one example of such a system. The AMS system monitors and controls important airport devices, including:

- Runway and taxiway signal lights and safety devices
- Radio navigation systems
- Power engineering equipment
- Meteorological devices
- Protective zones
- Emergency procedures in extraordinary and dangerous situations
- Traffic conditions in all categories of visibility
- Distant objects
- Fire signaling

### ***Repair Systems***

- When an equipment breaks, it needs to get fixed as quickly as possible. If it is a part of a production line, it can disrupt manufacturing. If it is a product that was sold to a customer, the ability to get it fixed quickly and correctly will strongly influence the customer's satisfaction and influence potential future sales.
- An expert knows that a particular combination of symptoms indicate one cause, but slightly different symptoms might indicate a totally different cause.
- An expert also then can construct the repair strategy to implement.
- Repair systems could be online interactive or can be developed onsite under the guidance of an expert.

### ***Online Support System***

Online support is an activity which can be executed by an expert with knowledge base to help the person in need of such a support. This support is available on call and begins with problem identification, analysis and then stepping into its resolution. The process is interactive between two persons, procedural or reference information delivered through computer software. It is a form of user assistance to resolve a technical problem.

## **14.5 KNOWLEDGE BASED EXPERT SYSTEM (KBES)**

Decision-making or problem solving is a unique situation riddled with uncertainty and complexity, dominated by the resource constraints and a possibility of several goals. In such cases, flexible systems (open systems) are required to solve the problems. Most of such situations, termed as the unstructured situations, adopt two methods of problem solving, generalised or the knowledge based expert system (KBES).

The generalised problem solving approach considers the generally applicable constraints, examines all possible alternatives and selects one by trial and error method with reference to a goal. The knowledge based problem solving approach considers the specific constraints within a domain, examines the limited problem alternatives within a knowledge domain and selects the one with knowledge based reasoning with reference to a goal.

In a generalised approach, all alternatives are considered and the resolution of the problem is by trial and error, with no assurance, whether it is the best or the optimum, while, in the knowledge based approach, only limited alternatives are considered and resolution is made by a logical reasoning with the assurance of the local optimum. The generalised approach is dominated by a procedure or method, while the knowledge based approach is dominated by the reasoning process based on the knowledge.

Since, the KBES considers knowledge as the base, the question arises whose knowledge is to be considered as a basis. It is generally agreed that an expert has knowledge, and therefore, he becomes the source of knowledge. An expert is difficult to find and the difficulty of 'no-knowledge' or 'limited knowledge' on the subject is always expressed. Knowledge is with experienced people and experience, is wide and distributed. Hence, a system is required which will hold the knowledge of experienced people and provide an application path to solve the problem. Such a system eliminates the knowledge bottleneck.

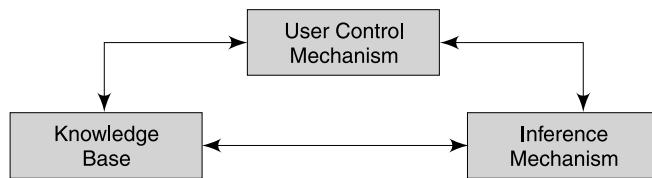
To build a knowledge-based system certain prerequisites are required. The first prerequisite is that a person with the ability to solve the problem with knowledge-based reasoning should be available. The second prerequisite is that such an expert should be able to articulate the knowledge to the specific problem characteristics.

Knowledge in the KBES is defined as a mix of theory of the subject, knowledge of its application, organised information and the data of problems and its solutions, and an ability to generate new avenues to solve the problem.

The KBES has three basic components which are necessary to build the system as shows in Fig. 14.14.

### ***Knowledge Base***

It is a database of knowledge consisting of the theoretical foundations, facts, judgments, rules, formulae, intuition, and experience. It is a structural storage with facilities of easy access.

**Fig. 14.14 KBES Model**

### **Inference Mechanism**

It is a tool to interpret the knowledge available and to perform logical deductions in a given situation.

### **User Control Mechanism**

It is a tool applied to the inference mechanism to select, interpret and deduct or infer. The user control mechanism uses the knowledge base in guiding the inference process.

In the KBES, three components are independent of each other. This helps in modifying the system without affecting all the components. Like in the database application, where the data is independent of its application, in KBES, knowledge is independent from application, i.e., inference process. The KBES database, stores the data, the cause-and-effect relation rules, and the probability information on event occurrences.

For example, the knowledge base of Health Care would have a knowledge such as “obesity leads to high blood pressure,” “there are 60 per cent chances that smokers may suffer from cancer.” The KBES, therefore, stores and uses knowledge, accepts judgments, questions intelligently, draws inferences, provides explanation with reasons, offers advice and prompts further queries for confirmation.

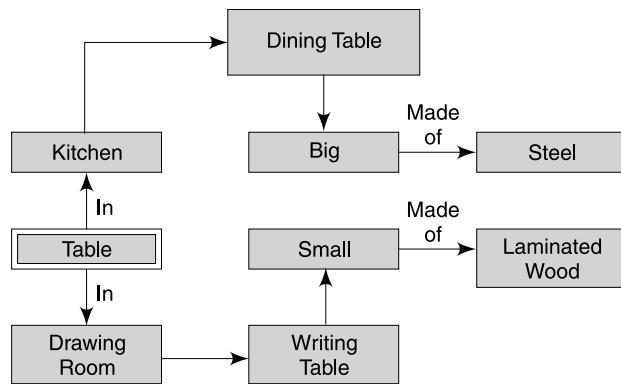
In the KBES, the knowledge data base uses certain methods of knowledge representation. These methods are—Semantic Networks, Frames and Rules.

### **Semantic Networks**

Knowledge is represented on the principle of predicate functions and the symbolic data structures which have a meaning built into it are known as semantic. A semantic network is a network of nodes and arcs connecting the nodes. The node represents an entity and the arc represents association with a true and false meaning built into it. The association and meaning uses the principle of inheritance. For example, all animals with four legs have a tail and a dog has four legs, hence the dog has a tail. The system inherits from the fact that the dog has four legs hence the dog is an animal and, therefore, a dog has a tail or not.

A knowledge base on ‘Table’ is presented in a Semantic network in Fig. 14.15.

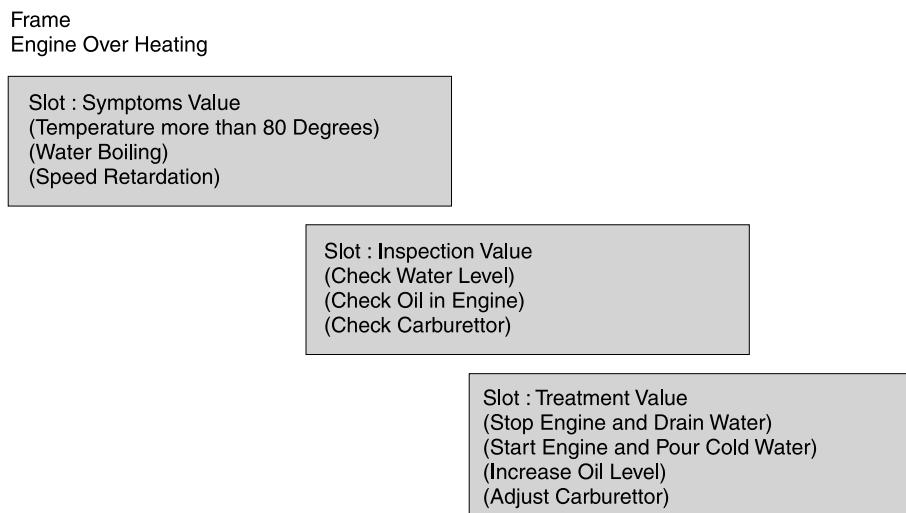
A knowledge database of the table is stored with the attributes like location, function, size and shape. If a query is put on table through any of these attributes, one can infer the specifications of table. The inference would be correct depending upon how the knowledge is designed and structured into database. For example, if table in the room is big and made of wood with lamination and has elliptical shape, it would be inferred as conference room table. This inference would be correct if the knowledge base has elliptical shape as an attribute of the table.

**Fig. 14.15** Semantic Network of Knowledge Database on 'Table'

The characteristic of a variety of tables are used to represent knowledge on table. A table in a drawing room, inherits the characteristics of a table in a drawing room.

### Frames

The second method of representing the knowledge is putting the same in frames (Fig. 14.16). The concept of frame is to put the related knowledge in one area called a frame. The frame is an organised data structure of a knowledge. The frames can be related to other frames. A frame consists of the slots representing a part of the knowledge. Each slot has a value which is expressed in the form of data, information, process and rules.

**Fig. 14.16** Knowledge in 'Frames'

## Rules

The third method of representing the knowledge is rule based. A rule is a conditional statement of an action that is supposed to take place, under certain conditions. Some rules can be constructed in the form of 'If Then' statements. An example of If-Then decision/action statement is given below:

IF AN ITEM IS MADE OF TUNGSTEN CARBIDE	THEN THE ITEM IS EXCISABLE.
IF AN ITEM IS HIGH SPEED TOOL	THEN THE EXISE DUTY IS 20%
IF AN ITEM IS NOT HIGH SPEED TOOL	THEN THE EXCISE DUTY IS 5%

## Inference Mechanism

Having created a knowledge database, it is necessary to create the inference mechanism. The mechanism is based on the principle of reasoning. When reasoning is goal driven, it is called *Backward Chaining* to goal and when it is data driven it is called *Forward Chaining* to goal.

For example, if there is a breakdown in the plant, then looking backward for the symptoms and causes, based on the knowledge database, is backward chaining. However, if the data which is being collected in the process of plant operations is interpreted with the knowledge base, it can be predicted whether the plan will stop or work at low efficiency. The data here is used to infer the performance of the plant and this is called forward chaining.

The choice between backward or forward chaining really depends on the kind of situation. To resolve a problem after the event, one has to go from goal (breakdown, stoppage, etc.) to data, i.e., it is a case of backward chaining. But if the question is of preventing a breakdown, then the data would be monitored in such a way if it is directing towards a goal (breakdown, stoppage), then it is a case of forward chaining.

The KBES uses both the methods of reasoning. The success of the knowledge based expert system depends on a degree of knowledge, the confidence in the knowledge and the quality of inference mechanism.

## 14.6 DSS APPLICATION IN E-ENTERPRISE

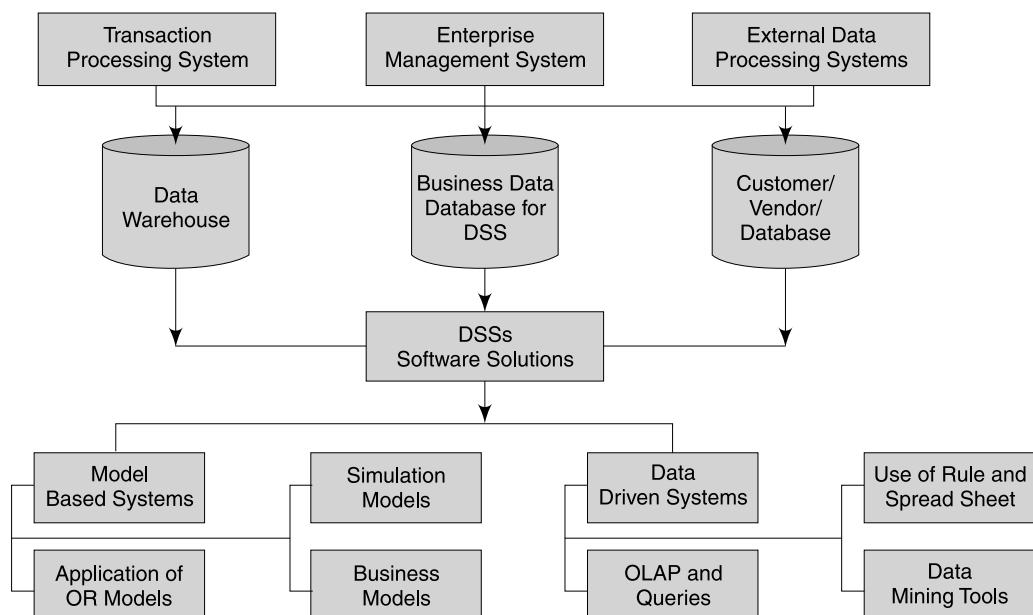
We have learned so far that DSS are data driven and model driven. They are used for solving problems requiring a systematic approach. DSS are used in Supply Chain Management as well as in Customer Relationship Management. The decisions in supply chain management (SCM) are of two types, one structural and other operational. Most structural decisions are strategic in nature and need a careful data analysis, problem definition, modeling, developing alternatives and selecting one out of them based on criteria of minimisation or maximisation of cost, time, profit and so on. Typical structural decisions are:

- Deciding number of warehouses, service centres, manufacturing units, and their locations based on the criteria of minimum cost of transportation or fastest delivery to customers. These decisions are model based, and problem of deciding the number is solved using operations research techniques.
- Use of mechanised and automated material handling systems in warehouse, use of computer aided manufacturing systems to speed up the manufacturing process.

- Use of inventory models to decide Stock Keeping Units (SKU) and application of different technologies such as RFID, Bar Coding, and Scanning to reduce inventory at various locations.

The operational decisions are in the areas of stock allocation to work orders in head, deciding on inventory control parameters (EOQ, SS, ROL), clubbing of orders to save cost of transportation to a destination, deciding alternative mode of transports such as rail, air, road.

The objective of DSSs in supply chain management is to reduce the cost of supply chain operations. Total cost of supply chain is made of cost of transportation, cost of material handling, cost of carrying inventory, cost of delayed operations, loss of business and cost of overheads relating to HR, Power, cost of maintenance etc. Figure 14.17 shows DSSs structure and architecture for SCM.

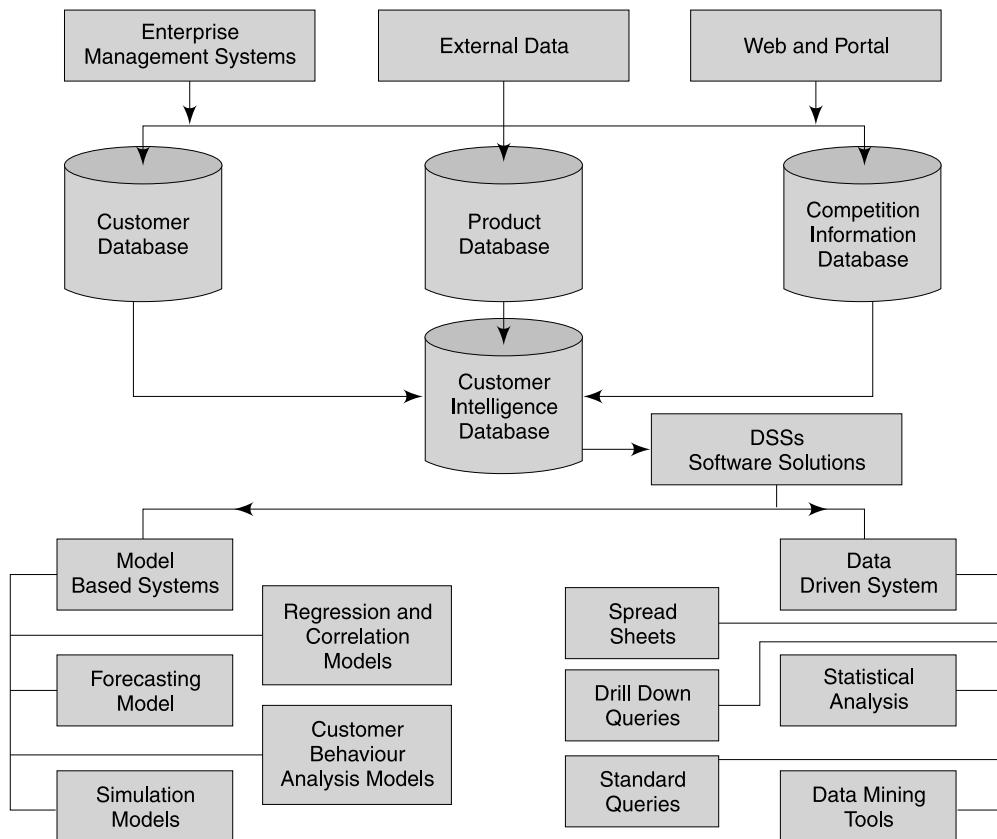


**Fig. 14.17** DSSs Structure and Architecure for SCM

Another major area of DSS application is Customer Relationship Management (CRM). DSSs for CRM focus on meeting customer centric decision requirements namely pricing, product differentiation, deciding payment options, and credit facilities, deciding method of problem resolutions, customer segmentation and so on. Figure 14.18 Shows DSSs structure and architecture of CRM.

After getting the data sets of interest, OLAP tools are used for analysis of data to form an opinion on the situation and deciding the course of action. DSSs are largely successful in gathering competitive business and customer intelligence and monitoring corporate performance. DSS provides new business vision and insight.

Third major application of DSS is executive decision support. The executives responsible for strategic management of business need DSS (also known as Executive Information



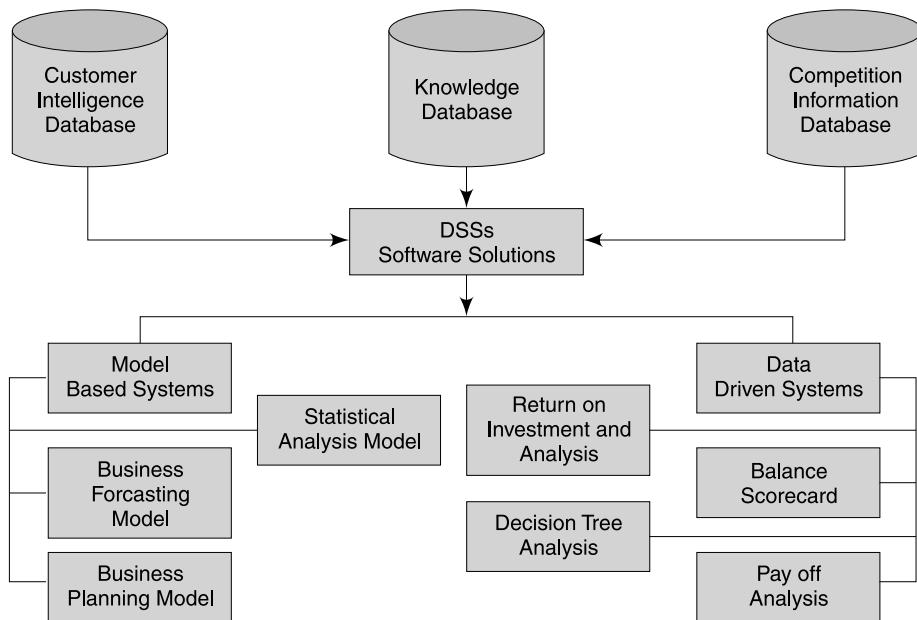
**Fig. 14.18 DSSs Structure and Architecture for CRM**

Support Systems (EIS) which are conceptualised; modelled and used by them to look into every new problem. Most of these DSS requirements emerge out of a situation where executive is required to solve the problem immediately and existing DSSs are not applicable to solve the problem. In each case, executive needs to view the situation differently, class for different dataset for analysis, problem definition and solution. Figure 14.19 shows EIS structure and architecture.

## 14.7 MIS AND THE BENEFITS OF DSS

The Decision Support System (DSS) is a special class of system which is used as a support in decision-making. Many of the decision-making situations, at all levels of management, are such, that its occurrence is infrequent but the methodology of decision-making is known. Some of the methods are proven and are widely used. Such applications are separated and are packed in the DSS.

These systems use data from the general MIS and they are used by a manager or a decision maker for decision support. The basic characteristic of the decision support system is that it



**Fig. 14.19** *EIS Structure and Architecutre*

is based on some tool, technique or model. These systems are used sometimes for testing new alternatives, training and learning. They are also used for sensitising the various parameters of the model.

The DSS could be an internal part of the MIS. When the decision making need is in real time dynamic mode, all such systems are designed to read, measure, monitor, evaluate, analyse and act as per the decision guidance embedded in the system. For example, in a simple case of order processing, the embedded DSS will accept or reject the order based on the CRI-SIL, credit rating, availability of stock and so on. If the order is accepted, the order acceptance is generated and the dispatch is scheduled for the ordered quantity. The DSS, in all such cases, uses the data already present in the system and gets it activated for action as per the guidelines.

The MIS designer has to look for all such situations and design the DSS for integration in the system. The MIS would become more useful if the decision-making is made person-independent and executed with well-designed DSS. All such embedded systems cover the normal variety of decision situations. If anything outside the considered variety crops up, DSS will bring to the notice of the decision makers that action is called for in the situation.

When the decision situation requires multidimensional analysis using the internal and external data, then such decision support systems are kept out of the main MIS design scope. Most of these situations call for the use of models and the nature of decision is strategic, calling for planned activity.

Decisions like a new product launch, price revision, appointing new dealers, change of product design or change in the manufacturing process are strategic decisions which require

critical analysis of data, careful evaluation of various alternatives and selecting one of them for implementation on the given criteria.

The decision support system plays a dominant role in the management information system, as a support to decision-making.

KMS sits on the top of traditional MIS model. KMS is result of organisation reaching maturity level on MIS. KMS initiative is taken when organisation wants to become a learning organisation out of its own operations and performance. Next possible initiative comes when business becomes knowledge driven, a case or stage beyond information driven business. In other words, KM becomes a mission critical application and therefore becomes part of formal MIS.

So, when we enlarge the scope of MIS beyond information management to knowledge management, KMS becomes part of MIS. Table 14.6 shows progressive extension of scope and definition of MIS. Most leading organisation in competitive business have started KM initiatives.

**Table 14.6** Scope and Definition of MIS

Decades	Scope and definition of MIS	Focus
60	Data processing and storing. Leveraging on data.	Past Data
70	Information processing and reporting by functions. Leveraging on formal reports and key information.	Key Results
80	Integration of systems, use of EIS, MRP-II, DBMSs. Leveraging on business information.	Information Analysis
90	Seamless integration of business processes. Use of ERP/CRM/SCM. Shift to user driven and managed information systems. Design for anytime anywhere. Leveraging on strategic information	Realtime online strategic information
2000+	Use of Data warehousing, OLAP, KM systems, Leveraging on knowledge and competency.	Knowledge

### The Benefits of Decision Support Systems

One strong reason for using DSSs is that existing information systems and MISs are not sufficient for meeting all the needs of information and decision-making. Decision maker still has to look for additional information, analysis, and a model for decision-making in certain one off scenarios. Exception reporting and controlling by using standards and targets are useful to some extend in decision-making. The decision maker still wants 'Inquiry and analysis' systems to support complex decision-making. The single largest benefit of DSS is that it raises the capability of decision maker to make right rational decisions. The capability is built due to several abilities DSS provides to decision maker to deal with the problem.

- Ability to view data/information in different dimensions and sensing the problem, trend, pattern through different views.
- Ability to understand and assess business performance and various results in terms of cause and effect, and enabling to define the problem.
- Ability to understand the problem and its ramifications, and ability to judge the impact on business.

- Ability to assess the impact of any change in the business performance and enabling to focus on the areas where impact is negative.
- Ability to view a complex scenario or problem and to design a model to analyse the problem, develop alternatives to solve the problem, test the solution and to conduct sensitivity analysis.
- Ability to make better decisions due to quick analysis, modelling, developing alternatives and testing for selection.
- Ability to control the risk exposure in decisions.

All these abilities together make a decision maker a capable person to handle any complex business scenario or problem. DSS enables managers to construct databases for ad hoc query, reporting, analysis, viewing and modelling the data to describe and understand the decision-making scenario. Manager through DSS, builds capability to execute the decision-making process 'Intelligent – Design – Choice' built by Herbert Simon.

## KEY TERMS

Models of DSS	Behavioural Models
Artificial Intelligence	DSS in E-enterprise
Knowledge and Knowledge Management	KMS Architecture
Knowledge Based Expert Systems	Group Decision Support Systems (GDSS)
Knowledge Assets	Tacit/Explicit Knowledge
Fuzzy Logic	Intelligent Agent
Generic Algorithm	

## REVIEW QUESTIONS

1. What is the purpose of DSS in MIS?
2. What types of DSS can be embedded in the application?
3. High end DSS systems need well conceived problem model and solution criteria to solve the problem. Explain with example.
4. Business rule, formula, algorithm and heuristics are extensively used in DSS. Explain these terms.
5. A good DSS needs a good abstractions process to construct a model of the problem. Before a model is accepted for DSS, what tests should the model be put to confirm that it is a valid model of the problem situation?
6. List the problems which most of the business have which need DSS and classify the DSS in following types—Deterministic and Probabilistic, and further they can be classified as OR models or quantitative models based on management science.
7. There are systems which use knowledge base extensively for problem solving. Identify the applications where knowledge bases can be used for problem solving.

8. What is simulation? Why and when is it used in problem solving? What are the assumptions and limitations of using the simulation model in DSS?
9. Which is the type of DSS that can be integrated in the MIS and which are types not worthy of integration?
10. Executive Information System (EIS) is a kind of DSS, which sits above and uses the data from MIS. What is the purpose of EIS and what kind of decisions EIS would support?
11. Develop DSS models for application in SCM. Using OR techniques to solve following problems.
  - (a) Deciding the route of delivery
  - (b) Deciding inventory control parameters
  - (c) Deciding a location for additional ware house.
12. Develop DSS models for application in CRM for forecasting of sales in a segment.
13. Identify the areas in SCM and CRM where DSSs are knowledge driven and not information driven.
14. Identify the following as Tacit or Explicit knowledge
  - (a) Software Product
  - (b) Smart Card
  - (c) Du Pont model of ROI
  - (d) Consultant's advice
  - (e) On-line help
  - (f) Tea testing process by tester
  - (g) Machine Setting and Tuning
15. Explain the following terms:
  - Fuzzy Logic
  - Generic Algorithm
  - Intelligent Agent
  - Neural Network
  - Artificial Intelligence
16. Explain how you would use GDSS and Expert Systems in MIS. What specific advantage the user of MIS would draw from GDSS?


**CASE STUDY**


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## 1. EXCEL SPREADSHEET

Branch offices of Sandvik India Ltd. are required to submit an expense budget for financial year April – March for planning and control of branch expenses. There are several heads of expense budget, which are decided by the corporate office, such as Payroll, Rent, and Taxes. These expense heads are kept out of this exercise. Though expenses are not directly linked with sales; at the year-end evaluation of performance, expense head amounts are linked to sales and the ratio compared to previous year ratio for analysis and correction. All expense vouchers require a mention of budget head for use in budget application and analysis. Expense budget head items are Sales budget, and Traveling, Hotel, Tele-communications, Customer training, Support, Special discounts. While sales budget is decided in consultation with corporate marketing Division, Branch Manager prepares expense budget. Expense budget is approved by corporate office.

'Excel spreadsheet' is used as a tool to model the expense budget. In this exercise branch manager uses previous expense budget experience i.e. budget vs. actual vs. sale performance; and ratios built over a period to decide on budget amount of the new year. Some budget needs are directly linked to sales budget and computed using percentage to sales formula. Traveling, Hotel, Telecommunications computed as percentage of sales budget. Support expenses are decided on budgeted new business multiplied by 25 per cent. Similarly, special discounts are built on new business less average 10 per cent discount multiplied by 15 per cent. Sandvik arranges customer training programmes for sales promotion, appropriate use of products and for relationship building. Table 14.7 shows sample spreadsheet of budget exercise. The excel spreadsheet tool is used for budget preparation and then it is used for controlling the expenses. All expenses are incurred by obtaining the approval of Branch Manager.

**Table 14.7** Excel Spreadsheet for Expense Control

Annual Sale	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total Budget	Actual by Quarter			
						Amt. (₹)	Amt. (₹)	Amt. (₹)	Amt. (₹)
ASB									
Advertising									
Traveling									
Hotel									
Tele Communication									
Customer Support Sp.									
Discount Training									

Expenses Budget Model using Excel spreadsheet is applied for following decisions.

- Decide annual expense budget for expense heads to be controlled by branch manager.
- Decide while approving the expense requisition based on the expense budget balance, both in terms of available balance and performance of expense head.
- Measure, Monitor and Track the expense and expense impact on sales to decide on the activity under consideration.

Sandvik uses Excel spreadsheet model for many applications in sales, production, procurement and finance. Inputs for the model are collected from Enterprise applications. Excel spreadsheet for expense budget is shown in Table 14.7.

## 2. FORECASTING MODELS

Maharashtra Agro Foods Ltd. is a company engaged in procurement of Fruits, Cereals and Pulses for processing, packaging and selling through their large chain of stores distributed all over Maharashtra. While there is no problem of wastage or spoilage in case of cereals and pulses, fruits pose a serious problem of preservation and quality retention. Though the company has a small production facility where, fruits if not sold, are processed further to produce pulp, squash, jams and so on. Maha Agro is not recognised for this line of business and distribution and selling of these items under Maha-Agro brand is not very competitive. It is also observed that this business of seasonal fruits is risky though highly profitable if decision of procurement is properly taken such that it just matches that years demand of fruit in the market.

This problem is only limited to seasonal fruits like Mangoes, Apples, Pineapples. Based on the last four five years experience in procurement and marketing of these fruits, Maha-Agro has developed forecasting models for deciding procurement quantity. Based on the sales forecast and expected production estimate of the fruits. Maha - Agro enters into contract purchase agreement with fruits growers. In order to sign such contracts in January - February for market season June - August, Maha - Agro needs a sales forecast for the season. This forecast is further adjusted for losses in handling and storage and raised further by certain percentage if fruit crop is expected to be high, normal and poor. Maha - Agro uses following procurement model for contract purchase.

Procurement quantity of fruit for the season (PQ) is equal to market forecast (MF) + Adjustment for wastage and damage (P1%) + Adjustment for level of fruit production (P2%), high, normal and poor

$$PQ = \text{Market forecast (MF)} + P1\% \text{ MF} + P2\% \text{ MF}$$

P1 historically is 12%, P2 is 15% if fruit production is high, 10% when it is normal and 5% when it is poor. MF is a moving average of sales of fruit of last three years.

Use of forecasting model in deciding procurement quantity reduces the risk of incorrect ordering of purchase quantity of fruits. It helps in negotiating the prices with fruit crop growers and enables planning post-season activity of production of Pulp, Squash, and Jams.

## 3. POINT RATING SYSTEMS

Kinetic Oil Engineering Ltd. (KOEL) follows a policy of Just-in-Time inventory. It uses an SAP ERP system for resource management and control. Engines are assembled and entire manufacturing of components is out sourced. Thirty per cent components like fuel injection system, valves, and filters are brand products of reputed companies. About forty per cent components are KOEL designed and are sub-constrained to SMEs near around KOEL. Balance thirty per cent component are 'C' category items, which do not pose a problem in procurement and generally do not disturb the assembly schedule. It is the practice of KOEL to assemble engines near completes to delivery and keep some items to be fitted as per customer requirements. KOEL follows the policy of pushing product differentiation to customer end. This has helped reduce inventory and also reduced the delivery cycle by few weeks. Since, assembly production is a stable operation due to various management practices, the possibility of it getting

disturbed is due to poor vendor performance of SMEs in the category of 40 per cent KOEL designed items.

KOEL has evolved a point rating system to decide on continuation of a vendor as KOEL business partner. It evaluates vendor performance on three factors on three point scale; 1-2-3 meaning Poor, Good and Excellent.

- Delivery date performance (DDP) points
  - Delivery on date = Excellent (3)
  - Delivery one day late = Good (2)
  - Delivery late by two days or more = Poor (1)
- Quantity delivered performance (QDP) points
  - Delivered as promised = Excellent (3)
  - Delivered between 90 per cent to 100 percent = Good (2)
  - Delivered less than 90 per cent = Poor (1)
- Quality assured performance (QAP) points
  - Delivered as required = Excellent (3)
  - Delivered 90 per cent quality scope as required = Good (2)
  - Delivered less than 90 per cent quantity as required = Poor (1)

This point rating system is used to compute vendor performance rating.

$$VR = \text{Vendor Rating} = \frac{\sum_{i=1}^n (DDPs_i + QDPs_i + QAPs_i)}{\sum_{i=1}^n \text{Deliveries}_i}$$

Vendor Rating is computed and updated on each delivery and category of vendor for purchase order selection is decided based on the following.

VRP = Vendor Rating Points

= More than 7 = A Category

Most preferred.

= Between 5 and 7 = B Category

Less preferred

= Less than 5 = C Category

To be chosen when A and B vendors are not in position to supply.

KOEL communicates current Vendor Rating points when new purchase order is placed on the vendor. The system is transparent to vendors and they get a chance to improve on continuing basis. The system is now fairly stabilised and would soon become an integrated application of procurement module of SAP ERP.

#### **4. FISHBONE DIAGRAM MODEL FOR PROBLEM SOLVING**

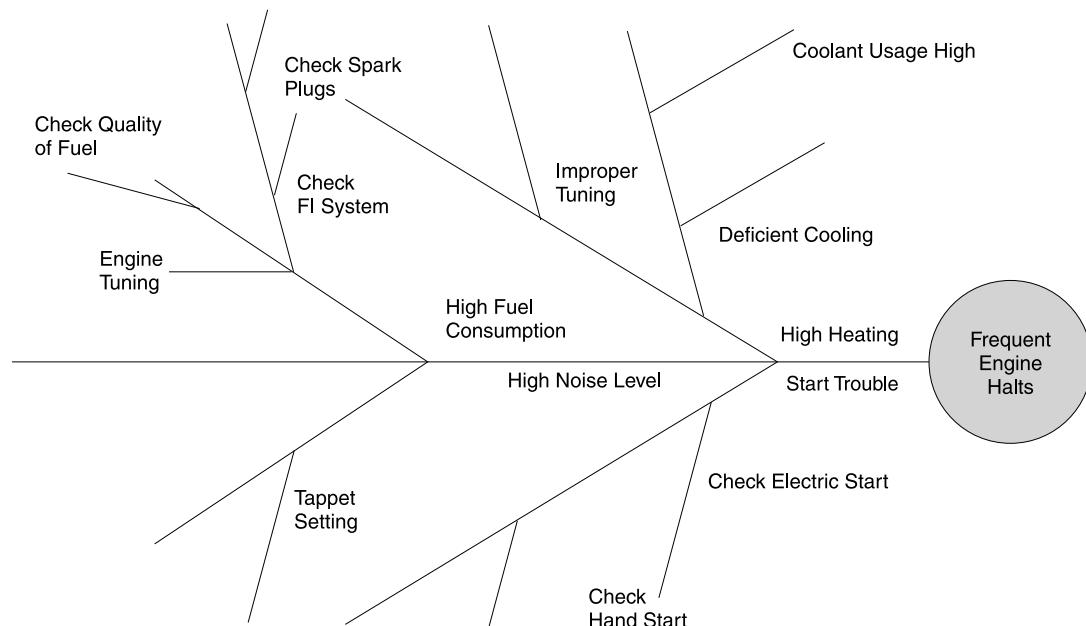
Kinetic Oil Engines Ltd. (KOEL) has appointed service providers for solving customer problems in using engines and their complex applications such as power generation, pumping, and powering.

Ninety-five per cent problems, service provider is able to solve through quick analysis of engine status. In all such cases, problem is solved by small repair or by replacing a component of a part, turning and overhauling.

The remaining 5 per cent problems are complex and emerge due to multiple causes affecting the engine operation. In most of these cases, engine halts and service provider is not able to start it quickly and needs a very systematic approach to attack the problem. The problems in this category are due to customer's negligence of engine maintenance and failing to replace the parts and components as advised by KOEL, based on the number of hours of operations.

In order to provide assistance to service provider to solve the problem in shortest period, KOEL has adopted Fishbone diagram approach. Most of the halt conditions are due to various system failures singularly or collectively. Based on the service experience in solving these category problems, KOEL has modelled problem in Fishbone Diagram Model.

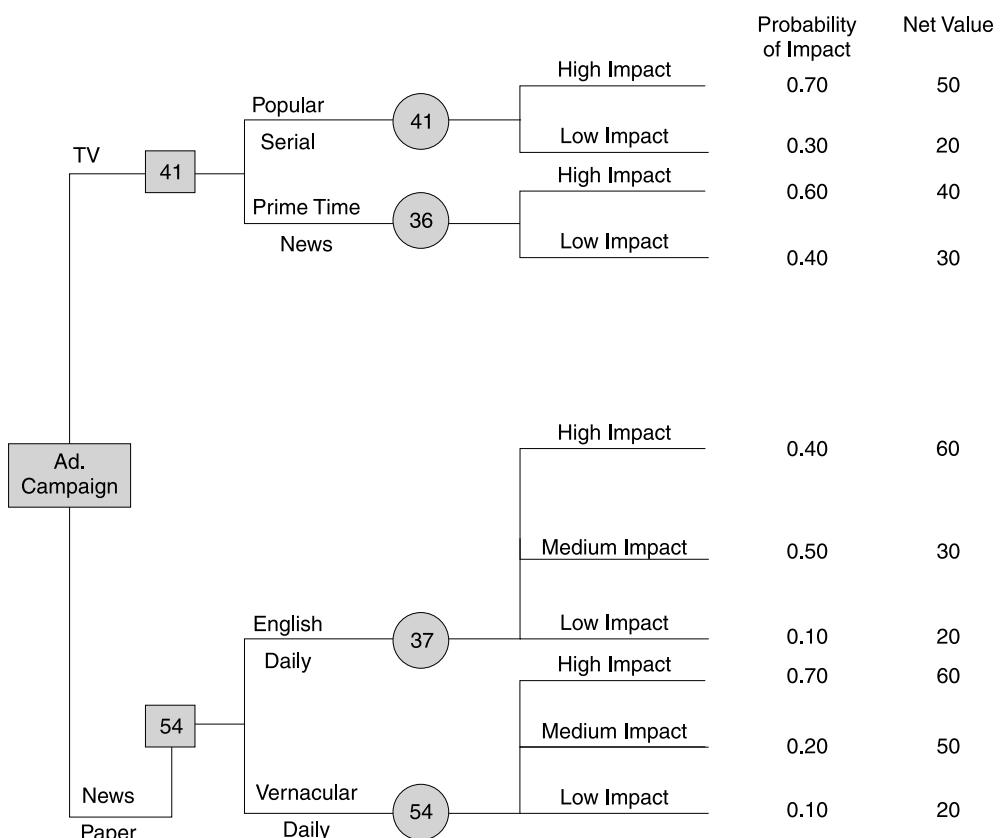
Based on the model, KOEL has developed a 'Cause-Effect-Solution' (CES) knowledge database along with engine maintenance history. Access to this knowledge database is available to all service providers. Knowledge database of CES is rich and it stores CES events in structured manner of over 5000 engines sold by KOEL and are being used in different applications.



## 5. DECISION TREE FOR DECISION ANALYSIS

Soubhagya Cosmetics Ltd. introduces new product almost every year in one product line or the other. It has a limited advertising budget to take care of existing products as well as new product advertising requirement. Hence, choice of Ad-media is very important and critical for successful launch of the product. Though quality of Ad is the main driver to pull the business, choice of media makes significant additional impact to raise the market share. SCL has two choices of media, TV and Newspaper and amongst them options are of time, language, channel, programme and so on.

Over a period, SCL has collected knowledge inputs about viewer ship and readership of consumers, and has developed probability of achieving certain impact and consequential net gain in business value for each choice and within choice all options. Figure 14.20 is an illustration decision tree used for deciding the Ad-Campaign for 'Hari Oil' targeted for young consumers. SCL continuously analyses post Ad results and improves the knowledge on probability of impact and net gain in value. Since SCL is a well-known brand, average sale (50 per cent market share) of the product, new or old; is assured. Ad-campaign adds further share snatched from competing products. So net gain in value is the difference between values of additional market share less cost of Ad campaign. In a given case, of hair oil, Ad-campaign through vernacular news daily gives highest expected net gain in value. Hence, decision is to launch 'Hair Oil' Ad campaign in vernacular news directly.



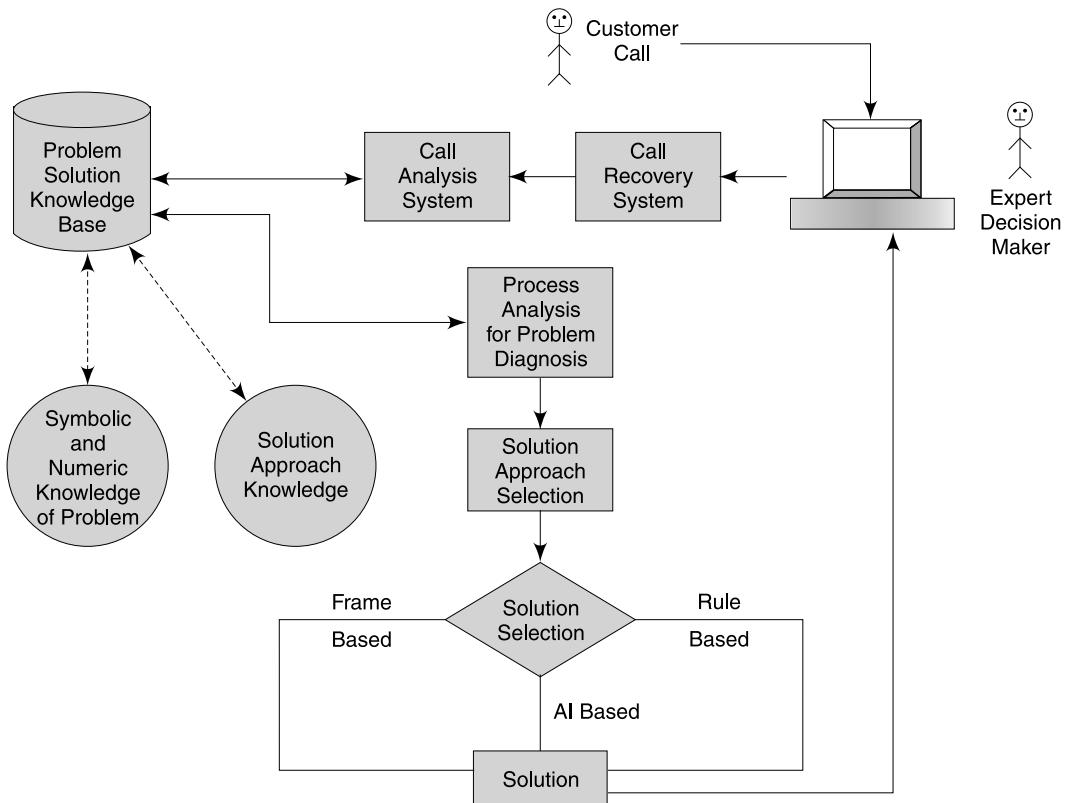
**Fig. 14.20** Decision Tree Analysis for SCL Hair Oil

## 6. EXPERT SYSTEM OF ON-LINE SUPPORT

Tej Infotech, a software product company, markets the products for health care industry. The products are enterprise solutions with considerable use of data capture, imaging, scanning, multiple data types handling technologies for data and information processing. Though products are customised to specific requirements and implemented with testing, user training and hand holding, customer queries do

occur in post implementation phase and Tej Infotech supports these quires with online support. For efficient and effective on-line support Tej Infotech has developed knowledge base of 'problems-causes-solutions' to support decision-making process of solving the customer problem.

When customer calls, decision maker on duty records the observation and findings, of the customer problems and uses this input to analyse the problem through cause analysis system. The call analysis system uses Problem Knowledgebase to define the problem. Then uses solution – knowledge base to select the solution for recommendation. The solution could be rule based, frame based or Artificial Intelligence (AI) based. The best choice of the solution is made by decision maker and guides the customer to solve the problem. Fig. 14.21 shows expert system flow chart of online support given by Tej Infotech.



**Fig. 14.21** Expert System Flow Chart for Online Support

## LEARNING OBJECTIVES

- Concept of Enterprise and its Management
- Benefits of Enterprise Softwares to E-business
- Information Management and Technology of Enterprise Software
- Enterprise Software (ERP) Implementation
- Role of IS and IT in Enterprise Management
- Aligning Goals of SBUs to Global Enterprise Goal
- Translating Global Strategy into Actions for the World Market

### 15.1 ENTERPRISE MANAGEMENT SYSTEM (EMS)

Computer, electronics, communication, and audio video technologies have converged closely to produce a new style of operating business. The dynamic business environment of today is full of challenge and opportunities. The dependence on the information, as driving energy source, is increasing. Every business has additional dimensions, viz., speed and time. The business needs of today are beyond the transaction processing. It requires and instant real time response in every case, wherever it occurs.

The word enterprise is chosen to convey that it encompasses the larger business community covering all the players and their participation in the business. The system is extended beyond the Corporate boundaries. In such a scenario, the system which you are designing is an enterprise wide. It must catch an event, interpret it and trigger the action, and communicate it across to the enterprise. Since, business is information hungry, it must have an ability to sense the situation and act accordingly. When the business requires online information to make the informed knowledge based decisions and have them executed in the business operations in a coordinated manner, it has to take support of many other systems.

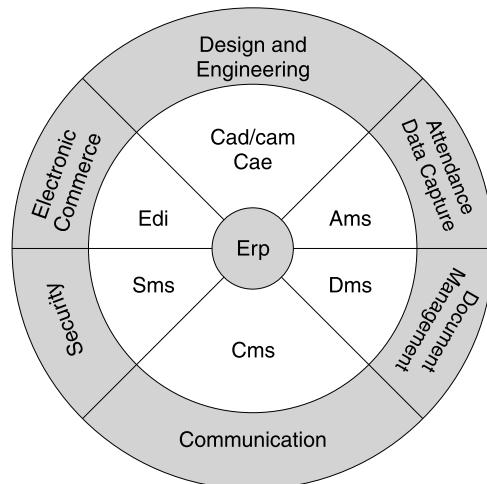
Take a simple example of customer order received in the company, which requires instant processing. In the very beginning acceptance possibility needs to be assessed and the customer should be informed immediately. Next step will be of ordering the material on the

vendor, booking the order and scheduling the same on shop floor for production, updating the business status and informing the marketing representative for monitoring the marketing activities. All this requires operations and management of a couple of systems besides the normal sales application. It needs the management of EDI systems to get hooked to the customer and vendor for a quick information communication. It also requires the management of interfaced systems such as CAD/CAM, MRP, etc. It also requires event monitoring and updating systems such as the Paging, Internet and the Imaging Systems.

Take another simple example of employee management, where the arrival of the persons or their absence raises a number of triggers in the Organisation. The well-known attendance recording system monitors the employee movement from all angles—availability, assigning, security, permissions, and salary and wages.

In the business today, the demand is a paperless operations, a wireless communications of a result of fully transparent and automated operations at all centres in an integrated and coordinated manner taking care of the business, actions and decision needs. To support such demands of the business, systems of information processing and communication are needed. These systems may be automated or mechanised interfaced with the other systems for data communication and processing. There could also be audio video and imaging systems to bring realism in information and remote sensing systems for security and communication.

Though the tools, the technologies, and the well designed solutions and systems are available to support all such needs of the business, what is needed is an integrated solution out of these technologies and the systems offering an enterprise wide management support. Such an integrated solutions is called as the Enterprise Management System (EMS). Figure 15.1 shows the following systems, which, when implemented in an integrated manner for co-ordinated and cooperative function of the business, give rise to the Enterprise Management System, i.e., EMS.



**Fig. 15.1** Components of Enterprise Management Systems (EMS)

- ERP: Enterprise Resource Planning Systems.
- EDI: Electronic Data Interchange System for commerce, communication and action
- CAD/CAM/CAE: Computer Aided Design Manufacturing and Engineering Systems for Production Management.
- AMS: Attendance Management System, i.e., employee attendance and presence management for the role management or Data Capture Systems on floors, in stores, at gates, etc.
- DMS: Document Management System, viz., imaging, copying and text management and dispatching document DBMS.
- CMS: Communication Management Systems, such as, paging, cordless, mobile telephone systems and the audio video systems.
- SMS: Security Management Systems such as the close circuit television, alarm or warning systems, movement tracing systems, etc.

In the EMS, the Enterprise Resource Planning (ERP) system plays the role of front running system. The major decision making and execution takes place through the ERP. It is a system of managing all functions of the business with information support coming through the ERP. It handles the operational system to run the business and provides the required inputs to planning and control systems handled by the middle management. With the internal sources of information and the use of information from the external sources, it provides a decision support information for strategic planning and control to the top management.

The ERP is supported by various other support systems which manage, independently, the specific requirement and simultaneously provide inputs to the ERP. The Electronic Data Interchange (EDI) system assists the ERP in connecting two systems electronically for E-Mail, Documents Transfer, Data Transfer, etc. It is designed to handle to commercial functions of the business popularly known as the electronic commerce. It also acts as a gateway to interact with the vendor, the customer, and the other associated institutions of the organisations.

The CAD/CAM/CAE, i.e., the Computer Aided Design/Computer Aided Manufacture/Computer Aided Engineering systems are the systems which handle design, manufacturing and engineering functions. It will provide the drawings and design engineering information to the ERP in its execution of manufacturing, purchase and inspection functions. They are also equipped with the database management facilities and there database act as a back up support to the ERP.

The AMS, i.e., Attendance Management System keeps track of the employee related information for personnel planning, availability and scheduling. It provides static information about an employee through the human resources management system and the current dynamic information such as his or her presence, shift rotation, the kind of job handled, the cost and so on.

The DMS, i.e., the Document Management System is designed to keep important documents in the database for viewing, sending messages, and for documenting support in the transactions handled. The system provides text edit facility for document manipulation for the purpose of transaction handling. In the ERP it is used for cross-checking the key

information and also to confirm the authenticity of the transaction. It handles the document access, editing, copying and mixing the information and sending the information to the various destinations for execution. It uses scanning, imaging, work flow automation and Document Data Base Management System.

The CMS or the Communication Management Systems are used for tracking the important resource for action. These resources are located, altered and advised to act from the location where they are. Their attention is drawn to event and advised to act to handle the situation. The ERP uses the CMS, as a tool, for all its communication needs of recording an event.

The SMS, i.e., the Security Management System handles the security, entry access requirement of the business operations. It may be a person, a vehicle, or material, its movement, availability and access if tracked, monitored, and guarded for security and safety. It provides a support to the ERP by clearing the situation to act further. A truck will not be allowed to enter unless it is an authorised one, and then it will be weighed and its weight will be transferred to the ERP for processing further information. An employees movement can be restricted or prohibited to select areas before his time is recorded and sent to the ERP for further processing.

These six systems together act as the support systems to the ERP. All these systems are extensively used for the main purpose for which they are installed. Each one of them have a specific technology to handle the function and are equipped to capture, store, process and transfer the data to the ERP. Each of these systems operate on their native systems and are interfaced to the ERP through the gateway by using a specific software. These systems are a part and parcel of the ERP System network.

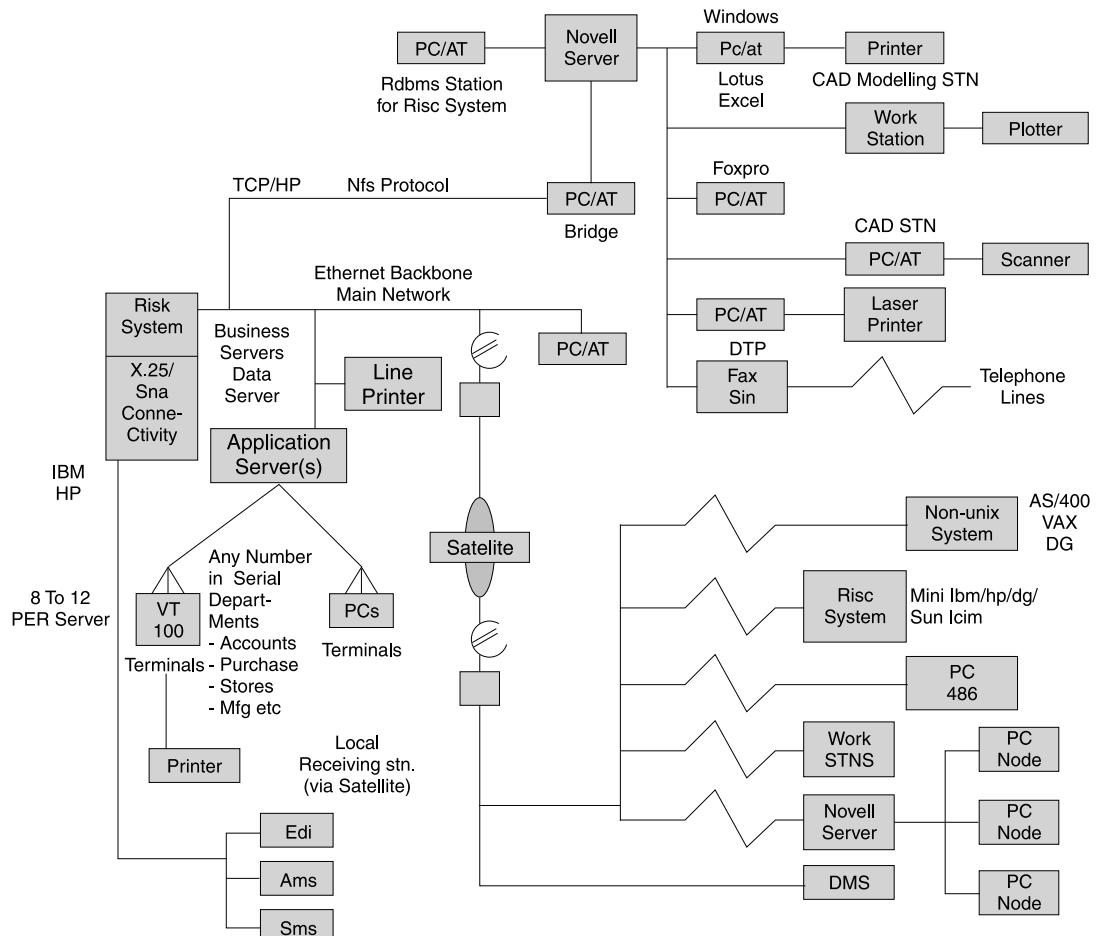
The EMS, therefore, can be defined as a Network System comprising the ERP, the EDI, the CAD/CAM, CAE, the CMS, the SMS, and the DMS as shown in Fig. 15.2.

## 15.2 ENTERPRISE RESOURCE PLANNING (ERP) SYSTEM

Enterprise resource planning (ERP) is an enterprise-wide information system designed to coordinate all the resources, information, and activities needed to complete business processes. The focus of ERP is on resource management within constraints to maximise the return on investment.

The ERP package design is built on the principle of 'Best Practices'. The user of the package is to choose the best one which is close to his requirement. Ideally customisation of the practice is not advisable to maintain the ERP software integrity. It could be required in extreme circumstances where user's function or feature is absent in the package. ERP implementation achieves the following

- Seamless integration among different functional areas.
- Design engineering support to make the best of resource.
- Customer or vendor order tracking till its fulfillment.
- Receivable and credit management linked order execution.
- Managing inter-dependencies of complex processes.
- Accounting and measuring the progress and performance with respect to resources planned and consumed.



**Fig. 15.2 ERP on Enterprise Wide Computer Systems Network  
(For Autonomy, Integration and Distributed Functionality)**

The ERP system deals with the planning and use of resources used in the business. The resources are finance, materials, manufacturing capacity and human resource. The ERP provides methodology of assessing the resource needs for a given business plan to achieve certain business objectives. It also helps to execute the strategies, plans, decisions, and actions in a time bound manner. The ERP provides a support system in the transaction processing, updation, and reporting across the functions. The ERP is a package encompassing all major functions of the business. The product is generic in nature and is supposed to incorporate the best business practices, generally followed in most of the companies.

The product philosophy is to implement the system as it is with some customisation which may be typical to the customer requirement. The system design of the ERP is integrated with the features and functions providing an enterprise wide solution to handle all the process functionalities. For example, it provides capability to process the purchase order from order-

ing to bill processing, and also meets the information needs of purchase, stores manufacturing accounts and finance.

The ERP packages build information base and provide knowledge base for planning and control of the business through the business function management. The ERP is the main system, interfaced or assisted by the other systems in the organisation. These systems may stand alone or from a part of the manufacturing or commercial processing systems.

These systems provide the database to the ERP or support the ERP by the basic data input directly or through the data transfer. For example, the manufacturing system module of the ERP is interfaced with the Drawing, Engineering database for query, viewing and usage of the drawings and it accepts the data of work order by process operations, for costing and for building the standards for the future.

The architecture is client/server and uses object oriented technology for design and development of the system. These packages are RDBMS based with the front end tools. The key benefit of the ERP is that it provides an integrated solution for all the requirements of the business. It addresses the issue of data integrity, information transparency, seamless integration and information communication. Simultaneously it respects the organisational hierarchy of authority, while conducting the business transactions through the system.

The implementation of most of the ERP packages begin with the enterprise modelling which defines the enterprise structure, the authority functions, the processes and the business rules. The enterprise model is the platform for the ERP system implementation.

The ERP solutions are available on the Unix platform and also on Windows NT. The solution is structured in the modular fashion to cover the entire business operation. A typical ERP package solution has following modules:

1. Sales, Marketing, Distribution
2. Manufacturing
3. Stores Management
4. Finance
5. Personnel
6. Maintenance
7. Purchase, Inventory
8. Planning and Control

These modules are designed for data capture, data transaction validation, it analysis, accounting updation and reporting. All the ERP solutions provide report writer for the user to create the reports. The standard reports like the trial balance, the stores ledger, the employee attendance report, the income tax return, etc. are provided with the solution at a generic level.

The ERP features are many. The important ones are security authorisation, referencing responsibility, and the implementation of the business rules. These are provided to safeguard the business of the organisation from illegal practice and also to protect the valuable information from misuse. These features help to keep the system, the information and the data integrity at the highest level. The ERP is activated by its users. The security is built for authorised usage and also for selective access.

The ERP usage can be controlled at all levels, viz., the data, transaction, information and analysis level. The security system of the ERP is build around the OS security and the additional features are provided while designing the system. It provides access and updation rights to the users as per the control requirement of the management.

Authorisation is a feature provided for ensuring that the transaction is completed with regards to the business rules set by the management. The systems provides the mapping capability to tie the data, information or process to the user. This means that only the authorised user can handle a particular aspect of the transaction and unless the authorised users sign, the transaction is not posted in the system for further processing and usage. For example, in the purchase order transactions the price and discount are confirmed by one user, the terms are decided by the other users and the purchase order is signed by the third user. The system provides defined levels to the users and there are no limitations on the number of levels.

Referencing is a feature, provided for tracking the chain of events for monitoring, progress checking and control. For example, if one wants to check the status of customer order, the referring feature helps to link the customer order to work order to delivery note to Excise gate pass to bill. It is possible to establish the link through cross reference of the transaction number or code of the previous transactions. For example, a work order will give a reference of customer order, a delivery note would give a reference of work order, a bill would give a reference to a delivery note and customer order. The feature does not allow the transaction to proceed unless such references are established.

The business organisation runs through the rules and the responsibility allocation. A strict adherence to them is essential for creation of the controlled environment. The ERP satisfies this need of the business. It provides a facility to ensure that the user-location (Department/ Division) transaction integrity is confirmed through check and validation and then ERP allows to process. For example, a cash transaction is allowed at the Finished Goods store and in the Accounts Department by authorised users only. At any other place evolving cash transaction is prohibited.

The material indents are processable in the stores while the vouchers are processable in the Accounts Department. The order entry is permissible in marketing. The ERP provides such facilities to ensure that the business is operated on the rules and the guidelines set by the management.

The ERP systems provides a variety of technology supports to implement the solution very fast in execution mode. The solution provides the E-mail facility for communication of memos, reminders, and text to the selected list. It also sends copies to the concerned persons as stipulated. Through the EDI connectivity, it can transact directly to the vendor or the customer in its own format.

ERP provides an aid to create the transaction by a cut and paste mechanism. It can raise a purchase order on the vendor by picking up and choosing the old purchase orders, which saves the generation time. The ERP solutions are build for a user friendly flexible approach to manage the business with the changing needs. This requires processing in a different manner to assess the impact. The solution provides facilities like the trial posting, the end of chosen period processing, the posting by choice, the flexible evaluation procedures, and the hold transactions, etc. Through these facilities the management can conduct an impact analysis to judge the financial results and make the business decisions.

The ERP also provides an intelligent support in business management. It allows the user to define the events, alert and schedule them at his choice.

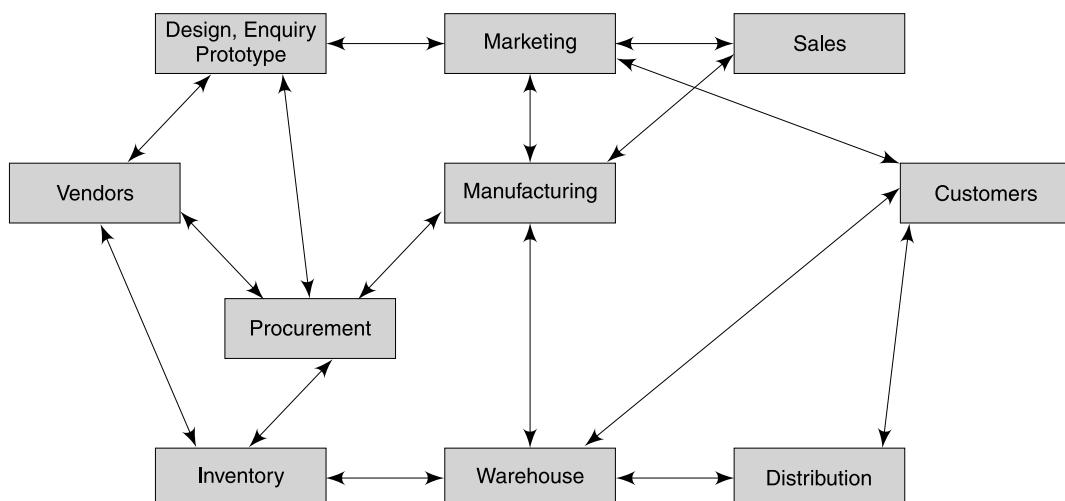
These events alerts are triggered by the database inserts or updates. Having raised the alert, it also allows you to define the action to respond to the alert. The ERP sends the electronic mail and executors the SQL statements. It is also capable of taking multiple actions through the stored procedures.

Take an example of an item receipt in stores. The receipt would update the database and the system will have an updated stock status. This database update is an event for using the alert. The alert in this case can be defined as, on receipt of an item send E-mail to the Purchase Manager, the Production Planner and further, show the work orders which are scheduled where this item is in use. If the receipt of this closes the Purchase Order then raise automatic Purchase Order on the same vendor with the same terms and conditions.

All the ERP solutions provide 'Drill Down' and 'Context Sensitive' helps to use the system. The drill down helps to run through the system to locate the weak spot for action and control. Suppose, the sales manager is viewing the sales by region by product line. Then he wishes to see the sales revenue over a time, in order to better understand the seasonality in the business. The drill down facility helps him to use the information the way he wants, to form the judgments on the business happenings. The drill down could be multi-dimensional to analyse the critical business information.

The context sensitive help provides an access to help library which can be used by the user by calling help. The help could be for information, guidance and understanding of the term or process or formats. The help facilities make the ERP user-friendly and easy to learn.

ERP solution's purpose is to integrate business functions through information flow and its management. In ERP solution information flow to all destinations where necessary. The decision makers have access to the information for decision-making and for use in desktop local applications. Figure 15.3 shows the model of Business Functions Integration.



**Fig. 15.3** Model of Business Functions Integration

Business functions integration is achieved through seamless flow of data and information across the function in real time. First there is data integration followed by information integration for application and system processing. ERP solution makes business organisation information driven with faster response to internal and external customers.

In the world of Internet today, the definition of enterprise however has undergone a change, and so also the change of definition of Enterprise Management System (EMS). In a globalise business scenario. Enterprise Management System now stands for integration of following systems:

- Enterprise Resource Planning (ERP)
- Supply Chain Management (SCM)
- Customer Relationships Management (CRM) addressing the customer requirements and expectations.

We will deliberate on all three ERP, SCM and CRM in the following sections.

### 15.3 ERP MODEL AND MODULES

The generic ERP package represents the commonly operated business model of the organisation. It is built with the function models like the Finance, Materials, Marketing, Sales, and Personnel and their sub-modules. These modules are then integrated to perform ensuring data and information consistency and concurrency.

The seamless integration of the modules allows the user at any level to take a micro and a macro view of the function and process view of the transaction across the function. A typical ERP solution has the following modules.

- Business forecasting, planning and control (Business)
- Sales, distribution, invoicing (Sales)
- Production planning and control (Production)
- Materials management (Materials)
- Finance and accounting (Finance)
- Personnel management (Personnel)

Table 15.1 shows the sub-module details of each module.

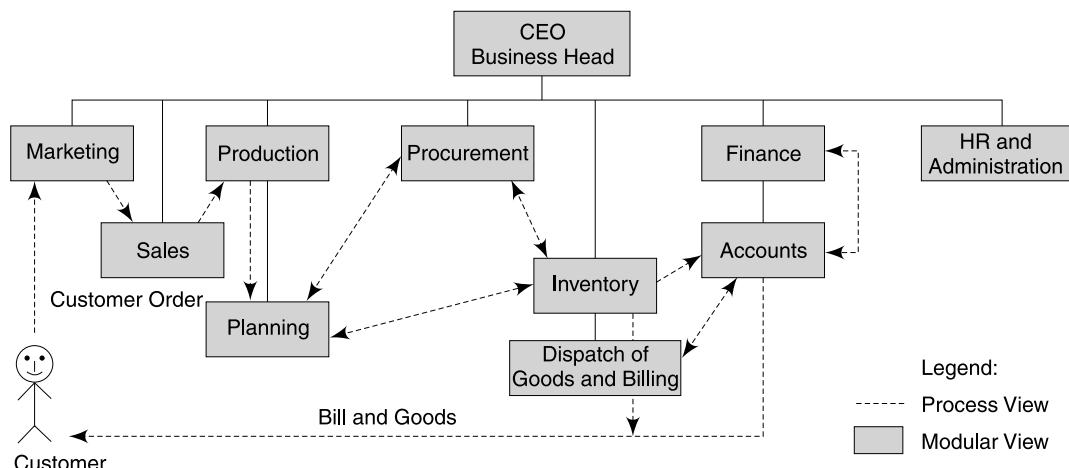
Figure 15.4 shows business organisation model with modular and process view of enterprise. It shows functional breakup and business process continuity of customer order processing across the functions. ERP solution architecture deals with business functions, popularly known as modules, but also takes care of business process needs across the functions. Integration of business functions is achieved through information process integration.

A more detail modular structure of typical ERP is made of

- Marketing/Promotions/ Advertising.
- Sales Order Management (Pricing, Credit, Delivery, Billing).
- Procurement and Inventory management.
- Warehousing & Logistics.
- Production Management (Capacity Planning, MRP I, MRP II, Scheduling, QA).

**Table 15.1** Sub Modules of ERP

<i>Business</i>	<i>Sales</i>	<i>Production</i>	<i>Materials</i>	<i>Finance</i>	<i>Personnel</i>
Forecasting	Forecasting	Planning	Purchase	Accounting	Human Resource
Planning	Planning	Order Control	Inventory	Funds Mgt.	Payroll
Goals	Sales Budget	WIP	Stores	Balance Sheet Processing	Accounting
Objectives	Order Processing	Quality	Valuation	Schedules	Skill Attendance Inventory
Targets Strategy Control	Order Execution Delivery Invoicing	Scheduling Despatch	Analysis Control	Analysis Control	Analysis Control
Fixed Assets	Maintenance	Quality Control	Cost Accounting	Management Accounting	Consolidation of business operations


**Fig. 15.4** Business Organisation Model: Modular and Process View

- Shop floor Management (Job planning, tracking, costing).
- Finance (Budgeting, Funds management, Funds Projections).
- Accounts (Business accounting, General Ledger, Receivables, & Payables).
- Fixed Assets Management.
- Facilities Management & Maintenance.
- HR and Personnel Management, Payroll.

Though structure is modular, it is a network of business functions. A business event impacts simultaneously on different related functions. It then updates the status and triggers condi-

tion based other processes of the consequence. Table 15.2 shows an illustration of customer order processing and its effects on other systems. The GroupWare technology (Work Group & Work flow) helps implement the seamless updating of effects on other related areas.

**Table 15.2** Order Processing and Effects on Other Systems

Event	Application	Effect on conclusion of the application	Systems involved
Receipt of customer order for stock item	Order Processing validation, acceptance, acknowledgement	<ul style="list-style-type: none"> <li>- Raises order book value.</li> <li>- Reserves the goods for delivery as scheduled</li> <li>- Reduces inventory by order quantity.</li> <li>- Effects changes in cash flow projections.</li> </ul>	Sales system. Finished goods inventory system. Funds management system
For non stock item	Order processing validation, acceptance, acknowledgement. Resources Planning – MRP I & MRP II. Manufacture planning and scheduling.	<ul style="list-style-type: none"> <li>- Raises order book value.</li> <li>- Effects changes in cash flow projections.</li> <li>- Reduces Raw Material Inventory for the order.</li> <li>- Raises purchase order.</li> <li>- Meeting resource shortfall through subcontract, outsourcing.</li> <li>- Job order scheduling.</li> </ul>	Sales system Funds management system Inventory system Procurement system Manufacturing, planning system Shop floor planning system

It can be noticed from the table that customer order event affects at least three business functions and processes across the organisation.

Most of the ERP solutions need some changes to suit the environment. The Commerce and Corporate Laws differ from country to country and the ERP in such cases need customisation to satisfy the local requirements of the business.

The ERP solution has an advantage of fast implementation as the design and development is eliminated being a package. Due to object oriented technology and the client server architecture, the changes are easy to make, which are less at the server end and more at the client's end.

Since, it has modular structure, one can implement the solution in a phased manner module by module. It can be implemented first on a smaller scale and expanded subsequently with more users, more locations and more modules as well. Since the whole solution is a package product, the manufacturer of the package brings out newer versions of the product offering more facilities to the user to improve the utility of the solution.

Some of these products are developed as an application in a particular organisation and then turned into a packaged solution. In view of this, some of ERP solution are more useful and efficient in similar organisation. The specific industry features have been taken care of more efficiently as customised solutions. Since the design/developer has a choice of RDBMS, front end tools, the interface tools, and so on the package efficiency changes with the choice

to tools. Some of these packages run better, if installed on a particular hardware platform; and used by a particular organisation.

### ERP Product Characteristics

ERP in contrast to legacy system is a process driven system. The process design of data, transaction, application or system processing is collaborative and parallel. This design reduces processing time of transaction enables faster decision-making and reduces the cost of business processing.

Next important character of the ERP product is instantaneous update of all affected entities due to transaction processing or application processing. The changed status update is immediate, offering same and consistent view of data/information for all its users.

Most value adding characteristics of ERP product is integration of applications, which are triggered by an event internal or external to the organisation. For example, if material is received against a valid purchase order following applications get triggered and they produce variety of results changing the business status of affected entities. The applications are:

- Purchase order updating for received quantity, purchase value, balance quantity and flagging the purchase order as 'open or closed'.
- Inventory applications updating the inventory by received quantity, checking inventory control parameters, and invoking stored procedure, if applicable.
- Receipt value and its breakup (Amount plus taxes & duties) is posted as payables in general ledger; called as General Ledger posting.
- Shows change in projected monthly cash flow for payables.
- Materials budget processing for the quantity and value, and showing the budget variance.
- Reprocess Vendor Performance rating for quality, delivery and performance.

Like application integration capability, ERP product design and architecture is capable of accepting inputs from different technology drive processes. ERP applications in different functional areas are capable of accepting the required input through Import/Export facility, system interface, or direct connectivity. ERP product accepts inputs from CAD/CAM/CAE systems, Bar code scanning system; point of sales system, production data from PLCs installed on manufacturing machines. So two main integration capabilities of ERP are application integration and systems integration resulting into seamless flow of information across the organisation. ERP systems are fully secured and can handle rule based authority structure for approvals, sanctions and for specific decision-making.

We now list features of ERP, which make it a valuable strategic tool for management of business:

- Business rules embedded in the process.
- Extensive use of stored procedures, triggers, and alerts.
- Stagewise cost data capture for analysis and decision-making.
- Resources planning, scheduling and optimisation.
- Creates knowledge databases using Data warehousing and Data mining applications.

- Can run in different network environments.
- Uses object and component technologies, and is easily configurable to RDD specifications.

ERP systems are IT enabled systems that capture data and gather information in business execution process across the functions. ERP systems are designed to execute transactions, monitor them and update the status of other functions suitably.

IT improves the ERP systems by automating the process resulting in higher efficiency and reduced errors.

ERP systems however lack analytical capabilities as they are designed largely to execute business operations based on rules, methods and procedures. They are intelligent enough to use embedded rules and DSS for decision-making.

#### **15.4 BENEFITS OF THE ERP**

1. Better management of resources reducing the cost of operations.
2. Planning at function and process level Increase in the productivity of the business.
3. Customer satisfaction increase due to shorter delivery cycle. Closer contact with the customer.
4. Simultaneous activation of the decision centers because of instant inducement through triggers or updates
5. Business operations transparency between business partners cutting down the execution time of critical business operations.
6. Intelligent ERP download the decision making at lower level, releasing the burden on the middle management.
7. Due to faster processing technology and SQL, management can see the information in their perspective and take different view of the business.
8. Due to strong interface capabilities, the human resource can be utilised better due to access to information across the databases distributed over the organisation.
9. Since, the ERP design is proactive, it makes the management alert at a number of points demanding the decision or action.
10. The processes become faster due to work group technology and application of work flow automation.
11. Due to the support technologies like EDI, E-mail, office automations, paperless office is a newer possibility as communication is faster and systems get connected directly.
12. The ERP still remain a valid solution with the expansion of business as it is a scalable architecture.
13. Due to the client/server architecture, the application of object technology and use of the front end tools, the process changes can be easily carried out in a short duration of time. Hence, the user service can be maintained at higher level.
14. The ERP implementation automatically leads to the usage of the best business procedures bringing the consistency of operations in the world of business.

15. With the use of the data warehousing and data reverse engineering, management becomes knowledge driven and the organisation becomes a learned one.
16. The ERP scope can be enlarged through the Internet/Intranet access, making the ERP sensitive to the latest events in the business, market and technology.
17. The quality of decision making improve as the user decision maker is made alert and knowledgeable and better informed dynamically.
18. The tools available to the decision maker are friendly whereby he is equipped to make decision and execute it simultaneously.

We now summarise different benefits of ERP in three classes: Operational, Business, and Management. These benefits are the results of ERP product technology, design and architecture.

- Operational Benefits
  - Reduced processing cycle.
  - Access to multi dimensional information.
  - Empowerment of employees to become a decision maker.
  - Effective cost control through use of cost data for business decisions.
  - Increase in resource productivity.
- Business Benefits
  - Higher profits and improved ROI due to cost savings.
  - Improved working capital management due to reduced inventory and receivables.
  - Higher utilisation of resources reducing the cost of production per unit.
  - Higher customer satisfaction due to prompt deliveries.
- Management Benefits
  - Change Management is easy due to configurable feature of the ERP product. Ease of configuration is due to use of object technology in ERP development.
  - Strategic information about sales, production, resource usage showed through Pattern, and Trends.
  - Secured information access to authorised users.
  - Cost of business reduced, business performance improved due to other technologies' integration with ERP processes.

It is necessary to appreciate that ERP product is a solution to improve enterprise performance all round. But this solution is not a panacea for ill health of the organisation and its business. If business and management has certain weaknesses they need to be removed first before ERP solution is implemented. For example, if company's products are not doing well for various reasons such as bad quality, high cost due to design, and others, then ERP does not have remedies to set this aspect right. ERP solution gets smooth sailing and shows higher returns if business is in good shape and has a potential to do better. ERP implementation accelerates the realisation of higher returns on investment.

Further, it is necessary that Business Process Reengineering (BPR) study is conducted before the ERP solution is considered for evaluation and implementation. ERP product has

number of good business processes and practices, which should be considered as an alternative to the current inefficient processes. Advice is, 'do not take inefficient and ineffective processes for implementation to ERP', improve them radically and then implement through ERP. It is also found by experience that implement ERP as it is. Do not insist customisation as it brings down the efficiency of the product, and you are running a risk of low returns on the ERP investment.

ERP product implementation should be seen as Change Management process and should not be treated as software product implementation. Since, it is a change management system, top management's commitment to ERP solution approach and in its implementation is absolutely necessary participation throughout.

Return on investment is higher if strategic analysis of business is done and business is restructured for new challenges before ERP initiative is taken.

### **15.5 ERP PRODUCT EVALUATION**

Market is flooded with ERP products with wide variety of functions, features and so also cost. ERP products are evaluated as following factors.

#### ***Factor***

1. ERP fit for the business of the organisation in terms of the functions, features and processes, business scope versus application scope and so on.
2. The degree of deviation from the standard ERP products.
3. Ease of use: Easy to learn, implement and train.
4. The ability to migrate to the ERP environment from present status.
5. Flexible design.
6. The level of intelligent usage of 'help', error messages, dictionaries.
7. The ability for a quick start on implementation.
8. Versatility of the solution for implementation on a platform with the project of saving the investment.
9. Rating on performance, response and integration.
10. Product quality in terms of security, reliability, and precision in results.
11. Documentation for system handling and administration.
12. Product rating in its class of products.
13. Solution architecture and technology.
14. Scalability and up-grad ability.
15. Product growth history, Support and Maintenance.

The methodology of selection will begin first with the study of organisations in terms of the business focus, critical applications, sensitive business process, etc. Since, the ERP solution is a tool to change the style of business management, it requires thorough understanding of the business, the business issues, the management criticalities, and the socio-cultural factors. Such a study will help find out if the ERP is fit for the organisation. It is a very important to find out that the ERP is fit or not, as it is the most important and critical success factor.

The price of the ERP package is difficult to judge and often it is a negotiable point in favour of the buyer in competitive scenario. Since the ERP implementation is a two three year's project, the ERP solution will sustain and be adequate for the current and the future business needs for a period of five to seven years. After that, it would become a platform for the future expansions and growth.

It is advisable for the organisation to form a committee for selection of the ERP solution. It should have important functional head, a strong information technology person and a person from corporate planning functions. The committee should be headed by a CEO or his designated authority. This committee should prepare a requirement document spelling out the business goals, and objectives, the futuristic scenario of business, the critical functions, processes, business focus and customer deliverables. A note on the management philosophy, procedures, practices and style will be a valuable input.

When such a document is ready, the selected ERP vendors should be called for seeking the ERP offer. The document should be given to the vendors, and they should be allowed to study the organisation and its business. All the vendors should be asked to submit a technical proposal explaining the fit of the ERP to the organisation. The submission of the vendors should be scrutinised by the committee for short-listing. The short-listed vendors then should be asked to give the product presentation to the selected group of decision makers to seek their opinion on the product.

When the product presentation is over, product demonstration should be arranged, for a detailed security and evaluation. In this process, the committee should confirm whether the critical requirement of business, in terms of information, process handling facilities, features, etc. are available or not. If some them are not available then there is a possibility of work around to achieve the same result.

A second evaluation note should be made for a comparative analysis of the ERP solutions and then a critical evaluation of this analysis should lead to the choice list. Simultaneously, the committee should gather information on the experience of the other organisation where the ERP is implemented. This information should be on how successful the vendors is, in the implementation of the ERP? The strengths and the weaknesses of the vendor, the product and the post sales processes should be ascertained. The choice list should be weighed by these points.

Though such an approach is appropriate, it is not always possible to bring out a clear win in the evaluation, as many factors are intangible in nature. In such an event, the committee should examine the trade off involvement in the selection. It should not happen that organisational issue dominate the choice of the ERP and in the process the best product is rejected. Ideally, the organisation should be carrying out business process engineering and reengineering study, restructure the organisation, modify the processes functionalities before the ERP decision is made.

Once the committee makes the decision, the vendor should be asked to resubmit the technical and commercial proposal with price and the terms of offer. The proposal should have the following details.

1. Scope of supply
2. Objectives

3. Modules and deliverables
  4. Implementation methodology
  5. Plan and schedules of hardware and software implementation
  6. Resource allocation
  7. Responsibility division between the organisation and the vendor
  8. Process of implementation
  9. Organisation of implementation
  10. Progress monitoring and control of the important events
  11. Process of resolving the issue at all levels
  12. The official product literature
  13. Association with the other vendor its purpose
  14. Commercial submission:
    - Price by module and number of users
    - Payment terms
  15. Process of acceptance of the ERP by stages and linking with the payments
- Once the ERP decision is made, the vendor and organisation enter into a legal contract. Such legal contract should list the obligations, duties, responsibilities, deliverables and the value components. It should also include the clauses on issues arising out of unforeseen circumstances and how to resolve them with the legal remedy available to both the parties. Since, the ERP is a product of several technologies, there should be clauses relating to safeguarding the interests of each other to cover the risk arising out of the technology failure.
- The ERP is a tool to manage the enterprise resources to achieve the business objective. It is a supporting system and does not solve all the problems of business management. The success of the ERP lies in its implementation with commitment. It requires full participation of the organisation. It is to be appreciated as a managerial tool and not as a labour saving device. Since, potentially the ERP is designed for productivity rise, the management must exploit it to its advantage by adopting the best practices or changing the practices through the business process reengineering.

## 15.6 ERP IMPLEMENTATION

The ERP implementation, generally, follows the waterfall mode approach. Once a firm order is received, the implementation begins with kick-off meeting between the vendor and the organisation. In such meeting the organisational issues are taken care of. Since it is a long-term activity a preliminary planning is done to start the implementation.

### Requirement Definition and Description (RDD)

Though, initially, the study has been carried out by the vendor, more in-depth study is taken up jointly by the vendor and the project in-charge of the organisation.

In this phase of study the users are contacted for their requirement specifications. These requirements may be of the data, information, function, features, processes or reports. It is necessary to understand them to evaluate the ability of the ERP solution to satisfy these requirements.

Since, the ERP is designed as a standard package, it often requires changes and modifications to suit the requirements of the business.

All the ERP packages provide standard features, functions list for all functions. These lists are examined vis-à-vis the requirements and new document is prepared called as the deviation RDD. The process is called gap analysis arrived after product mapping with RDD.

Once the deviation RDD is made, it should be approved by the authorised person in the organisation. The purpose of such a document is to freeze any requirement to carry out further changes in the package.

In the evaluation of standard RDD, two kinds of changes emerge, one major, where the ERP design needs to be changed. Such changes are time consuming and the vendor may charge additionally for such requirement fulfillment. Other changes may be minor and may not affect the design of ERP. The minor changes are cosmetic and/or presentation, and they are generally at the lower end of the process. The changes are like the field change, the report format modifications, the computing process and so on. The advantage of preparing the RDD and a deviation therefrom in that the users of the ERP get committed to the solution as they have through the standard requirement provision of the ERP and the deviation required in the provision. In this process, the resistance to change is eliminated, due to direct involvement of the users and the decision makers.

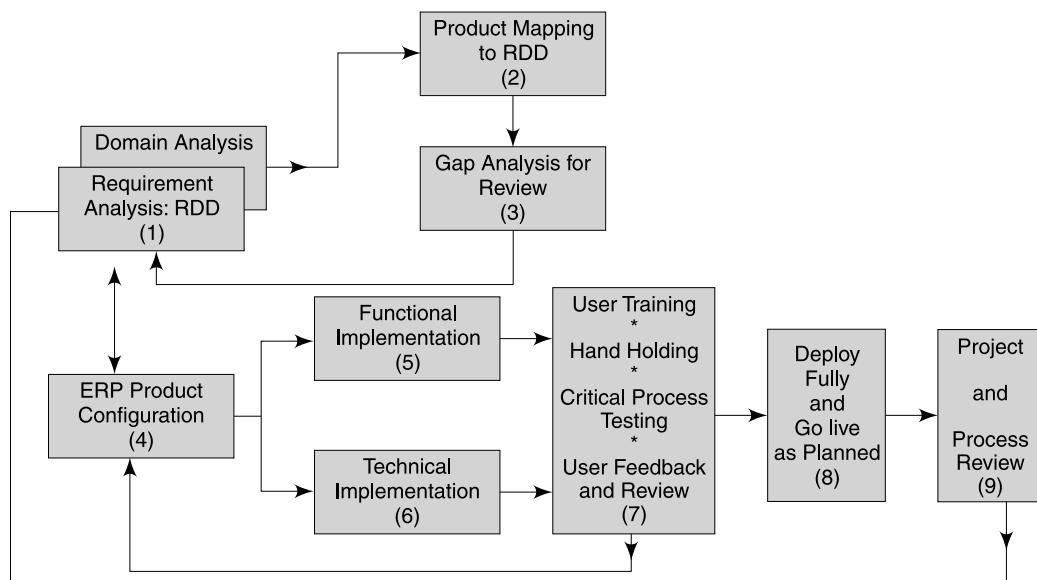
The another distinct advantage of the RDD and the deviation from the RDD, is that it provides the revised specifications clearly to the designer and the developer to bring out the changes required in the design of the ERP. It also further helps to assess the work load arising out of the changed requirement.

As soon as the new RDD is prepared, the process designers starts implementing the changes. The moment the changes are required the processes of design coding, testing, etc. come into picture for execution. The changes so made, are then tested on a sample data and other steps on unit testing, module testing and system testing for complete integration are taken. After establishing the requirement definition and description (RDD) and mapping it with the standard RDD of the ERP solution, the DRDD (Deviation RDD) is prepared for changes in the solution and implementation. The implementation steps are given as follows:

1. A user meeting is arranged to explain the ERP and process of implementation.
2. The RDD and the DRDD is explained for understanding and approval by all users.
3. The development resource to carry out the changes in the system, generally, known as customisation is provided. The changes could be business specific and customer specific.
4. The DERP (Deviation ERP) solutions is tested.
5. The solution on the recommended platform is loaded.
6. The solutions is tested on a sample data of substantial nature.
7. The solutions is then demonstrated to the users for their understanding and confirmation
8. The users are trained to run the solution and resolve the difficulties in operations of the system solution
9. The change overs from the manual system to the ERP solution are meticulously planned, taking care of the cut off dates, the opening balances, the data transfer etc.

10. A logbook of the system usage is kept to note down the problems, solutions and modifications carried out to make the solution more efficient and effective.
  11. Standard reports like checklists, ledger, trial balance, and sales analysis are taken to confirm the integrity of the ERP solution.
  12. The standard documentation of the ERP solution is changed to the changed version of the ERP.
  13. The system performance is checked in terms of speed, response, etc. and the ERP solution and/or the hardware is tuned for improving the performance of the solution.
  14. After three to four months' working, a review meeting with the user is conducted, taking the support of the log system for the purpose improvement, confirmation and finalisation of the ERP implementation.

Figure 15.5 shows ERP implementation process model, which most ERP vendors follow. It is a nine steps approach for successful implementation of ERP.



**Fig. 15.5** Nine Steps Approach to ERP Implementation.

The model is built on three reviews. First review product vs. RDD results into 'gap analysis' showing what ERP package offers and what Requirement Definition and Description (RDD) states. This confirms the utility of ERP product and makes a clear prescription of changes, which are must in the ERP solution. Second review is 'ERP configuration review' to confirm that configured ERP for customer specific requirement is useful to the users. And third and final review is after, say six months usage, to confirm that RDD is fully implemented and the solution meets all requirements, namely functions, features, facilities, technology interface, information requirements and reports and queries. Nine steps implementation model is dynamic where each step is checked, reviewed and confirmed. Implementation process is user driven and involves management of the organisation.

The major hassles in the ERP implementation are due to:

1. The resistance of the users in the acceptance of standard ERP solution.
2. The limited awareness of the users and the appreciation of the Information Technology applications.
3. The ability of the users to change over from the old conventional systems to the technology based new systems.
4. The level of acceptance of the standard business processes incorporated in the system. Lower the acceptance, longer the implementation time, resulting into a loss of efficiency and effectiveness of the solution.
5. A lack of clarity on the business requirement, the customer focus and the strategy of business and its impact on the ERP solution.
6. The ERP implementation is carried out without properly evaluating the business processes and practices through business process reengineering and is preceded by restructuring of the organisation.
7. The choice of the ERP solution. Not all the ERP solutions are appropriate for the organisation. Each solution has its own peculiarities in terms of design, architecture, technology, coverage of business scope, functions and features. Some solutions are good for certain type of business and industry and not for all the businesses and industries.

Ideally, the choice should be based on the ERP fit for the organisations, functions and features. Higher the fit, is the solution from all angles. If the fit is higher, the customisation will be less and the user acceptance will be higher. In short, the implementation cycle would be short.

To meet industry specific requirements more effectively, ERP vendors have brought out additional industry specific modules. These modules are implemented along with main ERP solution.

## 15.7 SUPPLY CHAIN MANAGEMENT (SCM)

Supply chain management (SCM) is an enterprise software to manage and integrate a network of customers, suppliers, business partners, distributors into organisations internal supply network involved in the ultimate provision of product and service packages required by end customers (**Harland, 1996**). Supply chain management spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point-of-origin to point-of-consumption. SCM system keeps track of inventory and value of material throughout the chain and provides information to SC Manager to act.

Supply chain management is a cross-functional approach to manage the movement of raw materials and components into an organisation, acting as a bridge between external network of suppliers, Customers and business partners. These functions are increasingly being outsourced to other entities that can perform the activities better or more cost effectively. The effect is to increase the number of organisations involved in satisfying customer demand, while reducing management control of daily logistics operations. Less control and more supply chain partners led to the creation of supply chain management concepts. The purpose of sup-

ply chain management is to improve trust and collaboration among supply chain partners, thus improving inventory turnover. The SCM performance is linked to business model and processes of the organisation. The SCM systems outcome and impact is at three levels strategic, tactical, Operational as elaborated here under.

### **Strategic**

- Strategic network performance optimisation.
- Strategic partnership with SCM partners to collaborate for improving the performance of supply chain.
- Product design and process design coordination, so that new and existing products can be integrated into the supply chain for superior supply chain performance management.
- Information technology infrastructure, to support supply chain operations.
- Make or buy decisions, make or subcontract decisions, domestic or import decisions
- Aligning overall organisational strategy with supply strategy.

### **Tactical**

- Sourcing contracts and other purchasing decisions.
- Production decisions: planning and scheduling
- Inventory decisions, including quantity, location, and quality of inventory.
- Transportation strategy, including frequency, routes, and contracting.
- Benchmarking of all operations against competitors and implementation of best practices throughout the enterprise.
- Focus on customer demand.

### **Operational**

- Daily production and distribution planning.
- Production scheduling for key manufacturing facility.
- Demand forecasting, planning and scheduling.
- Sharing this information with SC partners for coordination and collaboration.
- Inbound operations: Deliveries from suppliers and impact on inventory.
- Production operations: Receiving material on shop floor and impact on delivery
- Outbound operations: Planning dispatches and transportation to meet promised delivery date.
- Reacting daily on Supply chain performance measure.

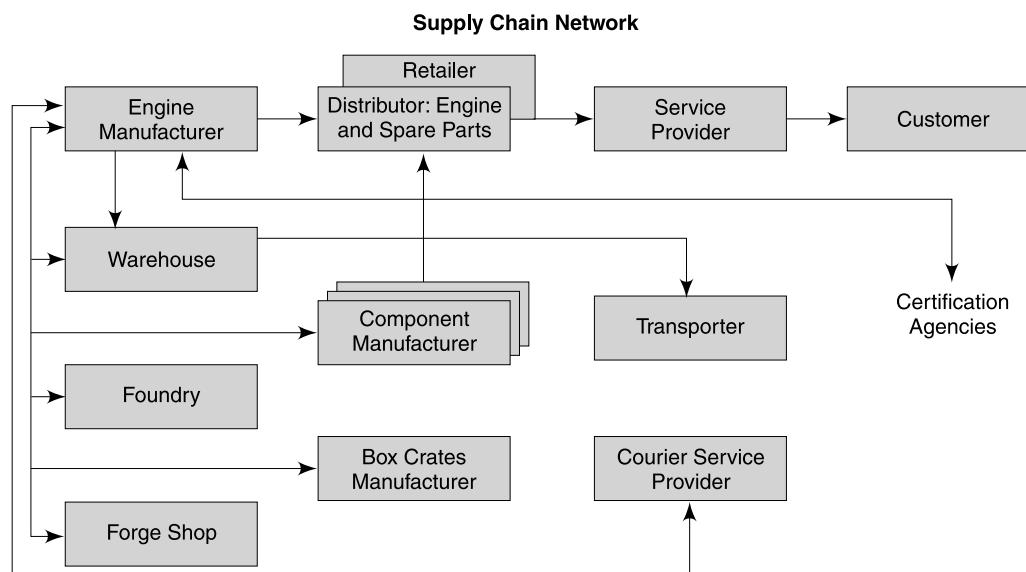
Supply chain consists of all stages involved in servicing the customer to fulfill the expectations. A supply chain not only includes the manufacturer and suppliers but also transporters, warehouse, retailers and customer themselves. A supply chain always need not have all of them. Those present in the chain will be there due to specific role in fulfilling the customer expectations. If the role is absent that entity will not be in the chain. A supply chain is an extended enterprise where participants in the chain have specific contributing roles to the goal

of reaching the customer. Table 15.3 shows participants in different supply chain models for Manufacturing, Trading and Service business.

**Table 15.3** Supply Chain Models and Participants

<i>Manufacturing Business</i>	<i>Trading</i>	<i>Service</i>
Customer	Customer	Customer
Retailer	Retailer	Consultant
Distributor	Transporter	Service provider
Transporter	Warehouse	
Warehouse	Supplier	
Supplier		

Major supply chain functions are Marketing, Manufacturing, Procurement, Operations, Inventory, Warehousing, Distribution, and Customer Service. The process begins with customer order and ends with delivery of goods or services. These functions are managed through supply chain participants who could be many at each stage in the chain. Note that supply chain is a network of participants. Figure 15.6 shows a supply chain of Engine manufacturing company. The company sells engines and spare parts through distributor, service provider channel.

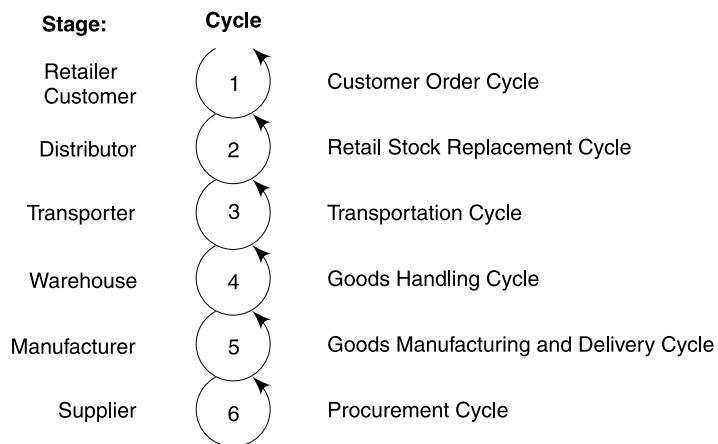


**Fig. 15.6** Supply Chain of Engine Manufacturing Company

The objective of supply chain is to maximise the value of supply chain where value is defined as 'Final Product worth to the customer less the value of effort spent in delivering that product worth'. Then supply chain profitability is the total profit of all participants in the chain. Supply chain profit is profit earned by all participants.

Supply chain is driven by three main inputs namely, Information, Funds and Goods. All three inputs flow between participants of the chain. Higher the speed of this flow higher is the response of the supply chain. The cost of supply chain depends upon service level set by you and facilities built in the chain.

So far we have seen supply chain as a functional view. But supply chain can also be seen as a process, made of several sub process. Such a view is known as process view of supply chain as shown in Fig. 15.7.



**Fig. 15.7** Process View of Supply Chain

Supply Chain Management (SCM) means management of these cycles effectively and efficiently maximising the value of chain. SCM needs information support to manage the chain. This information is about the customer requirements, stocks, and funds in the supply chain. Integrated supply chain management model is shown in Fig. 15.8.

Supply chain management effectiveness depends on supply chain design i.e. evolving a structure of production units and their locations, Suppliers, Warehouses, and locations; distributor — dealer — retailer channels and customers. Then it is necessary to decide on operational support systems at each stage to make supply chain highly responsive. Supply chain design, however, cannot be decided in isolation. It has to be a matching and supporting one to business strategy of the organisation. You can, however, be guided by broad principles of designing a supply chain.

- Less number of stages preferred between customer and goods/service provider.
- Physical operations as far as possible should be mechanised or automated to make each cycle faster and error free.
- Each stage is supported by IT systems for faster information processing for local decisions and SCM decisions.
- All stages are no network of communications capable of providing seamless flow of information about stocks, stock movement, order and order deliveries, Funds received and spent.

- Decision on location of factory, Warehouse, distributor and their numbers with the objective of minimising the cost of SC operations and maximizing the value of supply chain.
- IT infrastructure has to be supporting business strategy and SC strategy. It is to be made highly secured and protected from unauthorised access using firewall and proxy servers in the network system.
- IT infrastructure design should use B2C and or B2B e-business models.
- Ease of integration in ERP system at enterprise level is a necessity.

A supply chain design based on E-business models has a very favourable cost impact raising the total profit of supply chain. E-business processes offer following cost reducing opportunities:

- Reduction in products handling cycle at each stage.
- Enabling postponement of product differentiation till customer places the order leading to reduced inventory cost.
- Reduced inventory levels across the chain due to integrated SC inventory policies.
- Reduction in the cost of SC operations due to reduction in transportation, handling, loading and unloading of goods.
- Excellent coordination and communication between stages due to information sharing avoiding delays and waiting for information.
- Faster turnover of assets; inventory and funds blocked in SC.

There are number of cases where SCM has given excellent results. One eye opening example is of Hindustan Lever Ltd. (HLL). HLL saves \$ 125 million from its supply chain in India. HLL supply chain network is made of 80 manufacturing sites, 56 distribution centres and 3,400 wholesalers. SCM system was able to reduce stock levels from six weeks of sales to less than three weeks. The volume of finished goods inventory at distribution centres was reduced from 25% to less than 5 per cent. Another example is of Maruti Udyog Ltd. (MUL). MUL has brought down inventory level of indigenous items from nine days to 3 days at present.

## 15.8 INFORMATION MANAGEMENT IN SCM

Information is a key driver of SCM. The participants in supply chain need information about goods movement, order placed, and order delivered and payables and receivables. All the participants are tied up in supply chain through an integrated information system. Supply chain partners have their own information systems designed to meet their MIS goals to support the achievement of their business goals. However, for supply chain management integration of partners systems across the chain is necessary to have one view of data and information to all users in the supply chain.

- Determining the information needs of SC to manage it effectively is the first task. Such information need has to be common for all participants. Table 15.4 shows an information list (not very exhaustive) which all participants need in their decision making process for effective operations of SC.

**Table 15.4** Information List for SCM

<i>Information</i>	<i>Examples</i>
Customer	Customer class (A, B, C) Credit Limits, Volume of business Receivables. Credit history/rating. Buying pattern/Forecast indication. Preferences and Choices. Product purchase history.
Product	Product specification, Product quality. Product Applications, Product vs Customer Analysis, Drawing and Design information.
Sales	Sales Analysis by Region/Segment/Class of customer. Comparative analysis by period/segment/projections. ABC analysis of product/sales/orders etc, sales forecast.
Inventory	Class of item, store locations, Inventory control parameters. Leadtime Cost of item. Movement projections. Value of inventory.
Production and Supplier	Capacity, Capability, Schedules, Availability, Plans. Product range, specifications, lead times, quality specifications, price and commercial information, supplier supply history, supplier rating, strength and weaknesses in product, service, quality.
Transporter	Fleet capacity, carrier types, lead times, cost of transportation.
Marketing	Campaign Schedule, Message, and Objective, Response vs. Segment analysis.
Supply chain	Measures: Delivery period. Total cost per unit, Total inventory in the chain. Total funds blocked in the chain.

A successful SC strategy is built after:

- Understanding customer needs to build product strategy.
- Identifying demand uncertainty to decide on inventory policies.
- Deciding service level to build SC and IT infrastructure.

Obstacles in building strategic fit are product variety, shrinking product life cycles, ever increasing and changing needs of customers and global competition. SCM initiatives are unlikely to succeed if requisite information support and MISs are absent.

A supply chain is a dynamic network of its participants and runs with a constant flow of information; goods and funds between participants. The primary purpose of SC is to satisfy customer requirements and maximise the value of supply chain. SCM involves the management of flows to maximise the value.

## 15.9 CUSTOMER RELATIONSHIP MANAGEMENT (CRM)

With rapid globalisation of business and product differentiation becoming less relevant and competitive, customer relationship now is the key enabler for moving the business ahead. Customer relationship has become a factor of competitive advantage.

Customer approaches the organisation for product or service with certain expectations. If fulfillment experience of the expectations is encouraging then customer will revisit for service. If the experience is not encouraging then customer may go to competition. The ability to recognise this aspect and to actively manage the customer behaviour is the basis for customer relationship management.

The customer experiences a sense of service fulfillment if expectation about the service excels. The experience is built out of interactions between various entities in the customer servicing process. Interaction may begin with query, then request for service, configuring the service scope to the expectation of the customer and deliver as promised in quantity, quality, and time. Technology supports all these interactions across the organisation. The systems, which support these interactions, provide seamless flow of information across the system.

CRM is a comprehensive set of processes and technologies for managing the relationships with potential and current customers across the business functions. The goal of CRM is to optimize customer satisfaction and revenue through relationships built with potential and current customers, across the business functions. The goal of CRM is to optimise customer satisfaction and revenue through relationships built between customer and all those who deal with the customer. The relationship is built through managing customer initiatives and behaviour in such a way that customer experience is full of comfort, happiness and satisfaction.

CRM is a combination of policies, processes, and strategies implemented by an organisation to unify its customer interactions and provide a means to track customer information. The objectives of a CRM strategy must consider a company's specific situation and its customers' needs and expectations. Customer relationship management (CRM) system is used to track and organise its contacts with its current and prospective customers. CRM software is used to support customer interfacing processes. The CRM system is designed to capture customer queries, orders and contact information and then to be shared with internal departments for action CRM system is configured around three areas as under,

- **Front office operations**—Direct interaction with customers, through face to face meetings, phone calls, e-mail, online services etc. Capturing queries, requests, and problems raised by the customer and sending them to back office.
- **Back office operations**—Interfacing with front office and conduct operations of billing, maintenance, planning, marketing, advertising, finance, manufacturing, etc. Solving queries and problems.
- **Business relationships**—Interaction with other companies and partners, such as suppliers/vendors and retail outlets/distributors, industry networks who provide information and action support to solve customer issues, problems and queries.

Typical CRM goals are to improve services provided to customers, and to use customer contact information for communication and marketing. A CRM package generally has following function modules

1. Sales Force Automation (SFA) activities
  - Activity Management: Scheduling sales calls or mailings
  - Tracking customer responses
  - Generating reports on calls
  - Opportunity management and assessment
  - Account management and target account selling
2. Analytical CRM activities
  - Designing and executing marketing campaigns

- Analysing customer behaviour and responses in order to make decisions relating to products, prices and services
  - Business forecasting and customer profitability analysis.
3. Sales Intelligence CRM generates 3 As (Attention, Alerts, Action) when following change is seen.
    - Cross-selling/Up-selling/Switch-selling opportunities
    - Customers drift or walk away to competition.
    - Sales performance: Under or over in specific segments.
    - Customer buying trends in choices, brand etc
    - Customer margins and overall profitability.
  4. Campaign Management activities
    - Deciding the target groups for market campaign.
    - Designing campaign material and planning the launch.
    - Launch the campaign.
    - Tracking, storing, and analysing campaign feedback.
    - Tracking responses and analysing trends by geographic zones.
  5. Collaborative CRM activities
    - Identifying inter dependent activities.
    - Forming teams to handle major issues.
    - Support collaboration effort through information exchange.

### **Approaches to CRM**

One approach is ‘Customer intelligence’ driven, where CRM strategies are based on customer intelligence. The customer intelligence is built using the information from following systems.

- Sales Force Effort Automation
  - Lead tracking.
  - Opportunity Management.
  - Contact Management.
  - Order booking and follow-up till delivery.
- Customer Service
  - Call centre management.
  - Online help.
  - Internal help desk.
  - Knowledge based Expert Systems.
- Marketing Automation System
  - E-mail response management.
  - E-commerce.
  - Web enabled ordering systems.
  - Information sharing with internal and external customers.

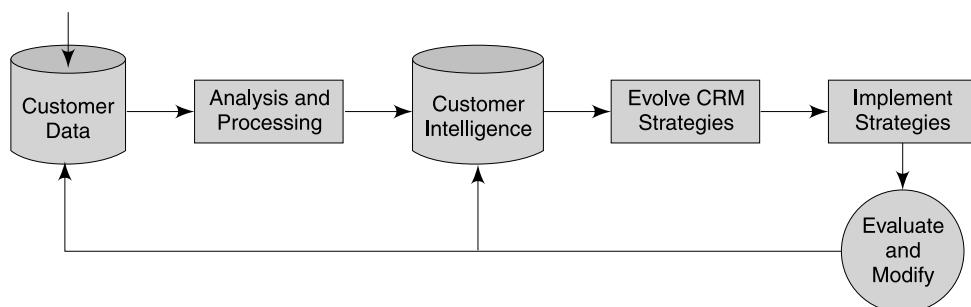
This approach essentially relies on the past data and information, and on customer intelligence for designing CRM strategies. It is also called as 'data driven approach' to CRM.

The second approach is more dynamic and uses processes to understand customer behaviour to formulate CRM strategies. In process driven approach, CRM solution senses the behaviour of the customer and acts proactively to deliver the service. In the process approach, customer service process cycle is managed online and in real time. The Customer Service Process Cycle has following phases:

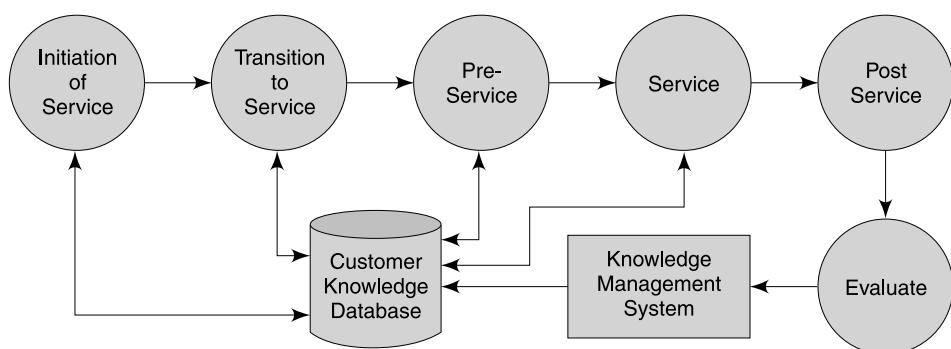
- Initiation of Service
- Transaction of Service
- Pre-Service
- Service
- Post Service

In this approach, customer is provided with tools and facilities to interact with the organisation. CRM system has capability to capture these interactions, analyse them, process them, and formulate a strategy to service the customer. In process driven approach every customer is treated as a unique customer. Fig. 15.9 shows two models of CRM, Data driven and Process driven.

#### (a) Data Driven CRM Model



#### (b) Process Driven CRM Model



**Fig. 15.9** Models of CRM: Data and Process Driven

Data driven CRM model is reactive as it relies on customer data history and customer intelligence. Process driven CRM model is proactive that uses customer knowledge as a basis for CRM. In either case CRM is a combination of software solutions and business processes to accomplish customer centric goals. In the current business scenario, with the implementation of internet and web technology, process driven CRM is most relevant and effective.

CRM is not Sales Management, similar to a typical module in ERP. This module includes Contract Management, Prospecting, Lead analysis and qualification, Lead Management, Forecasting, Pipeline management (tracking till the lead is closed). Sales Management System executes the sales order to customer. Its design is intended for delivery of service. It is a Sales operations management system. CRM is a system with strategic role and objective to build a relationship with the customer to build business potential, loyalty and repeat business.

### **Analytical CRM**

A large complex business organisation may have both CRM models working together. For both the models, data is sourced from enterprise systems, such as ERP, SCM, E-business, Finance and Accounts. Process driven CRM is also termed as 'analytical CRM' helping to enhance the value of CRM system.

Following processes are handled in Analytical CRM:

- Customer value management
- Customer satisfaction analysis
- Revenue analysis by customer segmentation
- Customer classification by different profiles
- Customer buying behaviour analysis, current and sequential
- Customer vs. servicing channel analysis
- Response capturing to marketing campaigns and its analysis

Analysis in Analytical CRM is carried with the help of IT tools. Most popular and often used tool is OLAP—On Line Analytical Processing. This tool helps access data online at all levels and provides analysis as required by the user. OLAP brings out certain attributes of data organised around several dimensions such as Customer Segment, Period of sale, location, Market segment and so on.

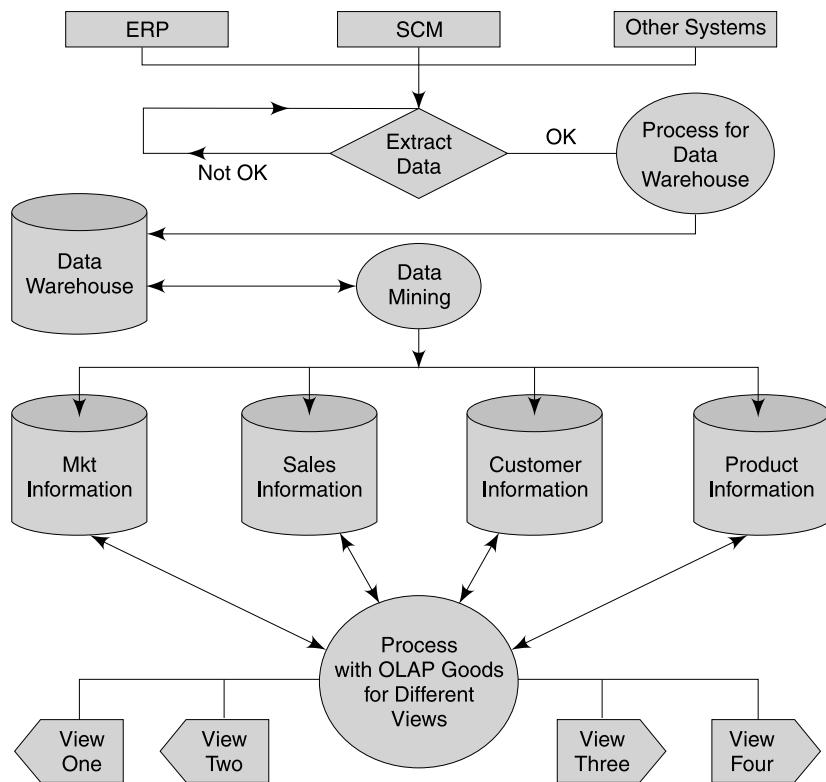
OLAP analysis deals with query or hypothesis a decision maker may have. Once the query is defined and executed, it gives the analysis as desired, enabling the decision makers to pass a judgment on the hypothesis. OLAP analysis digs into data and displays it as requested to throw light on the hypothesis. For example, Sales Manager believes and sets the hypothesis that sale of certain items is more in the middle of the month and much less in the last week of the month. Sales Manager would build a suitable query and run it for results. The query analysis display would prove or disprove the hypothesis of the decision maker.

Another powerful tool for analysis is 'Data Mining'. Data mining tool application is possible if an organisation has a data warehousing system. Date warehouse stores processed data with context from cross-functional areas with its metadata for strategic analysis. Data mining sources its requirement of data from data warehouse. Data mining tools identify patterns and relations in data and deliver valuable insight in the business. These patterns and prob-

able relations are not apparent or obvious in nature and hence are not known to the decision maker.

Data mining focuses on three areas, namely Prediction of customer decisions based on historical data, Sequence prediction of customer activities and association prediction of items, which move together.

A prerequisite to Data Mining and OLAP application is a good Data Warehouse built in the organisation. Figure 15.10 shows an Information System structure with Data Warehouse and Data Mining sets developed for OLAP applications.



**Fig. 15.10** Use of Data Warehouse, Data Mining and OLAP Tools

Each view throws some light on customer behaviour and customer response to various actions of Marketing and Sales personnel. Each view may show a new dimension of relationship for management to leverage upon. Each view provides knowledge that could be either predictive or descriptive; a power to understand the customer better. The views are generated using following techniques.

- **Classification:** Classification is a process, which uses criteria to classify customer population into different classes with associated business data. A class may predict some behaviour pattern. For example, customer views will tell which customers buy

which products and tell which mode of payment they prefer. When new customer enters the system, it is possible to predict buying and payment behaviour of the customer by identifying its class.

- **Regression:** Regression is the process of finding a value of a variable, which is dependent on other variables. Regression process succeeds when a significant relationship between variable and dependent variables is a tested one. For example, the value of business per day can be predicted in the case of grocery chain store using dependent variables, namely time spent, by customer frequency of visits, and class of customer.
  - **Link Analysis:** Link analysis is a process of finding the links between two sets of variables. The link relationship may be of following types:
    - Lag and lead (shows one lags the other).  
Sale of umbrellas lags the rainfall.
    - Moving together (shows affinities)  
Bread & Butter, Paper napkins & Cups
    - Configured links (Purchased as a set of items).  
*Drinks, Chips and Soda; Bread, Milk & Eggs*
  - **Segmentation:** Segmentation is a process of identifying finite sets of data clusters. For example, customers can be clustered using following clustering criterion:
    - Buying behaviour
    - Preference for high value
    - Value of purchase
    - Preference for discount/bargain purchase
  - **Deviation Detection:** Deviation detection is a process of identifying the deviation from confirmed prior trend or expectations. The analysis of deviation shows whether there is a shift in the pattern due to certain changes in dependent variables or is it a random occurrence.

You will now realise that data mining is an exploratory task. It is a research about variables operating in the business. The success of data mining depends on the extend the manager is able to see through the data in different view and perspectives. Secondly, the ability of the manager to sense the relationship between different variables raises the utility of data mining operations.

CRM is used to build a long term and profitable relationship with the customer. Analytical CRM is technology driven and uses high-end tools, namely Data Warehousing, Data Mining, OLAP, and Statistical analysis tools. The best results are obtained when CRM tools are integrated in CRM solution. CRM solution addresses three requirements of the business, acquisition of new business, expansion of current business, and retention of the customer base.

E-CRM

With Internet and electronic technologies making inroads in every business process, CRM process is also impacted by e-process giving rise to E-CRM solution. E-CRM provides a means to conduct interactive personalised interactions and communications with the customers in online and real time mode. In E-CRM, interaction begins more intelligently using customer intelligence. One can summarise key features of E-CRM as under:

- Driven by online data mining tools.
- Real time assessment of customer interactions, its analysis and interpretation and strategising the actions based on it.
- Begins to build relationship with customer initiative.

In E-CRM unlike CRM, every customer initiative is treated separately. Each customer is evaluated in real time using customer intelligence database for action prediction. The real strength of a CRM or E-CRM is its ability to provide a rich, value added experience to customer on all channels of initiatives namely call centres, Kiosks, retail outlets, ATMs, Self help, PDAs and websites and portals.

CRM is an IT enabled business strategy, supported by a system showed technologies designed to improve human interactions in a business execution process between customer and the organisation.

### **15.10 MANAGEMENT OF GLOBAL ENTERPRISE**

Management of global enterprise is a complex task because of its global character. Global enterprises are large in size, located and distributed in different countries where culture, laws, and markets are different. There is a diversity in markets, customer behaviour, language and so on. They have large number of products or services range, some are globally recognized and some are customised to country-specific requirement. The core design of the product is maintained for product life cycle management. Often, manufacturing processes are distributed for a product in different countries for cost advantage, but its market is the entire world.

Some enterprises have structured their business in different hubs say, manufacturing, design & development, assembly, services and so on. These enterprises influence global market because of their strength in capital assets, latest technology and product leadership and core competency in key areas.

These enterprises have features which differentiates them from others. They are the trend-setters in the market. Being a global enterprise, it is subjected to impact of downturn or upturn in the world economy or the economy of the country in which it operates. Global enterprises continuously conduct SWOT and PESTLE analysis to shape the strategies to remain a leader in the world market. They become successful global enterprises because above all they have core competency of managing diversity, may be market, technology, social culture factors, political environment and legal and tax structure.

Here is an example of a global highly successful enterprise.

Sandvik is a global, high-technology, engineering company that continuously grows – in business, organisation and skill. Sandvik is an engineering group in tooling, materials technology, mining and construction. Its corporate office is at Sandvik AB, Storgatan 2, SE 811 81 Sandviken, Sweden.

Sandvik is a high-technology, engineering group with advanced products and world-leading positions within selected areas. Worldwide business activities are conducted through representation in more than 130 countries. In 2011 the Group had 50,000 employees with annual sales of more than 94,000 MSEK.

The Sandvik Group conducts operations within five business areas—Sandvik Mining, Sandvik Machining Solutions, Sandvik Materials Technology, Sandvik Construction and

Sandvik Venture—with responsibility for research and development (R&D), production and sales of their respective products.

### Features of Global Enterprise

- The corporate office is located in one country.
- These enterprises function through world-wide network of SBUs, development centers, functional hubs like assembly or R&D.
- Technology is a driver and products are unique and distinct from others.
- Knowledge and business intelligence are key drivers of global strategy.
- Corporate strategies are global, but business or functional strategies are influenced by PESTLE conditions of the country of operations.
- Their strength is in ability to raise funds and its management.
- They operate through different business models designed to suite particular requirement of the market or country of operations.
- Collaboration and partnering is the approach to manage enterprise operations.
- Technology driven innovation in products and services is a competitive advantage
- They are recognised global leaders in one or two key aspects of business.

Successful global enterprises have the following enablers in place:

- Organisation structure which meets global requirement is also flexible enough to re-structure to meet local requirements. Organisation pyramid of corporate could be different from an organisation pyramid of strategic business unit (SBUs) in, say, India.
- Management and control is exercised through dispersed and delegated decision making clearly defined by policy and strategy. For example, pricing decision is local, design and standards are decided by corporate head of R&D. In product design, core design and features is corporate responsibility but some customer-specific customisation, localisation of the product is permitted to SBU. Enterprises in automobiles, white goods, food products are some examples of this decision making character of a global enterprise. Financial reporting standards are the standards of country of operation, but International Financial Reporting Standards (IFRS) are also adhered to.
- Leadership and HR management is the third enabler which makes the difference in performance of the enterprise. Leadership for the nature of business of global enterprises requires the following among other attributes of good leader:
  - Aggressive, transformational with global vision
  - Strategist and techno-savvy
  - Has a position of influence in the network of business leaders
  - Has a good understanding of business economy and political economy of the country of interest and that of the world
  - Innovator, out of box thinker.

In global enterprise, HR management is more on talent search and its management. HR management focuses on transforming proactively the critical HR mass to new requirements of the business.

The Business Model of Global Enterprise Management has three layers as shown in Fig. 15.11.



**Fig. 15.11** *Business Model of Global Enterprise Management*

Business model of a global enterprise management offers a diagnostic help to management to focus attention on five critical and interconnected factors.

- Strategy to go global
- Global Management Framework for strategy implementation
- Operations & Delivery Framework.
  - Management systems for excellent performance
  - Systems and processes to fulfill the global and local requirements
  - People competencies to meet changing needs of global strategy while meeting the local requirements

(Source: *Managing the Global Enterprise in Today's Multipolar World*, authored by Paolo Pigorini, Ashok Divakaran, David Suarez, Ariel Fleichman partners in Booz & Co, Chicago, USA.)

### **Strategy to go Global**

Top management strategise the intent of going global based on core competency and differentiating factors, deciding how it will expand and grow and where, which business models will be chosen, how different differentiating capabilities would be deployed in different markets.

### **Global Management Framework**

The management of enterprise translates global strategies and differentiating capabilities into different business models suitable to local environmental conditions. Business models define total scope of operations and management, specific to the market chosen. The business model is built after SWOT and PESTLE analysis.

For example, business model of white goods manufacturer in India, Malaysia, and Brazil would be different, but they would achieve the enterprise goal of going global. The difference mainly would be in revenue model, delivery model and marketing model influenced by country-specific conditions.

### **Management System Architecture**

Management systems have to be goal oriented enabling its achievement. MIS supporting SBU needs also caters from global enterprise information needs. It caters to control requirements of SBU while it highlights what is the performance at global level. The system has to be open and transparent with high level of empowerment down the line in the structure. It would be a technology-driven network management system.

### **Global Systems Processes**

When an enterprise goes global, it has to revisit its systems and processes to revamp the design and architecture which would meet global functionality and features of local requirements. The requirements could be of decision-making support, control of local key performance indicators, processes and practices aligned to country-specific rules and regulations.

The enterprise systems like ERP, SCM and CRM will have capability of meeting management needs of local SBU and also provide integrated management support to enterprise global management group. Global systems and processes would not only be standard across the countries, but also would have features to meet customised needs of local SBUs.

### **People Competencies**

When enterprise goes for global operations people competencies assume critical importance. It is a critical success factor for global strategy performance. Ability to improve or change people competencies in tune of delivery needs of global strategy is very important. Enterprise needs people of talent, knowledge, and skills to handle social, political and cultural issues. The successful global enterprises have shown strength in managing people competencies.

Uninhibited march of globalisation has created new markets and business opportunities in other countries forcing the enterprise to go global. These, however, come with challenges and risks requiring different leadership and people competencies to be successful globally while each SBU meets its business goal.

Management of global enterprise is full of challenges, requiring different types of competencies and skills to manage a number of diversities. The technology and people competencies need focused attention as they are the key enablers of success in the world market. The days of uni-polar organisation are over. The organisation is now multi-polar managed through network of SBUs, people and talent.

## **15.11 EMS AND MIS**

There is a qualitative change in the MIS design due to the complexity of the business operations and the risk involved in handling the business.

The management focus is shifting from the function to the process, i.e., the management requires the information support in the process management and not in the function management.

The process definition now goes beyond the organisations boundary. It connects the organisation to other agencies. The emphasis is on the automation of processes with a strong Information Technology implementation. Today's enterprise has ERP SCM, CRM implementations up and running. An integrated system of ERP, SCM and CRM is called an EMS.

The MIS is now required to maximise the process productivity and performance. The decision making support is required for the process optimisation. The decision models are built across the business management functions. Besides the normal MIS reports required for the top management, the Top Management also need a set of the additional reports, where the critical business processes and the critical success factors are a focus area.

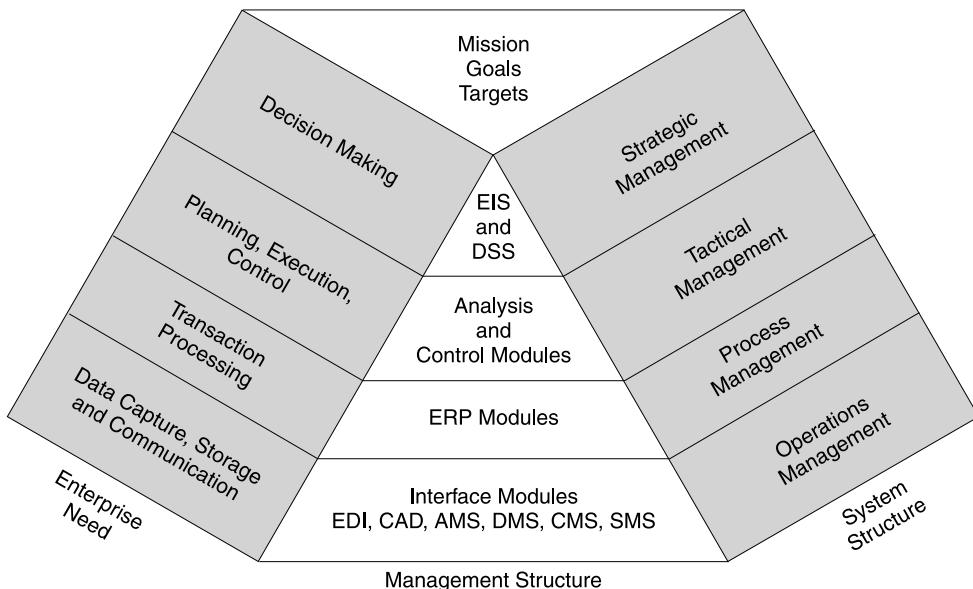
The EMS solution caters to this requirement very easily. The ERP solution is an integrated solution. The solution operation is seamless, disregarding the hardware or the software platform. The EMS solution takes care of data integrity and consistency across the extended organisation.

In today's competitive world, the shift of decision making is towards strategic management of the business. The EMS solution, due to its scope and coverage, and supported by a variety of tools, enables Strategic Management based on the strategic information for decision making.

The management attention on the focused area is easily possible. The conventional MIS design is more or less embedded in the ERP solution. They provide all the routine reports at any time for the middle management of the organisation. The EMS over and above this, provides an executive information for the strategic management of business. It helps to formulate the strategies to achieve the business goals. The EMS design provides transparency to the users of information giving them an access to the sensitive information to locate, define and resolve the problems.

The ERP enables the work group management efficiently and effectively. The effective uses of the variety of tools, like the data replication, the work flow automation, the EDI/E-mail, the data warehousing, the EIS, the bar coding, and the paging systems are built in ERP. The effective use of these variety of tools also speeds up processing, cuts down the operation cycle time and raises the ability of the management to take decisions. Once the ERP is built in the organisation, it takes care of the data, the information and its storage and, therefore, provides the capability to modify the Management Information System from time to time as per the changing information needs.

All the ERP solutions use the client-server architecture in the solution, where the data processing, and the application level processing logic is taken care in the server level giving freedom to the user, as a client, to define the problem and evolve the solution using the front-end tools. The front-end hardware and the tools are so powerful that an individual can develop his own MIS based on his decision making information needs beside the usual MIS like corporate, functional, etc. the decision maker can operate as an individual in isolation from the others, if needed.



**Fig. 15.12** EMS Model: Structure, Role, Objectives

The ERP through such an MIS design, improves the decision-making skills of the individuals very effectively. It provides an autonomy in a global system operations. With the ERP, the MIS design is more flexible highly decision intensive and efficient.

ERP long with other systems becomes and EMS, MIS design uses ERP which in turn uses other systems for inputs in terms of data capture, transaction processing and data base creation. MIS in ERP environment is a sophisticated design serving the needs of the organisation.

There is a qualitative change in the MIS design due to a paradigm shift of traditional business to E-business. Then the scope of enterprise operations is not limited to enterprise alone but now includes operations of suppliers, vendors, customer and business partners. Today business is information driven and strategic management of business is knowledge driven. Most of the companies are using ERP, SCM and CRM solutions to manage the business efficiently. In this changed business scenario, where customer initiates the business process, the traditional model of MIS is not useful for strategic and critical decision-making. Its purpose is limited to periodical reporting in predetermined formats.

Modern MIS is built as super structure on ERP, SCM, CRM systems. These systems are the source of information for managing business operations in real time. This super structure includes following systems:

- Data warehousing and data mining.
- Executive information systems.
- OLAP and query processing.
- Decision support system.
- Knowledge management systems.

Enterprise Management Systems (EMS), an integrated ERP, SCM & CRM is also so advanced that most of the operational decisions are automated in the EMS. The decisions at middle management level are delegated to functional systems. Managers at this level are empowered through information support to make decision. Main focus of MIS in E-enterprise environment is to support strategic management decisions at top management level. ERP system supports management in decision-making of capacity allocation, scheduling of jobs and so on.

MIS focuses on resources planning and control. MIS points out shortfalls, and under-utilisation of capacity. In SCM, MIS focus is on Value of chain of Supply chain. In CRM, MIS focuses on decisions related to improving customer relations.

EMS benefits can be summarised in three classes namely operational, business and management.

In operational benefits, significant benefit is in cost and delivery of goods, due to the reduced processing cycle. It also increases resources, resource productivity. The business benefits are improvement in profits and higher level of ROI. Management benefits are in the area of strategic information management and its application for strategic analysis and decision-making.

EMS solutions have proved more powerful due to business rules embedded in the process, automation of decision analysis and decision-making and generation of knowledge database. The solutions are advanced in technology application enabling seamless flow of information and integration of other technologies such as Bar coding, RFID, automated data capturing on shop floor and other operations centres, EDI, Internet and web.

MIS in E-business environment using EMSc solutions is really user driven for user specific information requirement. The users in E-enterprise could be customers, suppliers, business partners and employees of the organisation. MIS design, largely using the internet and web technologies for providing remote access to information and raising availability of information for 24 x 7 hours, call for the use of high security systems to prevent unauthorised access, and protect data from accidental damage or loss.

## KEY TERMS

E-Enterprise	Enterprise Management System
Enterprise Software: ERP/SCM/CRM	Modular Scalable Structure
Seamless Integration of Applications	Nine Steps ERP Implementation
Technology and Information	EDI
Supply Chain: Process View	Data Driven CRM
Process Driven CRM	Analytical CRM
E-CRM	RFID
Globalisation	Management of Diversity
People Competencies	Global Strategy

## **REVIEW QUESTIONS**

1. Explain the core role and purpose of ERP, SCM, and CRM solutions in management of E-enterprises.
2. Explain the key features of ERP, SCM & CRM for which they are designed to provide highest benefits.
3. Draw functional flow and process flow diagrammes to show modular and process view of following transactions:
  - (a) Receipt of raw material
  - (b) Payment of bill by the customer
  - (c) Order cancellation by the customer
4. Explain the concept of Function integration, Process integration and information integration.
5. ERP/SCM/CRM solutions are configurable to customer requirements. What is the benefit of this feature?
6. Explain why BRP study should be carried out before EMS solutions are considered for selection and implementation.
7. What is Gap Analysis? Why it should be done?
8. Explain how supply chain drivers are information, goods and funds.
9. Why Customer Relationship Management has assumed such high importance in E-enterprise?
10. Explain the following approaches to CRM:
  - (a) Analytical CRM
  - (b) Data driven CRM
  - (c) Process driven CRM

Give one example of each approach and model it as suggested in the text.
11. Why there is a sudden rise in number of Global Enterprises in the world?
12. Name two main factors which make management of global enterprise challenging.
13. Why global vision and supporting global strategy of an enterprise needs country specific moderation, customisation and localisation?



## **ARABIAN FOODS AND BEVERAGES (AFB)**

AFB produces and distributes foods, beverages and biscuits in Arab countries, Africa, and countries in Asian region. AFB is Dubai based and has country offices for marketing and distribution of the products. AFB product range is over 1000 units in various sizes, packages and weights based on customer requirements. AFB brand is popular and customer chooses AFB brand as a first choice for quality of the products.

AFB manufacturing and packaging plants are in Dubai and Delhi, and products are sold in respective geographical regions. Though AFB brand is established one, it is showing the sign of decline in market share due to competition from small and medium size companies. These companies compete on price and delivery.

To keep the customer's interest in AFB products, the company announces number of marketing and promotion schemes for retailers, and customers to boost the sales of the products. AFB has two or three main distributors in each country who stock the products for retailers in their regions. AFB as well as the distributors have marketing and sales staff to assess the market, take orders, deliver at the retailers' shop and recover the bills promptly. AFB supply chain participants are Farm products vendors — Transport Agents — Warehouses — Manufacturing plants — Finished Goods Warehouse — Distributor — Retailer and Customer. Retailers have Point of Sales systems Distributors have in-house developed legacy systems for purchase and inventory, accounting, distribution and sales. AFB has local area networks with a system developed for managing core processes of business.

IT infrastructure and information systems infrastructure of distributors and of AFB is old and runs on outdated technology. The systems were added as and when required with simple connectivity through file transfer or using floppy or CD for data transfer from one machine to the other. With global competition already set in, this infrastructure essentially catering for local business operations needs of information, is now found grossly inefficient and inadequate to meet the changing needs of the business. MISs largely meet local and country specific needs of information of accounting, reporting and transaction processing. Developing more sophisticated systems, like Data warehousing, Data mining, and Executive Information Systems for quick analysis of the situation, viewing the situation from different dimensions and modeling and developing business strategies is technically infeasible. Since, the business initiative is shifted to customer i.e. from 'Push to Pull', AFB would like to shift to a business model of 'Sense and Respond', a proactive management approach.

Present operations of AFB are data driven, where data is drawn from different systems running on different IT platforms using different software system architectures. Managers of AFB and distributors suffer from lack of information as well as inaccurate and outdated inconsistent information forcing them to use their best judgment for making decisions. As a consequence, critical decisions are delayed or could not be taken. Lack of reliable data prevented scheduling of production to sales requirement. This problem is faced by all managers responsible for operations and for strategic planning for growth and to meet the challenge of competition. The business now demands shorter production cycles matching to shorter sales cycles making scheduling a difficult problem. Due to this it is observed that manufacturing and packaging resources are either under-utilised or under heavy pressure to deliver.

To arrest the market share decline, AFB launches different sales promotions schemes at different locations. However, design of such promotion scheme is not appropriate due to inadequate or imprecise data and information on customer segments, customer choices, customer preferences, and leveraging factors of the promotion. So, most of the schemes are general in nature and lack ability to impact the

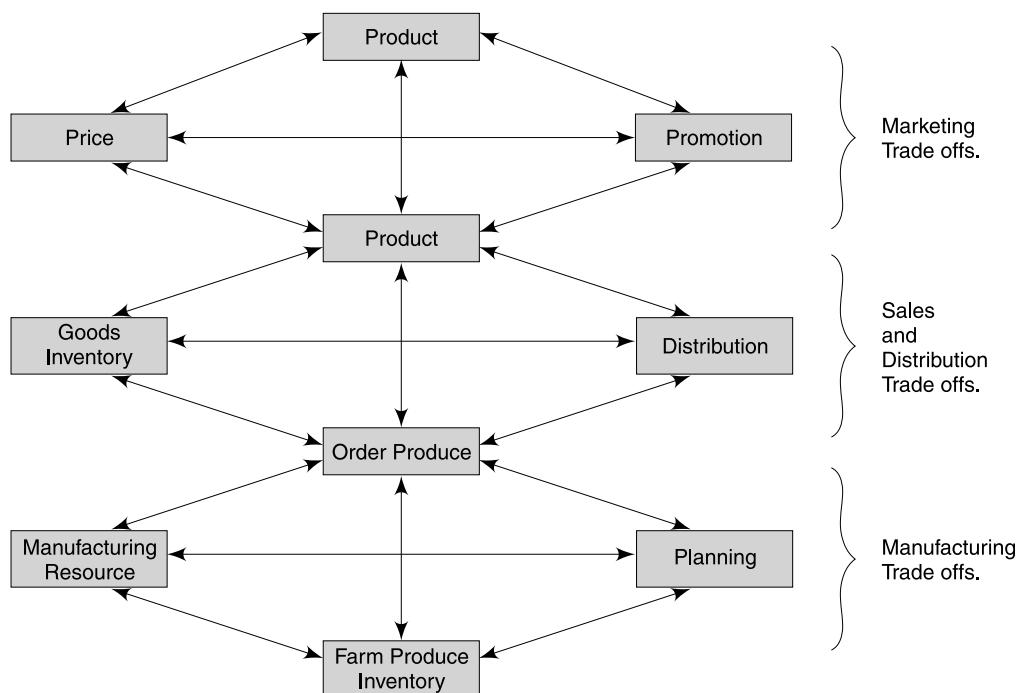
sales. Another major problem in this regard is isolating and assessing the impact of promotion schemes on product and segment to decide whether the promotion scheme is effective to continue.

Present MIS provides consolidated weekly reports by functions such as manufacturing, inventory, sales and so on. But the reports are processed late and are incapable of showing an integrated view of business. In fact MIS goals now are in consistent to information needs of AFB, and lack support to changing business goals and strategies of AFB.

In summary the impact on the business due to present inefficient, inadequate and outdated IT, and IS infrastructure is seen in the following:

- Higher inventory at all locations.
- Long order processing and delivery cycles.
- Under – Utilisation of manufacturing and producing capacity resource.
- Customer focus in business planning and operations.
- Control on key parameters due to poor information support.
- Operations is very high and showing the trends of increase.

Them consultant engaged by AFB analysed the problem and modeled the scenario in supply chain and in cost trade offs as shown in Figure 15.13.



**Fig. 15.13 Cost Trade offs in Supply Chain**

Cost-tradeoffs, which AFB requires to handle are:

- Product Vs Service Vs Price
- Product Vs Service Vs Promotion
- Service Vs Inventory Vs Distribution
- Service Vs Order Processing Vs Inventory
- Manufacturing Vs Producing Vs Farm Produce Inventory

AFB's marketing and sales objective is to use finance, manufacturing and material resources to create market and 'product mix' to maximise the long term gains and gain a competitive cost advantage. And AFB's logistics objective is to minimise total costs for desired service level goal where total costs of supply chain is equal to sum of transportation cost, warehousing cost, order processing cost, procurement and operations cost, and inventory carrying cost.

A system consultant made the case for implementing Enterprise Resource Planning (ERP) solution as an alternative to present legacy systems to meet marketing and logistics objectives. The consultant also advised to go for a package, which is friendly to other enabling technologies like Bar-coding, REID, Imaging, Web enabling, PDAs and so on so that processing cycles at each stage of customer servicing can be made shorter and smart.

The consultant also made a case for going for Supply Chain Management and Customer Relationships Management in phase II and III. He proposed the change over to customer driven enterprise management in about two years time. Management of AFB accepted the proposal of going for ERP and appointed a task force group made of system consultant, vice president (Manufacturing), vice president (Marketing), vice president (operations) general manager (Systems) and vice president (Finance) as a coordinator and leader of the project. The group is further divided into three teams with specific objective.

- Team 1: Select ERP package
- Team 2: Produce Requirement Analysis, Definition and Description (RDD) document with focus on information and technology integration of business process.
- Team 3: Study existing business processes and reengineer them so that ERP implementation is effective and efficient.

ERP implementation, however, is the responsibility of entire task force.

AFB selected 'Orion' ERP package and implemented it using nine steps model of ERP implementation. The ERP implementation was seen as change management project with heavy strategic content. The business objective set for AFB is to move from:

- traditional stock and sell model to sense, anticipated and sell model.
- data driven to information and knowledge driven operations.
- manual paper driven systems to paperless information driven.
- reactive person dependant decision-making to proactive automated system of decision-making.

AFB implemented ERP solution by 2003 and enjoys the following benefits. Implementation team studied RDD and made a gap analysis between RDD and Orion functions and features. RDD was revisited to establish the need finalised for execution. Orion package then was studied for configuring the need of AFB with specific customisation needs in manufacturing, sales, warehousing, distribution, accounting, and payroll.

Prior to this step; Team – 3 recommendations on BPR study were considered and implemented separately as a part of Orion implantation. The Orion system was comprehensively tested (Beta Test) before it was deployed at all locations. A core team of users across AFB was trained to lead the implementation. This team trained other users and became an effective change agent for successful implementation of Orion.

### **Post – ERP Implementation Scenario and Benefits**

AFB is now able to control the business processes through monitoring and tracking of the progress. With strong reliable sales information support, more efficient production schedules are now possible reducing the lead-time, between order and delivery.

AFB's trading operations become more efficient as management knows precisely when to order and when to order more stocks. Real time continuous information availability on product movements,

customer-buying behaviour, level of response to promotion schemes, and customer preferences added efficiency in marketing and sales effort. One significant advantage AFB got through palm PDA technology integration in ERP was each salesman can do order booking, invoicing, collections and accounting online without delay. Earlier the data was entered manually from customer invoices filled in by the sales men at various customer sites, a cumbersome and time consuming process.

Palm PDA implementation added speed in data and transaction processing. It gives quick feedback on various aspects of sales helping decision-making at all levels. The feedback on customer outstanding is highly useful and commercially advantageous to negotiate with the new order terms and new schemes. Management also went a step forward and empowered salesmen to devise customer centric and specific promotion schemes based on the information support to improve sales and relations with the customer. This was possible because ERP Orion Package is very flexible and provides user facilities and interfaces to deal with new situations calling for specific information.

The biggest business advantage was realised in reduced inventory and better inventory management keeping the customer service level at the described level. The entire operation is transparent and provides real time information for the management to take critical decisions without delay. Decisions which took earlier as many as two – three days are now taken in few hours. Besides quality of decisions is improved significantly.

With Palm PDA implementation management had greater control on sales operations. They could reach any customer, warehouse, distributors, and locations easily due to faster communication. It had affected almost all operations cycle positively. ERP implementation gave complete management control on critical applications namely order booking, inventory, management production scheduling and distribution management. Cost of business operations is reduced significantly. AFB passed on the cost advantage to customers for improving business and relations with the customer. AFB now gets sales analysis across all dimensions by regions, country, product, salesman and so on.

Managing Director summarised the ERP benefits in company's AGM as following:

- Reduction in Inventory but improvement in service level.
- More regular reporting on management information with added advantage of executive information.
- Empowering managers, salesmen with online information for quick decision-making.
- Multi dimensional sales analysis and drill down capability for information search.
- Optimum use of manufacturing resource
- AFB became cost/price leader
- Positive impact on cost trade offs
- Availability of strategic and crucial information for extending ERP solution to supply chain management and customer relationships management

## Questions

1. Identify the factors, which motivated AFB to migrate to ERP solution.
2. Explain the five trade offs of AFB and explain how ERP must have made impacts on these costs and then trade offs.
3. Explain what additional advantage AFB would get by implementing RFID, imaging and web enabling of the solution.
4. What is the supply chain and value chain in AFB?
5. What distinct additional advantages AFB would get by SCM and CRM systems?
6. What additional benefits Palm PDA offered to AFB?
7. Identify the steps taken by AFB for successful implementation of ERP.

# PART IV

## Infotech Infrastructure

### CHAPTERS

- 16. Technology of Information Systems
- 17. Unified Communications and Networks
- 18. DBMS, Client Server and Service Oriented Architecture
- 19. Data Warehouse: Architecture to Implementation
- 20. E-business Technology

As a manager of MIS, you will come across many technologies for selection to drive the information systems structure of the organisation. Besides considerations like Investment and Return on Investment (ROI), there are many other issues/factors that influence the decision on technology. To understand these issues/factors more clearly, this part takes you through the available technologies for data/information processing, database and client server architecture, communication networks, E-business technologies, data warehouse, knowledge management and business intelligence.

The learning objective of this part is to create a high level understanding and appreciation of technologies for application in business, enabling the enterprise to become information and knowledge driven.

Choice of IT infrastructure is a difficult decision as one has to consider platforms, connectivity, performance parameters, standards and protocols along with the challenge of meeting processing needs of functions, features and facilities of mission critical applications to get the best of the investment.

## LEARNING OBJECTIVES

- Technology Scope, Supporting Information Systems and MIS
- Processing of Data, Transaction, Application and Information for MIS
- Role and Importance of Human Factors in IS Design
- Application of CASE Tool
- IT, a Strategic Decision
- Analytical Study and Evaluation of IT Solutions
- Relevance of IT to MIS Design

### 16.1 INTRODUCTION

The development of modern information system is a complex process. It needs knowledge, know how, skills and technology in almost all the disciplines. The developer, the designer and the user must be knowledgeable in their respective area of functions and responsibilities. As information systems are being demanded for on-line real time usage in business management, its development requires thorough understanding of the business and the manner in which it is executed. Further, different technologies, other than the Information Technology, are used in the business which are used for providing input to the information systems. As the business processes are getting automated, the information systems are undergoing cultural changes making them more sensitive to the business needs. It demands a flexibility in design and reliability in its use.

In the seventies, the information systems were of a stand-alone type outside the mainstream of the business. In the eighties, the information systems were looked upon as a resource for information to support the decision making. Still, its use was off-line and was largely dependent on the user/manager/decision maker in the organisation. In the nineties, the information technology developed multifold and the business became global, strategic and competitive, with the business focus shifting from supply management to customer service management. In short, the nature, type and the quality of information system has undergone an overwhelming change.

The several systems operating in isolation as a stand-alone legacy systems are rejected in favour of the enterprise-wide integrated information systems. The off-line batch processing of data and bringing out reports at the end of the period has been rejected in favour of the on-line real time systems for an access to know the current status of the business.

The business management process has changed from function management to process management. The organisation culture also changed from centralised, bureaucratic, authority structure to work-group culture where members of the work-groups were trained and empowered to make decisions. This called upon the information system availability at the workplace.

The nature of business is such that a lot of initiative of the user is expected to decide his own information needs at a given point of time. Due to this, a change in the architecture of information systems is required, whereby the user requirements are made independent of data giving him the freedom to manipulate the data using his own methods. With such complex requirement, all around information systems development is becoming an art where a lot of technology inputs are required. To be a successful designer of information systems, it is necessary to have core understanding of different kinds of processing. In this chapter we discuss how the systems are built and what care should be taken in designing them. The basic understanding of the process is essential even though the technology is a significant factor in a good design of information systems.

## 16.2 DATA PROCESSING

In any information system application, the method generally followed is to design modular and hierarchical steps of processing leading to an output in a report form or information having certain—value specific or perceived—as seen by the user. The steps involved are data processing, transaction processing, application processing and system processing.

Data is the smallest atomic entity in the information system which is basic to build the information system. The character of data decides the quality of information it offers to the user. If the data is taken care of properly, its usage will ensure quality output. Hence, in any information system significant care is taken in building the data as a first level input to the system. The data is built through data design and modelling process which provides specification and character to the data. These specifications and characters are used throughout the information system of a variety of applications. Data processing is handling raw data in a systematic manner to confirm to the data quality standards and determined by the designer of the information system.

The atomic data entity is defined as a value attached to an attribute which has a character, meaning and presentation providing specific message and understanding to its viewer or user.

Let us take a simple example of a date used extensively in every application. Though the date is a universal entity in nature, it still requires determination of specification, character and presentation. A date in isolation conveys the position of the day in a calendar. In the information system, however, it may convey a number of things to the user. First, therefore, it needs specification. It is necessary to specify how the date will be specified, whether in the

form of DD-MM-YY or MM-DD-YY or YY-MM-DD. So the data 'date' has a specific order of positioning and presenting. Its interpretation also changes beyond its generic meaning as a day in the calendar. A date on cash receipt means the cash received date. A date on a fixed deposit receipt indicates the maturity date. A date with its associated context derives its meaning for the application in information processing. Such data specification determination exercise leads the data design further.

The specification of data means determining its manner of presentation (DD-MM-YY), its value, specific or in limits, its validity whenever possible. The character is numeric or alphabetical or both. Unless the data is defined in this manner, it cannot be used effectively. Hence to summarise, data processing means, each entity in information processing system is processed to confirm its specification, character and validity.

The system supports the user through checks and controls by responding and communicating errors for correction. In the data processing stage, the system would point out errors of wrong specification, errors of value (i.e., amount in multiples of thousands), errors in validity (postdated cheque or deductions greater than the basic amount, etc.).

The designer and developer has to have vision and understanding of the data to implement such processing in handling the data. If due attention is not given in this area of design, disastrous errors would occur during its usage in a variety of applications. A systematic approach calls for determining definition, model, character, value and its aspects, its purpose and then making use of this knowledge in processing before it is accepted in the database system as a permanent input. In information system design, the data needs to be designed by fixing its character, value and structure, and then be used it in data processing to control its acceptance for further use. To ensure the quality of information considerable effort is spent on this data control aspect. Wherever such efforts are missing, serious mistakes have occurred. Once the data is accepted in the system then its use becomes unabated and hence by instituting proper data processing methods, with due regard to data definition, character and structure, the quality of the information is protected and assured.

Hence, data processing means following steps or stages to be implemented before the data is accepted in the system for usage.

- Confirming the character, structure and presentation vis-à-vis data design.
- Checking the value of the data vis-à-vis data value specification such as single specific value, range of value, and limit value ranges.
- If a non-conformance is seen, point out the error and seek corrective response before the processing control shifts to a new field.

### 16.3 TRANSACTION PROCESSING

After the data has been processed, the next step is to process transaction itself on certain lines. A transaction is processed with reference to business rules, i.e., a transaction is scrutinised for conformance to the rules, policy or guidelines before it is taken up for further processing. The rules may be directly related to the transaction or it may have some relation and association with other transactions. In case, if transaction does not conform to the set of specified conditions governed by the rules, the error is displayed for user to take corrective action.

The transaction is processed for adherence to business rules, correctness and consistency of data values and for validity of transaction. It should be noted that these three aspects are applicable to all the transactions across the business management functions.

Let us take an example of the goods receipt as a transaction. Having checked the individual data entities, the goods receipt transaction is subjected to further checks for acceptance and execution. The business rules in case of this transaction are:

1. The purchase order must be present and open and the item received should be present on Purchase Order. Further, the receipt is as per the scheduled date.
2. The supplier has sent the necessary supporting documents such as Excise Gate Pass, Octroi Challan, Sales Tax Form, Certification by Third Party, etc.
3. Such other conditions that may be applicable.

One can add more business rules if necessary. However, if the receipt transaction is to be processed, it will first be processed for confirmation and conformance of these rules before it is taken to the next stage. The rules are checked at the entry level processing after the individual data fields are checked. If any one rule is not satisfied, the transaction is kept under hold for correction. If the correction is not possible, the receipt transaction is rejected.

The persons designing transaction processing system must have or acquire the knowledge of business rules for introducing them in the transaction processing system. In the absence of this knowledge or by not incorporating them, the transaction would be accepted for further usage violating the business rules.

The next check in transaction processing is to confirm internal consistency, correctness and completeness of the data. In our example of receipt transaction, a consistency should be confirmed between the quantity sent, the quantity received, the quantity accepted, and the quantity rejected.

Suppose the receipt attracts four per cent entry tax on value, then whether the entry tax value is in conformance of that value. Several such checks are desired to control the quality of the data. If through such checks, it is found that the data is not acceptable, an error message would be displayed, showing "what is wrong" in the data and transaction. In the transaction processing all such rules which may be universal or specifically evolved by business considerations by the management are checked for confirming the arithmetical and commercial accuracy of the data set in the transaction. It is very important to note that the data at its element level may be correct but at the transaction level it may go wrong.

The third check after confirming the data quality and observance of the business rules is for validity of the transaction itself for its use in application and system processing. The validity of the transaction is checked against the conditions present outside the domain of transaction. For example, the transaction of the Fixed Deposit might go through all checks at the data level and at the transaction level, it is not acceptable as the total deposit permitted is already received. Hence, though the transaction is in order but cannot be posted as it ceases to be valid at the Fixed Deposit application level.

Another example is of the goods receipt transaction which is in order by all dimensions but needs to be authorised by the higher authority for excess delivery. Unless such check is imposed all the excess delivery transaction would get rejected. Though the transaction is invalid on the basis of the internal considerations it is made valid by imposing external conditions where transaction is approved by the higher authority.

## 16.4 APPLICATION PROCESSING

After data and transaction processing, the data finalised in these stages gets posted on the affected files. Application processing is designed to process more than one type of transactions to bring out the specific business results in one or more business functions. This processing is carried out once the transaction is processed for its validity.

Let us take an inventory application which require the receipt and issue transactions duly validated for inventory processing. When these two transactions are processed, the inventory is updated for receipts and issues giving the net balance at the end of the processing for each items in the inventory.

The inventory application is designed to bring out inventory status affected by material transactions. In application processing, certain terminal files get updated. In the above mentioned case, the stock file will be updated for changes in the stock.

The application processing means the use of transaction data bringing out a particular status. The application could be designed to change the number of different files holding a variety of information. In our example, besides the stock file updation, the stores ledger will change. It might trigger certain actions based on the inventory status. For example, if the stock level is below reorder level, it would raise a purchase requisition. If it is below the safety stock level, it would raise purchase reminder on the supplier.

The application can be designed for status updation and the status triggered actions in the related field of the application. For example, if the number of work orders are on 'hold' for no material to process, then on receipt of the material the affected work orders will be released for processing. Then the production schedules would also undergo a change. A number of such examples can illustrate that the application process can be designed for a variety of functionalities and features which are essential in running the business.

The scope of application processing can be made diverse by incorporating different transactions from the same application area or associated areas. For example, the inventory and purchase application can be processed together for vendor evaluation, item valuation and payable accounting. The scope of the application can be made diverse, if it is foreseen at the design stage. At this stage necessary inputs are provided in the transaction which can be used at a later date in the other applications.

The advent of communication technology and its embedded use in application processing extended its scope beyond the boundaries of the organisation. The application can be designed for processing the results, updation of the business status, for triggering predefined actions and also communicating with the affected agencies located within and outside the organisation. The quality of application design will depend on the inputs provided through transaction processing and data processing.

## 16.5 INFORMATION SYSTEM PROCESSING

The system processing is at a higher level, over the application processing. The system is defined as a product made up of several applications set in orderly manner to produce a higher level information output different than the output of the application processing.

For example, the financial system is a product of finance, sales and purchase accounting applications. Normally the system processing addresses the management issues of the busi-

ness. In the financial system, processing is done for cash management, asset and liability management, working capital management, etc. Applications which are used for system processing are the finance transaction accounting, the fixed asset processing, the receivables and payables processing, the sales and purchase accounting. On the platform of these applications, the system is processed for the analysis of number of aspects of the finance management. It provides an insight into the funds flow, the sources and the uses of funds, profitability and productivity of the business. It throws light on growth, (past and future) through the analysis of various trends. The system outputs are generally required by the top management responsible for the strategic management of the business.

The nature, role and the type of the system is such that its design is very complex and sensitive to the business needs. The system designer, therefore, must have a good insight into the business for which the system is being designed. The understanding of the business in terms of its orientation, focus, critical success factors and knowledge of mission critical application is absolutely essential for effective system design. The basic management functions are same, i.e., finance, materials, production or service, personnel and sales, etc. in all the business.

However, these functions are executed in different manner on account of the following factors:

- Nature of business (trading or manufacturing),
- The type of business (product or service),
- The complexity of business (multiple locations, divisions, products, etc.)
- Management style (autocratic, participative),
- Decision making (centralised, decentralised and empowered),
- Quality of the organisation and the people (learning and positive proactive work culture).

Hence, at the lower level transaction processing and application processing may look similar but when it comes to the system design, it is influenced by the factors mentioned above. In all the business organisations, the basic application deck may be the same but its Input-Process-Output would be different.

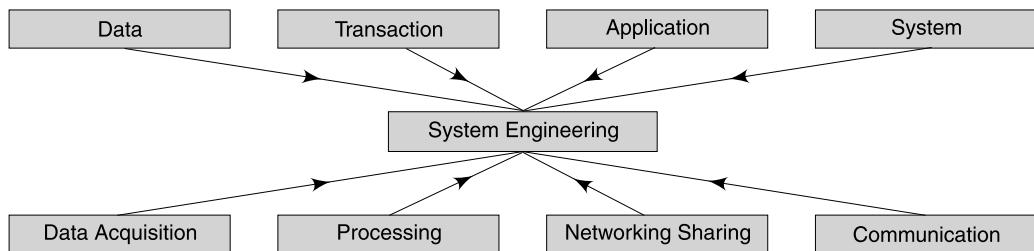
In the information system processing, the underlying design and architecture would very giving due regard to the specifics and specialities of that business. Though all the businesses need a trial balance, a balance sheet, an income statement, the payables and receivables statement and the expense analysis, the chart of account in each case would be different and typical to that particular business only.

The type of system and its operation also would change from case to case. Hence, once the information needs are finalised, the designer first finalises the scope, objectives, methodologies, outputs and its nature, interface requirements and the operational details. With reference to these details the system breakdown is made in a hierarchical manner, specifying the input-process output, going down to the data level, and then the processes are set for data acquisition, transaction processing, application processing leading to the information system design. This entire work of ascertaining the information needs to determination of the system design and architecture is called System Engineering.

System Engineering not only deals with applications and transactions but also with the various technologies which are used in the system implementation. The data acquisition tech-

nologies such as the bar code readers, the handy held terminals, the process embedded data loggers, the image processors, the digitisers, etc. are used for capturing the data inputs. The processing architecture is based on the application of an on-line real time processing need, distributed data base, and processing and application design. It could either be client-server with its variation or a mainframe and host-slave architecture or it could be a distributed processing architecture with a central system for a consolidation of data and information. It could also be a network based system with dedicated data and application servers spanning the entire organisation providing autonomy to the user and integrity and security of information to the management. The hardware/software could be, in all these cases, proprietary or general, in open category.

The third technology consideration is on communication. A wide range of technologies on communications are available for choice between the electronic data interchange to fax-modem data transfer. System engineering handles the total scope as shown in Fig. 16.1. The scope covers processing design it application.



**Fig. 16.1** System Engineering Scope

The information system processing, therefore, uses the system engineering methodologies which are capable of dealing with the data acquisition technologies, processing technology and architecture, networking technologies and communication. The system processing is efficient and effective provided an appropriate choice of technologies is used and they are blended together properly to produce the necessary information output.

Using the system engineering methodologies, when all the information systems in the organisation are covered, a stage is reached where the systems are integrated for a still higher level information output required by all the levels of the management. The systems so designed through an integration process are called as Enterprise Resource Planning (ERP) systems or as Enterprise Management System. These systems help in managing the business as a whole by way of functions and process management as also by providing support through the DSS. It is a total solution to meet the business information needs, irrespective of the function, process, location, for all the levels of management and people.

The total realistic solution is possible if the system design in information system processing is a real time system. The real time systems are open in nature having a relational exchange with external world realities. The real time systems integrate the hardware/software, human and databases to capture data, validate transactions, process applications and execute the system to produce a business result.

The real time systems trigger an action as a response to the external world events. To achieve this, the systems processing requires a high speed data acquisition and control, a high speed transaction processing, an appropriate application processing and highly responsive and sensitive system design and architecture. The system processing design is, therefore, concerned about the performance, which is a result of speed, accuracy and reliability. These issues are handled through the hardware and software technology choice followed by the processing design from data to application through a client server architecture seamless integration.

## 16.6 OLAP FOR ANALYTICAL INFORMATION

Information processing management has five basic systems

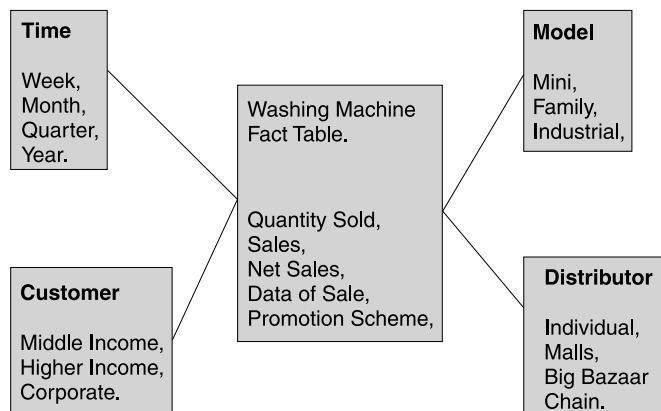
- **Data Processing:** Data Processing focuses on data acquisition, verification, validation, computing, summarising and so on. Then store the processed data results at designated storage and in medium.
- **Transaction Processing:** In transaction processing, the business transaction such as ordering, payment, delivery etc are processed at unit level using stored master data and data generated through a decision or event.
- **Application Processing:** In application processing, several transactions may come together to complete an event. For example, order processing and delivery processing are two transactions, two processing systems. We use transaction data of these two systems to process a bill. So customer billing is an application.
- **System Processing:** Customer billing data when processed for financial accounting and for credit rating of the customer, it is a commercial system. In system processing two or more applications are processed together to achieve functional results.
- **Integrated Processing at Enterprise Level:** In integrated system several systems are processed together to produce organisation's results.

The systems mentioned above meet the information needs to know the business operation status and after processing selected data it's processing gives knowledge about the business performance. It also supports information needs in all cases of decisions where decision rules, models and algorithms are determined. But these systems do not throw light on trends, patterns, associations hidden.

In the data and information processed and stored in databases and files. These systems are also not designed to display a multidimensional view on data sets. The classical MIS reports designed for particular purposes do not let one obtain fast, the enterprise information with differently data-dependent views. This need can be fulfilled if systems are designed to process data analytically. The technology which does this job is termed OLAP (on-line analytical processing) technology.

The problem of getting combined subject oriented information fast from an active enterprise databases needs a solution. OLAP allows the manager without any programmers assistance to gain the ability to draw out reports to be analysed to take a view on the scene just emerged. Online analytical processing (OLAP) has emerged as a "breakthrough" technology that can provide the foundation for Executive Information systems (EISs). OLAP enables senior managers to view extracted multi dimensional data into graphic and tabular displays

revealing new insight into the scenario. The extracted multidimensional data is an output of enterprise applications and or that of legacy systems. In MIS reporting the data is presented in one or two dimensions in different tables. It is the job of the manager to bring two three such tables together to make an in depth visualisation in the emerging scenario. This is a difficult task when view on data is multi dimensional. For example you want to view sales of washing machines for the period with four dimensions namely time, model, customer and distributor. Figure 16.2 is a Data Model of a washing machine with four dimensions.



**Fig. 16.2** Data Model of a Washing Machine

Application systems have given this data in three four different tables. What manager is looking for are trends, statistics and interesting rules behind the sales data having multiple dimensions that can help in business decisions. In many decisions, manager's data need is current and historical to identify the trend or for comparison. Further, in decisions data has to be subject oriented and not application oriented.

In a complex decision making scenario, manager needs different views of the scenario to develop a DSS. Further, he would need data manipulation through process, like Roll Up, Drill Down, Slice and Dice, Aggregation and Ranking. Decision support systems and data processing systems are created using OLAP technology.

OLAP technologies make it possible to view such data in non conventional manner in single table or in 3D graph.

**What classes of problems could be benefited in their solutions from using the OLAP-technology?**

- Selecting detailed information using flexible filtering method on processed data.
- Complex estimation of stored data through summary indexes, data aggregation, and multidimensional analysis.
- Analysis of data in view of its dynamic change by time for time periods of day, week, month, quarter, year.
- Searching for functional and logical regularities trend, pattern, style etc from the data stored.

**Let us understand how OLAP technology works?**

### **OLAP Technology**

OLAP technology consists of two major components, the server and the client. Typically the server is a multi-user, LAN based database that is loaded either from your legacy systems or from your data warehouse. OLAP visualization tools will reveal patterns of your business process, progress, trends etc that are hidden in the data.

#### ***The Server***

Think databases as multi-dimensional arrays or cubes of data, cube capable of holding hundreds of rows and columns of both text and numbers. The Multi Dimensional (MDDs) data bases are loaded from enterprise applications data bases or from data warehouse.

The cube is an interesting concept for viewing the data in three dimensions. Suppose manager is interested in viewing the sales data 'Quantity' by three views Product × Time × Customer or customer segment in one display either in table or 3 D graph, OLAP technology provides a tool to obtain such view.

#### ***The Client***

The client component presents a spreadsheet-type interface with very special features. Features available in some products include the ability to instantly change the data component of the x, y, or z dimension of your spreadsheet using drag-and drop.

You can change your display from tabular to any one of various charts. The charts available are pie, bar, stacked bar, clustered bar, line, or multi-line. Exception highlighting is another feature to attract immediate attention of the manager. Another interesting feature is to dynamically change font, point-size, and color of rows or columns based upon the value of a component of the display. You can also hide rows or columns based on dynamic values. Instant drill-down/drill-up is a particularly valuable feature to reach the origin of the data and its source. As you know data has a structure build using some entities. For Example a "Product" has a structure as class – model – segment- territory. OLAP technology provides a process of clicking to drill down from class to territory.

#### ***Rapid Development***

Some OLAP products require no programming in order to define an MDD

Once a data file is ready graphic view on any MDD is immediate. OLAP creates summary tables, charts, and tabular reports on the data. That's what it is designed to do, and it does it fast and dynamically, according to the wishes of the manager.

OLAP is software that enables a manager selectively extract and view data from different points of view. It is designed for managers looking to make sense of their information, OLAP tools structure data hierarchically—the way managers think of their enterprises, but also allows business analysts to rotate that data, changing the relationships to get more detailed insight into enterprise information. Powerful integrated OLAP tools allow managers to quickly slice and dice data to conduct in-depth analysis to search new meaning into the scene.

The main driver of OLAP is the OLAP server, which sits between a client and a database managed by RDBMS. The OLAP server understands how data is organised in the database

and has special functions for analysing the data. There are OLAP servers available for nearly all the major database systems. Popular Tools for OLAP are

- Business Objects,
- Cognos
- Hyperion
- Microsoft Analysis Services
- MicroStrategy

## 16.7 TQM OF INFORMATION SYSTEM

The objective of the Total Quality Management (TQM) in the information systems design is to assure the quality of information. This is done by ensuring, verifying, and maintaining software integrity through an appropriate methodology choice amongst the technology, design and architecture. It institutes appropriate procedures with checks and controls in all the processes of information systems development. It ensures that the scope and the objective of the system, choice of the design architecture and development methodology and further quality ensuring the processes and planned implementation methodologies are correctly chosen.

The quality of information is governed by the quality of the information processing system design. The perception of good quality is that of a customer or a user of the information system and not that of the conceiver, the planner or the designer of the information system.

The quality of the information and the systems which generate that information will be rated high provided it assures:

- A precise and an accurate information,
- A high level response in an interactive processing
- User friendly operations,
- Reliability of information, and
- An ease of maintenance.

The single most important measure of quality assurance is the level of user satisfaction it attains. The user satisfaction is highest if it meets information needs on a continuing basis in a dynamic business environment.

In the process of achieving user satisfaction, the information system must be conceived with business focus and orientation. It must address the total scope of the business with specific attention in the areas of core competence and mission critical applications. The choice of the Information Technology strategy should be such that it supports the business strategy implementation to achieve business goals and mission. Also that it meets the business process needs of effective execution and matches fairly well with the management ability, the knowledge and skills of the people in the organisation.

TQM addresses all these requirements of the information systems development. It ensures that the information system design is flexible, bug free and easy to maintain with the changing needs. Normally, if the systems are planned properly right from the inception, and broadly if the business strategy focus and objectives are not changed, then the system level changes are very rare, the application level changes are few, the transaction processing

changes are negligible and the data level changes are non-existent. The quality assuring ability of the system, therefore, is judged by its ability to sustain design and its ability to handle the changes with minimum cost.

In the TQM application to information systems, the technologies play a vital role. We can make two parts of these technologies. First, as a current and the second one as the emerging technologies. The current technologies are database management, distributed data processing, object orientation, parallel processing, data warehousing and replication, networks and communication.

The emerging technologies are Internet/Intranet, EDI and E-Mail, Groupware for term based application, client/server for application processing, multi-media for voice, video, image processing, imaging systems for image creation, storage mixing knowledge-based (KBS) for expert, artificial intelligence system and Computer Aided Software Engineering (CASE) for a systematic application development including I-CASE.

James W. Cortada\* measures the quality of information by seven parameters. They are flexibility, maintainability, reusability, integration, consistency, usability and reliability. Flexibility satisfies the changing and evolving needs of users offering quick responses. Maintainability facilitates a quick repair and resolution of the problem improving the user service. The reusability of the objects or the object codes reduces the development cycle and controls the cost of the development. Integration improves the processing time and offers a quick access to the users to the data and information. Consistency in the usage of standards, tools and technologies reduces the learning time of the users. The usability of the software component in different manner for different applications reduces the user training time and finally the reliability of the system assures a dependence and supports for all conceivable user end processes.

The TQM approach to the information system development ensures satisfactory level attainment of these parameters through the implementation of various strategies in the process of development. In the discussion hereafter we will call the information system software as just a 'software'. The software quality assurance is nothing but what is required which would ensure conformance to the standards set by the management.

The software quality assurance is an essential activity to ensure the attainment of quality goals. The activity comprises:

1. Application of the proven methods and tools
  - requirement analysis,
  - defining the scope and the problems,
  - modelling and prototyping,
  - finalising the software requirement specifications,
  - configuring the hardware software platforms.
2. Technical review to
  - detect errors in the functionality and its logic,
  - confirm that the software meets the basic system objectives,
  - confirm that it meets the predefined standard in all the areas,
  - confirm that uniform application of methods and technologies.

\*TQM for Information Systems Management, McGraw-Hill International by James W. Cortada.

3. Testing to

- detect errors at the data level,
- ensure the execution of known functionality
- ensure internal working of the software,
- ensure the execution on conditions and subsequent actions,
- confirm the integration process.

The testing is done at the data level, transaction level, application level and the system level. The normal practice is to develop a test plan and procedure to check the software from all the angles.

4. Version changes control to

- ensure that the change does not alter the original assured quality,
- confirm that no bugs are introduced in the software,
- ensure that proper documentation is made as changes introduced.

5. Record keeping to

- establish knowledge and know-how on reviews, audits, changes, testing for future reference and use in bug fixing.

It is observed that the software quality assurance largely depends on testing and quality of testing. In the TQM software testing strategies are proposed. There are different kinds of testings, viz., Unit Testing, Integration Testing, Validation Testing and System Testing.

In each of these testings a particular aspect of the software is tested and the quality is assured. In each of this testing one or more aspects of the software at that level are verified and validated. In verification the correctness of the test object which could be a code, a function, a process and a procedure etc. is confirmed. In validation the result of the process already verified is checked. If both are acceptable, quality is assured.

In unit testing, the smallest portion of the system is checked. It is essentially a code level testing. In this testing the quality of data in terms of the design and structure is confirmed. Further the conformance to boundary conditions such as limits, range, etc. and the module level data flow conforming to the conditions of switching to new path is sought.

At the module level, the input data, its processing methods and the quality of output are tested. Also whether the software handles error management properly. The error management means identifying the error, throwing the error message, controlling the execution path, seeking the error correction or alternately terminating the process with error message, and executing the file closing procedure before abandoning the execution. In unit testing, file handling is also checked, more so, when the module is interfaced with the other external files. This testing also deals with file opening, updating and closing. In all these steps unit testing should confirm for that integrity of module is maintained in all aspects.

In *integration testing*, modular structure of the system when it works together is checked to see whether it produces the desired information and quality. This testing is the top-down integration or either for the bottom-up integration. If the system design initiates a trigger at the highest level and then it flows down, then the integration testing would be from the top-down. If the design is bottom-up then the integration testing will be bottom-up.

One more variation is expected in both the cases, that is, a horizontal or a vertical integration. This, however, will be decided by the design structure for the execution of a process. Since, the unit testing has already been done, in integration testing the control switching as per conditions from one module to the next module is confirmed and the data is flown to the affected modules and the actions are triggered to execute the data handling procedures. In this process, the module interfaces are also checked for their role.

Like unit testing, plan, integration testing plan is also prepared which specifies the scope, the test procedure, the test environment, the test data and the expected test results. When such a test plan is executed the following major factors are assured. They are—module interface integrity, functions and features validity, correctness of information and performance of the system in terms of speed, results and objectives.

*Validation testing* is taken up when the integration phase is confirmed. Validation is necessary even though the checks and controls are satisfied and the outputs are correct and reliable. The validation tests confirm the conformance to the requirement specifications of the user, the scope and the objectives and the interface requirements. In other words, it is confirmed through the validation test that the software fulfils the user expectations on all fronts. These expectations could be in the performance, the ease of operations, the processing methodology, the coverage and the flexibility. A software may not pass the validity test, if there is a sufficient gap between the user expectation and what is being delivered, even though it is passed by the unit and the integration tests.

*System testing* is at the end after the first three tests are confirmed satisfactory and the software is acceptable. In the system testing the global issues are tested. They are recovery from the faults and restarting the next process, security from the unauthorised interventions, stress capability to handle the extreme conditions, and performance of the system in the live mode.

The system testing is important where we are testing the simulated conditions of stable live system of the future. In recovery testing we are confirming the ability of the system to identify the fault and recover through an automatic process of reinitialisation, check pointing and the data recovery, and starting fresh. In some fault tolerance situation, the system does not stop but proceeds to the next feasible process, keeping a tab on the fault. If this fault is not repaired in a specified time, the system stops for further processing. In many cases, the internal automatic recovery systems are difficult to implement. In all such cases, the systems are tested for fault tolerance and diagnosis, protection of the processed data up to the error stage, and its back up. Then the system throws the ball in the user's court to take a corrective action before the restart is pressed.

In the security system, the defence mechanism of the system, i.e., the ability to protect the system from both, known and unknown, system interventions, is tested. Many a times the system is vulnerable to exposure from the authorised and known persons. This testing ensures that the authorised users do not use their security system to enter in the unauthorised area. The other possibility is that the unknown persons break the security barricade of passwords and signatures. The software is tested for such conditions and corrective actions are taken.

The performance testing is the last of the systems testing where the operational performance of the system is tested. Most of the modern systems are on-line and real time systems.

Very few systems perform in the batch mode. In either case, the speed of processing is a key issue. If the speed is poor, then the system performance is rated as poor. It is important to note that the software will be rejected on the performance issue even though everything else is acceptable.

The performance is a function of architecture and technology, and the processing environment. If the configuration design of the hardware and the software is not proper from the performance angle then the software will not function at the desired speed. The performance of the system gets built from the data and the transaction level process to the entire system processing. In every stage specific attention is given to this requirement so that the issue gets eliminated and the software passes the performance test.

In summary, the software quality is assured through a well planned series of testing starting from the code level to the system level. The performance test is the last one on the quality assurance programme. These tests ensure confirmation and conformance against the internal standards and user expectations. Quality assurance is ensured through strict adherence to the proven and accepted standards at all the stages and applying them strictly to the users' expectations.

## 16.8 HUMAN FACTORS AND USER INTERFACE

The information systems are designed for the users who are human beings. The human beings are the drivers of the information system to meet their information needs. The use of the information system is made through an interactive process between the human beings and the system through which the information system is activated, operated and closed.

Many a times, in spite of the Information System software design being good, the user interfaces are not properly built causing a discomfort to the users. As it is difficult to consider all the users to build such an interface, many times the interface is a difficult one to use. Ideally, the human perception, the human skills and the skill levels, the behavioural profiles and the activities expected in the interactive processes are the factors of design of the user interface.

The use of the information system is accomplished also through a visual mode. The user reacts to the printed reports, the graphical presentations or the displays on the screen. The reaction is through the visual and the mental responses to these displays or reports through his perception of the information conveyed to him through size, shape, colour, format, layout orientation and such other characteristics of the display. The human response differs from person to person owing to the varying human perception. Hence, the user interface should try to minimise the distortions which may occur when the displays are made.

The quick human response neutralising the human perception difference is the requirement of the user interface. When most of the users belonging to the same class of human capabilities find the interface easy to operate and it results in the same human response, then the user interface is friendly. The system then is called as a user-friendly system.

The first step in the interaction is extracting the information from display. The speed of the extraction of information will depend on the display design which includes the text size, the font type, the text length, the use of upper case and lower case, positioning and application of colour, etc. The speed will be decided by the choice of these factors and its retention in the memory will be governed by the impact it makes on the human beings who are the users of the system.

The interactive process is conducted frequently where the information is registered from the display and it is used along with the information stored in the human memory to generate a mental response through reasoning. The quality of the user interface is more important when the user is confronted with a problem solving situation. Most of the users in such a situation try to hunt a parallel or similar problem situation and use the same problem solving methods to solve the current problem through the interactive displaying process. The user interface should be versatile and quick to offer support in problem solving. This is possible when the interface does not rely on the user's knowledge but uses the solution knowledge stored, in the system.

The next factor is skill levels and behavioural differences amongst the various users. The differences in the skill levels occur due to the difference in the training, experience and exposure of the people in the business operations. The behavioural differences occur due to personality variations and personality traits. In the organisational hierarchy, several users with different backgrounds will be the users of the system or software. To design an efficient and effective interface for all the users is very difficult. It will always be friendly to one group and unfriendly to the others. The solution, therefore, lies in building the interface looking into the skills, knowledge, experience and the quality of people in the majority of the users. Essentially, the interface design should satisfy knowledgeable frequent users. For novices, it will be an additional effort to get used to the interface. The information system organisation should help them acquire the skills of using the interface at least in their work domain.

The user interface is expected to assist the four tasks which are basic to all software systems. They are communication, dialogue, system execution and control of the process. In the latest technology advances, the interface characteristics are more or less standard. The system execution will be handled through a menu driven feature. It will provide a window based help for reference or local processing. Such windows can be popped up in a number of sequence. The interface will have a point and pick facility to pick the icons which could be general or can be built for the system.

While designing the user interface the issues which should be addressed squarely are: the response time of the system affecting the performance, user help facilities, bringing comfort and understanding in the system operations, error information handling for better management of the quality; and command labeling for ease or understanding and usage.

In order to achieve a high quality interface only general guidelines can be given. There is no proven prescription for a good design in the beginning with consistency in formats, layout, and display. The consistency helps quicker absorption of the system culture, provides a confirmatory feed back, either visual or auditory in all the communications and interactions.

When the action proposed has even the smallest risk of damaging information, the user should ask for verification of the action by forcing a reconfirmation of the command. He should ensure that the UNDO or the RECORRECTIVE action is available up to a certain stage to save the effort already taken. The interface should provide temporary storage for data in between two actions to ensure that the user is not required to remember. It should have pull down menus by category or class so that they can be placed in the menus properly. An interface should also provide a context sensitive help and use known verbs for describing the commands.

There are guidelines also on the information display. Only the relevant information to the current context should be shown on the display. The colours the meaning of which is commonly known and the abbreviations which are standard and common to the environment should be made use of. A meaningful error messages seeking the right mental response should be constructed. Full use of the screen in an orderly manner should be made and the contents of the display in its logical order of occurrence arranged.

The another set of guidelines can be given on the data entry processes which are basic to any software. An attempt should be made to reduce the typing work of the commands. Though the keyboard remains a primary tool for data entry, the use of mouse, digitiser, and even the voice recognition systems should be extensively made. The interface design should also recognise the possibility of data collected from remote places through the data capturing systems like the handheld terminals for entering in the system.

The choice of the input device should be based on the type of user, the nature of user and the quantum of work. A clerical person may prefer a keyboard. An engineer may prefer a digitiser or a scanner. A manager would like to use a mouse for a point and click actions. Generally, the user would like to avoid the repetitive entry of same values or zeros.

The interface should take default values where the input is not provided. As far as possible, the input once entered and validate should automatically fall in at the place where required. The cursor movement should be jumpy, based on the conditions. The cursor should move to a place by passing in between the fields as, under certain conditions, they are not required as an input.

The features discussed so far for the interface design are possible through the standard front end tools which extensively use these principles. They are based on the industry standards and have the facilities, features, tools, libraries, drivers and utilities to build a user friendly interface. The front end software like Power Builder, Delphi, Visual Basic, C++, etc. are readily available for user in building the user interface.

## 16.9 REAL TIME SYSTEMS AND GOOD DESIGN

All real time systems are triggered by the response to the external events. A real time system must also integrate the hardware, the software, the user and the database to achieve certain results with an acceptable performance.

The real time systems have the following design components:

- Data acquisition
- Measurement, interpretation and evaluation
- Decision making and action
- Initialisation, operation and control.

The real time systems are developed for diverse applications in the process control, process automation, medical and scientific research, traffic management, aerospace systems and instrumentation. In all these applications, the real time system responds to the external stimuli in a time which is governed by the external world. Hence, the performance of the real time system depends on the speed of response it offers to the action.

The entire cycle of acquisition, measurement, evaluation, decision making, action, control and bringing the system back to the initial condition is highly time sensitive. If this cycle is

not performed in a reasonable time the real time system needs relook and redesign. In most of the applications, the real time systems are many and they are organised to obtain certain output. They are dependent on each other and some of them run in parallel and some in sequence. Some of these work on priority which is in-built in the total application design.

In most of these applications the design complexity arises for multi-tasking and multi-processing requirements, synchronisation of tasks and communication support required to operate the system in an effective manner.

If the real time systems are analysed in an industrial application or in the business commercial application, it will be found that their functional requirements are same. They are as follows:

- Interface handling with the external world.
- Context switching after the measurement,
- Prime response time,
- Data management,
- Resource allocation by priority, and
- Task synchronisation and communication.

To explain the functional requirements of the real time systems an example from the commercial world can be taken. A popular application in the materials management is ordering against the stock level. The entire process is, measure the stock level, compare with the ROL, if stock level is lower than the ROL, raise an automatic purchase indent for the EOQ and send it to the purchase system for execution. In this system the choice of vendor will be based on the vendor performance, and the vendor-item relation. The purchase system will select the vendor and raise a purchase order in a standard format with the standard terms and conditions.

In this example the external world is of stores where the physical receipts and issues are taking place. The system must build an interface to capture the stock movement for the current status of stock levels. The ordering system does not respond till the stock level reaches to the ROL of the item. The interface also measures the context by evaluating the stock level versus the ROL and switches to the indenting action. So the interface includes communication, measurement, evaluation, and finally action. The response time in all the real time systems is crucial and critical from the performance point of view. The response time is a function of volume of transactions, a number of real time processes at a time, nature and complexity of the condition monitoring, the complexity of the priority handling, hardware-software configuration and finally the design of the system.

Unlike the industrial application where the response required is instantaneous to avoid damage to the material or to the process, in the commercial systems it is not required instantaneously. However it has to be fast enough to get noticed for follow up and monitoring. The nature of these systems require a proactive initiative and alertness, alarm and action built into the real time design. It also should simultaneously update, post, and hold certain activities in associated and related processes.

Since the real time systems in the commercial world are data-oriented, its management is a critical requirement. The data management includes all the activities starting from data capture, measurement, verification, validation confirmation, evaluation, condition test, text

measure, decision-making and action. This entire task cycle must be managed with utmost efficiency. The entire data management scope should be handled through the database management system and the application software developed specifically for the task in the real time mode.

When a number of real time systems are in operations they share the resources for all task execution. Then to handle the resource demand, the system of resource management is designed at the backend to handle the resource demands whereby a demand of a real time system is not kept waiting unduly at the cost of the result. The solution lies basically in installing an appropriate hardware configuration for optimum system performance and balancing the cost of the demand waiting versus the cost of servicing of the real time system demand.

Lastly, the synchronisation of a number of tasks is to complete a real time activity cycle. In our example, the vendor evaluation, selection and the number of purchase indents need to be handled in a synchronised manner such that no process or result waits unduly long for communication to proceed further. The distributed processing, parallel processing, data transferring and multi-tasking, multi-processing strategies are used for tasks synchronisation and communication to keep the real time system in a dynamic mode operating at an optimum performance level.

The real time systems are designed first with a prototype and then rigorously tested through simulation process to confirm the accuracy in handling the following features:

- Triggers and context switching on condition.
- Concurrency of the data and processes.
- Communication and synchronisation.
- Timing constraints attached to the tasks.
- Coupling of the processes and actions.

The real time software system has all the aspects of the conventional system design and in addition it has to handle a new set of requirements arising out of the time feature. The real time software is either time or event driven and hence the hardware and software which deals with these parameters gather a lot of importance in design of the system. These are best handled by user of simulation, querying and network models to assess the overall response time, processing rate of a task and a complete cycle time, sizing of all the tasks, process time and process delay. A real time system design which offers the acceptable performance on all these requirements is termed as a good design.

## 16.10 CASE TOOLS AND I-CASE

CASE stands for "Computer Aided Software Engineering." Just as computer technology is being used for automating business and industrial applications, it is being used for automating the development of the software. So, the CASE tools are used in the process of system development. It aids and expedites number of steps in the system development. The scope of the CASE tools application ranges from requirement analysis, modelling, prototyping, designing, coding to documentation. The tools are available for the conventional SSAD as well as for the object oriented development. One of the advantages of using the CASE is that it directs the user to the next logical step in the development process. It demands interaction

with the user while using the CASE tools, resulting in more exact requirement analysis and finally its acceptance by the user. By far, the most successful application of the CASE is when it is used for engineering the various business functions and subsequently the major functions in the system development.

A typical system development cycle starts through the business analysis, the requirement analysis, breaking the requirement into business systems and structuring them in a hierarchical order, system project plan preparation, analysis and design, programming, integration and testing and maintenance, and it concludes with documentation.

A number of tools are available to handle the system development requirements and they are as follows:

### **Business Analysis Tools**

These tools help to understand business in terms of facts but they also highlight the critical success factors and mission critical applications. They narrow down the focus on the critical functions, processes, products and finally some indication on the information requirement. EIS (Executive Information Systems), business modelling tools, financial analysis tools, etc. are aids to analyse the business and to decide future course of action. This course of action decides the scope, content, emphasis, etc., of the system for the information system designer.

### **Requirement Analysis Tools**

In the requirement analysis, the information needs are established with reference to the decisions which are often required to make. This is done by mapping information to process and then to inputs. The search is then made as to how to ensure the inputs to obtain certain information. This is achieved through mapping inputs to documents to transactions to the users. Then the transactions are mapped to applications and the use of transaction data in each application is determined.

While mapping, the user is always involved to confirm the validity of data and its application. In this process, essentially, you are building database inputs and its multiple usage in a number of applications. In the requirement analysis data, processes, applications and information are studied for the system development. At this time attempt is also made to reengineer the process to make it efficient and effective.

### **Analysis and Design Tools**

The next step after arriving at the requirement is to go in for the analysis and design of the system. The tools are available in both the areas. These tools help to build a model of the system. The model depicts the data and process definitions, the data and process flow and the control specifications. These tools further help in judging the quality of the proposed system.

The advantage of using these tools is that a fair amount of major errors and faults get eliminated in analysis stage before they are carried to a design stage. Most of the tools provide the SA/SD capabilities which help in modelling. All these tools provide aid in defining data, processes, modules and sub-modules in a structured manner. They are the tools for drawing DFDs, E-R diagrams and flow charts showing the data and control flow. All these outputs put together show a system model which the user validates before it is taken for detail design and coding.

## Interface Design Tools

Having finalised the system model, the interface design and development tools are used to create the menus, buttons, window structures, icons, device drivers and so on. These tools provide the programm libraries which when used help to mange the input devices, validate the inputs, manage the error conditions and controls the process execution. The SA/SD tools, the interface and the development tools automate the process of the system development to a stage of analysis and design. All front end tools provide graphical user interface (GUI).

## Programming Tools

The next phase, after design is to go for programming. The programming tools are available for the conventional programming as well as for the object oriented environments. The conventional coding tools are compilers, editors, and debuggers. With the development of the Fourth Generation languages, and query systems and code generators, the manner of coding process has undergone a change. The use of these languages help the designer to project the system at a higher level of abstraction.

Besides these tools, application generators are available now which use central database and the application specific process execution rules to create an executable code. On the same lines, if the environment is object oriented, the languages available are C++, Eiffel, Smalltalk. The object libraries are available which can be used for programming the object model.

In fact, if the survey of the CASE tools is made there are several products available which provide assistance in all phases of system development whether the environment is conventional or object oriented. CASE tool is a kit of all kinds of tools and the designer had to pick and choose as per the requirement.

The latest trend is to go for the I-CASE, i.e., the Integrated Computer Aided Software Engineering, tools. In the case of CASE there is the problem of integrating the development in the next stage. The advantage of the I-CASE is in the seamless transformation from one stage to other, i.e., the system model to the system documentation. The integration demands commonality in definition, presentation and application of the objects, relationships and dependencies and the software design rules. The I-CASE provides an integrated approach to the system development where the data integrity, the information sharing, the methods enforcement and the document standardisation is necessary.

The I-CASE is still in the evolving stage. The user of the CASE or the I-CASE tools is more efficient and effective when the large systems are the subject of the development. Whether CASE or I-CASE, the primary role is to bring the two parties, user and designer on a common platform for exchange of the ideas, conceiving the system, establishing the methodologies, confirming the choice and the use of process, producers and business rules. It helps to visualise the system in a structured manner to facilitate the confirmation of scope.

The user of CASE or the I-CASE brings a tremendous transparency in the development effort of the system. The user requirements and the user issues get proper attention in the development. With the advanced technology in each area of the development, one can build a system model very close to reality for user interaction and acceptance.

In the commercial world of software development, the CASE or the I-CASE tools are used for proposal finalisation, confirmation and then the same is used for control of the development.

### 16.11 STRATEGIC NATURE OF IT DECISION

A business enterprise or an organisation requires to make a decision of choosing an appropriate Information Technology (IT), as a vehicle, to handle the management information system. The choice of IT is a strategic decision, making long-term impact on the effectiveness of the MIS of the enterprise. The information technology affects the people, the processes and the productivity of the organisation. It is a strategic business decision and not a financial decision to be taken on the least cost approach.

Just as the MIS handles the decision support applications, the choice of the Information Technology makes a qualitative difference in the decision-making process. Hence, a wrong choice of the IT would kill a good MIS design as the information technology would not support the user on the aspects and the requirements such as speed, response, access, security, autonomy and integration of the information processing on the different hardware software platforms.

A wrong choice of the information technology would also kill the MIS designer's ability to develop a user-friendly end user computer system, providing all capabilities of the data and the information handling with flexibility and speed.

The choice of information technology can be compared to a decision of constructing a house. Though the cost of construction is a major decision parameter, many other factors such as the living comfort and convenience, accommodation of the family members with their respective living styles, etc. are equally important. Besides a house should have a privacy, should be attractive, airy and well lit and also the maintenance of facilities and utilities should be easy. A wrong choice of house, therefore, affects the buyer for the lifetime, both, in terms of the cost and also in terms of comfort. The decision is usually irreversible and very costly, and may not satisfy all the needs of the members of the family.

The modern information technology offers a number of different system configurations, each being a candidate, as a solution to satisfy the needs of the MIS. The information technology decision, therefore, is a technical decision, where it is required to decide between the various configuration alternatives made of a variety of hardware and software options. The configurations are the LAN or the WAN, the Mini or the Supermini, and the Front end and the Back Office Systems, Internet/Intranet, OOT, Client Server Systems.

The configurations could be evolved on the basis of the approach to the information processing. It could either be distributed or centralised, local processing or centralised processing, etc. It could be a conventional data processing approach versus the database management approach.

Each configuration has certain technical merits and demerits, and therefore has to be weighed on some other criteria for its selection. Each one of them covers a wide cost spectrum. The wide cost spectrum results due to the different architecture options in the hardware such as the Risc, the Cisc and the different processing chips such as the Intel, the Motorola or the Proprietary Chips such as the 'Alpha' of the Digital and the Power PC of the IBM, etc.

The third reason is the different operating systems for the different platforms, i.e., Windows NT, the UNIX, the OSF, the MOTIF, the OS2, the VMS and their proprietary versions such as the Ultrix, the HP UNIX, and the ORG UNIX, AIX, etc.

Several probable configuration options are further influenced by the available software running under each of the operating systems. The software options, an important dimension to the choice of the information technology, demand a certain operating system as a critical requirement. Some software options are efficient on one hardware platform and not on the other, so if the software is critical, then many times the hardware becomes a no option decision.

Another important factor which influences the information technology decision, is the organisation and its infrastructural arrangement of the offices, warehouses, factories and the customers. Many organisations perform under the multiple operations sites. Such a structure of the organisation would demand a hardware typical to that particular location and also be able to communicate with other hardware-software platforms. In such situations, the communication requirement becomes a dominating factor in choice of the information technology.

For example, the warehouse may need just a PC or a PCLAN, the nearby factory may need a mini computer system and the corporate office would need a large Supermini computer with special software suitable for its functioning. Each of these platforms may have different operating systems, and the MIS of such an organisation requires data and information sharing between all these resources at various locations. The information technology decision must consider the communication problem and the interface between the two hardware options so that the data sharing is operationally feasible. Many a times, the operational feasibility problems are solved by writing the system utilities, the drivers, and the programmes so that two platforms become ready to share each others resources effectively.

The information technology decision is also influenced by people-related factors. The choice of the information technology is made on the basis of the ability of the users. The place like warehouse may not have highly qualified computer literate personnel and, therefore, at such a location, PC systems would be an automatic choice or a dumb terminal of the main computer system. But at the factory location, since the personnel are of the higher skills, grade and qualifications, a Network or a mini system, capable of offering different software solutions, would be preferred. In such a place, hardware and software support is also required.

Though training the personnel to become computer literates is a solution to such problems, it may not be always possible and operationally feasible to solve such problems and give a high-tech information technology solution which is uniform across the organisation. The work culture and the people culture become the critical decision inputs for any information technology decision.

Finally the information technology choice is governed by the requirement of the mission critical applications(s) of the organisation. The hardware choice, and its configuration in terms of memory, disk and communication are decided on the base of processing needs of the mission critical applications. The other requirements of the organisation are to be fitted to this configuration.

For example, if the main business of an organisation is service to the customer, then the mission critical application is the inventory management of a variety of items manufactured and distributed at different locations. Such an application would need resource sharing at different locations—of hardware, software and databases. It could be a case of sharing between the UNIX DP network and the minis with a different DBMS systems. The sharing of each other's resources may be for input acquisition and processing for integrating the data on a higher plane and sending the results to different locations, and for presenting on the different

output devices such as the laser printers and plotters, and also on the storage devices available at the different locations.

The information technology decision is made for the current needs as well as for the futuristic needs of the organisation. Hence, the decision is influenced by the technology forecast and the business forecast. It requires some valid assumptions about the growth of the business, the manner in which it will be conducted and the information needs of the organisation to conduct the business. Such a probing in the futuristic needs helps to size up the various options and to weigh them critically on the various criteria.

The information technology decision, therefore, is a decision to be taken at a particular point of time and implemented over a period of time considering the various soft and hard options available from time to time. If the organisation is under a financial pressure as the budget is not adequate to implement the best information technology option, then the information technology opted for should be upgradeable, expandable and scalable. Such organisations can start with a smaller configuration and migrate to a bigger one with no risk of technological obsolescence or no loss of development effort.

The nature of IT decision is complex and is governed by a number of factors as shown in Fig. 16.3. Since, this decision has long-term business and financial implications and affects the entire organisation, it is a strategic decision.



**Fig. 16.3 IT: A Strategic Decision**

### Strategic Decision

The information technology choice is a strategic decision and, therefore, it should be taken after considering a number of factors. The information technology offers a number of alternatives which have varying costs. The costs differ due to the difference in the architecture of the hardware, capability of the software configurations but achieving more or less the same results. Apart from the cost factor there are other factors, such as data management, organisation infrastructure and satisfying its information needs which influence the information technology decision. These factors are discussed at length in the following sections.

### Management Process

The information needs of the people in the organisation arise from the process or the style by which the management 'runs' the business. The quality of management process depends on the people culture and the culture predominantly affects the decision-making process.

If the decision processes are centralised at a higher level and the delegation of responsibilities and authorities is not proper, then the information technology choice will weigh heavily in favour of the distributed data acquisition systems and the centralised high end information processing systems for decision support.

If the decision processes are decentralised, the information technology choice will weigh in favour of those systems, where the acquisition, processing, analysis and decision-making will be at distributed nodal points. The organisation which operates through a number of locations and on the basis of the Strategic Business Units (SBU), will opt for such an option. In such cases the typical nature of the concerned SBU will decide the hardware-software platform for the particular unit at the particular location.

If the decisions in the organisation are of the following types, then the information technology options would differ. These types are:

- (a) The decisions affecting the operations management.
- (b) The decisions affecting the execution and control of the business.
- (c) The strategic business decisions.

In such cases, the information technology choice would be the Front End Processing System connected to the Back Office Central System. Hotels, Hospitals and large corporate bodies are the examples, where such a choice is desirable. The front end systems take care of the operations management, while the back office systems take care of the strategic and the operations planning and control of the business.

There are other business situations where due to sensitive nature of the business, decision-making is concentrated at one business location or in one of the business functions such as marketing, research and development, manufacturing, etc. The information technology choice is largely governed by the information needs of that particular location or function. In other words, every business has one or more mission critical applications serving the information needs of the critical strategic decisions. The entire management process revolves around these applications. The organisations' information technology choice is, therefore, based on the requirement of these applications serving the critical business functions.

Due to the organisations' infrastructure and also due to the nature of the business it so happens that there are data centres, where a large number of transactions take place and these are the decision centres. In such cases the information technology choice will be in favour of the distributed high end data processing systems and the dedicated information processing systems at the decision centre using the distributed data bases. Many service oriented businesses like the banks, the insurance companies, etc. fall into this category.

It is, therefore, important to note that the information technology choice considers the management process, the business organisation, the decision-making style and the mission critical applications as the important dominating factors. The choice of hardware details and the software mix will be decided on these factors.

### **Business Operations**

There are many organisations, where the business operations are typical, voluminous and their information needs are largely for transaction processing. The typical example is that of

the banks where the banking operations are uniformly standard at almost all branch locations. The transactions are large in number and need to be processed very fast. The decision-making process is rule based governed by the policy and the guidelines issued by the statutory bodies in the banking industry. The information technology choice in such cases would be the one which satisfies this need the best.

In a Hospital where the transaction processing is very low, the decision-making need is satisfied by query type application. The information needs here are largely the patient and doctor-oriented. The information technology choice, in such case, will be of the front end processing system supported by the back office mini or main frame system with a strong database system which is very powerful in the data management and the query processing.

Suppose there is an organisation the main business of which is marketing of a variety of products through a nationwide distribution channel system. The business here operates mainly on satisfying the needs of the buyers by providing them what they want. Hence, inventory management is the main business function here. The information technology choice in such case will be the one where the sales and the receipts data is processed very fast, the inventory related decisions are taken, stocks are adjusted and the procurement action is also taken quickly. The hardware details in such case will be decided based on the data volume, the response, the speed and the communication systems.

There are certain business organisations the operations of which are such that if the organisation takes care of one or two major functions, most of the information needs and the MIS needs would be satisfied. Many a times these functions are special and would be demanding special hardware and software. If the organisation requires a mix of such special hardware and software, then the information technology choice will be based on the integration possibility of the different information technology platforms satisfying the organisational information needs.

For example, in the high-tech engineering organisations, a lot of engineering and design activities, such as drafting, designing, modelling and analysis take place. Such a function would need special hardware such as work stations and special CAD/CAM/CAE software, etc. However the data processed by such hardware-software system needs to be integrated in the business and commercial systems of the organisations. The information technology choice in such cases would be based on the feasibility of sharing the resources and data of the two locations and having special applications and information needs.

A number of such possibilities emerge and unless these factors are properly considered, the information technology choice may go wrong. The information technology choice, therefore, is strategic to the business performance.

In all the businesses twenty per cent information set is critical and eighty per cent is not so critical. If the information technology choice does not satisfy the critical twenty per cent need, then it can be said that the information technology choice is a strategic mistake with concurrent business and financial implications.

## Configuration Design

The details of the information technology, such as architecture, communication, RDBMS, storage media, and operating system are also strategic to the success of the MIS. There details

are configured carefully for effective implementation of the specific information technology platform.

## 16.12 EVALUATION AND FEASIBILITY OF IT SOLUTIONS

As we develop different choices of information technology and its configurations, the decisions making enters into the evaluation phase for selection. The selection criteria for evaluation would have different dimensions to be satisfied simultaneously. These dimensions are:

1. Technical
2. Operational
3. Financial

### Technical Evaluation

Technical evaluation deals with the testing parameters, such as data transfer needs, the response level, the successful connectivity of the different hardware platforms, and the degree of meeting the overall system performance standards.

Technical evaluations can be carried out first by studying the literature of the product in detail and then by conducting brain storming sessions with the vendors' specialists. In this phase a number of doubts are clarified and the vendors' claim in the areas of the system performance are confirmed. Technical evaluation can then be planned by scheduling the activities such as the bench marking for a couple of key parameters.

The bench marking studies could be at a 'raw' level where you test the vendors' specifications. Once these are confirmed, the specifications are put to test on a live platform, i.e., the technical specifications are tested by running live data in a particular format. Such an experiment would be a prototype model of your information processing need related to the mission critical applications. You may develop a mini representative processing application and run it on a model configuration of the system. Such experiment would confirm the vendors' claims and your expectations and needs. This would develop certain norms which can be used to configure the hardware details and building the architecture. The bill of material of hardware and software can be worked out with the help of these norms.

Following hardware software details are configured and the quality of each item is also decided using the norms developed in a live experiment. The decisions on the following points would facilitate the system configuration for a given requirement.

- Memory and Cache
- Disk Capacity, Features, Controllers
- CPU Speed, Processing Architecture and Capabilities
- Servers: Distributed/Dedicated, Types/Kinds
- Terminals—PCs, X Terminals, Work Station
- Network and Cabling, Internet and Intranet
- EDI, E-Mail
- Networks of communication and security
- Output Devices
- Monitors

- Operating Systems
- Standards: ASCII, ANSI, GUI
- Hardware Architecture
- System Software: OS, Gateways, Interfaces, Drivers, Utilities and Compliers
- Media, Copying Devices
- RDBMS, Features
- Software Packages: Enterprise/Quality/Tools for reports and documentation

Technical evaluation also confirms the information technology approach to the information processing needs of the organisation. The issues like the centralised versus distributed, the online versus the batch versus the real time, the network versus the mini or the Supermini are also evaluated. Technical evaluation also helps in narrowing down the hardware choices as all the vendors may not satisfy the requirements of the organisation.

Having narrowed down the hardware configurations to two or three options, the technical evaluation considers the performance related issues such as reliability, dependability, performance on the volume scale, security, integrity and autonomy, etc. All the options may not equally satisfy the evaluation standards set by the organisation on these factors. The performance related issues will help fine tune the configuration details such as the memory, the number of ports, the specific inputs and output devices and the hardware infrastructure. Technical evaluation also helps to break down the hardware on a time scale, i.e., the minimum required in the initial stage and subsequent add-ons, expansions and upgrades on a time scale.

In technical evaluation we are discussing utility of information technology. The information technology is constantly under development and the scale on which such improvement takes place is phenomenal. Hence, it is necessary to select the latest technology in all areas of information processing as it would take you a long way and help you to protect the investment. The investment is protected, if the Information Technology choice is scalable, upgradable and also expandable with the growth of the business.

### **Operational Feasibility**

The options approved after the technical evaluation are tested for the operational feasibility. What the technology offers may not be possible to operate at the practical level and at a scale to obtain full benefits of the various inherent features. The operational feasibility evaluation considers the people-related issues and whether the systems and the procedures of the organisation are complementary and conducive.

In a number of situations, the choice of technology determines automatically the calibre, the competence, the knowledge of the people in the organisation. It is also observed that the organisation does not provide people support to implement technology successfully. The shortcomings on peoples' side would be the lack of requisite qualification and the subject knowledge, the ability to absorb the technology, and use it efficiently and effectively. Many a times, the organisation would require to appoint a new set of personnel to fulfil these needs.

Other areas affected would be the systems and the procedures currently operating in the company. The shortcomings are observed right from the absence to the inefficient systems and procedures. The modern information technology needs sophisticated back-up of the data

at a requisite point and time. If such a data support is not available then the information technology would be underutilised or may not be worthwhile to implement.

For example, the information technology offers a solution of fast data transfer and processing between the two platforms at two locations, i.e., the data source is at one location and its need is at two other locations. Due to the systems and the procedures prevailing at the source location, the arrival of the data at the required location is late and hence not useful. Hence, the information technology solution is operationally infeasible to obtain the best of the solution.

Most of the issues in the operational feasibility evaluation are related to the people and business processes. The environment must be conducive to support proper implementation of a new information technology.

If the environment does not support the new technology, it will be managerially prudent to choose next best information technology solution as it is always possible to compensate the loss due to the next best option by obtaining full benefits in its successful implementation and further at a later date to switch over to the original best option.

### **Financial Evaluation**

All the options can be evaluated in terms of the investment it calls for. It is always possible to rank the options on the basis of the investment. All business investments are evaluated in terms of return on the investment (ROI) or certain payback period. They are also judged from budget considerations.

The information technology investments are difficult to judge on the ROI basis as some aspects of the investments are intangible and are difficult to quantify in monetary terms. The best approach in such cases is to judge the investment in terms of the value of information it gives on an incremental scale. If the value of information in relation to its investment is not significant, then it could be advisable to consider the next best lower investment option.

In regard to the budget restrictions, it would be advisable to examine the possibility of scaling the hardware and the software options. It is then possible to have a solution implemented in terms of the budget provisions. The scaling can be done in terms of the quality of hardware required in the option.

It may be possible to buy the requisite minimum in the first year and expand them in the subsequent period. It may be possible to configure the hardware in terms of the capabilities which are required now and which can be acquired later on.

The budget restrictions can be handled by taking the benefit of the scalable and the upgradeable technology. The scaling of the expansion can be done on two scales, viz. horizontal and vertical expansion. The horizontal expansion relates to the quantity while the vertical expansion relates to the quality and coverage.

#### ***Horizontal Expansion***

The memory, disk, terminals, peripheral equipment, etc. can be configured for the present needs and then expanded as the coverage increases.

#### ***Vertical Expansion***

The system integration, backward or forward, concentrates on the mission critical applications, covering only the main key business functionalities.

However, in all these matters the total decision is to be taken first and then broken down into components and in terms of the budget provisions for the next two years or more.

In all these matters, a thought should be given to protect the information technology investment. If certain technological advances are round the corner, then it is better to defer the investment. The choice of hardware and software should be such that it should facilitate the integration of new technology into the old one. The new versions of upgrades should be independent of the hardware. The application languages should be such that any open system can handle it without much changes.

A carefully worked out investment plan should be submitted for approval with the implementation plan of the information technology. A presentation of an hour and a half to the top management highlighting the investment, the productivity gains and the competitive edge that the business of the organisation acquires through the information technology, would help in obtaining the management approval, its involvement and support in implementation of the information technology.

### **16.13 MIS: CHOICE OF THE ‘INFORMATION TECHNOLOGY’**

The choice of the information technology is a backbone of the Management Information System. It is a critical strategic decision affecting the business operations and prospects. It affects the people, the processes and productivity and helps organisation emerge with a new work culture. Since, it is a high investment decision, the management would look at it from the returns it yields in the business.

The success of the MIS lies in how the information technology is implemented in the organisation. A lot depends on the people and their ability to accept the new work style and the new work culture. All the implementations of the information technology lead to organisational transformation in the content and structure.

If the human side of the organisation is not properly aligned to the information technology, the best information technology would fail in its implementation, adversely affecting effective development of the MIS. There is a risk in manipulating the information technology beyond a limit to suit the personnel of the organisation or the budget limitation. Hence, the implementation of the information technology could be slow on the time scale to accommodate a certain critical constraint, but it should not be allowed to adversely influence the information technology decision itself.

The information technology changes are very rapid. To protect the investment in the information technology, the selection criteria should include features such as scalable architecture, upgradeable software, an open system environment, communication capability through gateways and interfaces and so on. A good management information system design requires a matching support from the information technology.

### **KEY TERMS**

System Engineering

Human Factors and user Interface

TQM of Information

Real time Systems

Triggers and Context Switching on Condition  
Strategic use of IT  
Feasibility of IT Solution

I-case  
Configuration Design  
Strategic Choice of IT

## REVIEW QUESTIONS

1. What are the different levels of processing required to meet the information needs? How are they dependent on each other?
2. Why are checks and controls required at all the levels in processing?
3. What is the difference between verification and validation? Even though data is correct, transaction may not be valid. Illustrate the above statement with examples.
4. Write a small note on TQM of information system.
5. The quality is ensured by the designer and not by the technology. The technology is an enabler and not a quality assuring solution. Explain.
6. How is quality assumed on the information? Enumerate all the steps in quality assurance programme.
7. What is the relationship between system performance versus processing content? Is the concept of performance optimisation valid in information system? Is it possible to optimise the performance?
8. Enumerate the factors which affect the system performance.
9. How many performance issues can be taken care of in design, and hardware-software configuration?
10. Even though quality of information passes all tests still user may not be satisfied. Explain.
11. The selection of information technology is a strategic decision in MIS development. Explain.
12. What are the technology decisions? and what is their relevance?
13. What is a configuration of IT platform when it comes to MIS? Why should the configurations be determined?
14. Which are the three parameters used in the evaluation of the IT before decision is made?
15. Why is the operational feasibility of the IT system important?
16. What methods are available to contain the investment in IT to the budget availability without compromise on the plan or quality of the MIS?
17. MIS implementation and use of IT in business processes is a cultural change in the organisation. How would you handle it for a smooth change over from conventional to technology-based management?
18. Technology obsolescence is a fact of life when it comes to IT. While deciding configuration, what care should be taken so that the investment is protected for a reasonable period of time; application development effort is not wasted and organisation is not required to learn a new technology again and again.
19. Top management always asks for return on investment (ROI) made in IT. How would you calculate ROI in IT? What other measures would you suggest for evaluating the investment in IT?
20. How does the workculture, management style and the organisation's learning capability have a bearing on the IT or MIS decision?

## LEARNING OBJECTIVES

- Important Features of Efficient Networks
- Network topologies: Bus, Star, Ring
- Data Communication Technologies
- TCP/IP, OSI
- Network Applications
- Enterprise Networking, LAN, WAN

### 17.1 INTRODUCTION TO NETWORK

With the development of personal computers and workstations, the importance of the mainframe and the mini computers drastically came down and the computing and processing power center shifted to the users' desktop systems.

The personal computers and the workstations became so powerful and capable that each user started having such desktop systems personalising the use of data and information. This attitude of the user created problems of data availability, redundancy, communication, sharing of resources and information management for decision-making. Though the hardware and software became powerful and the desktop systems became more efficient, the organisations suffered from its under utilisation. So, the efficient islands of desktop systems became a bottleneck for the information flow, usage and sharing as they were not connected to each other.

It was, therefore, necessary to put these information islands on one platform whereby they can talk to each other. They can share the resources and the information processed locally becomes a corporate resource for all users, simultaneously meeting the requirements of confidentiality, security, and integrity of information. The networking primarily fulfilled this requirement of communication and access.

The networks brought the entire organisation and its users under one umbrella on the common information technology platform making the information a corporate resource sharable by all. It improved the utility of information, and made complex application building possible.

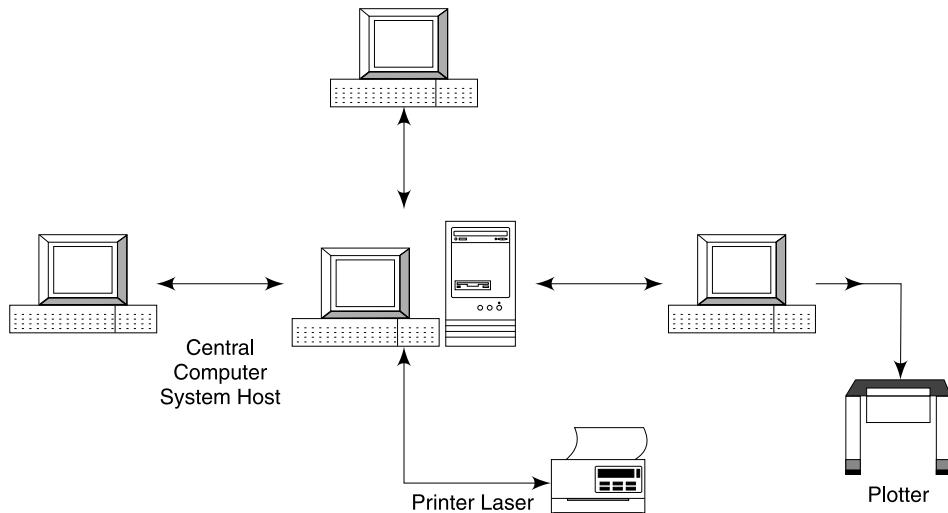
More and more technologies are supporting basic networking technology, making network approach to information management most stable, efficient and effective.

The network essentially serves some important features like:

1. It allows the users/departments/divisions to share the hardware resources like the laser printers, the plotter and any other storage media like the disk drives.
2. It allows the information to share across the company. The information such as the product literature, the price lists, the organisation information, the vendor/customer masters, the rules and regulations, and so on can be stored and maintained at one location to be shared by the other through a controlled access mechanism.
3. It enables the electronic transfer of mail, document, or data to the addressed locations with a confirmation.
4. It provides an access to the data file on other computer systems in the network for the local processing need.
5. With a wide area network, different computer systems can talk to each other for the purpose of processing, sharing and communicating.
6. It enables seamless integration of the business functions and operating divisions.

## 17.2 NETWORK TOPOLOGY

A simple model of the network is shown in Fig. 17.1. In this model the terminals are attached to the central computer system. It is a multi-user system. The network provides a modularity, connectivity, superior performance, security and reliability.



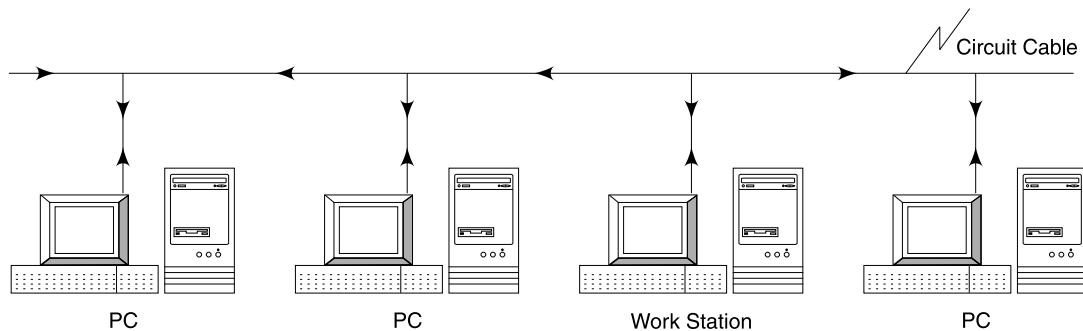
**Fig. 17.1** A Simple Network Model

The terminal could be a personal computer, a workstation or a dumb terminal/thin clients. The main system is called a server of the network and the terminals are nodes. In this model, the output devices like the printers and the plotters could be dedicated or shared.

There is a variety of networks. There are the Local Area Networks (LAN), when they serve the organisation and the departments. There are Wide Area Networks (WAN) when they cover and link the systems across the towns and cities or within the cities at the long distances. In case of the LAN network, communication system is private, while in case of the WAN, it is a public communication system like the PABX, satellite, V-SAT, and others. The network covering a cable distance upto 100 meters is termed as the LAN, between 100 to 300 meters it is also a LAN but the boosters and the drivers are added to expedite the communication. Anything beyond 1000 meters is termed as the WAN. The networks are designed with different topologies. Topology is a layout showing how the connectivity communicates and information flows take place in a network.

### **Bus Topology**

In this topology the terminals are connected through one cable as shown in Fig. 17.2. In this topology the circuit cable is known as a bus. The communication takes place along the bus and the terminal decides the ownership of the message and act. If the message does not belong to the terminal, it ignores the same. In this topology you can add the terminals easily by extending the circuit cable length.



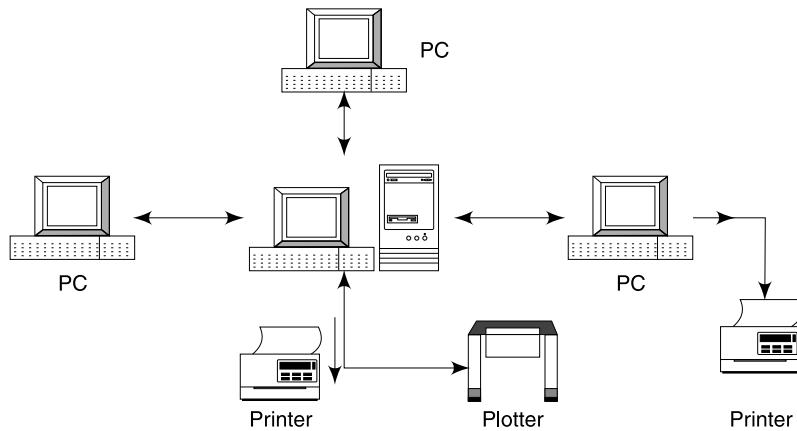
**Fig. 17.2 Bus Topology**

This topology allows for all messages to be sent to the entire network through a circuit. There is no central host and messages can travel in both directions. If one of the terminal fails none of the other components in the network are affected. In this topology, network can handle one message at a time. Hence, if communication requirements are high meaning if network traffic is high, network performance degrades.

### **Star Topology**

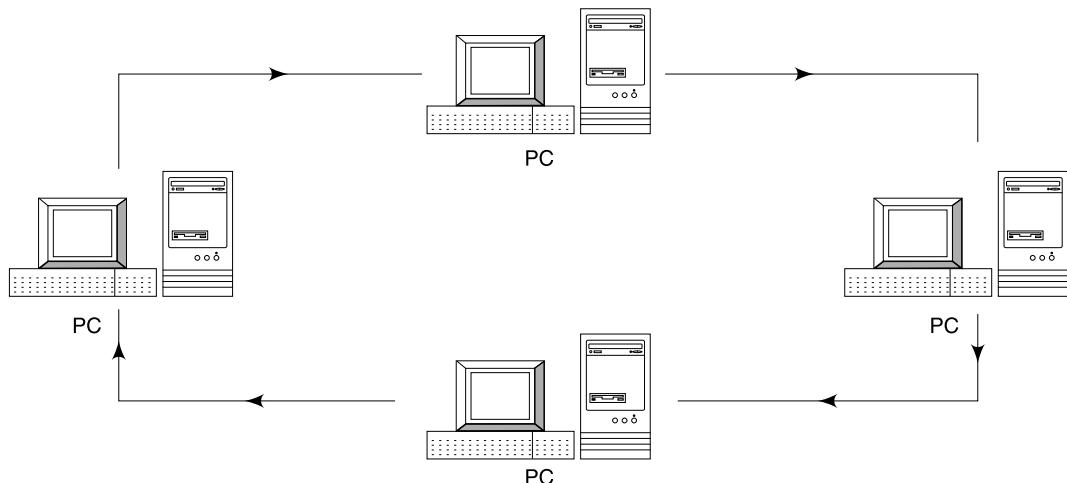
In this topology, the communications are routed though the central system known as the server as shown in Fig. 17.3.

This network is vulnerable to fail if the server fails. Since, the communication is through the server, the traffic on the network cable is very high. The network cabling and the server efficiency decide the performance of the network. This topology is useful for communications when some processing is centralised and some is performed locally in the terminal. The server is a network traffic controller. If the server fails, the entire network is down.

**Fig. 17.3** *Star Topology*

### **Ring Topology**

In ring topology, the terminals are connected on the ring like cable layout. The communication takes place from one terminal to the second, to the third and so on. The network fails if any one computer fails to perform. The ring topology is shown in Fig. 17.4.

**Fig. 17.4** *Ring Topology*

The communication moves with the address and at each station it is determined as to whether the address is valid or not. If the address is valid the communication is accepted, otherwise it is passed on to the next personal computer in the ring. In this topology there is no host computer or server. Each computer in the network can communicate directly with any other computer. Each computer processes its application independently.

In the organisation, you will find such networks working in a cooperative manner. This network is called a hybrid network made of LANs of different topologies. In comparison the

bus topology is the best because of its reliability, flexibility and cost. The LAN, generally, is Ethernet with data communication speed of 10 M bits/second.

A comparison of topologies is given in Table 17.1.

**Table 17.1** Comparison of Topologies

Item	Star	Bus	Ring
Complexity	High	Low	High
Performance	Good for moderate load, Depends on server.	Excellent under moderate load.	Stable under heavy traffic.
Expandability	Restricted to number of interfaces.	Easy and unlimited.	Unlimited.
Reliability and Dependability	Linked to central server. Failure is total, if server fails,	Linked only to the node or terminal. Failure restricted to the node and not to the network.	Moderate. Failure is total, if node fails.

In the organisation, no single topology is implemented. It is always a hybrid or a mix of these topologies. The networking technology can handle different topologies together serving the specific and the general needs of the users.

The choice of cable to make the network is out of three cable varieties, namely twisted pair cable, coaxial cable and fiber optic. The efficiency of communication depends on the choice of the cable. It also depends on the bandwidth, the data transfer reliability, the noise susceptibility, the transmission speed and the security. In all these parameters, the fiber optic cable scores over the other cable options except the cost, which is higher as compared to the twisted, and coaxial cables. Hence, the networks use different cables to control the costs. Generally a main back-end server to the server communication is handled through the fiber optic cables and the peripheral connectivity is handled through the other types of cables. All the cable technologies are proven but the optic technology scores over others due to its immunity to radio frequency, power line interference and electromagnetic cross talk and also it has a low bit error rate (BER).

### 17.3 FEATURES OF NETWORK

The network has some attractive features. The major ones are the resource sharing, productivity and scalable architecture for growth and expansion.

Due to the resource sharing feature, the possibility of overspending in the peripherals like the printer, the plotter, and the disks drives is greatly reduced as these resources can be considered as on-dedicated and sharable for all. Even the programming resources and the tools could be made sharable. Some static, standard information would also be shared reducing the possibility of redundancy.

Apart from the cost saving feature, it creates an environment of integrity because in such cases the data, file and the information management is handled as a centralised function, ensuring protection to the system as a whole.

The productivity of the work group increases due to the quick access to the information and its usage. The communication being fast, the networks are used for e-mail for sending the correspondence, data and information. Due to faster communication there is an easy access to the processed information. The work cycles have been reduced resulting in increasing of manpower productivity. Due to the network features and software like work flow automation, it is possible to restructure the work group in such a way that the work group productivity also increases. Due to the GUI and Window facilities, the presentation of information is improved significantly giving an intelligent mental response to the information. The network, therefore, increases the work and messenger productivity.

In the event of growth, the network can be enhanced from all the sides. It is possible to change the server or add more servers. It is also possible to increase the terminals with a proper networking technology. Hence, meeting the growth needs is feasible and economical as the existing network and the application development can still run on extended or enhanced network.

It is also possible to improve the efficiency of the network by configuring its basic resources at the server level keeping a long-term view. It is possible to change the roles of servers from dedicated to non-dedicated and vice versa. Hence the network can be restricted with marginal investment to take up the new processing needs.

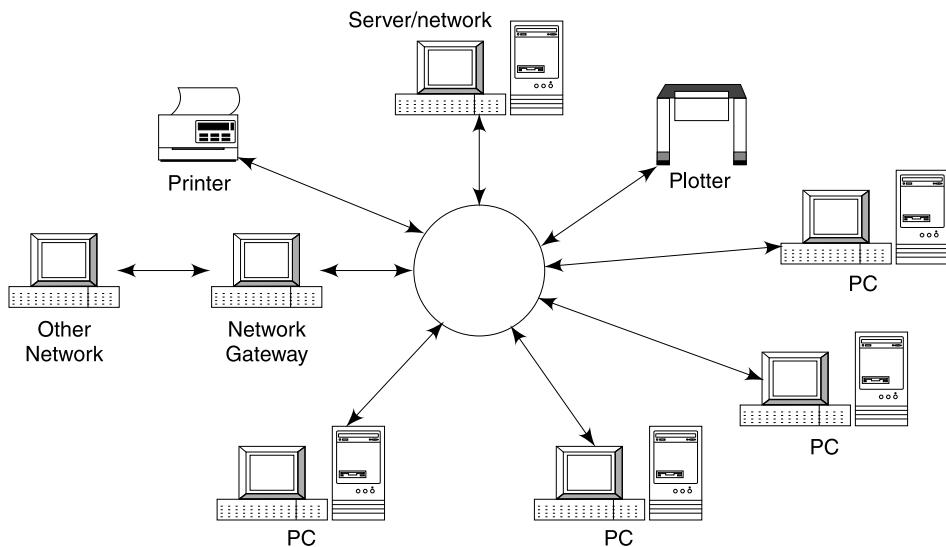
LAN has basically three components—the server, the networking components (cables, hubs, network interface cards) and a terminal (PC, workstation or output devices). Network further has its own operating system called the NOS.

The server could be dedicated or non-dedicated. In the case of a dedicated server, it is not available to run the applications locally. It only serves the demands on calls made by its network level terminals. In the case of a non-dedicated server, it plays the dual roles of a server as well as a local workstation. To save the investment, a server, which can be used in both the conditions, should be bought. The server could be dedicated for specific functions, like printing, communication or file serving.

Since the network can be expanded or enhanced being a scalable hardware, one can start with the smaller network and go on increasing its capacity and capability with growth requirements. You can connect two networks established in different locations through a gateway. The gateway, also known as bridge, is a hardware component. The gateway assists in transferring the information in bits from one network to the other. The gateways are used to connect different computer system networks.

The Network Interface Unit (NIU) is a microprocessor-based device containing hardware and a software, which supply the intelligence to control the access and the communication across the network. It is a means to connect the workstations and the personal computers functionally and physically. It has two parts — the communication interface and the host interface. The host interface supplies the connection between a specific terminal or transmission of the data or the information between the two units. The choice of the NIU decides the speed, the response and certain capabilities of the network.

The Network Operating System (NOS) is a system software that facilitates and controls network operations. As a personal computer or the Mini mainframe has an operating system, the network also has its own NOS to manage the network functionality. The NOS work in conjunction with the local operating system. It performs the following functions:



**Fig. 17.5 Local Area Network Model**

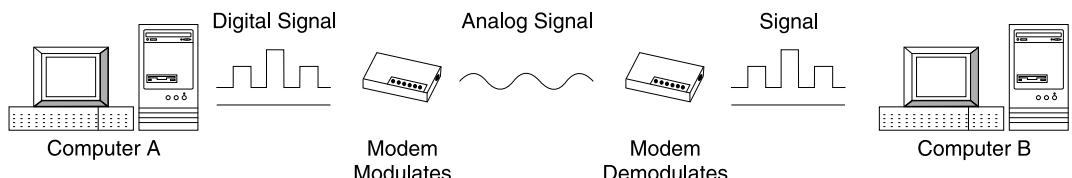
- Directory hashing
- Disk file caching
- Record or file locking for security
- System fault tolerance
- Printer or a plotter spooling
- On-line helping
- Menu utilities, drivers, and so on for user assistance
- Assisting in resource sharing and access control

## 17.4 DATA COMMUNICATION

Data communication is a process of transporting the data from one location to the other. Airlines reservation system, automated banking and the point of sale system used in departmental stores are the examples of the data communication, which is central to these systems. The data communication, therefore, needs a system to transport the data. The role of the system is to accept the input data, structure it for quick transportation and restructure it when received at the destination in an understandable form. It uses the data communication software along with numbers to perform the communication.

The communication link is shown in Fig. 17.6.

Suppose computer A wants to communicate to computer B. Then it will provide a digital signal to a modem to modulate the digital signal to an analog signal, and then to demodulate it to digital, and transport it to computer B. Before the computer B receives it, the modem attached to computer B will demodulate the analog signal to the digital signal for reception in computer B. Then communication software is helping this process on both the computers.

**Fig. 17.6** *Communication Link*

The communication is performed through three activities — entry, transmission and delivery. The communication software handles all the three, and while handling the process it controls errors, edits the data and formats the same for presentation. It controls the transmission by routing process and network features.

The communication of the message does not take place as a whole. It is broken into small packets. Each packet has the source and destination address, at the start and end of the packet; and an error control field to check the integrity of the packet. The packets are then transmitted through the network routes that are free to follow any available path in the network. The packets are reassembled at the destination in a proper order to form the complete original message.

The technology offers three types of switching techniques—circuit switching, message switching and packet switching.

In the circuit switching communication, path or route is dedicated with dedicated resources at both the ends. The example of circuit switching communication is a telephone network. The circuit switching communication is rather inefficient. Firstly, the connectivity is dedicated to the duration of a connection even if no data is being transferred. Hence, utilisation of the connectivity is not high. Secondly, time is wasted in establishing connectivity. It is established when the destination is free to receive the communication. Hence, the circuit switching communication is used in the case of data exchanges of continuous flow such as the voice (telephone) and some forms of sensors and telemetry inputs.

Message switching is an alternative to the circuit switching communication. The example of message switching are telegrams, electronic mail, computer files and transaction queries and its processing. The message is an assembly of the logical units of data and it is sent in a sequence. Each of the units have an address and an addressee. Once the units are built they are sent to the addressee location for storage. It is not necessary that the receiver connectivity be established first like in the circuit switching communication. The delay is at the most of receiving the message and its storing. In the message switching, line efficiency is higher and the simultaneous availability of the sender and the receiver is not required. It is a one-way communication system. The messages can be prioritised.

The disadvantage of a message switching is that it is not suited to a real time or an interactive traffic. Hence, it cannot be used for voice connections (telephone). It can be used for a data/information file transfer kind of applications.

In packet switching, the merits and the advantages of circuit and message switching are found together. It is very much like the message switching but transmitting the message is of a fixed length. If the message is long or large, it is broken into a fixed length called as

packet with an associated identity of message, the source, and the destination and its sequence through the header and trailer identity. Another advantage of the packet switching is that it can be sent through any route available in the network. For example, the message going to Mumbai from Pune may go to New York first and then reach Mumbai where it gets assembled as a full message. It is fast and could be used as an interactive system.

Since, packet switching is an efficient system, its transmission is handled through the public networks established by AT & T, VSNL, NICNET, and others. The subscriber pays service charges to the public network provider, which takes care of the message handling through its network.

Organisations maintain separate networks for voice, data, and video. But technologies' products are available, which can deliver voice, data and video in a single network infrastructure known as 'converged network' organisations, which have applications like video conferencing, call centers, converged networks benefit, distance learning or unified messaging. Unified messaging system combines voice mail, e-mail, and faxes and sends to destinations.

Another technology solution is through ATM (Asynchronous Transfer Mode). It helps in seamlessly and dynamically switching voice, data, images, videos between users. ATM also connects to LANs and WANs more easily.

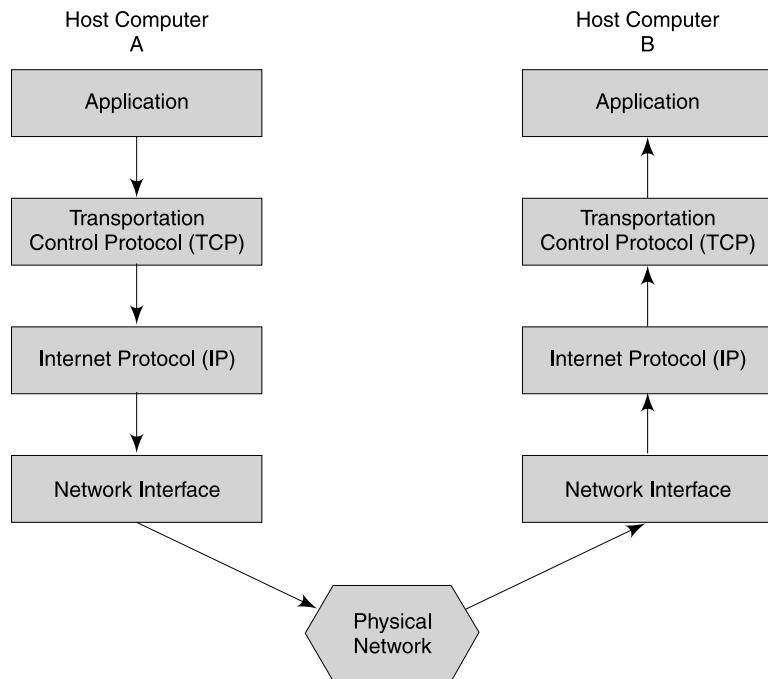
### Models of Connectivity for Network (TCP/IP, OSI)

These are different models for achieving connectivity in the networks. The Transmission Control Protocol/Internet Protocol (TCP/IP) model helps to link disparate computer systems using different hardware and software platforms. The United States Department of Defense in 1972 developed this model. Fig. 17.7 shows TCP/IP model of five layers, application, TCP, CIP, network interface, and physical communication network.

The five layers, which makes TCP/IP model protocol, are explained further hereunder:

1. **Application:** Converts the message into user/host software for screen presentation. Applications include e-mail, file transfer (FTP), and HTTP.
2. **Transmission Control Protocol (TCP):** Breaks the application data into TCP 'packets' called as datagrams. Each packet consists of header and address of the sending host computer, information on how to put back the data together at the receiving computer, and information on how to protect the packets from corruption. The packet model is header – datagram – trailer.
3. **Internet Protocol (IP):** Receives 'datagrams'/'packets' from TCP and breaks them into smaller IP packets. IP packet has a header with address and portion of information and data of the TCP packet. IP also routes the individual datagrams from host computer A to host computer B.
4. **Network Interface:** Facilitates packet transmission from one node to another node.
5. **Physical Network:** Defines electrical transmission characteristics for the packet for sending along communication network.

So, when host computer A has to send data/information to host computer B; application layer converts into a suitable screen presentation format; TCP breaks it into smaller packets/datagrams with header/trailer identity; IP further breaks it into smaller packets with header/

**Fig. 17.7** *TCP/IP Model of Communication*

trailer and pushes to network interface to understand, interpret the address (header/trailer) and entrust physical network to electrically transmit through communication network. Note that when physical network sends the message to host computer B, it starts reassembling the packets using headers/trailers. TCP/IP ensures that the data sent is same after reassembling but in the format which the receiving computer can use it for further processing.

The Open Systems Interconnect (OSI) model is an alternative model developed by the International Standards Organisation (ISO) for linking disparate computer systems. OSI divides the process into seven layers for linking different types of platforms of computer systems and networks.

Whether TCP/IP or OSI, information channel flows seamlessly from one network/computer location to other, unless interconnected applications use the same standards for presenting the data.

### **Key Terms in Network Technology and Applications**

Network technology is full of terms, which needs to be understood clearly to appreciate its application.

- **Bandwidth:** A measure of capacity of communication channel. It is the difference between the highest and lowest frequencies that can be transmitted through the channel.
- **PBX (Private Branch Exchange):** A central communication switching system handling voice, and digital communications.

- **Gateway:** Hardware, a communication processor that connects different dissimilar networks by providing the intelligent translation between different set of protocols. It is also called a bridge.
- **Router:** A device that pushes packages of messages from one network to another.
- **Blue tooth:** A standard for wireless personal area networks that can transmit upto 720 kbps within 10-meter area. The standard provides ability to communicate between wireless phones, computers, printers, and other devices without user's intervention.
- **Wide Area Network (WAN):** Telecommunication network spanning large geographical area using different technologies; such as cable, satellite, and microwave.
- **Value Added Network (VAN):** It is a network provided by third party to the organisation to avail the network services on chargeable basis.
- **Integrated Services Digital Network (ISDN):** An international standard dialup network access that integrates voice, data, image and other services in a single link.
- **Teleconferencing:** A process capability to interact with a group of people simultaneously using group communication software.
- **Data conferencing:** A process capability in which two or more users are able to edit and modify data simultaneously.
- **Video conferencing:** A process capability in which group members interact with each other and also see each other.
- **Electronic Data Interchange (EDI):** EDI is a direct computer-to-computer data exchange between two organisations through business transaction documents.

## 17.5 EXAMPLES OF NETWORK APPLICATIONS

The networks are used for the interactive communication needs between different locations. This could be periodic or in a real time mode when the databases are distributed and the distributed processing is the need of the business process. The networks help implement such solutions. The integration of the data and the interfacing of applications is possible because of the basic capability of the network on sharing of the resources and the services.

There may be dedicated applications distributed across the organisation and the network will help them to make them an integrated application from the organisation. Through the network it is possible to have data acquisition at one place, processing at a second, storing at a third and processing it for information at a fourth and present it at the fifth place.

The network virtually breaks the physical boundary of the organisation. There may be branches, factories, business units at various locations for the other benefits but when it comes to information, the network brings them under one umbrella through seamless communication and integration. In fact, the networks are extended to the vendors and the customers with a free authorised access. With the Internet and Intranet, the world is becoming united under one communication system.

In many organisations, the business is conducted through various locations. The data generation takes place at all the locations. Besides, meeting the local needs of the information, the processed data needs to be transferred to other locations or is to be made available through an

access mechanism. The networks connecting these locations will be used for the data transfer for processing to the respective destinations. For example, the stock balances from various warehouses at different locations are required for valuation and reporting at the head office. The stock balance file will be transferred at the periodic intervals to the head office.

In such a set-up, it is possible to keep the databases at the distributed location but its requirement is at other locations. For example, the sales order database is at the head office and the finished goods database is at the factory location. In such a case, if you have an application, which requires both the databases as an input, the network will establish the communication to the databases for the usage.

The networks are used by the organisation for e-commerce. The networks are capable of communicating through the satellite system to any location. The document transfers such as order, invoices, acknowledgments, and others are sent through the network. The e-commerce is carried out through the electronic data interchange known as the EDI.

The use of network for mail applications is well known. The e-mail is a standard application of the network. Apart from file transfer, distributed database applications, and the EDI/-e-mail applications, the networks are used for on-line real time business applications. A typical applications is of putting the dealer-distributor network on the network of the organisation for a direct interaction. The business processes of the dealer-distributor are integrated in the business of the organisation. The standard application is the order processing of the customer.

Since, the dealer has an online access to the system, he can break the customer order, validate it from all the angles, assess the load and give the expected delivery date. The processed order enters into the order book of the organisation with the associated details, which may be standard or non-standard. The planner in the factory, knowing the order opposition and the expected delivery, schedules the order accordingly. When the order is manufactured with one of the reference information, it is sent to the respective dealer-distributor location for execution. Such network is also used for answering the question of the customer.

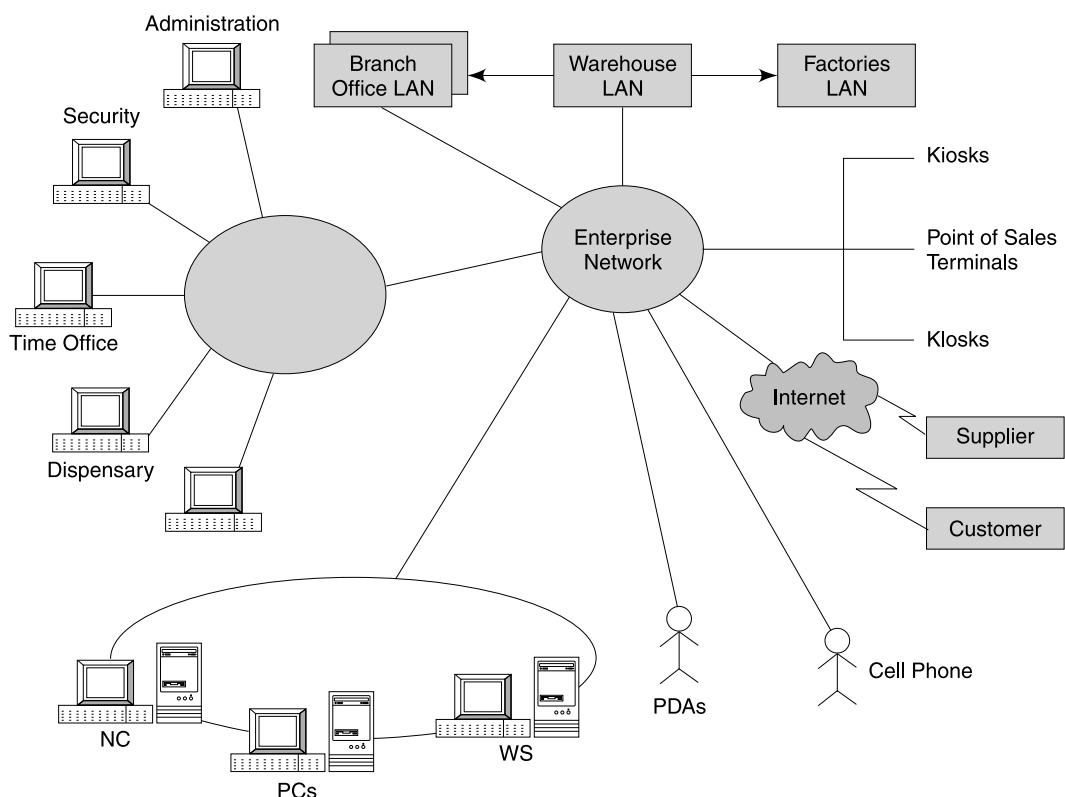
The above network is also used for invoicing and accounting and for further transferring the data to the head office. As against this the stock position is available at the head office on a real time basis. The network considerably cuts down the order processing cycle time. The latest information is available to the network operators.

Banking is another application area where the networks are put to use extensively. The branch banking operations are the LAN applications. The networks help to establish service centers at locations where the customer arrives. Traditionally, accounting was focused on account transactions involved in the branch operation. Now the focus has shifted from the account center data processing model to the customer service model. The banking operations are handled by switching over the client server model implemented on the network platform. The loan application processing, the credit card operations and round the clock banking service are feasible because of the network based client-server applications.

The point of sale system is another application where the networks are extensively used for buying, inventory control, sales, and accounting. The airlines and the hotel reservation system are oldest example of the network application. The network makes the enterprise lean and a fast track organisation serving the customer.

## Enterprise Networking

With the advent of Internet use in business, the new IT infrastructure in the organisation is very large and provides capability of connecting branches, factories, warehouses, customers, suppliers and business partners and mobile devices in a lay layered structure of network. The organisation is an enterprise comprising of internal customers and external customers, vendors, business partners and external entities brought under network. Enterprise network (Figure 17.8) helps to reduce transaction costs, and provides capabilities to run business applications such as e-commerce, ERP, and SCM CRM. Enterprise network is powered by network and Internet technologies.



**Fig. 17.8 Enterprise Network Model**

In an enterprise network, organisation's hardware, software, and data resources are so arranged that distributed desktops have more computing power. It also builds a large higher-level powerful network where smaller networks located at branch offices, warehouses, factories, and departments are connected for smooth flow of data. These small networks are connected by high capacity backbone network. Linking of suppliers, customers, and individuals to enterprise network is through Internet.

Enterprise network of such type works successfully when network members follow the same network connecting standards.

In today's new world of work, organisations face multiple challenges—globalisation, maintaining a connected mobile workforce, and increased competition. To maintain their competitive advantage, organisations must adapt and get better through process innovation, capturing strategic insights, and delivering customised services.

Unified communications technologies improve efficiency and effectiveness of supply chains by enabling stakeholders to collaborate located anywhere in different time zones. Different functional teams and experts along with external supply chain and logistics partners can share data and information to act fast. With integrated UC capabilities into business processes, employees can quickly and easily find the right person and communicate from within the software applications and business processes currently in use.

The unified communications solution makes it possible for executives to access instant messaging, presence, and audio, video, and Web conferencing from any location. This provides a great flexibility in work options improving the quality of life for employees. In addition, it increases home and flexible working opportunities for those who stay far away from work place and find it difficult to commute to the office every day.

Unified communications technologies bridge the divide between computers and telephones with two integrated servers: Exchange server and Communications server. They integrate in organisation's existing phone system and deliver complete communications services using your existing data network. Unified communications technologies maximise existing infrastructure by integrating legacy PBX systems through a VoIP/IP-PBX gateway.

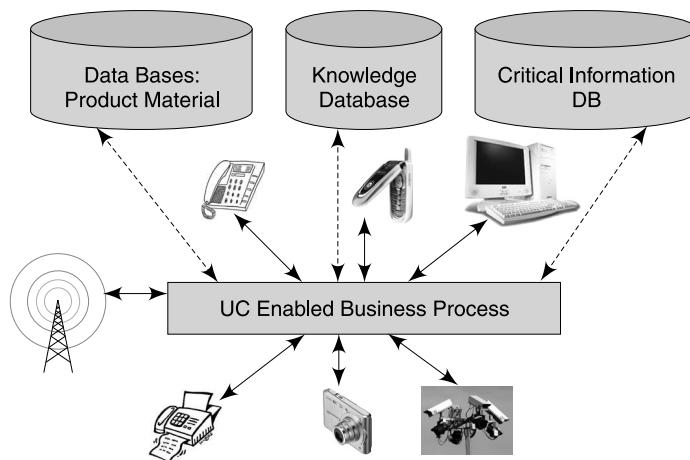
While UC integrates people and communication hardware through messaging and exchange of information, it is possible to make the business process UC enabled to the extend that it is completely automatic, termed as Communication Enabled Business Process (CEBP)

The goal of Communication Enabled Business Process (CEBP) is to optimise *business process* by reducing the human latency that exists within a process flow. UC enabled business process automates human side or aspect of the process execution. That is recognising the problem, seeking information, analyzing and resolving to put the process on hold back to track.

All business processes operate on and manipulate data to produce results. But automated processes can only do operational functions. People are needed in the process to make decisions and take action at key points or when unexpected business conditions arise. UC technology handles human side of the process.

CEBP is about improving the processes and systems that drive your business. To make a process communication enabled a study of 'Human – Process' interaction is necessary. A human intervention in the process delays the progress and flow of information. The more intervention the longer is the process cycle time. You may start by examining your current business processes particularly the customer facing ones or processes in key result areas. Look for gaps or delays in the flow between systems and people. Identify the processes where human intervention causes bottlenecks and delays due to lack of availability, missing data, or indecisiveness.

More detail discussion on CEBP is in Sec. 17.7. Figure 17.9 shows the model of CEBP enabled Business Process Model. The business processes function with support of databases. These processes however need human intervention by way of approval, choice of alternative and sending alert to other location and so on. UC technology implementation in the process makes it automatic saving time, cost and delays.



**Fig. 17.9 UC Enabled Business Process**

### What Is Unified Communications?

Unified communications (UC) systems bring together voice, video, data, and mobile applications in business to improve business competitiveness and profitability. Such integration of different communication technologies liberates employees from their Desk and Desktop adding speed into decision and action raising HR productivity. The rise in HR productivity has direct impact on cost and the profitability. UC is typically a software program suite and technology infrastructure which enables an individual to send or receive a message in one medium and receive it on another at the destination. For example, a voice mail message sent at project site will be read by site engineer in his E-mail Inbox.

The software program combines these communication mediums to transfer the message to another medium. The program automates unification of all forms of human and device communications into a common user required medium. Such unification optimises business processes and increases efficiency and effectiveness of human communications. It also reduces latency, simplifies the flows, and eliminates device and media dependencies. A very strong feature of UC is that it checks the 'presence' of the recipient and then allows the communication to trigger. The feature 'presence' identifies the recipient, the location, and availability in real time before communication is pushed to the destination.

Unified communications is different as opposed to UM (Unified messaging). Unified communications makes a real-time delivery of the message to a preferred location on preferred device, medium. Unified messaging system gathers messages from the different sending sources but holds those messages for retrieval by the recipient at a later time. UC is in Real-time and UM is not in real time. Unified communications integrates all the communication systems and helps those systems to work in sync in real time.

Unified communications is very useful for knowledge workers and service workers alike. These personnel are required to work in collaboration to achieve some results. In today's dis-

tributed business operations the knowledge workers and service supporters are at different locations. A customer requirement or query may not be satisfied from one location. It may call upon drawing the assistance from different sources through communication exchange. UC technology enables collaboration and process integration to meet the customer expectations. UC capability helps in defining the requirement through collaborative interaction of experts, getting acceptance from the customer, changing and integrating the process change to deliver the new requirement. The knowledge, service workers and process designers work in collaboration to satisfy the customer requirement.

Employees, business partners, and customers collaborate to conduct business operations with a combination of different communication modes across multiple workspaces such as

- Their own desks
- Conference rooms
- Airports
- Warehouses
- Branch offices
- Customer or vendor locations
- Vehicles

## 17.6 COMPONENTS OF UNIFIED COMMUNICATIONS (UC)

Unified communications includes a variety of communication elements or methods, such as

- Instant messaging
- Telephony
- Video
- E-mail
- Voicemail
- Short message services
- Video Conferencing
- White boarding.

The immediate benefit of UC is seamless collaboration with other person at separate location. For example, the project manager could quickly locate the site engineer and engage in interactive communication session and then change the session to another medium, say a video call if required. In another example, a customer support manager receives a query from the customer. UC enables the manager to access a real-time list of expert colleagues, and then make a call on the chosen expert facilitating the manager to answer the customer faster in real time without lengthy rounds of emails and phones.

While collaboration is important, UC capabilities can be used to transform business processes as well. This is achieved by integrating UC functionality directly into the business applications using development tools. For example on UC integration, the workflow process application automatically identifies the required resource at the point in the process where it is needed and secures it through appropriate communication medium. UC enhances workforce and application productivity impacting on cost, time and delivery.

## Unified Communications in Action

The sophistication of unified communications technology enables generation of many applications in business. Suppose two persons want to collaborate to produce a contract document. UC helps to find the recipient's current location (office, car site) and the choice communication such as e-mail, voice or instant messaging, then they together seamlessly set up a real-time collaboration event to create the document. Another example is, use of UC for retail price checking for the customer. A floor boy in the mall can do a price-check on a product using a hand-held device or a cell phone and consult commercial manager to satisfy customer inquiry on the price. Many such situations are there in all organisations whether they are in manufacturing, or service, where parties are at different locations supported by different communication aids. In all such situations collaboration and action is demanded instantaneously in real time based on knowledge and information stored at different places. UC is best where action is needed.

Unified communications helps businesses to streamline information delivery to desired location through chosen mode of communication in real time. Human delays are also minimised or eliminated, resulting in better, faster interaction. The service-delivery for the customer is faster and cost savings for the business. Unified communications also allows easy direct collaboration between co-workers and with vendors and customers. Together they can set up a problem and solution design to handle a specific situation. This allows for possible reductions in business travel, cost and time.

## Extended Unified Workspace

Unified Communications from combines all forms of business communications into a single unified system to collaborate. This combination creates a unified workspace for collaboration for customer, knowledge workers, designers, vendors and service personnel. Unified Communications extends the work environment boundary beyond your desktop to any location. UC gives ability to the organisation to

- **Collaborate across any workspace:** Organisations can quickly adapt to market changes and build competitive advantage.
- **Accelerate decision making:** Supported by faster information delivery to the right persons in real time at any location.
- **Innovate across the value chain:** Integration of UC into business process raises the value of the process.

## Productivity Rise Across the Organisation

Unified communications uses the network as a platform for integrating communications with business processes. Business productivity and profitability improves further with:

- Instant connections to the person
- More effective communications.
- On-demand collaborations between employees using different technology platforms and checking the presence of the person.
- Easy and quick access to information.

- Reach people anywhere.
- Spontaneous communication.

Unified communications systems improve competitiveness of the business through reduced cost of operations and higher return on investment. A complete unified communications solution is offered by Microsoft & Cisco.

## 17.7 COMMUNICATIONS ENABLED BUSINESS PROCESSES (CEBP)

The goal of Communication Enabled Business Process (CEBP) is to optimise business process by reducing the human latency that exists within a process flow. UC enabled business process automates human side or aspect of the process execution. That is recognising the problem, seeking information, analysing and resolving to put the process on hold back to track.

All business processes operate on and manipulate data. For example, applications such as Supply Chain Management and Sales Force Automation are used to automate business processes. But automated processes can only do operational functions. People are needed in the process to make decisions and take action at key points or when unexpected business conditions arise. UC technology handles human side of the process.

CEBP is about improving the processes and systems that drive your business. To make a process communication enabled a study of 'Human – Process' interaction is necessary. A human intervention in the process delays the progress and flow of information. The more intervention the longer is the process cycle time. You may start by examining your current business processes particularly the customer facing ones or processes in key result areas. Look for gaps or delays in the flow between systems and people. Identify the processes where human intervention causes bottlenecks and delays due to lack of availability, missing data or indecisiveness.

Most business processes are automated through software to reduce manual work and shorten cycle times. But to function correctly, even these processes must still have people to provide and receive information, analyse data, and make decisions.

The process owner's involvement is latent. The process progress is dependent on the owner. It halts till owner recognises the intervention need and acts on it.

Unfortunately, in the vast majority of processes, the communications needed to coordinate an effective response are poorly automated or not automated at all. Business process reengineering efforts focus on optimising business applications and data management, but often don't address human interaction in processes.

The largest single value in unified communications lies in its ability to reduce latent human intervention within processes and improve a business' ability to respond and be agile.

Let's say a manufacturing company has to shut down production due to a quality control problem. The shutdown triggers the production control system to send an alert to a supervisor, who would engage team members to resolve the problem. But what happens if that supervisor doesn't answer the alert immediately? The process stalls. CEBP solution to this problem integrates with the manufacturing system a automated communication process to call the supervisor through a variety of fixed and mobile devices. CEBP solution will locate and alert the supervisor and seek response to the problem. If a problem demands an expert

group attention, communications could also be sent to the group members, even bringing them all together in a live conference call to work on the problem.

This new way of UC application to interact with a process is a breakthrough for productivity. CEBP solutions even keep a full audit trail of such transactions. The result is efficient resolution of the problem and the process is restored quickly. Later, the situation can be analysed and the process revised or reengineered to ensure future smooth operating.

For example, a insurance claim process and settlement is longer due to responses required at various stages from surveyor, agent, manager and so on. These personnel may be on leave or traveling or engaged in another tasks. The claim process waits for the response to progress towards settlement. The involvement of these three key people in the process is latent. The process experiences the delay due to human latency. To reduce this latency, the process leverages UC capabilities by embedding them into the business process flow.

If any one of these the persons does not provide the necessary response within a designated period of time then the business process would invoke a UC service such as "notify and respond" from an *IP PBX*, voice portal, conferencing application, etc. These embedded UC services would "notify" the person that action is imminent. If the person does not "respond" to the notification then it can be escalated to higher up in the same manner.

UC services that could be embedded within a business process to reduce human latency are conference [on demand], alert, escalate, contact resident expert, etc.; all of which create measurable business value. The great thing about CEBP is that it can be applied horizontally across different lines of business and different industries. Virtually every business process is hampered by human latency.

In claims processing, the organisation's goal is to decrease claim close times and improve their closure rate. However, this process is often hampered by several inefficiencies—the paperwork process can be manually intensive; time-sensitive dependencies on member signatures exist, resulting in significant delays in the approval process.

A CEBP solution would be implemented to automate all communications in claims process with embedded UC services like, reminders, alerts, notifications and escalations. Quantifiable business results of such automation is decreased cycle times; greater HR productivity, enabling them to spend more time adjusting claims rather than fielding calls on the claims; increased revenue and customer satisfaction and retention. As described above, CEBP is much more sophisticated in its ability to automate business process flows; it is usually event triggered, providing a much stronger ROI to many lines of business and vertical industries.

## 17.8 WiMAX TECHNOLOGY

WiMAX is a wireless broadband technology that takes internet connectivity limited to the home or office to day anywhere and anytime on laptops and mobile phones.

The internet is all set to expand its customer base who is contemplating to do business on line. As per Intel study, 100 million people of India are required to be connected in next five years. The connectivity through broadband is a major limitation. This is where WiMAX technology will come very handy to solve the problem of connectivity. WiMAX is a proven technology for carrying multimedia content. It can work in the bands of 2.5, 3.5 MHz. WiMAX

is a mobile internet and revolution in computing. IT acts as a bridge between telecom and Information Technology.

WiMAX, meaning *Worldwide Interoperability for Microwave Access*, is a *telecommunications* technology that provides wireless *transmission* of data using a variety of transmission modes, from *point-to-point* links to portable internet access<sup>1</sup>. The technology provides up to 75 Mb/s symmetric broadband speeds without the need for cables. The technology is based on the *IEEE 802.16* standard (also called *Broadband Wireless Access*). The name "WiMAX" was created by the *WiMAX Forum*, which was formed in June 2001 to promote conformity and interoperability of the standard.

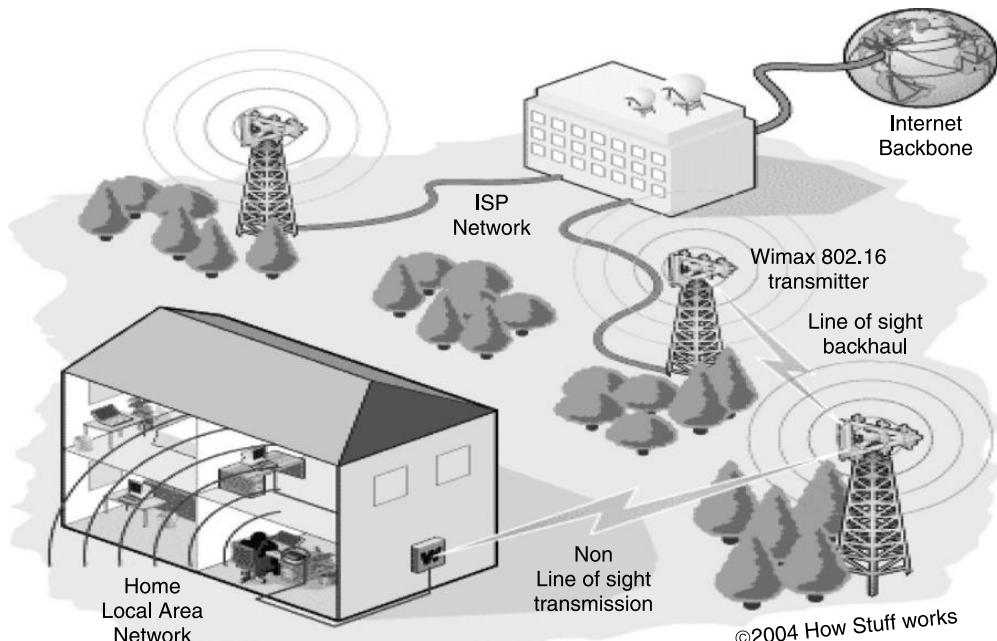
WiMAX is the next-generation of wireless technology designed to enable pervasive high-speed mobile Internet access to the widest array of devices including notebook PCs, handsets, smart phones, and consumer electronics such as gaming devices, cameras, camcorders, music players, and more. As the fourth generation (4G) of wireless technology, WiMAX delivers low-cost, open networks and is the first all IP mobile Internet solution enabling efficient and scalable networks for data, video, and voice. As a major driver in the support and development of WiMAX, Intel has designed embedded WiMAX solutions for a variety of mobile devices supporting the future of high-speed broadband on-the-go. (*Source: Intel corporation*)

WiMAX is a highly scalable, long-range system, covering many kilometers using licensed spectrum to deliver a point-to-point connection to the Internet from an ISP to an end user. WiMAX can be used to provide a wireless alternative to cable and DSL for broadband access, and to provide high-speed data and telecommunications services. WiMAX can also be used to connect many Wi-Fi hotspots with each other and also to other parts of the Internet. With WiMAX enabled handsets and laptops coming into the market, people could connect to the fast broadband internet from anywhere, without having to depend on the slow rate mobile network data transfer. You can work on broadband, call friends and colleagues and watch real-time TV from the top of a forest hill station many kilometers away from the access point - without compromising on quality, speed or screen size. WiMAX could connect remote locations to the Internet using broadband. This would avoid hassles in cabling through the forests and other difficult terrain only to reach a few people in remote places. Maintaining such system would also be easy. WiMAX could provide Internet access, voice and IPTV to those areas.

In contrast to WiMAX , Wi-Fi is a shorter range system, typically hundreds of meters, typically used by an end user to access their own network. Wi-Fi, which stands for *wireless fidelity* is a wireless networking technology used across the globe. Wi-Fi refers to any system that uses the 802.11 standard, which was developed by the Institute of Electrical and Electronics Engineers (IEEE) and released in 1997. In a Wi-Fi network, computers with wi-fi network cards connect wirelessly to a wireless router. The router is connected to the Internet by means of a modem, typically a cable or DSL modem. Any user within 200 feet or so (about 61 meters) of the access point can then connect to the Internet, though for good transfer rates, distances of 100 feet (30.5 meters) or less are more common. Wi-fi is technology designed to cater to the lightweight computing systems of the future, which are mobile and designed to consume minimal power. PDAs, laptops, and various accessories are designed to be wi-fi-compatible. There are even phones under development that would switch seamlessly from cellular networks to wi-fi networks without dropping a call

Wi-Fi is low cost and is generally used to provide Internet access within a single room or building. For example, many coffee shops, hotels, railway stations and bus stations contain Wi-Fi access points providing access to the Internet for customers. Wireless routers which incorporate a DSL-modem or a cable-modem and a Wi-Fi access point, often set up in homes to provide Internet-access and inter-networking to all devices connected (wirelessly or by cable) to them. One can also connect Wi-Fi devices in ad-hoc mode for client-to-client connections without a router. Wi-Fi allows LANs to be deployed without cabling for client devices, typically reducing the costs of network deployment and expansion. Wireless network adapters are also built into most modern laptops. (Source: Sree Pillai, TECK. IN) . WiMAX is similar to Wi-Fi but it operates at greater speeds, over a greater distance and for a greater number of users. WiMAX has the potential to bring internet connectivity to rural remote areas. WiMAX will bring web world within reach of rural community.

The main problems with broadband access are that it is pretty expensive and it doesn't reach all areas. The main problem with Wi-Fi access is that hot spots are very small, so coverage is sparse. WiMAX has the potential to do to broadband Internet access what cell phones have done to phone access. In the same way that many people have given up their "land lines" in favor of cell phones, WiMAX could replace cable and DSL services, providing universal Internet access just about anywhere you go. WiMAX will also be as painless as Wi-Fi—turning your computer on will automatically connect you to the closest available WiMAX antenna. The Fig. 10 shows a model of How WiMAX works?



**Fig. 17.10 Model of How WiMAX works**

A WiMAX system has two components,

- A WiMAX tower, like cell phone tower, providing coverage to 8000 sq kilometers.
- A WiMAX receiver. The receiver and antenna could be a small box or PCMCIA card to be fixed to laptop or desktop.

A WiMAX tower station connects directly to the internet using a high broadband width connection, a T3 line. It can also connect to another WiMAX tower using a line – of – sight microwave link. This connection to a second tower is also called as ‘backhaul’.

Mobile Phone Network Backhaul – WiMAX can provide point-to-point links of up to 30 miles. Therefore mobile phone operators could use WiMAX as a backhaul instead of a wired alternative at a far greater expense.

Wireless Service Provider Backhaul – Even if WiMAX is not used as a “last mile”

Solution but it could be used as a backhaul for wireless service providers. Again deployment of a wired solution would be far more costly and take more time to install.

### **Applications and Benefits of WiMAX**

The speed and reach are the biggest advantage WiMAX offers to the users.

The potential capability can be used to build networks covering remote areas for communication, information sharing, spreading knowledge and for e-learning.

Deployment times would be significantly lower than with wired solutions as minimal construction is required.

Following networks are the few which can be tried out very easily.

- **Education Networks:** Taking knowledge to remote place is a difficult task. Providing teachers in remote villages is impossible. Therefore, group of schools could use WiMAX to connect schools within a district and near by rural area. Classroom instruction could be delivered in real time between two or more schools using video link via a private WiMAX network.
- **Public Safety:** In a crisis like terrorist attack, fire, earthquake communication is weakest link hampering rescue operations. WiMAX networks could be used to aid response in emergency situations. As well as two-way voice communication, video communication could also be relayed between the accident/disaster site to a dispatch centre allowing emergency teams to assess situations in real time. Also mobile WiMAX could allow emergency teams to access databases of information from moving vehicles.
- **Offshore Communications:** WiMAX could provide a communications link between land based facilities and offshore sites to support remote operations. WiMAX networks are quickly and easily deployed, even when offshore sites are moved to a different location. Oil drilling sites in far away locations from the shore can use WiMAX for communications.
- **Campus Connectivity:** University, large public sector undertakings, research laboratories, government office complex are distributed in different buildings over a large area, called as campus. Multiple locations within campuses could be connected via WiMAX.

- **Temporary Construction Communications:** As construction sites are temporary wired solutions are impractical. WiMAX equipment is highly portable so therefore can be redeployed and reused at other construction sites.

### Strengths of WiMAX

The strengths of WiMAX are many in number. Some of them could include:

- **Cost Efficiency:** The very fact that WiMAX is a wireless technology means that the expensive procedure of laying cables can be avoided. This removes the cost of labour, materials, land, etc and can be replaced with the cost of only installing a WiMAX tower. This could help, bring internet connectivity to rural areas, without the cost of wires WiMAX could easily be deployed in less densely populated areas.
- **Mobility of Data:** WiMAX makes data mobile ready to move many users anywhere. If WiMAX connection is available and a user has appropriate WiMAX ready devices, internet connectivity will be readily available. This offers a potential of real time media streaming. There is also the potential for using VoIP.

WiMAX towers can be quickly and easily redeployed and reused in a completely different location, enabling WiMAX networks to be setup in many different locations after it is no longer required in a previous location.

### KEY TERMS

Network Topology

LAN/WAN/VPN/V-SAT

Network Operating System (NOS)

Data Switching Technology

TCP/IP or OSI for Connectivity

Enterprise Network

### REVIEW QUESTIONS

1. What are the features of networks and what benefits does it offer to the user?
2. Can a larger integrated network of different topologies be made?
3. Take a product literature of any network system design company and list the variety of items used in network installation. What is the role of each item in the network?
4. In network environment, reliability of network is rated higher than the network performance. Explain.
5. What are the different applications of networks in information management?
6. What is network management? How it is done?
7. How is seamless integration achieved when network has different hardware-software platforms operating together?
8. In network communication, consistency of data and concurrency of data are critical to information management and its quality. Explain.
9. Write small note on: following after reading from library.

- V-SAT
  - EDI
  - VPN
10. Which new issues and problems have arisen as the world is put on information superhighway through networks?
  11. Identify different technologies used in Enterprise wide WAN network.
  12. Explain how TCP/IP helps to solve connectivity of different disparate computer systems.
  13. Explain the use of Teleconferencing, Video conferencing and Data Conferencing with application.

## LEARNING OBJECTIVES

- Database and its Use in IS Management
- Database Management Systems
- Hierarchical Network and Relation Database Models
- Relational Data Model and Design
- Normalisation of Database
- Security in Database Environment
- Client Server Architecture (C/S)
- C/s Strategies for IS Management
- Service Oriented Architecture (SOA)

### 18.1 DATABASE CONCEPTS

A database is an integrated collection of well defined data and information, centrally controlled in all its aspects, created and stored in a typical structure for an organisation. In an organisation the database could be, one or more, depending upon the needs and the operations of the organisation. The data structure and its storage should be such that it facilitates shareability, availability, evolvability and integrity of the data. The database separates a design of the information system from the data design, and its management.

#### Why Database

Conventionally, in an information system, the information is obtained by developing the systems and integrating them. This calls for breaking the system into various subsystems and developing the information systems independently. In this approach, each system will have its master files and transaction files. They have to be processed separately at different times, depending upon the needs and schedules. The file layouts and the access methods could be different in different systems. Therefore, the files be updated at different times. This approach does affect the quality of the information across all the systems due to various reasons.

The data in many systems are common, and there is repetition of data storage in various systems. This is called data redundancy. The redundancy of data gives rise to problems of keeping the data current and same in all the files. The data management is complex in such a

situation. The reports generated out of such files show discrepancies in the information. Since the data files are different for different systems, data sharing is not possible. These files need to be created at different times. Transaction updating is also carried out at different times. It requires the increase of a magnetic media for storage because the systems are developed independently. The redundancy causes lack of integrity and inconsistency of the data in the various files.

To illustrate these points, let us consider three systems in the materials management function. They are the purchase systems, the stock accounting system, and the quality accounting system, which use both master files and transaction files. Table 18.1 shows the data entities in each of the above mentioned systems:

**Table 18.1** Data Entities

<i>Purchase system</i>	<i>Stock accounting</i>	<i>Quality accounting system</i>
Item code	Item code	Item code
Item name	Item names	Item name
PO No.		PO No.
Supplier code		Supplier code
Supplier name		Supplier name
Delivery Schedule		
Qty. received	Qty. received	Qty. received
Qty. rejected	Qty. rejected	Qty. rejected
Qty. accepted	Qty. accepted	Qty. accepted
Goods received Note No.	Goods received Note No.	Goods received Note No.
Goods returned Qty.	Goods returned Qty.	

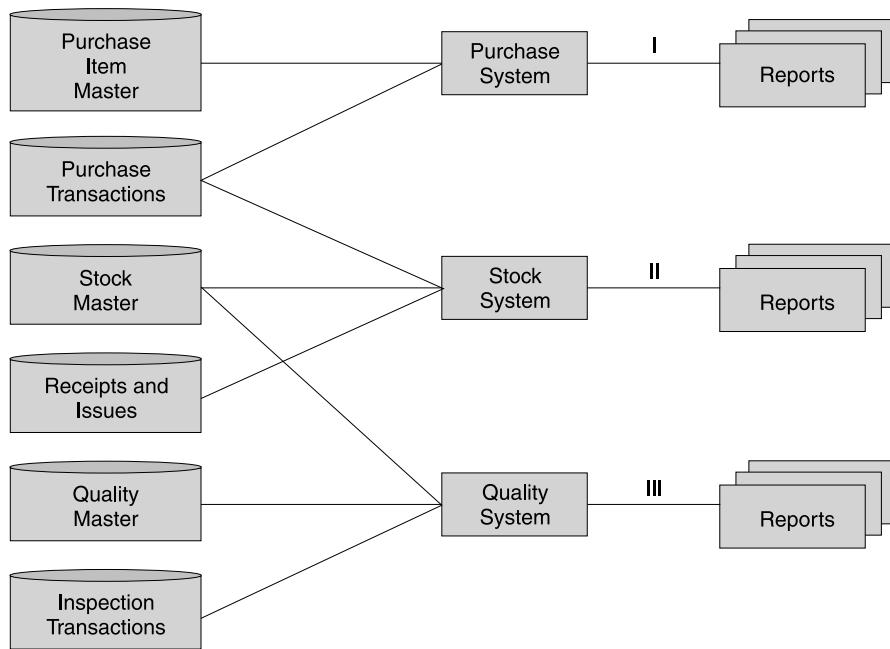
These systems are processed separately and, therefore, they may give information not matching with each other. The reason is that updating of the data in each of these files may not have taken place and, therefore, the results are inconsistent.

You will observe that, a number of entities are common in three files and are required to be processed separately. These files should be handled concurrently and correctly so that they bring out complete and consistent reports. In the conventional approach, the management of data and bringing out the correct reports is always problematic. The three systems are as given in Fig. 18.1.

In a typical file processing systems, as described in Fig. 18.1, there are disadvantages. The main disadvantages are as under:

#### ***The Data Redundancy and Inconsistency***

Since the files are created for each application differently, the files are likely to have different formats and data designs as they are created by different designers and programmers over a period of time. Hence, the same data record may be present in more than one file, the creation, updation, and deletion of which is managed by different programmes. Over a period of time, a situation arises when the data is redundant and inconsistent, due to the changes not being incorporated simultaneously, in all the applications and in all the files.



**Fig. 18.1 Purchase, Stock and Quality System**

### **Difficulty in Access to the Data**

In conventional system design, the file structure is consistent to the specific information needs. If the information needs change, gaining access to the data present in different files to satisfy the revised need, requires writing the necessary application programmes every time. This is difficult and very time consuming at critical times.

### **Concurrent Access Anomalies**

In a dedicated file system application, the concurrent access is provided to improve the response of processing. However, the file systems are incapable of supervising and coordinating the changes arising out of the concurrent access to the record. It is quite likely that the record may be accessed within seconds and information may not be current. This creates information anomalies in a short space of time.

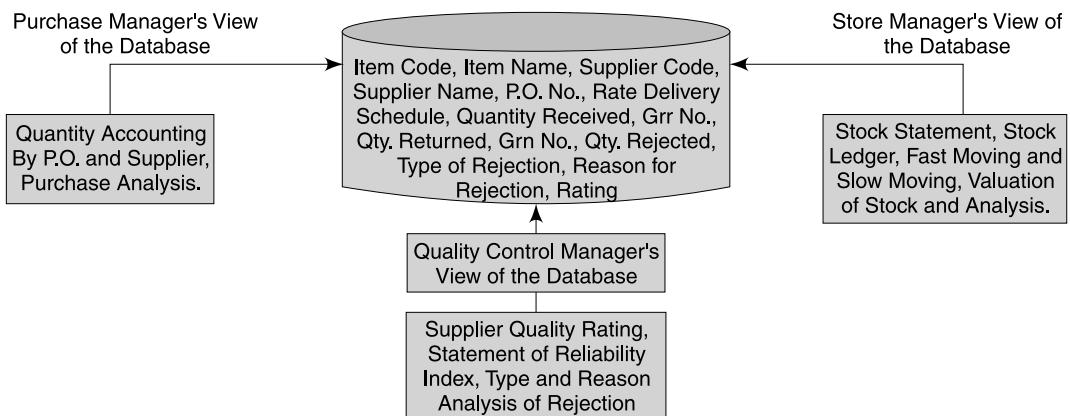
### **Security Problems**

The file systems have a limitation of controlling the access to the record causing insecurity with respect to the information. Since the application programmes are written time and again, it is difficult to enforce a discipline on the security constraints across all the applications.

### **Integrity of the Data**

In a file system it is difficult to maintain an integrity of the data across the applications. The integrity rules are added when the programmes are written. If any changes in the rules occur, it is very difficult to ensure that it is effected across the files in all the applications.

To eliminate the above problems, database approach is suggested. The database is designed independent of its use for the application. In other words, the user of the database should view the data in the database as on which he can develop his systems separately. Since, the database matching his needs is common, the problems of redundancy and inconsistency are eliminated. The above illustration is reacted under a database file. This database is used by the purchase manager, the stores manager and the quality managers. These managers can have different uses for data in their respective functions. Hence, each one can take a different view of the database which may be partial or full. The database for materials management function is given in Fig. 18.2.



**Fig. 18.2** Database for Materials Management and Different Views

The advantages in the database approach are as follows:

1. All the three managers are using the same database, hence, any report using the information will not be inconsistent.
2. All the three managers can view the database as per their needs.
3. The application systems can be developed independent of the database.
4. The data validation and updating will be once and same for all.
5. The data is shared by all the users.
6. The data security and privacy can be managed and ensured because the data entry in the database occurs once only and is protected by the security measures.
7. Since the database is a storage of the structured information, the queries can be answered fast by using the logic of the data structures.

### Database Management System (DBMS)

The DBMS is a software designed to manage and maintain the database of an organisation. The main steps are data structuring, defining, interrogating, updating and creating. Through these steps, it manipulates the data and provides an environment which is appropriate to use in retrieving and storing the database information.

The DBMS is a collection of the interrelated files and a set of programmes through which the users can access and modify these files. In DBMS file contains tables.

### **Data Store**

The data are stored in a database in a particular manner. The user of the database need not know how the data are actually stored. For example, if the quality control manager wants the vendor quality rating and the reliability indeed of the selected vendors, then he can get this report without bothering where and how it is stored in the database. The DBMS will locate them, assemble them and show them in a report format for the user.

### **Data Definition and Data Directory**

Since the data independence is provided to the user, it requires that all the users understand the data in the same manner. Therefore, each data entity is defined in the system and its directory is formed for all the users.

### **Interrogation**

In interrogation, the data are selected from the database and extracted or copied for processing. For interrogation, it is necessary to identify the data or a part of the data and then through the use of query language the information is processed and printed.

### **Updating**

The database needs updating as the values of the data keep changing from time to time. For updating the database the following information is necessary.

1. Description of data
2. Present value of data
3. Changed value of data
4. Processing rule for update

This procedure enables to add, change or delete the data from the database. The updates are made by processing the transaction data against the data in the database.

### **Creation**

Initially, the database is to be created in the manner and the kind as defined in the DBMS. The data is entered in the database by the transaction processing. A special programmes is written to create the database. The DBMS organises the data internally in the structure defined in the DBMS.

### **Schema and Subschema**

There are three different view of the database. The view are seen through the schema and the subschema of the data.

#### **1. Logical View of the User of Data**

This is a view of the application programmer or user as he wants it. This could be a partial view of the database. For example, the quality control manager and the purchase manager would view the data differently for their use.

#### **2. The Views of the Database Administrator (DBA)**

This is a view of the person who is managing the database through the creation, updating, structuring and ensuring that it is up-to-date. The view of the DBA is a global view.

### **3. Physical View**

This is the view of the data actually stored and organised on the physical devices.

The logical view of the data is defined through the schema and the subschema. The schema is a description of the database. For preparation of the schema we need the data entity and its attributes (e.g., an employee is a data entity, his name, address, category are the attributes). The attributes describe the data entity. The schema is a description of the logical view of the entire database. This description is a list of the names of data entities, their attributes and the relationship between the entities. The schema does not give values of the data entity. The database and its logical view is a framework of the data entities, their attributes and their relationship. When values are given to the data entities and their attributes, then these are called as the instances of the schema.

The subschema represents a logical view of the data items and records held by the specific user. Since the subschema relates to the specific user, some items of the schema will be in the subschema. The subschema, therefore, is a subset of the schema.

In our material database we can illustrate the schema and the subschema as: The Item, Suppliers, the P.Os and the quality are the data entities. These entities are described by some attributes. For example, the item is a data entity and is described by the code, name, weight, length and supplier. The schema and subschema are given in Fig. 18.3.

Based on the subschema, the purchase manager develops the systems for his requirements, the quality control manager can develop systems for his requirements and the Materials Manager can develop systems based on the schema for his requirements. Please note that each viewer, i.e., the materials manager, the purchase manager and the quality control manager need not worry about how the data is stored, how the data is accessed and so on.

Once the schema and the subschema are defined, it is necessary to describe them. The language used to describe them is called Data Description Language (DDL). Once the database is described, the application programmer can take different views of the database and write different programmes to get the information. This is done by the Data Manipulation Language (DML). The DML provides the commands which help to retrieve, modify, store and delete the data in the database.

## **18.2 DATABASE MODELS**

There are three types of database models which are common in the industry. They are—the Hierarchical Data Model, the Network Data Model and the Relational Data Model. These models have their own particular nature, and, therefore, they are application in the industry where a similar situation exists. There is a fourth model known as the Object Data Based Model (ODBM) in which data is structured as objects at a much higher level as compared to the other models providing a flexibility in designing the applications.

### **Hierarchical Database Model (HDBM)**

The HDBM is applicable when the data in an organisation can be put down in the hierarchical or in terms of the levels, one after another. The data model is equivalent to a tree. A tree has roots, branches and leaves; their equivalents in the HDBM being records, nodes and fields. A typical hierarchical structure can be seen in a product manufactured out of the parts and the components, as shown in Fig. 18.4.

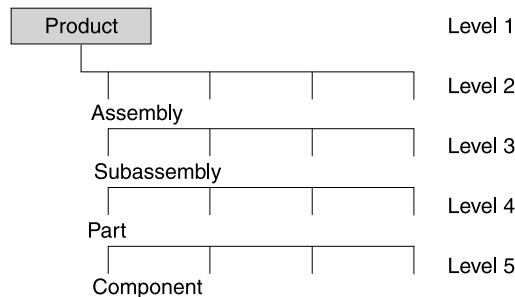
Schema of Material Database					
Item					
Item Code	Item Name	Item Weight	Item Length	Supplier Code	
Supplier					
Supplier Code		Supplier Name		Supplier Address	
Purchase Order					
P.O. Number	Item Code	Supplier Code	Del Schedule	Qty.	P.O. Value
Quality					
Item Code	Qty. Received	Qty. Rejected	Rej. Type	Rej. Reason	

Subschema of Purchase Manager					
Item					
Item Code	Supplier Code	Qty. Received	Qty. Rejected		
P.O.					
P.O. No.	P.O. Value				

Subschema of Quality Control Manager					
Item					
Item Code	Supplier Code	Qty. Received	Qty. Rejected		
Quality					
Item Code	Supplier Code	Qty. Rejected	Type Rej.	Reason Rej	

**Fig. 18.3** Schema and Subschema of Material Database**Fig. 18.4** Hierarchical Structure of a Product (HDBM)

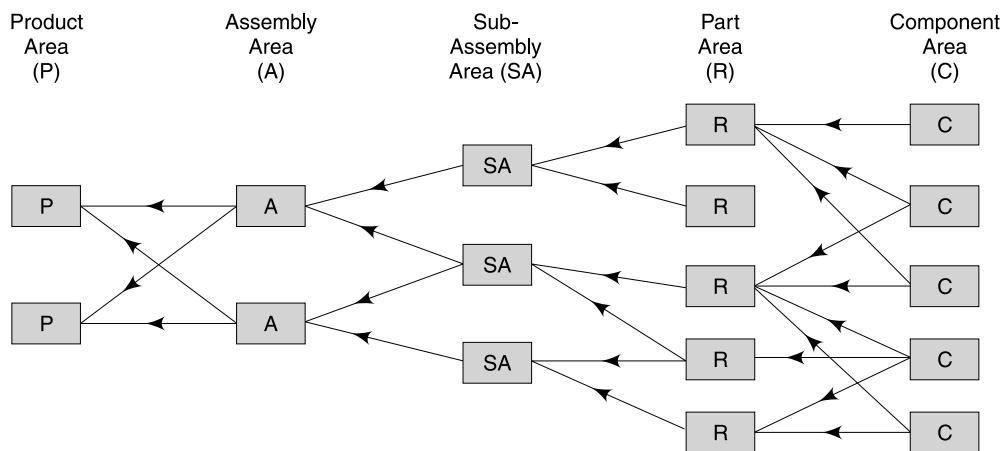
In the HDBM the data is stored in the hierarchical form recognising the fact that each of the levels is bounded by the Parent-Child relations to the earlier level. The typical characteristics of the HDBM are:

1. HDBM starts with a root and has several roots.
2. A root will have several branches.
3. Each branch is connected to one and only one root.
4. A branch has several leaves and a set of leaves are connected to one branch.

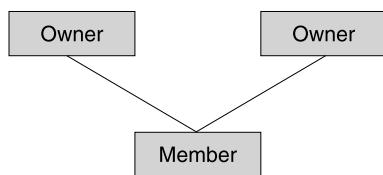
A hierarchical tree structure is made of the branches (nodes) and the leaves (fields).

### **Network Database Model (NDBM)**

The NDBM interconnects the entities of an organisation into a network. The data model is shown by an arrangement of the blocks. The block represents an entity or a record. The collection of the blocks is called as the Area of database. The NDBM uses the blocks, the area and the arrows to represent the database of the organisation. The method, popularly known as the Bachman's diagram, was suggested by Mr CW Bachman. Figure 18.5(a) shows NDBM model. The model is expressed in 'Y' structure in Fig. 18.5(b).



**Fig. 18.5(a) Product Database in NDBM**

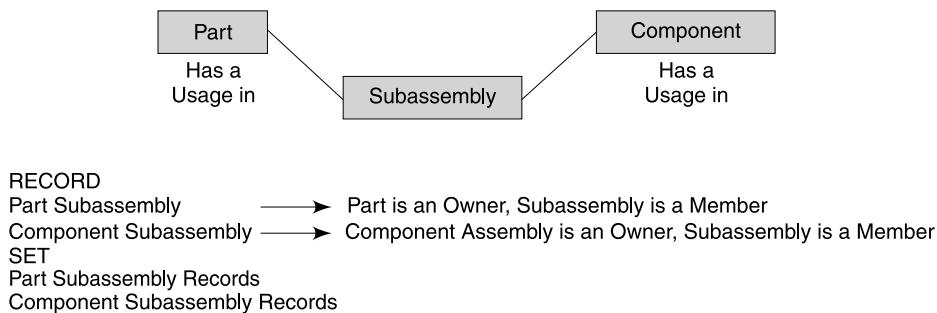


**Fig. 18.5(b) 'Y' Structure in the NDBM**

The NDBM deals with the sets and the records. A component, a part a subassembly and an assembly are the records. A record located at the tail of the arrow is known as a member

record, and a record at the head of the arrow is known as an owner. An arrow connecting the owner to a member is a set. For example, the component in the part is a set.

The set may have more than one member occurrence, i.e., a component may be used in more than one part. The same is true for the part subassembly set and subassembly-assembly set, and so on. Every owner is a member besides being the owner and also is a member of the set. If all the relationships are to be shown, then the model is equivalent to a Network. Hence, the Data Model is known as the NDBM. Figure 18.6 explains the record and set in network with definition of owner and member.



**Fig. 18.6** NDBM Model of Two Sets

### Relational Database Model (RDBM)

In the RDBM, the concept of two dimensional table is used to show the relation. In our example of the product database, the table showing the component name and the component number is a representation of the data in a table form (Table 18.2). RDBM model users theories of relational algebra in representing the data in various tables.

**Table 18.2** Product Database

Component number	Component name
100	Washer
102	Nut
109	Bolt
111	Screw

The relationship between a component and a part is shown in Table 18.3.

All the relationship are shown in a table form. For example, the washer number 100 is used in the part numbers 10 and 11, and this relation is shown in two rows in the table. In the RDBM, the relation is shown in table, attribute is shown in the column and record in the row of the table. The values of attributes are taken from a domain. The set of attributes is record and the record is identified by a unique key known as the primary key.

**Table 18.3** Part-Component Table

Component number	Part number	Usage of component in the part	Component name
100	10	3	Washer
102	11	2	Nut
109	12	1	Bolt
111	14	4	Screw
100	10	3	Washer
109	10	4	Bolt
111	12	6	Screw

So, there are three types of database models the HDBM, the NDBM, and the RDBM. A database situation can be represented in any of these three models. But for the working and the ease of operations, the advantages and the disadvantages differ in each of them. Secondly, certain database situations can be handled more effectively in one than in the other. Thirdly, the manner in which the database is to be used also recommends the choice of the database model. It is interesting to see the difference between the three database models regarding some basic operations, which shown in Table 18.4.

**Table 18.4** Basic Differences in DBMS Models

Particulars	NDBM	HDBM	RDBM
Record relations	Pointers	Pointers	Values in tables
Data storage	Sets and Record in Y structure	Tree structures parent child relation	Table structure
Insertion of entity	Easily possible with Y structure	Not possible	Possible
Deletion	One type set deleted but other record information gets deleted causing deletion of another set type	Along with root,nodes are also deleted	Possible
Simplicity from users point of view	Not so simple	Have to know tree structure of database	Very simple
Requests for information	Complex and procedural	Have to be procedural in line with the tree structure	No possible dependency between relations. Hence can be nonprocedural.
Degree of data independence	Low	Low	High

### Difference Between Three Models

The main difference between three models of the database lies in representation of the entity relationships and its structure, and the user has to understand the structure, while designing the application based on the database models. The network model provides the relationship in the form of network giving easy navigating path to the user of the database. The HDBM

shows Parent-Child relation. The NDBM shows the Owner-Member relation and the dependencies of any two entities.

Of the three, the Relational Model has found wider acceptance for the following reasons:

**(a) Simplicity**

The entity relationships are identified in simple tabular form, understandable to the users of the data. It is not related to any structure of entities like the hierarchy or the network.

**(b) Non-procedural Requests**

Since there is no structure dependence, the information can be obtained from any point in the database. No procedural language is to be used.

**(c) Data Independence**

Since the model is based on the relations and not on the structures, there is a high degree of data independence. This, however, calls for ensuring that the relationships must be complete and accurate.

**(d) Theoretical Foundation**

The relational data model is based on the set theory of relations and is designed on the principle of normalization. For the other models, such mathematical foundation does not exist. The disadvantages of the relational mode are that it demands a large amount of storage, access and speed capabilities to handle the model.

In the hierarchical model, the insertion or the deletion of a record becomes unduly complex higher level record is deleted, it automatically deletes the lower level record in the hierarchy. The navigation in the data base is through the levels calling for a procedure in line with the hierarchy.

The network model has a major disadvantage in the complexity of the network approach of the data build up. The organisation and recorganisation of the database may lead to the loss of data independence, unless great care is taken in data management.

The relational database model scores over the other two, mainly on account of the simplicity of design and the ease of understanding for the designer as well as the users. It assures data independence and allows the use of the non-procedural methods.

The Oracle, the Progress, the Informix, the Sybase, and the Ingress are the packages of the RDBMS supplied by the various vendors. These packages run on different operating systems and have certain advantages and disadvantages in terms of the performance in a given condition or environment. But they have been developed on the relational concepts of the entities.

### 18.3 DATA MODELS

A Database Management System (DBMS) uses the data model as its underlying structure. The data model represents the relationships between the entities. The main difference between the three database models mentioned earlier in the representation of the relationships between the entities in the DBMS.

## **Relationships within a Data Model**

To understand the relationship concepts clearly let us understand the terms used in explaining the same. They are: the Entity, Attributes, Values, Key Attributes and Records.

### ***Entity***

The entity is the person, place, thing, event or concept about which the information is recorded. The customer, the bank account, the part and the employee are all entities.

### ***Attributes (or Data Elements)***

The attributes characterise the entity or describe the entity meaningfully. If a 'house' is an entity, then its attributes are the size, colour, age, number and the owner, etc.

### ***Data Value***

Each attribute of an entity has a value and is called as a data value. The data value could be quantitative or descriptive, depending upon the attributes. For example, the size of the house will be the area and hence quantitative, the location could be descriptive and the construction quality could be qualitative. The attributes can have a single value or multiple values.

### ***Key Attributes***

Some attributes can be key attributes of an entity. Using this key attribute, we can find the values of the other attributes. For example, the Customer Number is an attribute of an entity 'Customer'. From this key attribute, we can find the name of the customer, his address and account balance.

### ***Record***

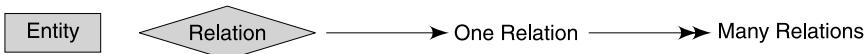
The record is a collection of the attributes of an entity. The set of the attribute values is called as a record.

### ***Relation Types***

There are three types of relations between the entities. They can be shown in Entity-Relation diagram, known as E-R diagram.

1 "ONE-TO-ONE"      2 "ONE-TO-MANY"      3 "MANY-TO-MANY"

The symbols used in E-R diagram are as given here.

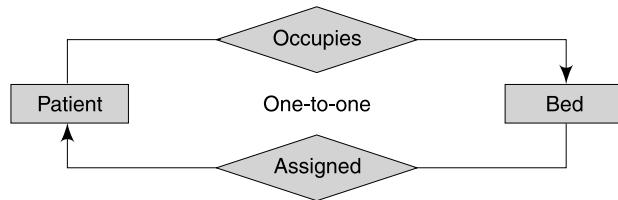
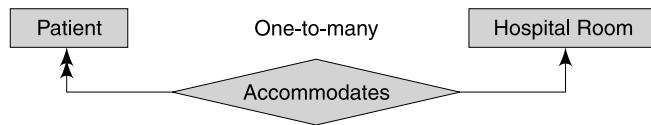
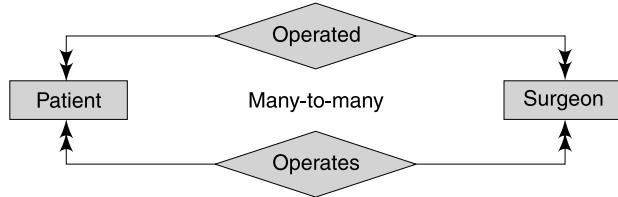


Let us take the hospital environment to understand the relation types. The patient, bed, hospital room and surgeon are the entities in the environment. Their relation is shown in the Fig. 18.7 (a, b, c):

At a given point of time, a patient occupies a bed or a bed is assigned to a patient. Since the patient cannot occupy more than one bed, the relationship is one-to-one.

At a given point of time, one or more patients are assigned to one hospital room, hence, the relationship between the hospital room and the patients is one-to-many.

A surgeon operates on many patients or a patient may have been operated by many surgeons. Hence, the relationship both ways is many-to-many.

**Fig. 18.7(a)** One-to-one Relation**Fig. 18.7 (b)** One-to-Many Relation**Fig. 18.7 (c)** Many-to-Many Relation

The relationships are built on the assumption that the patient, hospital room, surgeon and bed have unique keys as the identifiers.

## 18.4 DATABASE DESIGN

To develop a database that satisfies the information needs of today as well as of tomorrow, it is necessary to understand the database conceptually. The first task of the designer is to develop the *Conceptual Model*. The conceptual model is independent of the user applications, the hardware and the DBMS.

The steps in the development of the conceptual model are:

1. Data analysis
2. Relational identity
3. Graphical representation
4. Design process

### Data Analysis

The database administrator should initiate a plan to collect the data needs of each person in the organisation. It is necessary to investigate further as to how the data is processed by these persons in executing their functional responsibilities.

Collect all the names of the data entities and determine its description and spell out in brief the use of it in the operations and the management of the organisation. As mentioned earlier, the entity is to be described by its attributes. An attributes should be described with the details, viz.:

- (a) Name and description
- (b) Source
- (c) Characteristics of attribute—Numeric, Alpha, its unit of measure, its value range.
- (d) Use of the attribute in the various applications.
- (e) Security, Access, Read, Update protocols.
- (f) Importance: Importance in the database.
- (g) Attribute relationships

To illustrate, these details let us take “Employee” as an entity.

• Entity	:	Employee
• Attributes	:	
Name	:	Mr. Sane S.Y.
Key	:	Employee Code
Source	:	Appointment Letter
Characteristic	:	Alphabetic. Maximum 60 alphabets
Use	:	Payslip, employee registers, etc.
Security	:	Access to all, but updates by the Personnel Department only.
Importance	:	The reference value hence cannot change.
Attribute relationships	:	Associated with the employee number, department and address.

The meaningful assembly of the entities with its attributes is called the data dictionary. The importance of the entity can be decided based on its application in future for the information processing and decision making.

To ensure a complete coverage of the entities in the organisation, the method used is, the *Functional Data Mapping*. It helps in identifying systematically, the functions, sources, its use and the various end-users of the entity. Let us take an example to illustrate (Table 18.5) the concept of data mapping.

**Table 18.5** Functional Data Map of an Entity

Function	Entity	User department	End use
Sales	Order	Accounts	Billing/Accounting
		Dispatch	Order execution and order accounting
		Marketing	Order booking, product sales accounting and analysis
		Finished goods store	Stock status and replenishment decision making
		Business planning	Forecasting

Another benefit of data mapping is that it provides a tool for discussion with the functional heads and the users at all the levels, regarding its use in the data processing, decision making and cross referencing.

### **Relational Identity**

The conceptual model is used to develop a logical model which can be implemented with the relational, hierarchical or network model of the Database Management System.

The major concept used from the relational theory is *Normalisation*. The noramalisation process groups the entities and attributes in the form of two-way tables.

The first step in the normalisation process consists of transforming the entities into two dimensional table. There are five forms of normalisation. The fourth and the fifth forms are difficult to achieve and handle. Let us take an example of the hospital environment for understanding of the noramlisation process. The data in an unnormalised form is shown in Table 18.6.

**Table 18.6** Unnormalised Data Form

Patient no.	Surgeon reg.no.	Date of surgery	Surgeon's name	Patient's name	Town	Name of surgery	Drug	Side effect
10	9/11	1 1 90	Ray	Deo	Pune	Gall stones removal	X	Rash
	9/16	1 5 90	Rane	Deo	Pune	Brain	Y	Fever
11	9/13	1 2 90	Paul	Singh	Mumbai	Cancer	P	Swelling
22	9/24	10 3 89	Patil	Bose	Indore	Cataract	Q	Swelling
	9/33	10 6 89	Puri	Boaw	Indore	Leg	R	Fever
33	9/36	22 3 87	Singh	Sane	Mumbai	Open heart	X	Rash
64	9/49	20 4 89	Kher	Pal	Kolkata	Bypass	Y	Fever
95	9/62	25 6 88	Kane	Bal	Jaipur	Tumour	Z	Rash
100	9/09	26 6 88	Kaul	Mane	Kolhapur	Cataract	S	Fever

This form of the data is called as the *Unnormalised* because at the crossing of the row and the column, more than one value of an attribute is present. For example, for one patient identified by a unique primary key the 'Patient Number', there are two values of the surgeon registration number, and two types of surgery. Hence, for a given patient, we cannot determine the value of the non-key attribute uniquely. When the data is such from it is called as an un-normalised. The normalization process in stages brings data uniquely into the *Normal Form*.

### **First Normal Form**

A relation in the first normal from is a table. At every intersection of the row and the column there can be only one value. No groups of values are permitted at the intersection. In the unnormalsied table above, for a given value of the primary key, the values of the non-key

attributes cannot be determined uniquely. To eliminate this difficulty the table is recasted as shown in Table 18.7.

**Table 18.7** First Normal Form

Patient no.	Surgeon reg.no.	Date of surgery	Surgeon's name	Patient's name	Town	Name of surgery	Drug	Side effect
10	9/11	11 90	Ray	Deo	Pune	Gall stones removal	X	Rash
10	9/16	15 90	Rane	Deo	Pune	Brain	Y	Fever
11	9/13	12 90	Paul	Singh	Mumbai	Cancer	P	Swelling
22	9/24	10 3 89	Patil	Bose	Indore	Cataract	Q	Swelling
22	9/33	10 6 89	Puri	Boaw	Indore	Leg	R	Fever
33	9/36	22 3 87	Singh	Sane	Mumbai	Open heart	X	Rash
64	9/49	20 4 89	Kher	Pal	Kolkata	Bypass	Y	Fever
95	9/62	25 6 88	Kane	Bal	Jaipur	Tumour	Z	Rash
100	9/09	26 6 88	Kaul	Mane	Kolhapur	Cataract	S	Fever

With the patient number, the surgeon reg. number, and the date of the surgery as a primary key, we can uniquely identify the surgery, the drug administered and the side effects. The underlying assumptions (for the sake of simplicity) are—the patient is treated with done drug, a drug has one side effect and is dependent on the drug administered. Through we have resolved the problem of the non-uniqueness by bringing the data in the first normal form, certain anomalies have crept in. They are as under.

### *(i) Insertion Anomaly*

This anomaly arises on account of a primary key (the patient number, the surgeon reg. number, the date of surgery) which is required to access the record. For example, if we want to introduce a new patient in the database, and he has not been operated earlier in the hospital, then the surgeon's reg. number is not available. In the absence of this portion of the key, it is not possible to introduce the new patient in the table or data base. Same is true for the new surgeon introduction. To handle this anomaly, we go to second steps of the normalisaiton process, leading to the second normal form. In the second normal form to handle the insertion anomaly, we split the data about the patient and the surgeon into two separate tables, the Patient Table 18.7A and the Surgeon Table 18.7B.

In these two tables with the primary key patient's number and surgeon's reg. number, we can insert a new patient and a new surgeon in the hospital database. The patient's name and the town appear in the relation Table 18.7A, and the surgeon's name appears in the relations Table 18.7B.

### *(ii) Update Anomaly*

By splitting the data into two tables, we have eliminated the update anomaly. For example, in Table 18.7, the patient 'Deo' appears at two places. If the patient 'Deo' changes the town,

**Table 18.7A** A Patient Table

Patient no.	Name	Town
10	Deo	Pune
11	Singh	Mumbai
22	Bose	Indore
33	Sane	Mumbai
64	Pal	Kolkata
95	Bal	Jaipur
100	Mane	Kolhapur
Patient no. is primary key		

**Table 18.7B** Surgeon Table

Regd.no.	Name
9/11	Roy
9/16	Rane
9/13	Paul
9/24	Patil
9/33	Puri
9/36	Singh
9/49	Kher
9/62	Kane
9/09	Kaul
Regd.no. is a primary key	

we have to update the town of the patient 'Deo' for the number of times it has occurred in the table. By making a separate table we can change the town once only.

### (iii) Deletion Anomaly

We can delete the patient record only once, and not for a number of times it occurs.

Hence, the first normal form data is split into three tables, i.e., the Patient Table 18.7A the Surgeon Table 18.7B and the Patient-Surgeon Table 18.7C

**Table 18.7C** First Normal Form

Patient no.	Surgeon reg.no.	Date of surgy	Surgery	Drug	Side effect
10	9/11	1 1 90	Gall stones removal	X	Rash
10	9/16	1 5 90	Brain	Y	Fever
11	9/13	1 2 90	Cancer	Q	Swelling
22	9/24	10 3 89	Cataract	Q	Swelling
22	9/33	10 6 89	Leg surgery	R	Fever
33	9/36	22 3 87	Open heart	X	Rash
64	9/49	20 4 89	Bypass	Y	Fever
95	9/62	25 6 88	Tumour	Z	Rash
100	9/09	26 6 88	Cataract	S	Fever

Three tables together resolve the anomalies.

With this table in a second normal form the non-key attributes, the surgery, the drugs, and the side effects can be identified uniquely with the primary key as the "Patient No. + Surgeon Reg. No. + Date of Surgery". The first normal form table, therefore, is split into three Tables 18.7A, 18.7B, and 18.7C resolving the problems arising out of the various anomalies and providing unique identity to the non-key attributes. A relations is said to be there in the second

normal form when every non-key attributes is fully and functionally dependent on the primary key for the unique identification.

Though we have resolved the problem of unique, in the second normal form some anomalies about the storage of data have crept in. For example, if the patient number 22 dies then the record on the patient number can be deleted from 18.7A and 18.7B. However, the surgeon relation with respect to number 22 in the Table 18.7C cannot be deleted, otherwise, the information on the Surgeon who operated on number 22 would be lost.

The another problem with the second normal form is that if two non-key attributes are dependent on the primary key, then we cannot insert a relation unless it is satisfied by the same primary key. For example, the side effect of a drug is dependent on the patient and, therefore, we cannot enter the drug side effect relation straightway. Similarly, in the deletion process, we might lose the information, while maintaining the single value and the uniqueness of the identity.

Further, if we want to update a non-key attribute, it calls for a total search in the relation table. For example, if the manufacturer changes the drug formulation of 'X', we have to make a total search in Table 18.7C. The second normal form has these inadequacies. Further, when the two non-key attributes (in the example the drug and the side effect) are dependent on each other, the dependency is called "Transitive" dependency. The problems of the second normal form are mainly due to the transitive dependency.

### ***Third Normal Form***

A relations said to be in the third normal form, if there is no transitive dependency between the two attributes. To break the transitive dependency, we split the table further into four Tables—18.8A, 18.8B, 18.8C, 18.8D.

As a result of this normalisaiton process, the four third normal form relations (tables) are derived. They represent the entities and their relationships and correspond well with the intuitive idea of the entities; Patient, Surgeon, Surgery and Drug. These four relations represent the conceptual model of the hospital database as shown in Fig. 18.8.

To sum up the normalisation process, it can be said that, the firs normal form achieves the uniqueness of the value. The second normal form removes the insertion, update, and deletion anomalies. The third normal form eliminates the transitive dependencies, leading to the conceptual model of the database. In the process of normalisation no information is lost but is arranged in a number of tables as required for data management and its applications.

### ***Design Process***

It is necessary to examine systematically the purpose of the input data which will find place in the database of the desired outputs. The design process considers information requirements of many different types of users (data views) and designs the inputs for the database. The conceptual relationships will decide the key data entities and its attributes. While designing the database, these elements play an important role.

Table 18.9 shows the entities and the attributes of the hospital database. The entities—the surgeon, the patient, the drug and the surgery can be viewed and used suiting to the information ED requirements. For example, the surgeon can view only the 'Patient and Drug' data.

**Table 18.8A** A Patient Table

Patient no.	Name	Town
10	Deo	Pune
11	Singh	Mumbai
22	Bose	Indore
33	Sane	Mumbai
64	Pal	Kolkata
95	Bal	Jaipur
100	Mane	Kolhapur
Patient no. is primary key		

**Table 18.8B** Surgeon Table

Regd.no.	Name
9/11	Roy
9/16	Rane
9/13	Paul
9/24	Patil
9/33	Puri
9/36	Singh
9/49	Kher
9/62	Kane
9/09	Kaul
Regd. no. is a primary key	

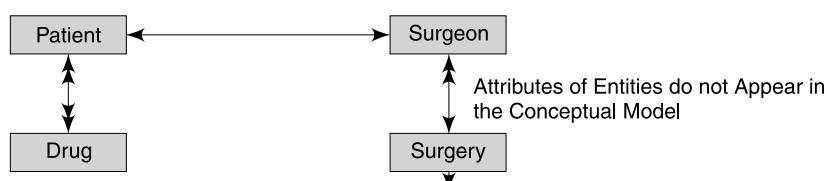
**Table 18.8C** Patient-Surgeon Table

Patient no.	Surgeon reg.no.	Date of surgy
10	9/11	1 1 90
10	9/16	1 5 90
11	9/13	1 2 90
22	9/24	10 3 89
22	9/33	10 6 89
33	9/36	22 3 87
64	9/49	20 4 89
95	9/62	25 6 88
100	9/09	26 6 88

**Table 18.8D** Patient-Surgeon Table

Surgery	Drug	Side effect
Gall stones removal	X	Rash
Brain	Y	Fever
Cancer	Q	Swelling
Cataract	Q	Swelling
Leg surgery	R	Fever
Open heart	X	Rash
Bypass	Y	Fever
Tumour	Z	Rash
Cataract	S	Fever

Primary key is patient no.+ Surgeon reg. no. + Date of surgery; Primary key is Drug

**Fig. 18.8** The Conceptual Model of the Database

The hospital administrator would like to view only the 'Surgeon, Patient and Surgery' data. The surgeon can have a single view of the 'Drug and Side Effect' for study and analysis. You will, therefore, observe that the users can access the database, extract the data from the

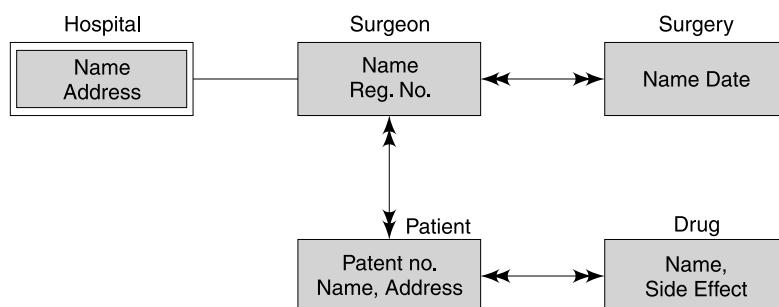
database suitable to their needs of information. While designing the database selection of the entities and the attributes is based on the information needs of the users of the database. The design process gives considerations to the assumptions regarding the entities and the attributes.

**Table 18.9** Hospital Database: Attribute Representing Entities

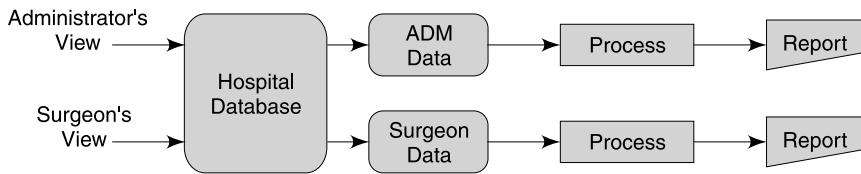
<i>Entity</i>	<i>Attributes</i>
Hospital	Hospital Name
Surgeon	Surgeon Name Surgeon's Reg. No. Surgeon's Phone
Patient	Patient Name Patient Town Date of Surgery
Drug	Drug Name Side Effect
Surgery	Name of Surgery Name Date

## 18.5 CONCEPTUAL MODEL AND PHYSICAL MODEL

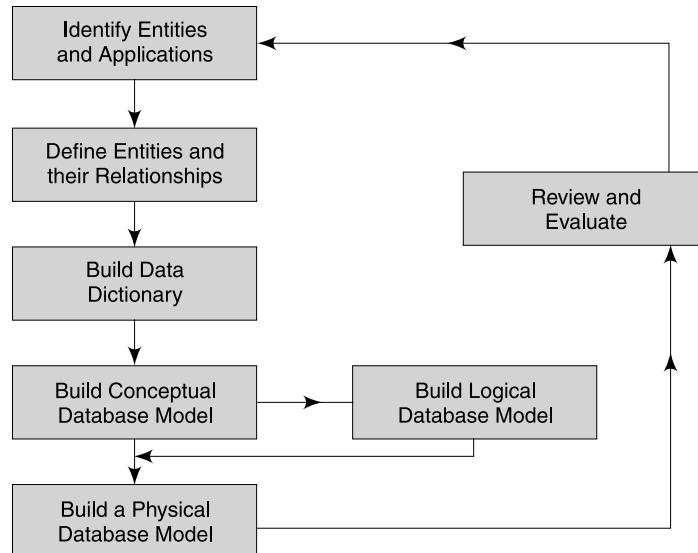
The rectangle in Fig. 18.9 indicates the relation table in the third normal form. If you want some information about the surgery conducted, the patient and the surgeon, you join the tables on the surgeon + the patient + the surgery. The application programmer or the user of the database takes an appropriate view of the database and makes a joining operation of the tables possible to get the information. The views of the hospital administrator and the views of the surgeon are shown in the Fig. 18.10 and Fig. 18.11.



**Fig. 18.9** Conceptual Model of Hospital Database



**Fig. 18.10** Database View of the User (Surgeon, Administrator)



**Fig. 18.11** Database Design Steps

### Physical Database Model

The physical model of the database is a stored framework of data on a physical device. Since a large percentage of the databases are used in an on-line environment, one has to be concerned with the visible performance. The performance of the database is a multivariate function with the physical model as a major variable.

The designer of the database always tries to optimise the physical model for the space and the time considerations. The three areas, where the database designer needs expertise for an optimum performance of the database are:

1. Knowledge of the Database Management System.
2. Understanding of the characteristics of the direct access devices and the access needs.
3. Knowledge of the 'applications'.

Figure 18.11 gives a broad flow chart of steps involved in building a physical database model.

## Implementation of the Physical Model

### *Physical Creation*

Usually, it is not a best strategy to store the data regarding the entire enterprise in one large database. It is advisable to create the separate databases on some rationale basis and provide the 'linkages' between the databases. The placement of the database on a physical device is yet another consideration for the performance of the database. These considerations are:

- (a) Storing the frequently referenced data on fast devices (disk devices).
- (b) Positioning data in a manner that lengthy searches are avoided, wherever possible.
- (c) Selection of the address and the search schemes that require few seeks.

The physical creation of the database is done through the DBMS, a vendor supplied Database Management System software.

### *Operations*

Once a database is implemented, one of the major concerns of the managements is to keep it up and make it available to the users. The major components of the database environment are the operating system—the Database Management System, the application programmes, the transactions, the hardware and the users. The database can be made available by ensuring that "that same" is not damaged. If an error occurs the following steps are to be taken:

- (a) Detecting the error that has damaged the database. Identifying the part of the database which may have been damaged, which has triggered the error, application programme or the transaction, and the situation in which the error has occurred.
- (b) Tracing all the activities in the database that took place between the occurrence of the damage and the correction of the damage.
- (c) Restoring the database with no errors.

### *Reorganisation*

In most of the database environment, it is necessary to clean up the data—base from time to time. The DBMS generally provides clean up routines to achieve the following:

- (a) Rearranging the untidy database.
- (b) Moving the records from overflow areas to free space.
- (c) Rearranging the records so that their physical sequence is the same as their logical sequence.

The process of the reorganisation and its frequency should be under the direct control of the DBMS administrator. The reorganisation of the database is required on account of the following reasons:

- (a) Heavy activity of insertions and deletions of records.
- (b) Failure to provide sufficient free space.
- (c) Incorrect selection of the organisation and access methods.
- (d) Incorrect selection of the storage media.

### *Restructuring*

It is conceivable that in a dynamic environment, after sufficient use of the database by various users, the usage pattern of the database have to be changed from what was conceived in

the initial design and further the database performance requirements also have changed. It is also possible that the database is in for expansion of account of new records, and new entities. Implementing these changes in the conceptual model and then in the physical model is called "Restructuring". The restructuring changes are of three types—(a) Procedural, (b) Physical, and (c) Logical.

The restructuring should be done with an utmost care, only after taking a complete back-up of the database.

- (a) Procedural changes : (i) Back-up and recovery.  
(ii) Access control.
- (b) Physical level changes : (i) Database placement changes  
(ii) Reconfiguration of pointers.  
(iii) Changing block sizes, prime areas, overflow areas.  
(iv) Changing the attributes.
- (c) Logical level changes : (i) Adding or deleting the attributes.  
(ii) Combining or splitting of the records.  
(iii) Changing the relationship pattern.  
(iv) Changing the role of entities or attributes in data base.

### Performance Monitoring and Tuning

The performance monitoring is possible if a detailed knowledge of the performance of the existing system is gained. For this, a number of useful statistics can be collected on the database.

In an on-line environment, the performance is seen chiefly in terms of the response time at the terminals. Significant degradation of the performance is visible after some time. Many factors determine the performance of the database. These factors relate to the software of the database and communication.

When the user of the database interacts with the DBMS, it is not just one transaction. One access to the DBMS may generate several operations to conclude the user interaction in accessing the database. All such operations consequent to the user access are to be counted as transactions.

The transaction mix will decide the performance of the DBMS in terms of the response and the usage of resources. The mix could consist of the data entry, a single point query, a multiple access query, a processed query and so on. Certain number of physical I/O operations are made per transaction of the database. These operations affect the elapsed time and the CPU time. This aspect is to be decided while designing the database, i.e., deciding the access method, the database structure, the queries and relationship model and the degree of normalisation.

The performance also depends on other tasks in which the hardware and the software is engaged. The computer system along with the DBMS operations may be engaged in batch processing and the time sharing jobs. The administrator of the system has to pay attention to this aspect and give priority to the DBMS function.

In an on-line environment the components on which response time depends are:

- (a) Tele processing line time
- (b) Queuing of inputs
- (c) Scheduling of tasks of DBMS
- (d) Application processing
- (e) Application output mode
- (f) Termination

The selection of the DBMS package considers all the above aspects. The response times is affected by the hardware configuration, the terminal network and the database design. It may be noted that the response time increases in an exponential fashion as I/O rate increases in a linear fashion.

To understand the performance of the existing system and to be able to take it to the desired level of response, the following statistics should be collected.

- (a) Utilisation of the CPU and other devices
- (b) Memory usage
- (c) Transaction statistics
  - Transaction rates and the distributions
  - Transaction response time
  - Transaction priorities and classes
  - Number of database calls per transaction
  - CPU time for transaction processing
- (d) Distribution and use of the database contents.

The analysis of the statistics would lead to action such as:

- (a) Change in the hardware configuration
- (b) Restructuring of the database
- (c) Rationalising the database
- (d) User's training
- (e) Keeping those database results ready on which the query is frequent
- (f) Frequent monitoring of database functions and changing priorities
- (g) Rescheduling of various tasks
- (h) Matching hardware, DBMS and application software to the needs of the user.

### **Security in the Database Environment**

The security of the data is crucial in the database environment. The data security means protection from:

- (a) Unauthorised disclosure
- (b) Accidental disclosure
- (c) Unauthorised alteration
- (d) Destruction

The one and only way to protect the database is by controlling the access to the database and the database record. If the access can be monitored, regulated and controlled, it is possible to protect the data to a great extent.

But considering the fact that perfect security is unattainable, the objective of the data security system should be to minimise the risk and the probability of the database exposure to unauthorized and accidental trespassers. The solution lies in providing a limited and a restricted access through the security passwords on a layered basis with the selective options such as read, write, alter, delete to the selected personnel or users in the organisations. This would help to protect data from destruction, also the back up procedures and the recovery programmes provided they are administered with a strict adherence to the schedule.

In spite of the increasingly reliable hardware and software, it is the people who may breach the security either intentionally or unintentionally. The people who may be the cause for insecurity are:

## **Users**

In a database environment, the database is used by several users, but the database records may be created by a few in the organisation. The one who originates the data has the first entry access to the database. To provide accuracy and integrity to the data, there must be only one agency/department responsible for entry and update. Further access is controlled through the following measures:

### ***Partial Retrieval of Records***

An authorised user can only see a specific part of the data and cannot change it, i.e., the user has only READ access to partial database record.

### ***Retrieval of all Records***

The authorised user can see the entire data but cannot change it. The authorised user can insert only certain types of records but cannot change the existing ones, i.e., user has WRITE access on a selective basis.

### ***Deletion of Certain Records***

The users can read certain records and delete them. This authority can be given on a selective basis for a selected person.

To exercise the security measures such as listed above, the DBMS provides facilities for identification, verification and authorisation of the users of the database.

The facility is through a confidential password system, for various access possibilities such as Read, Write, Delete and Update. The DBMS will first check the entry of the user through the password, and allow such actions which are permitted for that password. An additional security can be implemented at the physical of the terminals through an administrative control on the entry to the system.

## **Programmers/System Personnel**

These personnel have the knowledge of the DBMS and, therefore, need to be watched more carefully in the following manner.

- (a) The changes in the application program can be made only by the application programmer.
- (b) Only the latest version of the program is kept for access.
- (c) The application program is written by the application programmer and he does not touch the systems programs.
- (d) The same principle is to be followed for systems programs. They are only handled by the system programmer.

## 18.6 RDBMS

Organisations need Management Information Systems that would give them a "competitive strength". Simply computerising the back office or the front office operations is no longer sufficient. The need is to handle an on-line operations, mission control applications and exercise the operational and management control. The need demands a tool to effectively handle both the transaction processing and the decision processing requirements. It also requires the capability of dealing with hundreds of users who are using, and updating a large database. The need further demands the use of multiple database residing on the hardware platforms situated at different locations—nearby sites and remote site.

The decision-making is required more in a real time environment where the decision making process, right from the problem definition to solution, needs to be handled quickly. The business environment is distributed and decentralised requiring a real time resource (hardware, software, data, information) sharing with a complex data flow. All this demands the RDBMS which can serve both the decision support and the transaction processing requirements.

The latest RDBMS systems have two subsystems or parts. One deals with data management and transaction processing which is independent of its applications in the information processing. The second part provides a set of tools for developing and utilising on-line applications for the decision support. This is handled by the Client-Server architecture which separates the data management functions from its application. The data management function is handled by the server and the applications are handled by the client. The server centrally enforces all integrity, security and autonomy rules and the Client (User) makes use of the database over the network of heterogeneous hardware.

The latest trend in the Information Technology is to make the end user computing simple, easy to understand and easy to use. The concept is extended to the system analyst and programmers, where the RDBMS provides the tools, saving development and processing time. It allows the business rules of the organisation, standard transactions and queries to be programmed once and makes them available to all the users and developers as a stored procedure in the Data Dictionary. These stored procedures can be nested to develop an application. These procedures are, both, reusable and sharable and are developed using the standard SQL. The RDBMS is also capable through the interface to handle the data sources from the other database and application tools developed on different Operating Systems.

The user does not have to change the development made on other platforms, i.e., the RDBMS can interact with the other RDBMS, or call the data from a Personal Computer based Lotus application or can use the program written in the other languages such as C, FORTRAN,

COBOL, etc. with these facilities of the modern RDBMS over the traditional DBMS, the information processing through-put and the resultant performance is considerably enhanced.

The modern RDBMS system operates under the client-server environment as against the traditional master-slave environment. In the traditional DBMS systems, a transaction is processed in three steps before the transaction is stored into the database, i.e., the creation, validation and checking the transaction integrity logic. This is done for each transaction separately based on the procedures developed for each transaction for validity and integrity checks. In the modern RDBMS system, the third step of the integrity checking is done through a stored procedure common to all types of transactions.

This facility of stored procedure offers a high level data quality by way of safeguarding the accuracy, consistency and referential integrity of the data stored in the multifields and multi-tables. The RDBMS offers a field level integrity by allowing only certain data types including the user defined data types. The system further distinguished the 'Nulls' (non-entries) from any specific entry, including 'O' for a number field or 'blanks' for a character field.

The system allows default values when no value is explicitly entered. For example, if the date is not entered, the system inserts the current date in the date field. The system also allows the developer to provide the domain of values by defining specific rules. For example, in the unit of measure field, only the legal values defined in the system are allowed, i.e., the system allows 'kgs' and not 'kg' as a unit of measure of the weight.

Having ensured the filed level integrity, it is necessary to ensure the referential integrity between the various tables stored in the database. The referential integrity is distributed when the system handles "insert, delete or update" a data field. For example, while deleting the employee code from the personnel master record, it should be checked for any dues pending in the loan register. Deleting the employee code from the master is the last step only after ensuring that the employee code reference is not required in any other stored procedure or developed application. To ensure such referential integrity, the RDBMS allows the developer to develop rules of referential integrity and store them in the system. Such rules are then automatically triggered when the insert, delete or update operations are carried out on the data field or on the transaction type.

Modern RDBMS allows high level security by providing various tools to the system administrators, the database owners and the users to grant and revoke permissions to the specified users or a group of users on the specified tables, view, columns, stored procedures and commands. In the traditional DBMS system, the data was required to store in different databases in line with the security levels. While in the modern RDBMS system a multiple security is taken care of by one integrated database management system.

The latest RDBMS allows an on-line maintenance, rapid recovery and software-based fault tolerance. These features ensure the availability of the database round the clock as the database maintenance is possible on-line when the system is in use. The maintenance activity consists of the following tasks:

- (a) Backup,
- (b) Diagnostics,
- (c) Integrity changes,
- (d) Recovery,
- (e) Design changes,

## (f) Performance tuning.

The rapid recovery feature also provides the system administrator to provide a 'time' to go back for recovery of the data if the system fails due to the power failure or network crash. Based on this, the system automatically goes and collects all the changes and writes to the disk.

The software-based Fault Tolerance (SFT) is a feature of the disk mirroring to protect the loss of committed (logged) transaction in the event of media failure. Mirroring the database ensures a continuous operation. The disk mirroring, therefore, requires two disks on-line to write a committed transaction on the second disk. The concept of mirroring is also used in a multi CPU clustered environment.

The modern RDBMS, unlike the traditional DBMS, handles the distributed heterogeneous data sources, software environment and hardware platforms. The system is open RDBMS. The modern business enterprises operate through multiple locations having a specific or a general business activity using the multiple hardware-software platforms. Such a business enterprise has multiple databases residing at various locations. The information needs call for the unification and coordination of these databases. The data would get updated in the distributed locations while its use could be at other locations. Hence, the information system requires a distributed access to the distributed data. For example, a transaction of the order processing would call for an access to the product and the policy database at the head office, the production and the inventory database at the factory, customer database for the credit terms and clearance in the marketing division of the company.

RDBMS allows communication at the database level and performs in a unified manner as a single entity through the updates, and processing would take place at the respective distributed locations. This is achieved through a software interface across the organization. Since the environment is distributed, it calls for a distributed integrity control and autonomy to perform. The distributed integrity control is achieved through the stored procedures residing at appropriate locations with the ability to use the data from the distributed databases. The use of the stored procedures is made to protect the database from a remote external update or processing, to maintain the autonomy which would be affected by the unauthorized updates from remote locations.

The characteristics of the modern RDBMS includes hardware independence, software independence, workability under a client-server architecture, a control feature of integrity, security and autonomy and built-in communication facilities to achieve and open the system feature for the MIS. It, therefore, provides a very efficient and effective tool to a skilful designer, developer and user for handling the information needs of the business enterprise. E.F. Codd\* prescribes 12 rules to determine how relational a DBMS product is. If these twelve rules are satisfied, then the DBMS product is fully relational. The rules are as under:

1. The information rule.
2. The guaranteed access rule.
3. Systematic treatment of null values.
4. Active on-line catalog based on the relational model.
5. The comprehensive data sub-language rule.
6. The view up-dating rule.

\*Source: E.F. Codd, "Is your DBMS really relational," *Computer World*, October 1985.

7. High level insert, up-date, and delete.
8. Physical data independence.
9. Logical data independence.
10. Integrity independence.
11. Distribution independence.
12. The non-subversion rule.

These rules can be explained as follows:

### ***1. The Information Rule***

Information in database is represented by values in column positions within rows of tables and this is the only way it can be done.

### ***2. The Guaranteed Access Rule***

Every individual scalar value in the database is uniquely addressable by a primary key, containing table, column and row identities.

### ***3. Systematic Traditional of Null Values***

Missing or inapplicable information is termed as null value which is distinct from zero. DBMS should provide systematic method of handling null values in contrast to value zero.

### ***4. Active on-line Catalog***

The DBMS supports on-line catalog accessible to authorised users.

### ***5. Sublanguage Rule***

DBMS must support one relational language which helps data definition, manipulation security, integrity constraints, and begin, commit, and rollback operations.

### ***6. The View Update Rule***

All possible views must be updateable by the system.

### ***7. High Level 'Insert, Update, and Delete'***

DBMS must support all the three at time required by three different operators.

### ***8. Physical Data Independence***

It does not matter for the application how data is physically stored in database.

### ***9. Logical Data Independence***

The data store and its application is not determined by the logic applied in use of data.

### ***10. Integrity Independence***

Integrity or rules of constraints must be possible to handle without affecting the application.

### ***11. Distribution Independence***

DBMS should function with no error even though data is distributed.

## 12. *The Non-Subversion Rule*

A low level interface provided by the DBMS should not subvert the system's relational security or integrity constraint.

Some of the major advantages of RDBMS against HDBMS and NDBMS are:

- Scalable high performance.
- System-based integrity, security and autonomy.
- Longer availability of time to the users.
- Handles simultaneously the multiple RDBMS.
- Operates on the character terminals and bit-mapped workstations.
- High level data management of different classifications.

## 18.7 CLIENT-SERVER ARCHITECTURE

The need to access right information at the right time by its user is increasing at a rapid pace. With the business environment become competitive and cost of business processing increasing rapidly, the managers of business need flexible, dynamic, simple-to-use, technology friendly information systems to meet their business need. Big business operations have multiple locations and multiple divisions and because of that data generation, acquisition and maintenance became a technological challenge. To contain cost of running the business and to improve the services to the customer, the managers developed variety of strategies.

The computing technology of the sixties and seventies supported centralised processing with mainframe computing. In this period data and transactions were brought to a central place, processed in batch mode and the resultant information was delivered at fixed intervals in pre-determined form and content. In this period computing, storage and communication technologies were grossly inadequate to take a care of dynamically changing needs of business information.

On analysis of the needs it was found that what was needed is the capability to separate data from its usage or application. It was found that data entities are same but they need to be processed differently in different situations. It was a case when a situation demands more data from different sources. The user of information also wanted freedom of option to choose information and its processing. In the wake of such requirements, large data volumes and transactions required speedier processing to deliver the desired information. Mainframe, host based computing technologies did not serve these needs satisfactorily.

With downsizing of mainframes, increased CPU power and data storage capabilities, this problem was overcome to a limited extent by resorting to distributed processing. In distributed processing hardware-software is distributed at various locations and further data is distributed where it is required most. The approach was to bring the data and the application closer to the user, reducing dependence on centralised authority.

The networking technology coupled with Personal Computer (PC) becoming powerful, the user found great relief in meeting their needs. The proximity to data is no more an issue because of networking capabilities. The PCs being powerful in all requirements, user could think of processing data as he feels right at a particular point. In this period first time the need

was felt that data, transaction and application should be logically separated and placed at appropriate hardware locations for quick access and usage.

The managers of the business are always looking for an environment where communication, coordination and collaboration between individuals carrying out their tasks and responsibilities is easily possible in the shortest possible time. The environment should have capability of offering autonomy and independence to the use without disturbing the data, information security and integrity, and the application development remaining undisturbed.

This required certain characteristics in the processing environment. The data and its processing should be platform independent, so that once application is developed it could be used on new hardware-software platform. In order to take care of the application changes to meet new needs, it is necessary that application structure should be such that it is divisible and distributable on best suited hardware-software platform and also accessible from user locations.

Application logic so build should be reusable at a number of places, expandable at new locations and then the change should affect the smallest portion of the application build and so on. The design and architecture of the application logic should be such that it can communicate with other applications and it can be interfaced tightly with other applications.

This required great amount of standardised approach to the application development and indepth thinking is choosing hardware, software, its configuration and its placement. The business environment and its infrastructure application must be in sync to produce efficient and effective information processing environment.

This requirement to the business puts certain demands on the architecture of information processing system. The demands are as follows:

1. Data, business rules and usage should be independent.
2. Data and database should be distributable with controlled access from any point.
3. Choice of hardware and software should be such that it is application independent.
4. The processing platform should be easily scalable with no need to change the development.
5. The architecture of the hardware should be scalable to meet the budget constraints meeting ongoing changing user needs.
6. The application designed should be such that it follows standards of coding, presentation and storage giving same look and feel in all application to all users.
7. Data and hardware resources should be sharable.
8. Its platform should remain same even if the organisation is restructured, downsized, protecting the investment and development.

The system architecture from the sixties to eighties was grossly inadequate, inefficient and incapable to handle this genuine business requirement. This was mainly due to technology incompetence which is now in the nineties overcome. The technology in all walks of business has become very efficient to handle these requirements. The technologies of computing, storing, programming, processing, communicating and presenting the processed result are so advanced that one can build a new architecture called as **Client-Server**.

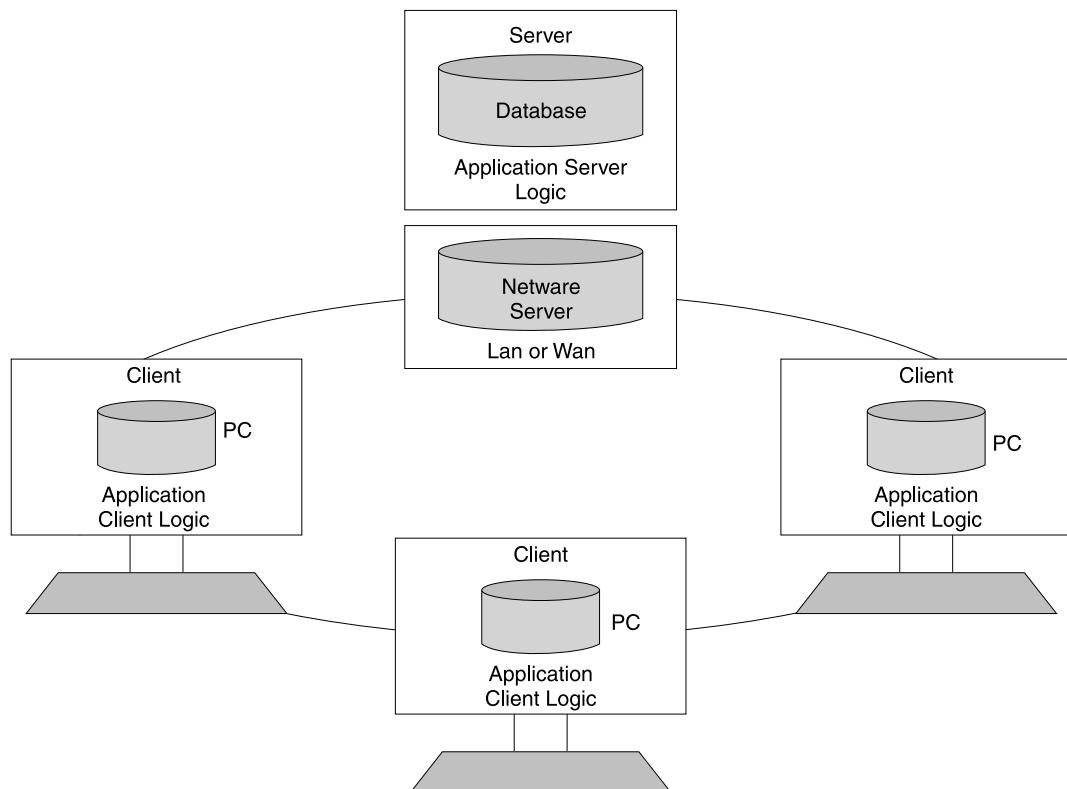
Client-Server Architecture (CSA) is a distributed, cooperative, processing environment whereby the entire task of processing is divided in such manner that there is a demand on the

system through a client and there is a server in the system to serve this demand. The architecture has two components, client and server, where client makes a request and the server then processes the request and serves the client by offering the result. The clients and servers are connected to each other through a network component which handles communications between the two.

In the CSA, client sits at the front end and the server is at the back end. The client represents front end tasks requested by the end user. Their server represents the back end tasks of processing and communicating to the clients.

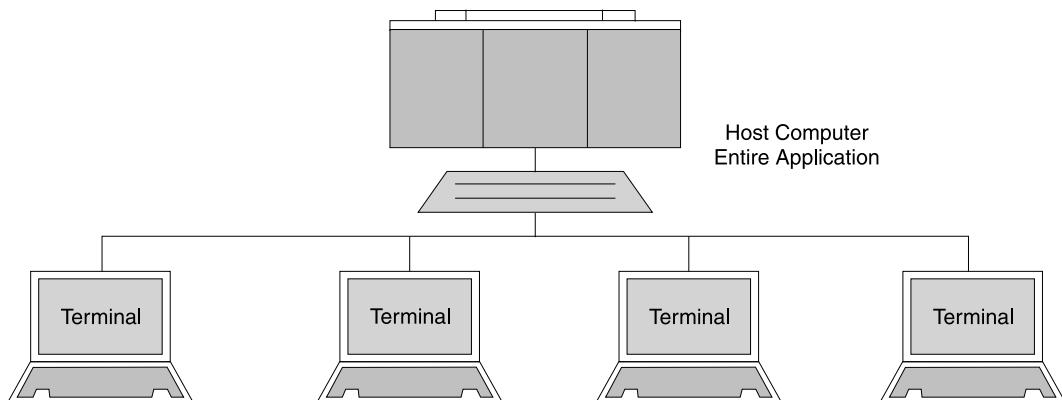
The simple architecture of Client-Server is where application is broken into two logical divisions, data and its processing logic. While data sits on back end server and its management is done by DBMS and the application processing logic such as validations, application of business rules and computing is placed in a front end client device. Both client and servers are essentially computers of varying capacity and capability.

Figure 18.12 depicts a simple Client-Server configuration. As the diagram shows, the clients and servers are connected through either LAN or WAN network. The client has its own processing application logic and server has its own processing logic to handle data and its processing.

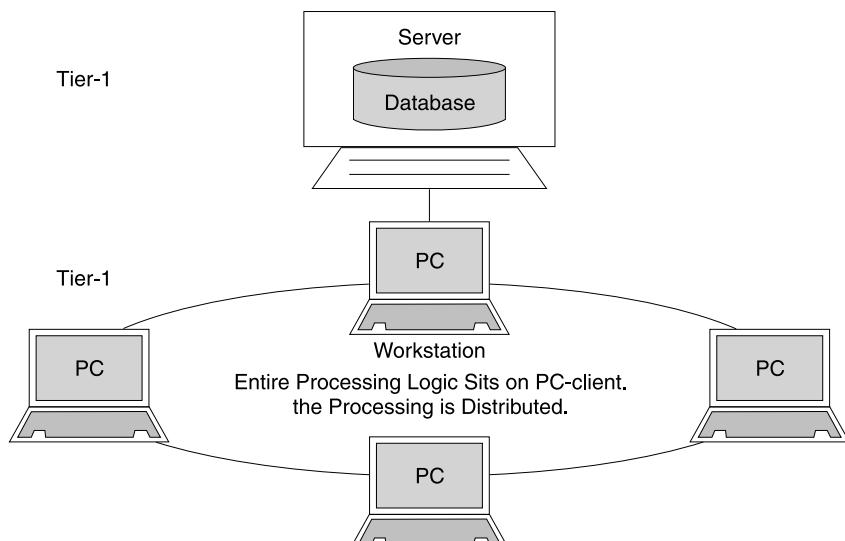


**Fig. 18.12** *Client-Server Architecture: Model*

The client handles server independent tasks through its stored application logic and server handles client's request which are triggered after processing in the client. Hence, true Client-Server implementation requires, application programs split in such manner that client level processing is done by the client and communicated to server to carry out the rest and offer the feedback to the client with the processed result. Broadly, back end server has DBMS system and related application logic, and the client has front end tools to handle the requirement in terms of input, process and presentation. Figure 18.13 shows traditional model of the mainframe system.



**Fig. 18.13 Mainframe-Model\***

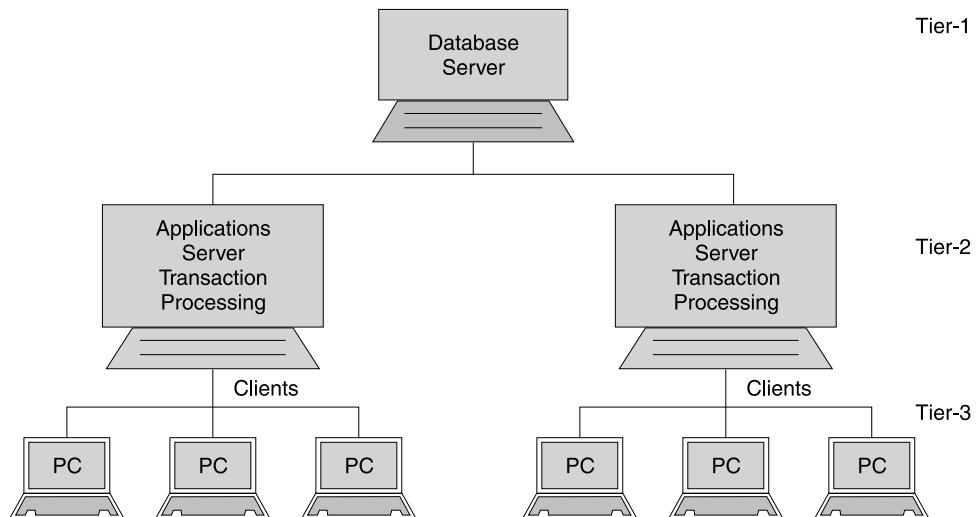


**Fig. 18.14 PC-Centric Client-Server Model: First Generation Client-Server Model**

\*Data files, application logic sit on host computer. Terminals are provided to access the files and programs. Entire processing is done in the host computer. Client here is a dumb terminal. While in Client-Server model, client is intelligent PC with processing logic.

The traditional model is proven on but suffers from poor response, requires maximum systems and maintenance control. It has limited and unappealing user interface and rigid application logic implementation. Since the entire task of processing is handled by mainframe host system, the performance of the whole system depends on the capability of host computer system and the load put by its users.

A improved version of the traditional model is shown in Fig. 18.15 known as PC-Server model. Hence, PC plays the role of client performing under the control of server. In this model architecture, personal computers (PCs) share applications and data resides on one or more servers. This model is called PC centric as processing is done on PC and the results are pushed to the server for update. This is LAN based implementation. Since, PC client requests filed from the server and handles all processing within itself, it puts heavy load on the communication links and engages client PC for a very long time.



**Fig. 18.15** Client-Server Three Tier Model: Second Generation\*

This model is good for small application systems. But, if the applications and its complexity increases, the performance of this model goes down drastically due to heavy traffic on network.

The heavy traffic is due to transfer of data files to and fro between server and PC, PCs should be, therefore, high end with high capacity RAM and CPU. This model is implemented where information needs are strong on function basis. Hence, such systems are implemented separately in each function or division with critical applications and then servers are connected to each other to meet corporate information needs.

PC-Centric server model has advantages of sharing resources, flexible user and solution on PC, graphical user interface, and relatively open solution compared to traditional model. There is also a PC-Server Centric model where the roles are reversed. In both models, advan-

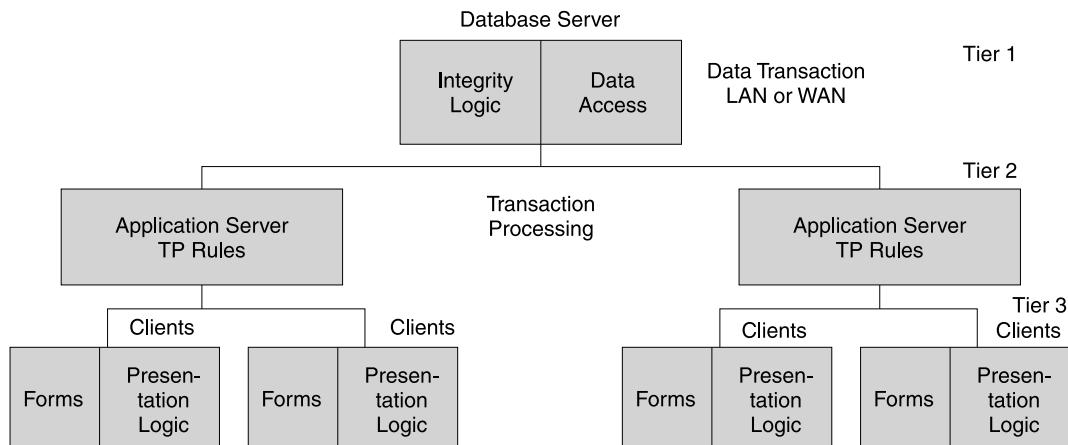
\*Processing logic is split into three tiers server, and clients, making it a three tier architecture application server, database

tages and disadvantages are similar. In PC-Server model high end PC client requires windows environment to run front end client tool such as Power building, SQL windows, Visual basic. All windows applications are single tasking and single threaded. It is not possible to split the logic and, therefore requires to reside on PC or server. The model suffers from inability to scale the application when it grows in size and complexity.

In this model, developer is required to write complex cod in 3GL like 'C' raising the complexity of development and maintenance. With this complexity of both application design and architecture, the modification to the application is time consuming, delayed and occasionally difficult to achieve. In summary, this first generation Client-Server model is good for small users' group for simple applications with minimal changes and no expansion. This is a two tier model, server with data services as the tier one, and the client with most application logic as the tier two.

In view of this characteristics of the two tier first generation model, a second generation Client-Server model is evolved/this is a three tier customized architecture, offering the benefits of scalability, application logic splitting in more than one level, open on many platform, high performance and appealing graphical user interface.

Figure 18.16 shows the three tier Client-Server model. There are three basic software components of Client-Server—front end software, middleware and the server software. Front end software includes application development tools and reporting tools, including spreadsheets and word processors. The role of this software is to connect to servers, submit the requests and receive processed information result. Front end development tools such as Power builder, Delphi, Visual Basic are widely used. These front end tools support open database connectivity (ODBC) features to popular databases like Oracle, Sybase, Progress, Ingress, making these tools DBMS independent.



**Fig. 18.16** Client-Server Architecure Three Tier

Reporting tools also link to Database servers, allowing users to create ad-hoc reports and graphs using back end database. These tools provide rapid application development allowing users to use prebuilt components of other applications systems which resides in the directory or library.

Middleware is a software that sits between the client and the server to facilitate communication. Middleware provides to developers the Application Processing Interface (API) for remote server access. ODBC is an example of middleware which provides open database connectivity. It provides a common interface for the front end software and the server, using common calls.

Raising tiers from two to three or more means, the application is distributed over more servers which provides additional processing power. Developers can create multitier Client-Server applications using applications partitioning tools, employing distributed objects and TP (Transaction Processing) monitors.

A typical three tier Client-Server model has three components as shown in Fig. 18.15—Data Server, Application Server and PC-Client. The middle tier, usually is used for transaction processing or object request processing. Since middle level servers can be provided easily, developer can plan the system for much more number of users than the two tier model provides. The second server can be introduced considering the possibility of dividing the application processing, and distributing it one more than one server. Such distribution makes the processing faster. The techniques of distributed processing and parallel processing would be used for suggesting the partitioning of the processing logic.

Whatever may be the number of tiers, each tier has a role to play in the application processing. Database servers don't just serve up the data, they provide locking mechanisms, access controls, optimise database queries and support communication calls received from server of client.

Database server also stores procedures to be used in application when called by client or server. The stored procedures, triggers and rules allow developers to program the database server itself providing another location for application logic. The stored procedures to triggers are a collection of SQL statements and procedure logic, which can be placed in database server as objects. Client applications can execute these stored procedures or triggers by making call on them. The difference between stored procedure and triggers is that the trigger is activated automatically by data-related events that the database server may come across. A rule (stored procedure) is a special type of trigger which is activated if data is checked for a condition and it is satisfied.

Application server is used for application logic processing. Using partitioning tools the processing logic is split into server or between servers, and PC clients. Essentially it is a place where applications are broken into smaller units, known as transactions and the server ensures that they are processed completely in a coordinated manner to produce the application result. Application partitioning tools. *Dynasty* of Dynasty Technologies and *Forte* of Forte Software enable developer to partition of logical application dynamically over several reducing the processing load resulting into better performance.

At client level, applications development tools are put to use to develop and execute the application. Some of the popular tools are Borland's Delphi, Symantec's Enterprise Developer, Powersoft's Powerbuilder, Gupta's SQL Windows 5 and Microsoft's Visual Basic. The basic features of all these tools are that they perform the role of middleware, help in object oriented development, aid in designing GUI (Graphical User Interface) features and provide mechanism for the application distribution among the client and servers. With the ODBC feature, developer needs only to load appropriate database drivers and log-on information leaving rest of the process to the tool itself.

The tools also provide interface drivers to create data windows, data entry forms, menus and other components of a GUI application. Though developer can do most of the application development using these tools, many occasions call for adding a code to complete the task. All tools provide 4GL programming language for this purpose, like 'Power Script' for Powerbuilder. Some offer low level 3GL language. These tools distribute applications to the end user by creating executables which reside on client PC.

Report writer is a third component which is provided to developers and end users to generate documents, records and reports. All front end tools are supported by the report writers. They use middleware or ODBC to communicate with database server. Based on the user criteria, report writer generates the database request and sends it to server or serves. It processes the request and returns the data in a desired format to the client. All report writers run in Microsoft Windows GUI Environment.

The "Report writer allows developers to select data elements from a menu and paste them directly on the report. These tools support application development in three ways, a stand alone reports, as embedded objects and as components of an application. Some of them provide a complete development environment with runtime report distribution facility.

In summary, second generation Client-Server characteristics are:

- Application logic placement in servers
- Application partitioning
- Transaction intensive
- Scalable form simple to complex environment
- Supports multiple platforms
- High order security, testing and maintenance

It uses Oracle, Sybase, Informix, Open-Ingress as back end database in database servers. It uses application servers for loading transaction processing portion of the application. It uses development tools such as Powerbuilder, Delphi, Visual Basic, SQL on PC client. Most of the current Client-Server implementations use ERP packages such as SAP, Peoplesoft, MAMIS, Oracle financials with their proprietary development tools. Figure 18.16 shows Client-Server architecture with three tiers, each tier having a specific role.

**Client's Role (Tier 3)**—Data Entry, Forms Creation, Windowing, Querying, Reporting.

**Application Server Role (Tier 2)**—Rule based processing on command from client and fetching data from database.

**Database Server (Tier 1)**—All database management functions and serving the needs of clients and applications servers.

The client-Server architecture will continue to mature over next three to five years. The research and developments continuing on all components of the architecture. Improvements in front end tools, middleware and DBMS will facilitate easy customisation of the architecture in terms of distributed computing, partitioning of applications and processing on more than one server and achievement of the desired performance.

## 18.8 CLIENT-SERVER IMPLEMENTATION STRATEGIES

The Client-Server Implementation, is a customised solution. It is complex to conceive and difficult to plan.

The complexity of the implementation is due to following reasons:

- Application mix and load
- Varying load with different nature of applications such as transaction intensive, database intensive, traffic intensive.
- Organisation structure: Divisions, locations and information management requirement.
- Hardware-Software variety due to applications, special and general, requiring coexistence.
- High processing load and data transfer and replication requirements for implementations in multiple locations.
- Seamless integration of technical talent, hardware and software with varying configurations.
- Conceiving enterprise wide solutions for at least, five years.

The implementation procedure would broadly involve the following steps:

1. Setting the goal, time frame to cover the scope to brought under the implementation.
2. Forming a project group of experts comprising business analyst, system analyst, information analyst, network specialist, hardware and software specialist supported by a consultant.
3. Discussing the requirement of information in terms of definition, scope, content, frequency, number of users, distributed processing, data and application responsibilities and so on.
4. Translating the requirement of information into applications with systems involved and the processes which run the systems.
5. Making a broad classification of applications as critical and non critical, transaction intensive and data intensive. Further putting them by location, and assigning the responsibility and ownership.
6. Understanding the underlying processes which run across the functions, locations and usage to define the integration needs.
7. Classifying the applications in terms of their requirements of dedicated specialised hardware and software, like CAD/CAM/CAE, and use of other technologies.
8. Constructing an application grid, system grid to bring clarity of enterprise functioning with mission critical and other applications marked.
9. Deliberating and deciding Hardware, Software, Operating System needs and configuring each of them based on load, nature of load, users, processing needs, nature of processing, reporting needs, and so on.
10. Making a plan of networking the variety of platforms with infrastructural details namely servers, routers, gateways, TCP/IP, NOS and networking strategy LAN/WAN, Internet/Intranet.
11. Selecting enterprise wide solution comprising ERP solution, dedicated local solutions to meet specific needs, solution on supporting technologies for data capture, transaction capture, data replication and transfer.
12. Deciding on RDBMS, front end tools, report writers, packaged solutions for text processing, data handling and communication. Care should be taken while deciding

whether they can coexist and function in a cooperative and coordinated manner and in an intelligent way to meet the unified needs of information across the organisation.

13. Assessing the needs of hardware and software of all kinds in terms of users, capacity, capabilities and quantity. Configuring them in terms of disk capacity, RAM, controllers, drivers, utilities and features and most important processing speed in terms of Mhz.
14. Finalising the numbers of servers, client and hardware components in network with clear role identification as data Servers, application Servers, dedicated Servers and Clients.
15. Focusing on long-term requirements and choosing vendors who have clear vision on technology, growth and are committed to serve and support your plans. The products are selected first for its merit and then the vendors who make them.

The Client-Server architecture is a customised structure to achieve total performance. Hence, each component however, small contributes to the performance. Hence, its selection is strategic to the success of the system. The, choice the number and capabilities are decided by network traffic which may arise due to transaction process, DSS or combination of both. Every Client-Server implementation requires fresh scrutiny before it is finalised.

16. Most of the programming is done on the client and selection of the appropriate development too is very important. The choice of tool should largely be based on the features it offers, in comparison with the features required by the applications.
17. Client-Server implementation, roles not only change by they are fixed to individuals. It is, therefore, strategic to assess manpower resource to manage server, network and client operations. A thorough training is essential to each of them to understand the working of the system and their role in it. A team of experts headed by a system administrator should support and maintain the system.
18. Long-term planning, with phased implementation to protect investment and then to ensure the best technology, is critical to the success of Client-Server implementation. Information technology, business and the information requirements change continuously to an extent that obsolescence cannot be ruled out. Hence, architecture plan must be long term, investment in hardware and software should be adequate to meet present needs and some of the future as well. Investment in the application software should be slightly long term. This approach provides flexibility to change and protect investment and gives highest price performance in a given situation.
19. Ideally after planning, a pilot project should be chosen to confirm variety of decisions involved in Client-Server implementation. If pilot project proves efficient, the decisions on large scale bi implemented.
20. A typical Client-Server projected implementation would take two to three years to establish and mature.

## 18.9 SERVICE ORIENTED ARCHITECTURE (SOA)

Service Oriented Architecture (SOA) is a flexible, interoperable framework which uses principles of system development and integration, and packages services for use in multiple

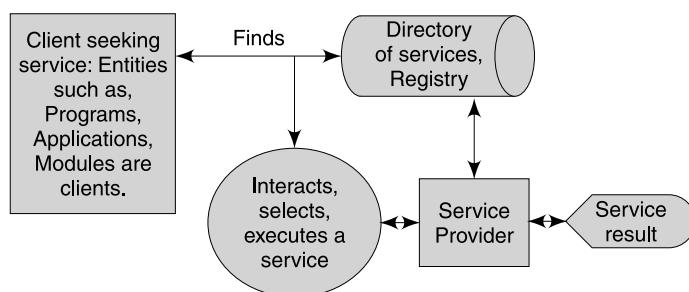
systems in different business domains. SOA uses web services by which services can be published, searched, and used on call by clients in technology independent environment. SOA is supported by an organisation's policies, standards, practices and framework to ensure that right services are delivered to the clients.

Before we move further, the word 'Service' in SOA means business service like billing the customer, making a payment, sending a rejection advice. The word 'service' in Web services means communication & connectivity services in the enterprise network.

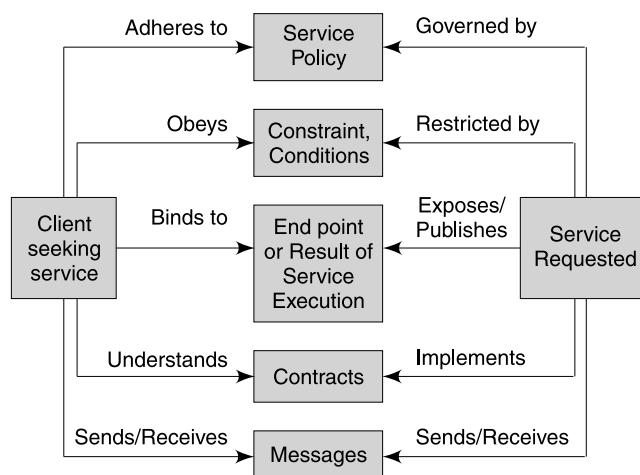
Gartner reports, "SOA will be a prevailing Software Engineering practice, ending the 50-year domination of monolithic software architecture" and that SOA and Web services will be implemented together in most software projects in the business in this century.

### What is SOA?

SOA, fundamentally, is an architectural style for describing loosely coupled systems, each performing some service to business enterprise. A service oriented architecture is a way of sharing business functions in a widespread and flexible way. SOA configures services, registries, contracts, and proxies to maximise loose coupling and its reuse in systems and applications. In the process of service execution it relies heavily on Web services technologies. See Fig. 18.17 (Source: ORACLE' SDN) and Fig 18.18.



**Fig. 18.17** A Service-Oriented Architecture



**Fig. 18.18** SOA reference Model: Components and their Role

A *service oriented architecture* is an approach or strategy in which applications make use of support services available in a network such as the World Wide Web.

SOA is a new way of building software applications with following characteristics.

- Services are software components governed by contract to serve with specific interface.
- The contracts are platform, language, and operating system independent.
- Simple Object Access Protocol (SOAP) is the technology platform.
- Clients discover services by access to service directory.
- SOA is a structure of three entities: Client seeking a service, Service designed to deliver certain functionality; and Service registry, a repository of services available to clients to fulfill their needs. The client could be a person, program or application.

Implementing a service oriented architecture in applications means developing applications that use stored services, and making applications available as services. Once a service function is developed, other applications can use those services after due scrutiny for use in a project in hand. Let us understand in depth the term 'Service' as used or understood in SOA.

SOA has in it the following four core elements in network relation:

- *Service Registry*: Records Service Definition and Description (SDD) of services available to clients, and accepts new services developed by the service provider.
- *Service Provider*: Manages, executes and delivers service on call to the client.
- *Client*: Receives and benefits from the service processed by the service provider.
- *Service Interface*: Designed to provide access to the registry and service provider through 'contract conditions' execution, i.e identity of service and rules of service execution.

SOA is built by three persons: Service designer / developer, Application designer / developer, and service registry administrator.

SOA is also often equated with Web services, and the terms used interchangeably. While it is true that SOA is made easier through the adoption of Web services, the two are distinct. SOA is an approach to designing systems. In contrast, Web services are an implementation methodology or an enabler that uses specific Web standards and language protocols to execute a SOA solution developed for the system.

SOA is efficient to an extent how service design is made. The good service design is enabled by Web services making SOA more efficient. Web services help to make interface in SOA technology neutral, standard and usable in multiple domains.

Bill Gates of Microsoft says the following on the subject:

SOA is a third generation paradigm following the first generation OO approach and second generation component based approach to systems development. Fig. 18.18 shows SOA components and the role they play in the architecture.

In order to develop SOA as an efficient architecture, two requirements are critical to meet one is interoperability and use of common business format. The guiding principles are:

- *Reuse*: Through granularity of service, modularity of services, composability, and interoperability

- *Standards compliance:* Industry specific and common universal standards
- *Service:* Identification to monitoring, tracking and maintenance

In brief, we can say the following:

- *Service:* It is a behaviour or behaviours put together for use by the service user or client having an aim of well defined unique result.
- *Service description:* It is a text describing the specification what is the service is all about. It helps client to decide whether it serves its business purpose.
- *Service publication:* It is a method of communication of service existence to potential client users.
- *Service data model:* It is an expression including technical expression of the data service needs to be used in fulfilling a service contract.
- *Service contract:* It is a set of conditions and constraints including syntactic, semantic and business logic which are governing the service execution.
- *Service policy:* It is a statement of assertions and obligations client and service provider must adhere to.

These set of components together bound by relations is termed as SOA Reference Model.

A short, precise and clear definition of SOA is a software architecture which aims at delivering functionality through loosely (Flexibly) coupled services that can be reused across the organisation in predefined sequences to execute the service demanded by the client.

### **SOA vs Client Server Architecture (CSA)**

CSA is a framework of client and server combination where client does mainly processing, called as fat client and server provides application process logic, stored procedures and triggers, and supporting data from database server. The client plays the driver's role in the system. This separation of roles between client and server is very rigid.

In case of SOA, application logic by choice can be kept in distributed manner in the network anywhere. Further, in SOA, service has clear functional boundary and resource requirement in contrast to CSA. CSA has limitations due to its role framework in distributing application processing task, while SOA provides facility to break the processing logic in smaller granular services and distribute them in network in most optimum manner. Due to this SOA offers many deployment choices for the service increasing the agility of the service process. SOA provides synchronous and asynchronous communication between client and service. In CSA it is not so. It is mostly asynchronous.

CSA uses 4GL and also 3GL programming languages and RDBMS packages. SOA uses XML data representation along with SOAP messaging framework and web services technologies.

Security in CSA is entrusted to server using multiple technologies while in SOA it is a Web service framework responsibility. Security in SOA is relatively more complex.

To understand the traditional monolithic software architecture practiced in sixties to eighties and then client server architecture and now SOA, let us set up an example as follows.

You have decided to go out for lunch. You have three choices as under:

- Restaurant 'Thali'
- Restaurant 'Order by Menu'
- Restaurant 'Buffet'

In 'Thali' restaurant, you get a lunch as prepared earlier based on most popular dishes sought over a period by the customers. Here Inputs, Processes and Outputs design and architecture is rigid, fixed and not flexible at all. The customer's demand of different choice is not possible even in a reasonable time as the entire system design and architecture is inflexible and difficult to change. You might get lunch probably at the dinner time. The software design and architecture in main frame, mini and multi-client system era was of this nature. The change in software is difficult, time consuming and costly with no chance of winning customer satisfaction. Software processes were tightly coupled, with complex programs written for specific IT platform; OS, language, and database.

In 'Order by Menu' restaurant which is equivalent to Client server architecture, the customer (client) processes the items in a menu, prepares a lunch order and orders (submits) for serving. In the back end kitchen (Server), order is processed for items ordered in quantity and quality terms and delivered. In the language of client server architecture, customer is a thin client, and the kitchen has two servers: one, Application server where appropriate processes are stored to meet specific client's requests; and two, database server where semi-cooked items are stored for JIT ready to use in every new client's lunch order. The client server architecture is relatively far superior to conventional monolithic architecture as there is a flexibility in input ordering, processing the inputs in different manner (Punjabi, Gujarati, South Indian and so on) but database of semi-cooked items by and large is common for all types of orders. Though better than the conventional monolithic architecture, service is governed by the limited cooking processes the chef knows.

In 'Buffet' restaurant, there is no rigid coupling between customers, food items, number of items, quantity to serve and so on. All food items placed on the buffet table are loosely coupled items and can be termed as Fine Grained service objects which customer can choose in any order, in any manner. The items are customer independent, and also customer class/type independent. The Buffet restaurant architecture is more or less the same as SOA. Theoretically, the number of lunch services are hundreds and few more can be fulfilled at ease. Every customer service order, small or large, can be served. Multiple orders of different type and class can be served. Also the customer orders can be served in a synchronous manner. The customer base in Buffet is far larger than in 'Menu by order' and 'Thali' Restaurants. Buffet arrangement SOA attributes of reuse and interoperability.

In Buffet arrangement lunch service can be expanded, extended and enhanced. If customer (Client) satisfaction is an aim, then Buffet restaurant architecture (SOA) is the best.

## 18.10 MIS AND RDBMS

The MIS is supported by database in its endeavour to support the management in decision making. The database models be it the NDBM, the HDBM or the RDBM, play the same role in the MIS. with the latest computer hardware and software capabilities the RDBMS have become popular. The concept of the end user computing can be implemented easily with the database approach to the information system. With the database approach, considerable data

processing efforts, which were spent in the approach of the conventional system, are saved. The data is made independent of its application.

Now, the users of the data have a clear understanding of the entities and its attributes owing to the concept of the data dictionary. The major problems, which the MIS designers had to face earlier, were an account of the different definitions of data by the different users, and its applications. These problems have automatically disappeared with the database approach. Another problem which the designers faced was that of data concurrency and redundancy. Once an entity is defined and located in the database, it is same and common to all. All the users using the database will get the same results on account of the concurrency and hence avoid data redundancy.

With the database approach, the manager's information needs on queries can be easily met. With the RDBMS and the development of the Structured Query Language (SQL), it is possible to interact with the database and satisfy the queries by using the SQL. The development of the SQL is a blessing to the users of the database. The dependence on the EDP Personnel is now reduced considerably because of the SQL.

The attributes of a good information, viz., accuracy, scope, timeliness, form and so on can be easily achieved with the database approach to the MI System.

The MIS designs have become more dependable due to the database and the SQL. The rigidity of the design is replaced by the flexibility of the design. It is now possible to review the applications more frequently from the point of view of utility and have them modified, if necessary.

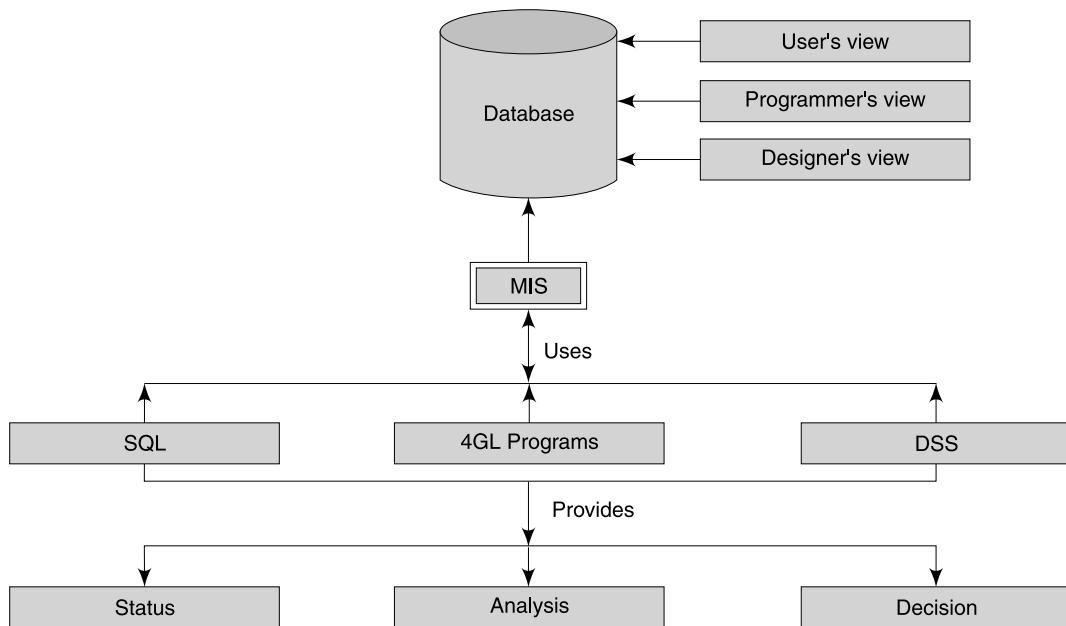
The database has strengthened the foundations of the MIS due to the following:

- (a) The database can be evolved to the new needs of the MIS.
- (b) The multiple needs can be met with easily through every systems and desktop applications.
- (c) The data design and the output design is flexible.
- (d) Open system design of the MIS is possible.
- (e) The query handling becomes easier due to the Standard SQL.
- (f) User-friendly end user computing is possible.
- (g) The data is freed from its ownership and its use has become universal.
- (h) The information Technology provides tools to handle distributed multiple database making the MIS richer.

Modern MIS uses databases and SQL, 4GL programs and decision support systems extensively for information generation as shown in model in Fig. 18.19 MIS with database support offers business status, its analysis, and decisions through DSS.

MIS design is more dynamic with well-defined authority and decision making structure. The client server architecture because of its capabilities servers well this need of the MIS. it provides comprehensive support to the decision makers. With the business growth, it allows easy expansion of any nature. The architecture is scalable on both the scales and also cost-performance effective.

The decision making has shifted from data to information to individual. The architecture of the system should, therefore, be such that it is flexible, easy to change. It is required of he



**Fig. 18.19 MIS and Database**

nature where business processes and rules governing them can be changed as suited to the decision maker and also they can coexist. Database should be stable and secured and process management flexible. The architecture should meet local needs and serve corporate global needs. To meet this complex architecture need, it was necessary to built a model where data-business logic—its usage and presentation is on different hardware software platform. The concepts is that the smaller the division of processing task, easier it is to maintain, change and update.

The Client-Server architecture helps this requirements very efficiently. It is user centric as each user can have his view of the business and its process. He can evolve his own decision making processes. What is needed is the availability of data and a mechanism to build and store individual business processing logic. This called or an access to large databases which are distributed at various locations with no communication barrier. It is required also the ability to change with dynamic change of business and business parameters.

The Client-Server architecture offered such a platform due to its following important characteristics.

On physical side, it is scalable, expandable and distance between two locations for communication is no issue. The system components are divisible locally or at different locations. For example, you can have distributed processing. It is platform independent where operating system, hardware, architecture, vendor specific differences are no longer serious limitations. It is possible to build the system suitable to the user locations, data sources and application requirement. CSA offers distributed physical environment, and logically a integrated services.

Due to capabilities of data warehousing, data replication and distribution of application logic across the servers, it is possible to optimise the usage of hardware and software with full benefits to the users. Modern business requires more instant information and use of stored procedures, triggers and business rules to perform efficiently and effectively.

Client-Server architecture provides the environment where MIS is a flexible and dynamic model as compared to traditional model if MIS working on main frame model.

MIS for competitive and strategic needs requires heavy transaction processing and using processed information to update the business status initiating a variety of actions. Client-Server architecture offers such functionality to perform.

Most critical and important need of competitive business is the strategy mix change from time to time. This calls upon first to formulate strategies namely business strategy, product strategy, marketing and sales strategy, manufacturing planning strategy and so on. CSA with its capabilities serves the demand strategy formulation and its implementation with change management.

Ability of Client-Server architecture to store data and swift access and processing capability helps to try and simulate variety of strategies before they are firmed up. It also facilitates analysis of the various strategy models. Use of Executive Information System (EIS), Data reverse engineering for evolving and analysis of strategies is easily possible because of Client-Server architecture using front end tools and packaged software on business modeling, risk analysis, and forecasting.

Hardware software platforms with ODBC drivers and other systems software facilities pooling of the information residing at different platforms at different locations and then presenting it in a form which is easy to understand to evoke a managerial response. Modern day business requires MIS which can pool such information from various sources and present it to the user in an appealing manner.

MIS essentially revolves around mission critical applications designed for highest customer satisfaction. A majority of such applications are real time transaction processing at multiple locations. The resultant business status needs to be put together to infer the position of performance. Client-Server architecture essentially focuses this requirement of business across the organisation.

MIS today serves the effort of enterprise management. The enterprise management requires management of following technologies, namely

- Information technologies
- Data capture technologies
  - Bar coding, Scanning, Imaging
- Communications
- Network technologies
- CAD/CAM/CAE
- Process automation and computer based manufacturing and many more.

Client-Server architecture recognises this need and provides interfaces, connectivity and gateway to these systems.

## KEY TERMS

Data Redundancy and Inconsistency  
Data Analysis for Database Design  
Performance Tuning of Database  
RDBMS  
ODBC

Data Model  
Unnormalised vs Normalised Data  
Security of Database  
Client/Server Architecture  
Service Registry  
Service Policy

## REVIEW QUESTIONS

1. Explain the concept of database? What is the difference between data file, data bank and database?
2. Which are the three models of database? Which is mostly used and why?
3. What benefits does database offer to the information system designer and the information user?
4. Take a case of personnel database and explain the database in terms of Conceptual model, Logical model and Physical model.
5. Why should the database performance be measured? Why does performance degrade and what methods are available to keep the performance at the desired standard?
6. Study ORACLE, Sybase, Open ingress, Progress, Informix declared as RDBMS and rate them according to EIF Codd's rules.
7. What is normalisation of the data? Why it is done? How is this concept used in a database design?
8. What is the importance of security in database environment? How is security offered to the user of database?
9. What is the role of database administrator?
10. Explain the relation types, between data items, How is used in database design? Draw E-R diagram showing relationship between teaches, courses and students.
11. Explain the concept of Client-Server architecture. What are we achieving in this architecture?
12. Define client and server. What roles do they play in the architecture?
13. Why is application divided into different tiers? What is the objective behind it?
14. By putting more tiers, are we simplifying the design, or improving the user friendliness or improving the service to the clients?
15. In Client-Server architecture, what is the role of networks?
16. Can we have Client-Server architecture and also distributed data bases and distributed processing?
17. What is a middleware? Why is it required and how is it used?
18. In this architecture, what additional benefits does the user of the information system get?
19. Which additional aspects of the system are studied when you go for Client-Server architecture for application design?

20. In Client-Server architecture, benefits necessarily do not match with the resource investment it requires. Explain, why? What can be done?
21. Make a comparative analysis of client server architecture and service oriented architecture.
22. Define a 'Service' in SOA. Service is managed through the following:
  - Governed by policy
  - Ruled by constraints and conditions
  - Implements contracts
  - Sends messages
  - Shows results

## LEARNING OBJECTIVES

- The Need of Data Warehouse for MIS
- The Difference Between Databases and Data Warehouse
- Importance of Metadata in Data Warehouse
- Justifying the Data Warehouse on Productivity
- Data Mining and its Application
- Business Intelligence
- DW Tools: Extraction, Manipulation, Projection

### 19.1 INTRODUCTION

The concept of Data Warehouses (DW) emerges from several sets of information which users need. The needs have arisen from change in the management style of different classes of end-users, who now need organisation-wide view of the information. These needs are critical for the success of business.

The decision makers are required to react quickly to mission critical needs due to rapidly changing, volatile and competitive markets. They need multidimensional support of information. The decision makers now need information for strategic decisions and not for routine operational decisions, which are automated now. The character of their needs have changed from data to information and now to knowledge. The decision maker is a specialist and needs information urgently from internal and external databases which gives larger view of the problem scenario. The features of such needs are fundamental in nature calling across functional analysis of the business. It is not atomic in nature but looks for patterns and trends and also requires enterprise view as against functional localised view of the subject. The DW designed to meet these needs delivers the same effectively.

The need for DW is felt due to quality and content requirement of different kinds of end users in an organisation. There are three kinds of end users of information, the management, knowledge workers and operations staff. The management needs holistic view of a situation expected predicting in the future. It helps to know whether a critical changes has taken place in the business, is the change showing any pattern and which factors are affecting the change

and its pattern? In order to control the change and use it to business advantage, the management requires analytical information support to make strategic decisions. The DW designed to meet these needs would satisfy such requirements.

The knowledge workers belong to middle management level in the organizational hierarchy. Their needs are multidimensional depending on their position and role. Their information needs are met from different sources both internal and external and derived from a variety of information systems operating in the organisation. The need cuts across the application systems in different functions. These information needs are fulfilled by assembling different information sets derived from related functional systems and presenting in a manner which offers additional value of information to the decision maker.

The needs of operations staff are fulfilled through transaction processing system, where decision making process is automated by embedding the rules in the system. The stored procedures and triggers built in the system help to execute the processes. The operations staff's dependence on DW is almost insignificant.

As business is becoming more competitive, the business risk needs to be insured. The view of decision making situation is no longer atomic, local and functional but it is larger in scope and content. The view may vary between the business functions, entire enterprise and the global environment. To meet such needs, data and information is sourced from within the organisation and also from external sources. The database designed to serve the needs of transaction processing systems and functional information systems fall short to meet this critical need of the decision maker. If we rely on database stored in multiple locations to fulfill this need, the system designed to meet the needs is poor in response and also lacks quality and value in critical information or various reasons. To meet instantaneous fulfillment of the need cutting across internal and external sources of data and information, it is necessary to design a Data Warehouse where data and its attributes are stored and are quickly available to bring out different view of a given decision making situation.

The Data Warehouse is defined by Bill Inmon as, "*A collection of non-volatile data of different business subjects and objects, which is time variant and integrated down various sources and applications and stored in a manner to make a quick analysis of business situation*".

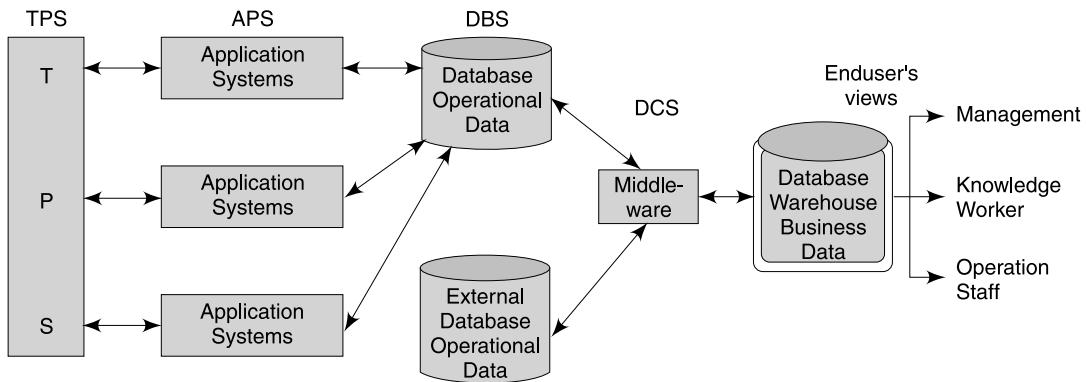
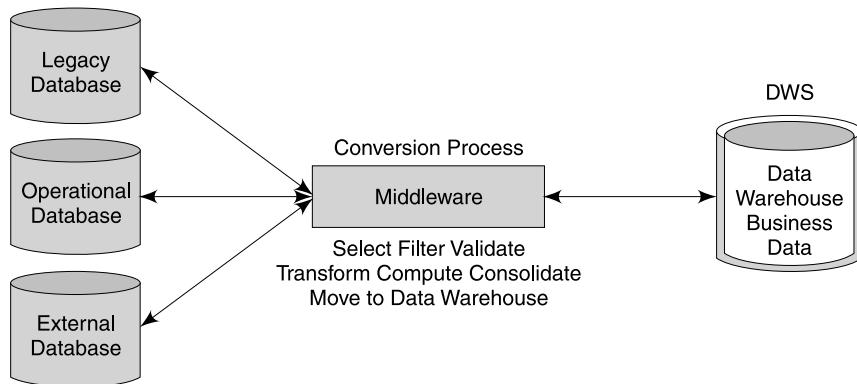
Data Warehouse is a

- Subject oriented data organised by business topics: Functions/results and not by customer, vendor, item code and so on.
- Integrated data stored in single unit in same structure or organisation. Distributed data in different files is rationalised and organised to one structure.
- Nonvolatile data once stored is not discarded or over written. New data on the topic is added on scheduled basis.
- Time-Variant Data stored with time dimension to study the trends and changes with times.

The concept of DW is given in Fig. 19.1.

Hence, DW is a special containing large stocks of enterprise data and related meta data processed to a 'ready to use' stage for decision maker for operational and analytical business analysis.

The operational architecture is shown in Fig. 19.2.

**Fig. 19.1** Concept of Data Warehouse**Fig. 19.2** Operational Architecture

First step in building Data Warehouse is to extract data from different sources. After this the data needs to be validated for coding structures, names and formats. It is rationalised to a common unit of measure through transformation or conversion process. Such data set is then consolidated to common reference level such as end of month, region, zone, etc. The data so processed is then moved to DW.

All these processes are handled by middleware, written to construct the DW. Middleware is a set of programs and routines which pulls data from various sources, checks and validate, moves if from one platform to other and transforms to the DW design specifications and then loads in the DW.

Since, data in DW is ready to user for decision-making, it needs to be delivered in DW after instituting QA measures on the data. Since, data sources are wide and different, the data needs to be checked for reasonable values, permissible values, inconsistencies arising out of different sources of data, missing values, data gaps arising out of application failures for a period and most important for violation of business rules. The physical view of DW is given in Fig. 19.3.

**Fig. 19.3** *Physical View of a Data Warehouse*

Following are the characteristics of Data Warehouse which differentiate it from Database.

- The scope of Data Warehouse is the whole organisation.
- It contains the historical record of business created from existing application.
- It enables you to take business view, application view and physical view at a point-in-time on any aspects of business situation.
- Data Warehouse supports cross functional Decision Support Systems (DSS) to manage the business, as it provides detail, historical, consistent, normalised business data for further manipulation by the decision makers.

TPS = Transaction Processing System; APS = Application Processing System;  
DBS = Database System; DCS = Data Conversion System; DWS = Data Warehouse System

The data Warehouse usage makes business decisions on facts and not on intuition. This is applicable to both tactical and strategic business decisions. It enables you to get insight in key areas of business where information support for strategic decisions is necessary. If viewed intelligently and with imaginative mind, it helps you to sense early warning on some aspects of business, calling for business review and radical change in policy, rules and strategies.

## 19.2 DATA IN DATA WAREHOUSE

In a computerised environment variety of data is available from various systems in the organisation. But all data does not enter into the Data Warehouses. Some enters and some does not. The data in DW is termed as business data, because it has a business value. The business data, representing the state of the business and only its value enters into the Data Warehouse. The business data assumes value because it represents facts and figures about the business but speaks volumes when processed and put in the proper form. Along with this business data, its metadata is associated to describe the meaning of the business data.

For example, let us take a sales application where sales statistics such as quantity value, region, discounts, period, sales representative and customer, etc. is available. But in Data Warehouse only quantity, value, region and sales representative will enter while remaining results of sales applications are not considered for Data Warehouse. The reasons for this is that the sales management does not perceive any business value for remaining data in sales statistics. Hence Data Warehouse designer has to decide before hand which data is a business data and which is not. The business data may fall outside the normal data and information need of knowledge workers. In airlines ticketing application, passenger data assumes importance to promote airlines business. The passenger data was processed and it was found that some passengers were frequent flyers on the airlines while others were not. Airlines used this information to start frequent flyers scheme for offering attractive incentives and prizes to the frequent flyers. The management of airlines perceived passenger data as a business data of a value to attract the business. While passenger revenue, travel agents data is considered as routine data and is not moved to Data Warehouse.

Business data assumes importance when it is useful to manage the business. The data, which is necessary to manage the business, has a value from strategic point of view. The rest of the data is useful to run the business. All business data are candidates for the Data Warehouse. It is also true that the business data of one organisation would turnout to be routine information in case of the other organisation. For example customer data has no business value in manufacturing organisation, but in post-sales service organisation customer data has a business value. The qualification for business data depends on the business, its current status and business strategy need sat that point in time. There are no thumb rules for deciding. Normally, operational data used to run the business and required to support short term actions or decisions, is not considered for Data Warehouse. For example in inventory application, item and its inventory related statistics is not considered for Data Warehouse, but the data related to consumption and its measure of application in product is considered for being in Data Warehouse.

When business data is determined for Data Warehouse, it is necessary to determine its scope. Business data could be stored in data warehouse in atomic form or in summary. For example, sales data could be stored by product that is in atomic form or also summarised by product family. The decision depends on its utility and application to manage the business.

Other important decision about business data is to decide its currency level in terms of time. The three currency features for the business data are, current data, point-in-time data and periodic data.

- Current data is a view of the business at the present time. It is unique to a second and changes with respect to time.
- Point-in-time data is a snap shot of business data at a particular moment in time indicating the business status at that point of time.
- Periodic data is a representation of business data by periods such as last three years, last twelve quarters, etc.

For example hotel occupancy data which is required every now and then is to be made available as current data. The room reservation data is required as Point-in-time data. Monthly hotel occupancy data for last two years is termed as periodic data. In this example, hotel occupancy data and room reservation data is a business data to run the hotel business. But periodic hotel occupancy data is a business data required for evolving strategies of suitable nature to improve occupancy in a period, which is generally recognised as high occupancy period.

Broadly, current and point-in-time data are not candidates for Data Warehouse but the extracted data and analysis of this date are the candidates for the Data Warehouse. This data is useful to show travel patterns, trends in occupancy, direction of the business and reveal certain underlying business currents. Hence this data has a case for being in Data Warehouse. Some selective examples illustrating this concept are given in Table 19.1.

Business data entering in Data Warehouse is often a derived data. The derived data is taken from the data set generated at point-in-time or data processed periodically. The derived data may be aggregated at some level through summarisation process. The aggregation could be for all levels or for selective levels. For example sales summary is for major market segments and other minor segments put together. The derived data also would be put in Data Warehouse after enrichment. For example, sales summary along with major customers in that segment is an example of enrichment of business data. While deriving and enriching the data from various sources, it is required to reconcile the data across the sources. The data is derived from variety of transactions processing and application processing systems where data model and definitions may vary from system to system. When data is sourced from such systems, data reconciliation across the systems is necessary to bring precision in the business data. In absence of reconciliation process, business data may show mismatch across the data stored in Data Warehouse. For example, sales data from accounting system and marketing system would differ, if definition of sales in both the systems is different. While deriving the sales data from these systems, the definitions need to be considered for rationalisation and reconciliation. Hence, process of derivation of data from various sources is itself an application sitting in between variety of information systems and Data Warehousing application.

**Table 19.1** Examples of Business Data

<i>Business data</i>	<i>Uses managers</i>	<i>Use of business data</i>
Sales summary	All by Sales	Pattern and trend recognition.
Marketing analysis, Product analysis	All by Marketing	Impact analysis of strategy by market or product segments.
Rejection analysis for critical raw material.	Manufacturing by Purchase	Determine correct choice of vendor, process and application.
Passenger revenue	Transport	Determine pattern and trend in passenger revenue and measure impact of special offers and incentives.
Patient vs Disease	Health care	Determine any sudden emergence of disease and patient incidence to take emergency measures to prevent the growth of disease.

## Metadata

Various data sources could be options for taking the business data to Data Warehouse. Further each source may have application specific data definition and its use requiring special derivation and reconciliation process. It is, therefore, necessary to know the data model, data definition, data structure and data usage precisely in each case. This data about the business data is called as Metadata. In other words metadata is a 'data about data'.

In any information system application, three types of metadata are created. They are system design-Time, Control and Usage metadata.

### ***Time Metadata-System Design***

While designing a system, a data which describes the use of input data in the application is known as Time Metadata. This metadata gives details on specification, value, allowed value, the business rules it would use to validate and formula to compute and so on. Such metadata is built time to time with time reference using CASE tools. The case tools help to build data dictionary. Metadata is stored in data dictionary.

### ***Control Metadata***

The Control Metadata is used by the system to produce Data Warehouse. This data is used to manage and control the process of Data Warehouse creation. For example, data hierarchy is a metadata which is required to control the business data entry into the warehouse. This control metadata is often sourced from data dictionary. The second source of Control Metadata is infrastructure of the warehouse. There is a metadata for warehouse design which explains the business data definition, its description, scope, usage, etc. in Data Warehouse.

### ***Usage Metadata***

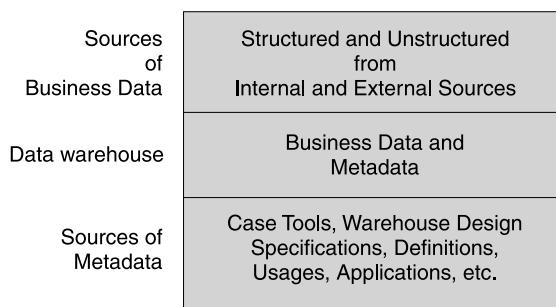
The users of Data Warehouse require this. This metadata is sourced from Data dictionary. The usage metadata describes the use and application of the business data, in business management. The business data is correctly valued and perceived, if its definition, usage and application is known to the user of Data Warehouse. The usage metadata explains business data

in terms of its meaning in the business data structure in terms of picture, size, and used for which applications. Table 19.2 give the examples of metadata.

**Table 19.2** Examples of Metadata

<i>Metadata</i>	<i>Examples</i>
Business process	Definition of business terms and its use in function and so on. Excise, LC, Payment voucher. Definition of business process and its relationships with other processes. Invoicing and accounting.
Organisation	Hierarchy, Roles and Responsibilities of personnel.
Application	Definition of applications and procedures. Definition of reports and processes behind them.
Data	Data input and models used and applications. Data groupings: Quality and value, Product and Market segments; Vendor and Performance. Data derivation rules. Data quality information. Translations of codes and abbreviations.

The correct and precise knowledge of metadata is necessary to design a Data Warehouse and to ensure its correct usage. The scope and content of Data Warehouse is given in Fig. 19.4.



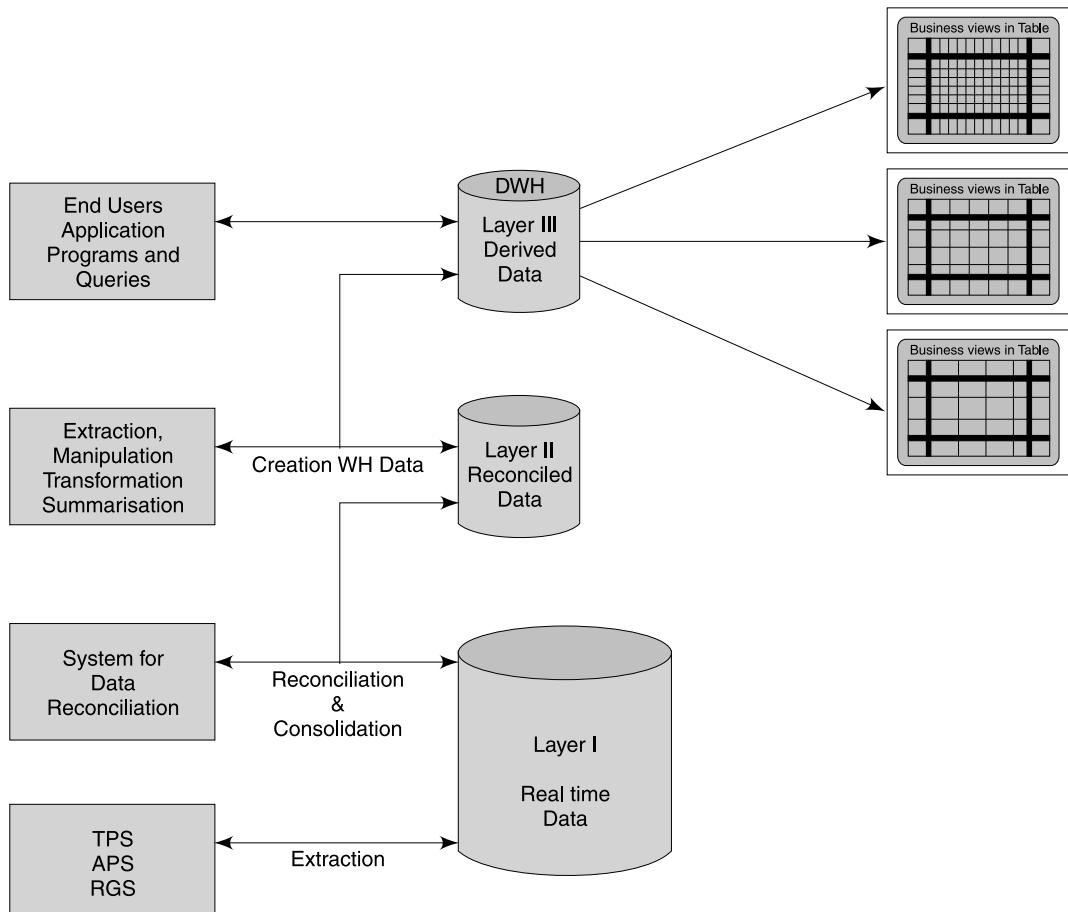
**Fig. 19.4** Scope and Content of Data Warehouse

To summarise, the business data could be structured or unstructured and sourced from internal and external sources. The data needs to be operated through various processes of data manipulation and control before it assumes the qualifications of business data in Data Warehouse. Metadata is used extensively to generate the quality business data for Data Warehouse. The processes and systems used to extract data from various sources are chosen and designed giving due regards to metadata. This ensures the quality of business data entering Data Warehouse and user of the Data Warehouse is assured of correct application of the business data.

## 19.3 ARCHITECTURE OF DATA WAREHOUSE

### Conceptual Data Architecture

Three-layer architecture is recommended for efficient Data Warehouse creation. It is useful and supportive to first meet the needs of IS department to maintain the Data Warehouse and also to meet the data access needs of end users of Data Warehouse. The three-layer architecture is shown in Fig. 19.5.



**Fig. 19.5** Three Layer Architecture of Data Warehouse

In three-layer architecture, layer-I builds real time data; using Transaction Processing Systems (TPS), Application Processing Systems (APS) and Report Generation Systems (RGS). This data buildup is done through different systems working in the organisation on different platforms and designed to meet specific functional of information of the end users. At layer-I, data is created which is of business interest and has a strategic use through Data Warehouse.

Such data then needs to be put to scrutiny from the angle of content, scope, definition, intended use, etc. Since data are coming from different systems operating within organisation and outside organisaiton, it is necessary to reconcile the data in number of ways to make it eligible for Data Warehouse processing.

Some data would need reconciliation on time lines. Some data may need some manipulation as definition and scope is inconsistent to the business data intended to be in Data Warehouse. The data definition in Data Warehouse model may differ from data definition in say two other applications from where it is sourced. Since Data Warehouse is a composite database of business entities, any data inconsistency arising out of two different definitions needs to be reconciled before entry into Data Warehouse. For example, customer data from customer table in order entry system and customer table in invoicing systems needs to be reconciled and rationalised before customer data is taken into the Data Warehouse.

The reconciling step takes data from multiple, heterogeneous, distributed systems, and combines and enhances it into a single logical image of a business data as defined into Enterprise Data Model. In this step, no new data is created but available data is treated for inconsistencies and irregularities. The purpose of reconciled data is to offer single, definitive authenticated business data for use by the end users of decision makers. In this step extensive use of metadata of a data is made to develop reconciliation process as an application.

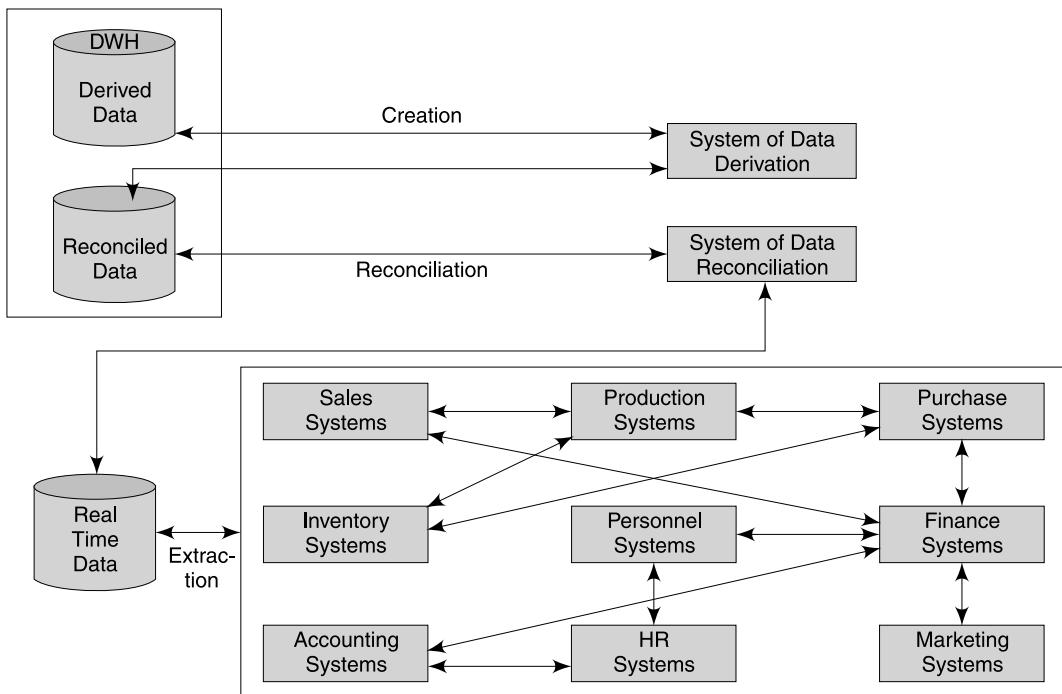
Another important factor, which is handled in reconciliation step, is rationalizing the data from various sources on time scale. For example one application gives month end data and other application gives weekend data. Now, Data model in Data Warehouse requires consistency on time scales for two data coming from two different sources. Month end definition is 30 days for the month but weekend definition is 7 days a week, which may cross over in the next month. This would cause inconsistency while comparing or combining the two data sets from different applications. The reconciliation process will add or delete data from weekend data to match end of the month status required in Data Warehouse.

After reconciled data is available in layer-II, it is then used to derive business data for use of various end users and decision makers. The derived data from reconciled data is not based on random selection, but it is derived based on the most commonly asked queries in the business. The commonly asked queries may be from individuals, departments, group of departments, group of users. Most of MIS reports required by these users can easily be generated using data in derived layer. Such Data Warehouse is very handy and very quick in response in producing the MIS reports. The reason for quick response is most of the processing for searching, accessing, matching, computing and reconciling is already done while creating the reconciled layer.

### **Logical Data Architecture**

The real-time, reconciled and derived data layers are conceptual and each of these layers have physical counterparts. Figure 19.6 shows logical data architecture.

Data Warehouse is the physical realisation of the real time data into a derived data. The scope of the Data Warehouse includes reconciled data and derived data. The derived data is a business information while reconciled data is a business data. Business information is higher in value compared to reconciled data. Derived data is ready for view and reconciled data is ready to use for certain application requirement.



**Fig. 19.6** Logical Data Architecture

Like reconcile data, Business derived data (Information) is detailed in content and modeled on the line of Enterprise data model. The user then normalises it for quick application.

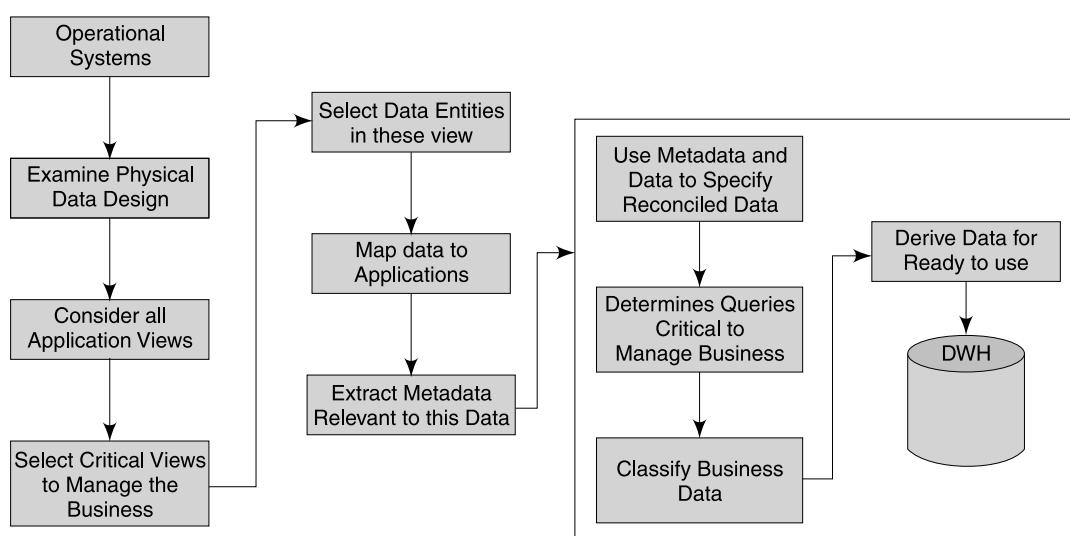
Data Warehouse is implemented as RDBMS. It can reside on single server or can be distributed at different locations. Data Warehouse management will be central through DW master or DBA. Since, Data Warehouse contains business data and information which is strategically important, it needs to be secured from unwanted unauthorised exposures. Hence the management and DBA has to decide which data/information should be on-line and which should be put in archives, for authorised users in the organisation.

When it comes to use of data from external sources in Data Warehouse along with data sourced from internal operational systems, the principles applied to internal data to conform its eligibility to be in Data Warehouse are also applied to data from external sources. The only difference between the two is, internal data indicates business performance within the organisation and external data indicates performance and prospects in the market place. The information support for strategic decision making calls for inclusion of data from both the sources. Since, data from external sources has critical application, it should be subjected to some scrutiny as done for internal data and then further should be reconciled to data model designed for internal data. For example, sales information data model should also be applied to sales information of competition products. Major difficulty in achieving this is very little knowledge of metadata of data from external sources. It is therefore necessary to educate users on this aspect so that they understand and appreciate the limitations and implications of using this data for critical applications.

## 19.4 DATA WAREHOUSE DESIGN

Data Warehouse design process brings with the construction of Enterprise Data Model. The enterprise data model is build keeping in mind its application to build Data Warehouse. The objective of this step is to obtain high level unified view of data required for strategic decisions. Enterprise data model may first begin with the help of a generic model of the business. In this model all views on data required to manage the business are considered. It also takes into consideration a generic industry data model, if it exists and customise it to enterprise requirement.

Building Data Warehouse Design calls for bottom up approach to use of data in Data Warehouse. Figure 19.7 explains the process of reaching Data Warehouse Design Model.



**Fig. 19.7** Process Flow of Data Warehouse Model

A detailed process of building the design is explained in the following points.

1. Build Enterprise Data model which specifies the need of data in terms of form, content, period and its application to manager the business. The data in data model therefore is common to any business view across the levels in the organisation.
2. Locate operational systems which are more appropriate from where data can be sourced to build Enterprise Data Model.
3. Identify critical applications, which are necessary to manage the business.
4. Select low-level data entities which when processed, build the critical view of an applications or function.
5. Identify related metadata which describes the data used in critical view of the function or business.
6. Map data and metadata to applications from where they would be sourced.
7. Get into the process of building reconciled data for subsequent generation of derived data.

8. Determine most sought queries from the organisation and process them to produce the results known as derived data which would show instantaneous status of business based on preconceived view of the business.
9. Then clearly define the reconciled data and derived business data for storing into the warehouse. Use DBMS to put derived business data in Data Warehouse.
10. The design techniques used in Data Warehouse creations are essentially three, enterprise data modeling, reconciling on time scale, and data replication.
  - Enterprise data modeling technique defines the data which is common for all business and stipulates agreed view for common understanding of the end user.
  - The reconciling techniques using time dimension of data are useful for viewing the performance of the business on the time scale.
  - Data replication is a technology for taking data from one source with time stamp to other location. It is a set of techniques that helps to copy and transfer the data from source to target location without losing its consistency and integrity. The replication process is a scheduled one and as far as possible it is system triggered.
  - Populating the Data Warehouse, after capture, conversion and application of operation data, is done through DBMS. Archiving and retrieval are the basic processes used in managing the Data Warehouse.
11. Most important after data modeling is to decide on data capture from various sources. A static capturing method collects data once which is time independent. The methods of capturing the increment value in data due to change in the data source are also available. Application assisted capture is the one where data set changes across the file due to a processing of application. Triggered capture is the process in which the data is moved to Data Warehouse when certain conditions are met. Time stamp based capture is the process of triggering the capture at predetermined time. It could be daily, weekly or as decided.
12. The process of putting data in warehouse at appropriate place is executed through a separate application. It is executed through the following steps.
  - Load the new data replace the old.
  - Append the incremental data to the last up-to-date. For example monthly sales data is appended in month table of sales in Data Warehouse.
  - Merge new data into the old one either through constructive merge, where data gets added to the existing set or through destructive merger where when the data key matches, the data is replaced. Where it does not match it gets added.

## 19.5 JUSTIFYING THE DATA WAREHOUSE

The traditional justification approach for any investment is to prove that Return on Investment is attractive. Essentially, it revolves around savings and benefits, which would be realised from such investment. Implementation of Data Warehouse does not eliminate jobs. It helps to save the time of high priced manpower which is normally wasted in searching, retrieving, processing data required for decision making. Hence, the same manpower is available for

better quality of jobs in the management. Data Warehouse therefore improves the productivity of end users. With the Data Warehouse in place, following problems are solved.

1. There is no difficulty in finding and accessing the data as business data is available in 'ready to use' condition in Data Warehouse.
2. An interpretation of business view is a problem due to different data dictionaries used in application system. This problem is eliminated as business data in Data Warehouse is to be interpreted with Enterprise Data Model. Hence, interpretation of business view is only one by all end users.
3. As Data Warehouse design considers data from internal and external sources, the difficulty faced by users to match the data from various sources, in absence of Data Warehouse environment, is no longer there. The reconciliation process while building the Data Warehouse sorts out these problems of data mismatch, multiple copies of data and different names for different data sets with references to different time periods.
4. The quality, accuracy and consistency of data in operational systems developed and maintained by different people is always a problem. Data Warehouse eliminates these issues. Hence, end users find the use of business data from Data Warehouse more safe and reliable for strategic decision making.
5. Data Warehouse enables and users to take the business view of their choice as against IS department views provided by predetermined MIS reports. The flexibility in viewing with speed and quick response is single largest benefits to the end user.

In short, the support, cost and time required to produce a business view for end users has gone down considerably with Data Warehouse implementation. In mathematical terms, value of information is greater than incremental cost of building a Data Warehouse application.

Apart from increase in productivity of end users, the Data Warehouse in number of cases has helped to find new ways of competing through building new and radical competitive strategies. With superior quality of business data in Data Warehouse, more correct and focused business view is possible bringing along knowledge of changed business environment. This means better understanding of critical areas of business forcing application of management effort into key result areas of business.

The Data Warehouse normally is justified in competitive business environment. The businesses, which are driven by customer expectations, justify investment in Data Warehouse. All service industries where customer satisfaction is a critical success factor, work with Data Warehouse to evolve different service strategies to please the customer.

In comparison with difficulty in assessing the benefits of the Data Warehouse, estimating the cost of Data Warehouse design and development is simple. There are three major costs, data storage cost, processing cost and development cost.

- Data storage cost is dependent on the data volume stored in the warehouse, its period and level of details.
- Processing cost is sum of the cost of data extraction, filtering, validating, computing, aggregating, reconciling and pre-processing for standard queries of most of the users.
- If data is sourced from external sources, cost of procurement and cost of data handling is the additional cost.

- Development costs for Data Warehouse are variable depend on quality and readiness of the operational systems and applications to throw the data for incorporation in Data Warehouse. It may require installation of new platform, hardware and software and also modification of the existing systems. This would be the additional cost. The major components of development costs are analysis of existing systems, cost of development of methods for extraction and reconciliation of data and populating the warehouses. The development costs include cost of requirement analysis to ascertain the need of business data to manage the business, building Enterprise Data model for Data Warehouse and bridging the gaps in metadata and base data to ensure quality of business data in the Data Warehouse.

In general the key to justify the warehouse lies in specific business advantage arising out of strategic analysis of a business situation and evolving competitive strategies to have edge over the competition through offer of better quality service and level of satisfaction. This assessment is often qualitative and intangible in nature. The costs are relatively easier to estimate. The management in competitive business justifies the need of Data Warehouse for its business benefits in the long run, and does not spend time in justifying the need of it. In such businesses, Data Warehouse development and its use is an act of faith, believing that investment will show a return sooner or later in a reasonable period.

## 19.6 ORGANISATION AND MANAGEMENT OF DATA WAREHOUSE

Data Warehouse is a subject generally taken up for consideration after major and critical operational systems and business applications are successfully implemented in the organisation. The purpose and need of Data Warehouse is to help in managing the business. It is essentially developed for senior managers who continuously seek varied information cutting across the organisation. this being the case, apart from IS and IT specialists, the business analyst is required to be a part of special team formed for development of Data Warehouse. The Data Warehouse project is a team effort. The team members and their roles are as given.

### ***Project Manager***

Project manager is responsible for design and development of Data Warehouse. The person should be from the business management group performing at a senior level and should understand the business of today and that of tomorrow. His exposure to information technology and tools should be adequate to play a role of leader in this project.

### ***DW Architect***

DW architect is a technical person on the team who has good understanding of RDBMS, ORDBMS, Enterprise Data Modeling and knowledge of complex application development tools. He should have good communication skills to justify the technical needs of Data Warehouse. His knowledge of existing and planned applications and infrastructure tools has to be up to date.

### ***Business Analyst***

Business analyst plays the role to provide the inputs for business viewing and its interpretation, qualify the business data entering in Data Warehouse and throw light on its futuristic

use by different end users. He should have undergone training in strategic planning and decision making in competitive business environment.

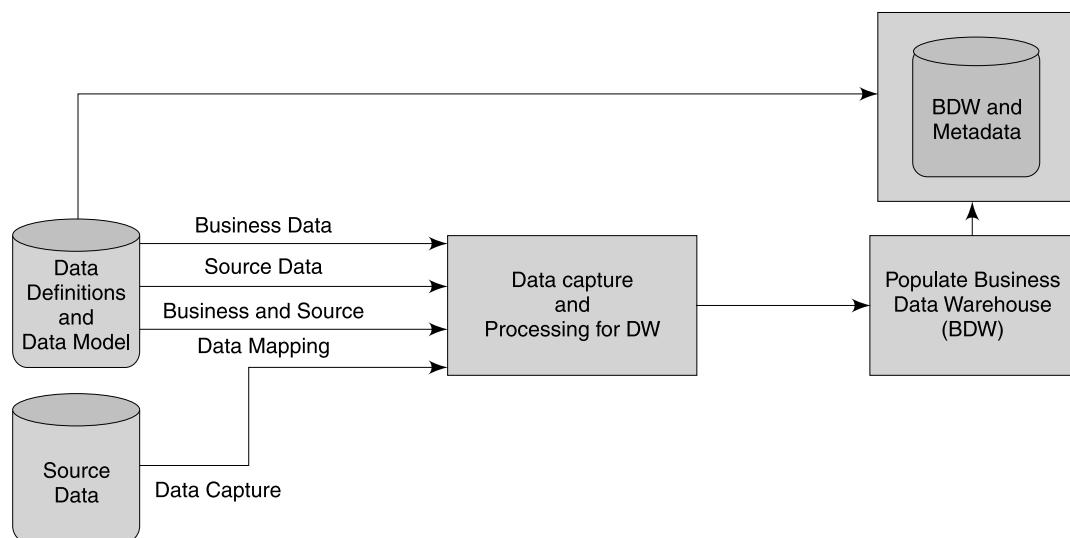
### **DW Developers**

DW developers are in the team to design processes to take up data from various sources and make it ready as business data to be in the warehouse. Their role is similar to a software engineer or programmer in application development.

The team of DW Architect, Business Analyst, DW developers will be led by a steering committee consisting of Business Managers responsible for conducting the business in critical areas of business. They handle key result areas. They would be guiding the Architect and Business Analyst. They will also ensure that required business data in the warehouse is available from operation systems and business applications. The steering committee members will justify the need of Data Warehouse for its business benefits.

The project management team essentially deals with the following.

- Establishing the need of Data Warehouse with justification.
- Define enterprise-wide information need to manage business.
- Build enterprise business data model for end users.
- Determine the operational systems and applications, which are the source for enterprise data. These are the sources from where data will be processed for populating the Data warehouse.
- Ensure the availability of metadata for the business data in Data Warehouse.
- Design processes of extraction, validation, reconciliation, computation, aggregation and transformation of data sourced from internal and external systems.
- Map the source data to business data in the warehouse.
- Populate the Data Warehouse backed by processing schedule.



**Fig. 19.8** Process Model to Build Data Warehouse

The detailed steps in Data Warehouse creation and management process are given here, which when implemented give good performance of Data Warehouse.

- Build business data definitions for the data/information intended to be in the warehouse. The definition states location, format, access method, fields with qualification of key or other.
- Build source data definition with the same detail as that of business data definition.
- Obtain basic metadata of a sourced data for use in conversion or transformation process and for use in Data Warehouse.
- Map the data in warehouse to source data. Mapping is done by defining the relationships between data and fields within it, vis a vis data in Data Warehouse. The definitions clearly define choice, rule, application and process which converts source data to business data in warehouse.
- Build the process management steps to take source data to Data Warehouse. These steps are necessary as means, for sequencing various inter-linked steps in a larger process of building a Data Warehouse. Main step in the process management is data replication. This is required to take data from multiple locations being created in different applications. Instead of reentering data from various locations, data is replicated to the main system after executing necessary validation checks.

Replication eliminates the errors of duplication and ensures the validity of the data in terms of time, content and definition. In order to execute replication effectively following steps are necessary.

- Process schedule specifies series of tasks and decisions to be initiated repeatedly or just once, at regular intervals such as daily, weekly, etc.
- Process Map Definition shows each process of replication, tasks and decisions in its order of execution to automate the process of replication.
- Task initiation is done on various platforms at different locations to acquire the data through replication process. A support is necessary to trigger the task and to know its status during the execution cycle.

Data transfer is required to support replications. When source data and would be business data are residing on different physical platforms, the data transfer functionality is required to send messages between various components of Data Warehouse processing. Following requirements are stipulated while data transfer takes place.

- Support to hardware and software to send and receive the transfer.
- Asynchronous and synchronous data transfer.
- Transparent data transfer mechanism.
- Support to ensure the delivery times.
- Full error recovery mechanism.
- Status seeking whether transfer is complete, in progress or pending or a waiting for some action.

Since Data Warehouse holds sensitive data, the security assumes paramount importance. The security needs for the warehouse are functionally the same as are for any database environment. Security needs of Data Warehouse are as mentioned.

- Security features of DBMS are assumed to be provided in Data Warehouse management as well.
- Since, Data in warehouse has a business value and is interpretable by the end user, it needs to be protected from unauthorised access, sharing and usage.
- Data Warehouse generally should be accessible to user for read only under certain conditions. Access control can be exercised through selective access to rows or columns as a subset of the larger table.
- Access to warehouse should be restricted and limited to analyst or administrator of Data Warehouse.
- In general access rights and authorisation rules must be strictly imposed.

The reliability and authenticity of the data and information warehouse will be a function of the reliability and authenticity of the warehouse and the various source systems that it employs to get the data and information. It is dependent on the type of security net which is put around the systems which creates the DWH. In data warehouse environments specifically, there is a need to ensure the integrity of data first by having procedures to control

- the movement of data to the warehouse from operational systems
- and second by having controls to protect warehouse data from unauthorised changes.

## 19.7 IMPLEMENTATION OF DATA WAREHOUSE

Though sufficient tools are available for each process involved in the design and development of Warehouse, the subject is complex and requires participation of senior management and IS personnel. In practice Data Warehouse conceptual model could be for the enterprise as a whole, however it needs to be developed in stages to ensure its success and business benefits. So, the implementation of full Data Warehouse would be in stages, starting with warehouse initiation project.

This is done through segmenting the Data Warehouse in smaller components. This means defining high-level enterprise model and enterprise data. Model the subsets of the bigger model keeping in view the feasibility of data capture for Data Warehousing. The subset should have its own clear source options and business data which it would create must have business information value for strategic application. The subset could be visualised as critical area of business, critical management application, affecting key result areas and so on. The steps involved in staged implementation are following.

- Establish infrastructure namely DBMS, extraction, replication tools and report writers.
- Model that enterprise data from logical structure to physical structure.
- Prioritise the business data need and segment the enterprise data model matching to this need.
- Determine sources of data from internal systems and applications which need to be handled as stated earlier. Simultaneously, collect the metadata about the data being considered for processing in Data Warehouse.
- Model the business data at both logical and physical levels.
- Design and develop queries and procedures to view the data or process the report.

- Finalise and implement security aspects and release the security code to the end users on the installation of Data Warehouse.

To get a better start on the project; it is better to initiate a preparatory project to get everybody in the organisation to understand the why and how of the Data Warehouse. Following activities are carried out.

- Obtain necessary management approval to undertake such project.
- Initial exploration and education on data warehouse for the key people in the organisation, that is key decision makers and key and users.
- Build a small Data Warehouse pilot. Present the same to the concerned people to justify and convince the need of it.
- Obtain the approval for building enterprise Data Warehouse.
- Go for Data Warehouse requirement definitions. This essentially means studying existing business strategies and business scenario. Looking for changing needs of strategies in emerging scenario and the kind of business data which is now necessary to build new strategies. The managers and decision makers holding key positions in critical business functions should be able to envisage what are their business data needs to cast new strategies.
- Having ascertained the business data needs with enterprise wide data access, next steps is to go for high level enterprise data model.
- Obtain the approval for enterprise wide data model which will form the basis of designing Data Warehouse. This approval could be obtained by presenting the case for enterprise data model and its benefits.
- Prepare a road map to build the Data Warehouse with stages to obtain the benefits as it gets implemented. In this road map following topics should be dealt with.
  - Executive summary on business needs of Data Warehouse.
  - Note on business strategy, current and future.
  - Data Warehouse architecture. Explain three layer architecture (Operational data, reconciled data and derived data).
  - Inputs required and implications on existing information systems, operational and functional.
  - Potential areas of benefit and cost estimates considering hardware, software and tools.
  - Data warehouse design, development and implementation schedule.
  - Project team approval by the management.
  - Communication directive from the management to go ahead on the project.
  - Launch the project.

The critical success factors for successful conclusion of Data Warehouse project are the same as that for any information systems project. It requires long term commitment and involvement of key business managers whose business data needs will be served through Data Warehouse. A pragmatic and staged implementation plan ensuring the success and assuring the benefits is necessary. The sound understanding of existing information systems

supplying operational data for data warehouse is necessary. The architect and developers must have mastery on related technology and tools for their effective application in building the Data Warehouse. Training the end users for using the Data Warehouse for fulfilling their business information needs and expectations is absolutely necessary. The point is Data Warehouse makes them self reliant to meet their needs. They are not dependent any more on IS dependent to process their information needs. This is a cultural change. Hence, training in tools like report writers, spread sheets and SQL is necessary to exploit the benefits of Data Warehouse.

### **Looking into the Future and Guidelines**

Data Warehouse is described as a logically single and ultimate source of all business data required for complex, strategic decisions. It is same for all users of the enterprise. Most of the data in Data Warehouse is from internal sources and from operational systems. This data is highly structured, and permits analysis and viewing of this data only. As technology is advancing and internet is coming in big way, access to external sources is going to be easy. The data from external sources would be unstructured and may not interface properly with internal soured data model. The technology being there, it is possible to download this data and put in Data Warehouse, giving altogether different picture of business to the end user.

With internet technology, it is possible to conceptualise inter-enterprise data warehouse to share the information. It is now possible to enhance the scope of enterprise model to different Strategic Business Units (SBUs,) subsidiaries, sister companies and so on. With intranet in place in these organisations and with the assistance of internet it is also possible to source data from operational systems of these organisations to be put in the Data Warehouse.

With internet technology and mobile computing it is now possible to access Data Warehouse from remote locations. The effort of sourcing data from various sources will reduce as access will be available to individual Data Warehouse residing at different locations. So emerging scenario consists of distributed Data Warehouse made of different Data models available to end users for interaction.

General Guidelines and Points to Remember are the Following.

#### **(a) Data in Data Warehouse**

- Justification of Data Warehouse should be with potential business benefits due to improved vision of the business, enabling you to make better strategic decisions.
- The utility of Data Warehouse is higher, if it provides consistent and well defined business data, needed to manage the business as a whole.
- Data Warehouse needs to be packed with historical data and current duly reconciled and validated enabling the end users to take different views.
- Where possible, technology provides access to data products such as images, audio and video, enhancing, the utility of the Data Warehouse to a great extent.
- Understanding of business data in Data Warehouse will be poor, if it is not supported by metadata which describes the meaning and structure of business data, how it is created, accessed and used.
- The cost and time of Data Warehouse development will depend on number of sources from where data is extracted and up to what level it is processed to assume the qual-

fication of business data required to manage the business. The best architecture for Data Warehouse is three layer, real time data, reconciled data and derived data.

### **(b) Processing for Data Warehouse**

- Ownership of business data in Data Warehouse should be distinct from ownership of data in operational systems. This is necessary as the users of the data are different and have different role responsibilities in business functions.
- Enterprise business data model offers accurate and meaningful business data definitions, data structures and differences in the meaning due to different sources of the data. What is true for data is also true for the business processes which use this data build different business views, whole or part and further helps to interpret the views for strategic decision making.
- The data sourced from external sources should be put to through acceptance tests to get entry in Data Warehouse. This is more necessary because metadata of such data is not always available.
- A stored procedure to trigger should be built for automatic update to Data Warehouse. When data changes its value and character the frequency of update is influenced by the utility of the data in Data Warehouse to manage the business.
- Statistical data processing techniques should be used for data cleansing to improve the quality of base data for conversion to Data Warehouse.
- Enterprise data model should be complete for whole organisation but Data Warehouse should be built in stages starting from critical business areas first such as sales and marketing, production, etc.
- Standard MIS reports are not replaced with the Data Warehouse implementation. In fact more enterprise wide picture is available from MIS reports processed using Data Warehouse.
- With Data Warehouse in place, on line analytical processing (OLAP) is more useful and fasts as compared to time when Data Warehouse is not built.
- Populating data warehouse is similar to creating and maintaining data base through DBMS.

### **(c) Project Management**

- Data Warehouse begins with base enterprise data model. But with change of business and change in the way business needs to be managed, Data Warehouse model would undergo changes to suit the new needs. Hence, it is not a static design but has dynamic character.
- A successful Data Warehouse grows in scope and application.
- A staged implementation approach is recommended for Data Warehouse development. It is similar to modular development of applications and integrate them.
- Project management function for Data Warehouse should be very strong.
- Data Warehouse pilot is a necessity to justify and train the users to understand and appreciate the purpose of warehouse.

- Keep the number of operation data sources small and the systems which provide such data must be stable and have fulfilled users expectations. This is necessary for meeting the success in installing Data Warehouse in the organisation. subsequently in stages, the scope should be expanded by adding more sources.
- Long term and committed management to the goal of installing a Data Warehouse is absolutely necessary.
- IS department or group should act as a facilitator or resource person for the project. The project should be lead by senior manager of critical business department who will be the biggest beneficiary of the warehouse.
- Data Warehouse should have internet interface to make it web enabled, whereby some external data can be linked and viewed along with business data in the warehouse.

### **Process and Manipulation of Business Data**

When Data Warehouse is built it is available enterprise wide for viewing and application. The viewing of data and its application first requires access to the data and series of active steps to convert the accessed data into information. In order to use business data for generation of business information, the user must have means of selecting, manipulating and displaying data in business terminology. Table 19.3 shows the steps involved in converting business data to business information as an example.

**Table 19.3** Steps: Business data to Business Information in DWH

<i>Steps</i>	<i>Outcome of the step</i>
1. Define the business need	Market share profile over last three years by month in domestic and export markets.
2. Selection of a data set	Monthly sales data from sales application and total sales from external sourced data set.
3. Select corresponding metadata	Definition and specification of sales; cash sales, credit sales, export and unit of time
4. Manipulate the business data for market share	Pair the data of sales in domestic and export market and summarise the sales for cash and credit and make the grand total. Reconcile with time.
5. Structure the information for better viewing	Construct a table showing total sales by month in domestic and export market along with total sales in the market. Arrive at a ratio of sales to industry sales in domestic and export market.
6. Presenting the information in graphs	Plot quarterly average sales and industry sales in domestic and export market.

The success of Data Warehouse lies in the users ability to use different tools of selection, transformation and manipulation of business data to view it as business information. The standard queries supported by spread sheets, report writing tools and presentation tools will make Data Warehouse a useful decision support tool. There also are called user interface for business information built up. The popularity of Data Warehouse largely depends on whether these tools are available to users to pull the data and view it as they wish. The benefits of Data Warehouse are largely realized by making these tools available to the users whose role is to manage business with strategy development and management.

## Query and Reporting Tools

These tools are built to satisfy the need of viewing the subset of business data to meet a particular business information, such as market share, vendor performance corporation, cost and quality matrix for critical material, etc.

## Data Analysis and Prediction Tools

These tools are available in two varieties. One is statistical which helps to compute averages, standard deviations, curve fitting and so on. The other set of tools are spread sheets which help you to structure the data in tabular format using business rules and helps to present the data in graphical form. Data analysis and prediction tools help you to look for underlying pattern or trend in any business aspect. It also helps you to ask questions and then helps you to find answers by going through different analysis of the same data for additional data. OLAP (On Line Analytical Processing) is a tool very handy for analyzing data which has following characteristics.

- Large volume of data.
- Consolidation upward and drill down is necessary to search a meaning.
- Dynamic viewing and analysis of data from different perspectives using complex relationships.

OLAP is particularly useful when user wants business data analysis multi-dimensionally. For example sales analysis is required on time, zone and branch organisation as dimensions.

When you build a Data Warehouse for the organisation it is an information asset for the top management. Most of the Data Warehouse are of large size storing business data for strategic use and multidimensional views. The query and reporting systems help to know the status of any business subject. OLAP systems provide multidimensional analysis of any business subject.

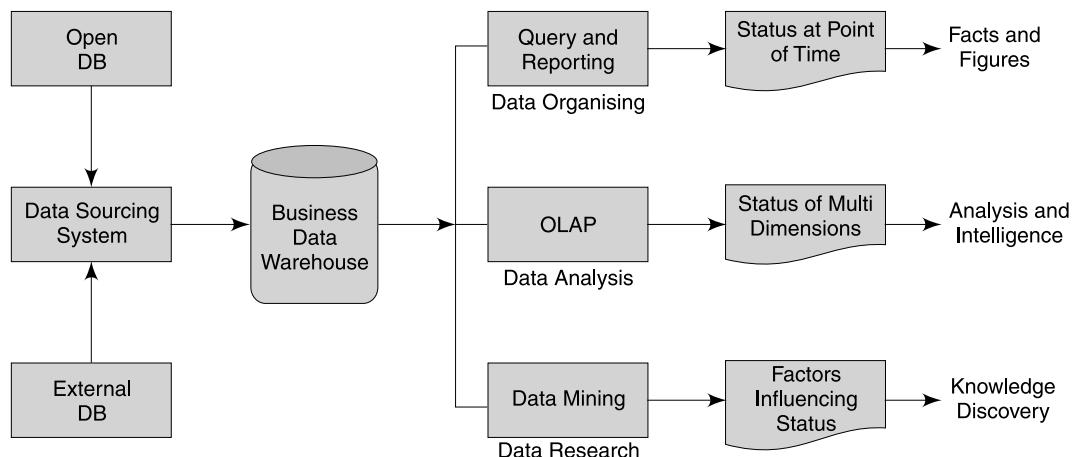
## Data Mining for Data Warehouse

Data Mining is a third tool available to the top management to make impact analysis of factors and relationship. Data mining tools help to unearth underlying patterns in the business and factors influencing these patterns. Figure 19.9 shows the role of different tools in Data Warehouse application.

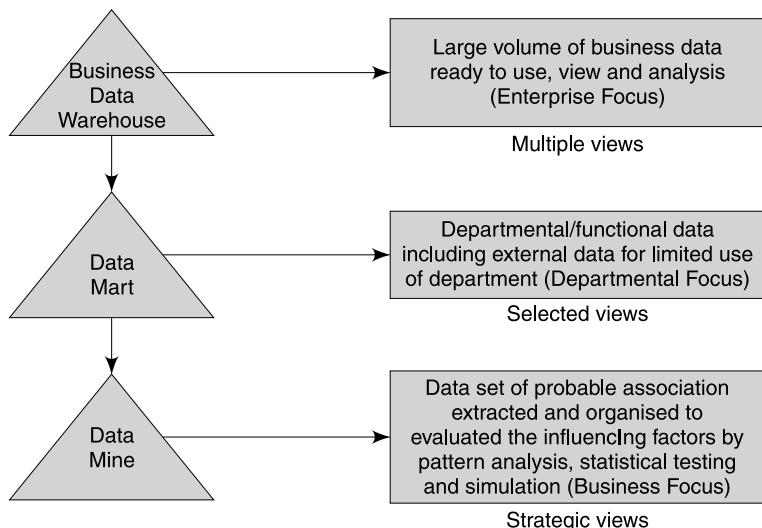
Data mining solution provides capability to build prediction model. It helps to discover association and sequential patterns in the business data. For example through a data mining application we can discuss a pattern of sales linked to time and some influencing factor. It is not possible to see such a pattern unless we visualise the possibility and mine the business data from warehouse and test their association.

Data mining tools help you to research into warehouse data to confirm the pattern of trend and also in some cases helps to discover the pattern itself. Such research adds to knowledge of the decision maker, making him strong in decision making. Data mining helps to get insight into underlying business complexities and its behaviour and with this knowledge, decision maker knowledge gap is reduced.

There are three separate components of enterprise data warehouse, the Data Warehouse, data mart and data mine. Figure 19.10 shows the difference between these three components.



**Fig. 19.9** Role of Tools in DW Application



**Fig. 19.10** Data Warehouse, Data Mart, Data Mine

Data mining focuses on business and/or some aspects of business where knowledge about the business is lacking. During the course of analysis, viewing and querying, if some findings are unexplained, then data mining will help to unearth why and how the particular scenario has emerged.

### GIC Mutual Fund: An Illustration

GIC sells units to the general public who are then known as unit holders. The money collected from unit holders is invested in shares and debentures. The small investors are expected to maximise their return on investment in mutual funds.

GIC views its investment in different angles to find out the performance of their investment in different options and whether unit holder's money is getting good returns or not. This calls upon GIC to process investment transactions and interest and dividend transactions to access the financial results and to know its highlights. But this does not help to develop strategies for improving unit holders returns unless it is further processed and viewed in different angles to ascertain and interpret whether GIC options for investment were productive. GIC continuously evolves strategy based on industry and portfolio analysis and manages unit holder's funds to provide rising income year after year.

Business Data Warehouse is built using transaction based systems and historical data and certain statistics in build-in Data Warehouse to view it in different angles.

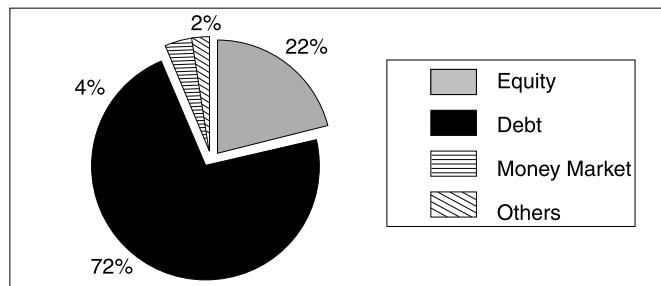
GIC's initial portfolio strategy of the scheme was directed by the objectives of the schemes, that is to generate rising income and capital appreciation. As a result the investments were directed towards index and non index based scripts with strong fundamentals and healthy growth potential. Hence, investment was made in debt portfolio of the schemes consisting of high quality, high yielding corporate debentures.

The investment in equities had been giving good returns in the earlier years of the investment scheme operations when share market remained buoyant. However subsequent volatility and investor apathy in the equity market gave rise to average low returns on the equity investments. Overall the assurance given to small investor was becoming weak calling for different strategy on the investment as known in different views. (View 1, View 2, View 3).

**View 1 Asset Allocation by Funds Market**

	(Rs. Lakhs)	%
Equity	3554	22
Debt	11547	72
Money Market	640	4
Other	342	2
Total	16083	100

Numeric view



Graphic view

Hence, a new strategy was evolved, whereby investment was required more in fixed income securities than equity. Accordingly strategic exercise of restructuring the investment was taken whereby investment in equity with no long-term growth prospects was taken out and was put into debt investment. GIC believes the larger exposure to debt will ensure steady income without seriously affecting the potential or capital appreciation.

GIC uses business data in Data Warehouse for analysing the portfolio investments and viewed it from different angles by company, by industry sector to re-strategies their investment approvals.

#### **View 2 Equity Portfolio by market value**

<i>Company (Industry)</i>	<i>Market Value (₹ Lakh)</i>	<i>% to Total</i>
Punjab Tractor (E)	278.95	10.51
Hindustan Copper Ltd (E)	187.88	7.08
L & T (E)	174.21	6.56
Reliance Petroleum (P)	143.30	5.40
IDBI (B)	139.80	5.27
HPCL (PP) (P)	139.62	5.26
Indian Oil Corp. (P)	135.98	5.12
Reliance Industries Ltd	114.19	4.30
Castrol (P)	97.58	3.68
National Fertilisers (P)	94.15	3.55
ICICI (B)	83.72	3.15
Tata Hydro (E)	83.56	3.15
ITC Bhadra (E)	81.04	3.05
HPCL (P)	80.47	3.03
Coats Viyella	75.75	2.85
Neyveli Lignite Corp. (E)	68.11	2.57
ACC (E)	67.64	2.55
State Trading Corp.	64.22	2.42
HMT Ltd (E)	59.99	2.26
Others —	484.10	18.24
<b>Total</b>	<b>2654.26</b>	<b>100.00</b>

\* E:Engineering and Product, P:Petroleum and Chemicals B:Banking

## **19.8 BUSINESS INTELLIGENCE**

Business Intelligence (BI) is all about converting a large amount of corporate data through processing and analysis into useful information and knowledge thereby triggering some profitable proactive business action or decision. Business intelligence environment is made up of business models, data models, extraction, transformation and loading tools (ETL Tools) needed to transform and organise the data into useful information and knowledge for storage and further analysis. To set up BI environment, skilled people are required who can understand business intelligence requirement at a point of time and know the right source of data and applications from where the data and information will be extracted to build B. Fig. 19.10 shows the BI Environment, process of generation of BI database.

## Business Model

Business Model explains business process, flow and connections between processes and data models used by them.

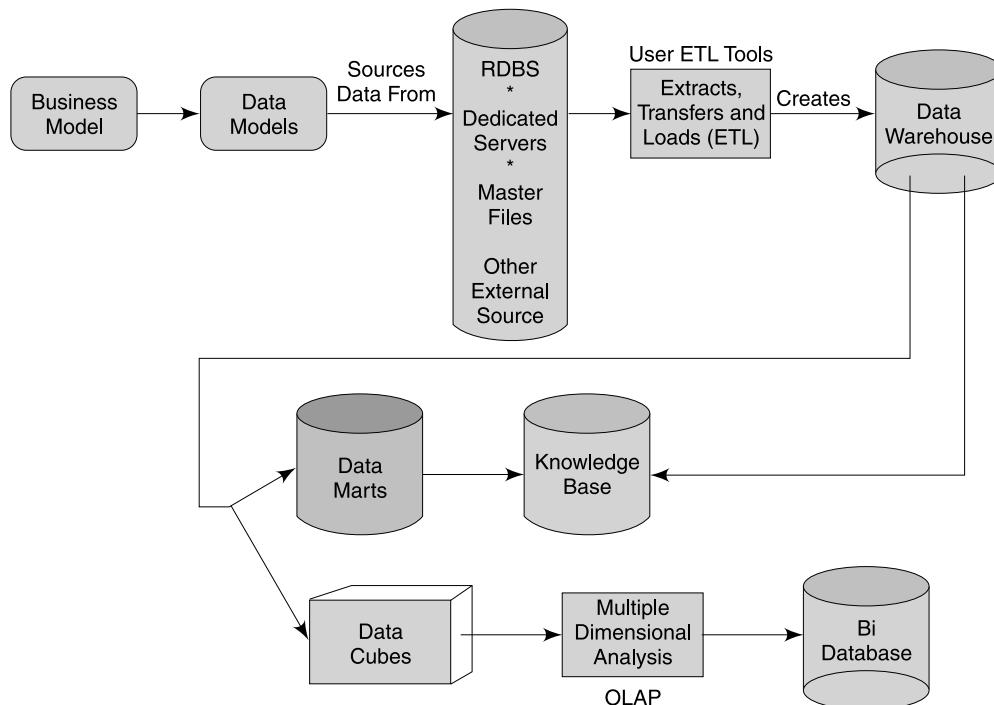
## Data Model

Data Model is all about representing the data and relations between them with specification. Data model explains data structure. Conceptual data model give a view of the overall data scope and model with no details. Logical model gives more details like entities, attributes and their relationship.

Physical data model gives representation to logical data model of entities in tables, columns, rows, properties and relationship among them.

Relational Data Model puts physical model showing entity – relationships in a database satisfying Codd's rules of data representation in database.

Once the data, information and knowledge is built it is used for dimensional analysis. Two things need to define. One 'Entity' and second 'Dimensions' to view the entity. You collect facts (data about entity) and dimensions of the fact. For example, sale for the month is an entity and dimensions are product, segments, markets, time, channels. So sale for the month are to be viewed in these dimensions. The facts organised in different dimensional tables then are used further to aggregate for summary results, which may throw light on some aspect or reveal a new development. Dimension analysis and modeling could be two ways or more ways.



**Fig. 19.11** BI Environment and Generation of BI Database

The process leading to BI begins with application of ETL tools, which extracts data, cleanses data, and organises it in data model after checking for validity and referential integrity for storing in data warehouse. Data warehouse is a centralised repository of such data. The next step is to build data marts. Data mart is a section of data warehouse on subjects like sales, production, and others for the functional or subject analysis. Data warehouse and data marts are used further to view data in different dimensions, in the three dimensions (cube) to throw light on subject's performance and behaviour. Once data warehouse, data Mart, knowledge base, data cubes are built, queries are built to see the contents of these bases, which is then termed as business intelligence. The different views are obtained through query and OLAP tools. The quality of B.I. Therefore depends on the person who has a vision of views and puts queries to extract data to get the view on a subject.

### **OLAP Tools**

OLAP, an acronym for 'Online Analytical Processing', is a technique by which the data sourced from data warehouse, data mart is visualised and summarised to provide multi dimensional view of the subject. Popular OLAP tools are capable of rolling up the data. For example, product sales can be summarised by rolling up the data in product group, then families by different dimensions such as segment, market and so on.

OLAP provides information-based intelligence. Business intelligence based on knowledge comes from data mining processes, which are similar to OLAP, but they unearth the knowledge through finding patterns, trends, and behaviour of the subject providing an action. Besides OLAP kind of analysis, data mining uses techniques like memory based reasoning, link analysis, neural networks and so on. OLAP records a view or problem; data mining helps to find the solution of the problem. For example, OLAP would reveal the customer class based on credit history and receivable performance while data mining would link it to knowledge whether the customer of a class is credit worthy or the order should be rejected.

## **19.9 DATA WAREHOUSE AND MIS**

With the rapid advance of information and communication technology, MIS defined, as the support to decision making has become a reality. The conventional MIS sourced its data from internal operational and appreciation systems and helped to produce MIS reports for operations and middle management. The MIS satisfied largely the information need to running the business but it lacked completely the support for strategic management of business. The strategic thinking was possible at the functional level and not at the level of enterprise.

The purpose of Data Warehouse is to convert operational data to a level where it can be used to manage the business in terms of long term requirement. The top management's need of information is strategic in nature. They are responsible to make decisions for growth profitability, diversification, expansion of the business which have a long term bearing on the business. These job calls for strategic thinking and evolving strategies to beat the competition, increase market share, identify new markets, assess consumer behaviour and decide on customer satisfaction strategies. This requirements can best be met by implementing Data Warehouse in the organisation.

### View 3 Equity Portfolio Sector Wise Allocation as on 30th September 1997

Company	Market Value (₹ Lakh)	% to Total
Oil	556.86	20.98
Auto	407.66	15.36
Diversified	360.62	13.59
Finance	254.64	9.59
Metal	196.53	7.40
Power	151.66	5.71
Textiles	143.76	5.42
Lubricants	97.58	3.68
Other	484.96	18.27
<b>Total</b>	<b>2654.26</b>	<b>100.00</b>

With Data Warehouse in place, top management gets distinct advantage over the conventional MIS and reputing systems due to following advantages.

- Enterprise vision through enterprise data model.
- Viewing business data in multiple dimensions.
- OLAP and data mining tools provide insight into patterns and trends in number of critical factors such as consumer behaviour, product versus market segment performance.
- Drill down to a level where cause and relationship can be found in a typical business scenario.
- It is possible to take enterprise view of data through Data Warehouse and functional view through data market.
- Report writers and SQL has made it possible to play with high quality business data to get on-line real time reports for quick proactive thinking and actions.
- It provides ability to see cross-section of the business data from internal and external sources triggering view ideas of business through the knowledge of potential opportunities.
- Data Warehouse enriched with business data gives better understanding of the business on multi-dimensions, product, people, markets, growth and gets competitive advantage.
- In short data warehouse properly visioned and designed provides business intelligence to the top management to decide on large term business strategies.

The conventional MIS model is slow in processing and can give portion view through static MIS reports as functions. It could at the most be use for better running of business operations but lacks quality and intelligence support for strategic management of business. The Data Warehouse and associated tools have overcome these problems and offer a knowledge platform for long term perspective planning and gives strength to top management to get a grip on management of business.

There are number of Data Warehouse applications which industry is using to get competitive business advantage. Some illustrations given here explain raw top management about the uses of Data Warehouse.

- Cell phone industry analyses user call behaviour and evolve pricing strategies, discount schemes based on the pattern of call behaviour.
- National stock exchange (NSE) warehouse provides trade intelligence which discovers unknown trading patterns and unexplained price movement which helps NSE in surveillance and other control functions.
- RBI use Data Warehouse to understand what influences money markets and to study individual banks, their position in money market and monitor the changes in their position. This helps RBI to evolve more intelligent regulatory mechanism.
- LIC has a Data Warehouse of millions of policyholders. The study helps them to analyse the business in terms of policyholders, their social status, duration of policies, popular policies, etc. This helps them to guide insurance agents as to concentrate for business.
- Railways use passenger and freight data to strategic resource planning, attractive freight policy. One the basics of traffic pattern, railways are in position to start holiday trains on selective routes.
- Airlines analyse passenger data in terms of flight, destinations and in flight needs to offer fare discounts and offer most liked beverages, meals and movies.
- Consumer goods industry uses Data Warehouse for product movement tracking and understanding cause and relationship between product, consumer and market segment to promote business in untapped market and to get more market share in growth market.
- Banks in credit card business offer variety of attractive schemes to card holders by analysing their buying pattern. This helps bank to increase credit card business volume.
- Entire service industry analyses customer data of ordering, delivery services demanded, etc. to organise internal resources to other quick responses to customer call. It helps them to work out service strategy on three dimensions, price, delivery and response.
- Hospitals and health care industry analyses data from the warehouse on patient, disease treatment, success and failure, patterns and incidence etc. to plan health care resources and there effective deployment, where needed most.
- Tourism industry analyses data in tourist traffic in terms of country, length of stay, number of visits, transport's preference and hotels to plan development of tourism business.

The examples are plenty and it is proved beyond doubt that Data Warehouse implementation adds intelligent in MIS building. In fact return on investment is far more with Data Warehouse applications due to business benefits it offers through superior management of business.

Toping of conventional MIS by Data Warehouse applications results into following benefits.

- Ready to use high quality high-end business data with multiple dimensions.
- Access to information in a business data through data replication functionality.
- Enables to reinvest the business and helps to highlight weak and strong spots in the business.
- Provides single information source and simultaneous distributed information availability.
- Customised decision support applications by end users without involvement of IS personnel.

Data Warehouse is a mandatory requirement of the business of 21st century. The business is now more vulnerable to competitors due to globalisation of business. It runs the risk of product or process obsolescence due to rapid technology advances. The top management now needs more information driven business applications, support of business intelligence, assistance of decision support systems using high quality data and on line real time business data for decision making. It requires high end analytical tools for processing multidimensional data to unearth business trends, patterns and new opportunities.

Data Warehouse designed with these requirements in time is an absolute necessity. The technology provides tremendous support in achieving this requirement of top management of the business.

## KEY TERMS

Database and Data Warehouse	Non Volatile and time Invariant Data	
Metadata for Data Warehouse	Data Warehouse	Raw Data
Data Mine	Data Mart	Reconciled Data
Business Intelligence	OLAP	View Data

## REVIEW QUESTIONS

1. Explain the need of Data Warehouse in modern business.
2. What is the difference between database and Data Warehouse in the organisation?
3. Explain three layer architecture of Data Warehouse.
4. Explain the following terms: Metadata, Operational Data, Business Data, Information, Business Intelligence and Knowledge.
5. Which processes are carried out to transform operational data to reconciled data and then further to derived data?
6. Which are the main three tools used in application of Data Warehouse?
7. Explain the terms Data Warehouse, Data Mart and Data Mine?
8. What are the benefits of Data Warehouse to the enclosures? What distinct advantage and users get when Data Warehouse is in place against the situation when it is not in place.
9. Which key factors are important in designing Data Warehouse? What role pilot Data Warehouse plays in implementation?

10. Why staged built-up of Data Warehouse is necessary? What distinct advantages the organisations gets in this approach of staged implementation?
11. Explain the role of Data Warehouse and Data mining in information support to strategic business analysis and management.
12. Explain DW and DM application in for coasting, diagnostics, and DSS, for high level strategic need of information support.

## LEARNING OBJECTIVES

- E-business: Organisation, Character and Processes
- E-business Infrastructure
- E-business Models for Business Applications
- Internet/Intranet/Extranet
- Web Applications
- Security Goals and Strategies
- Firewall and other Measures of Security

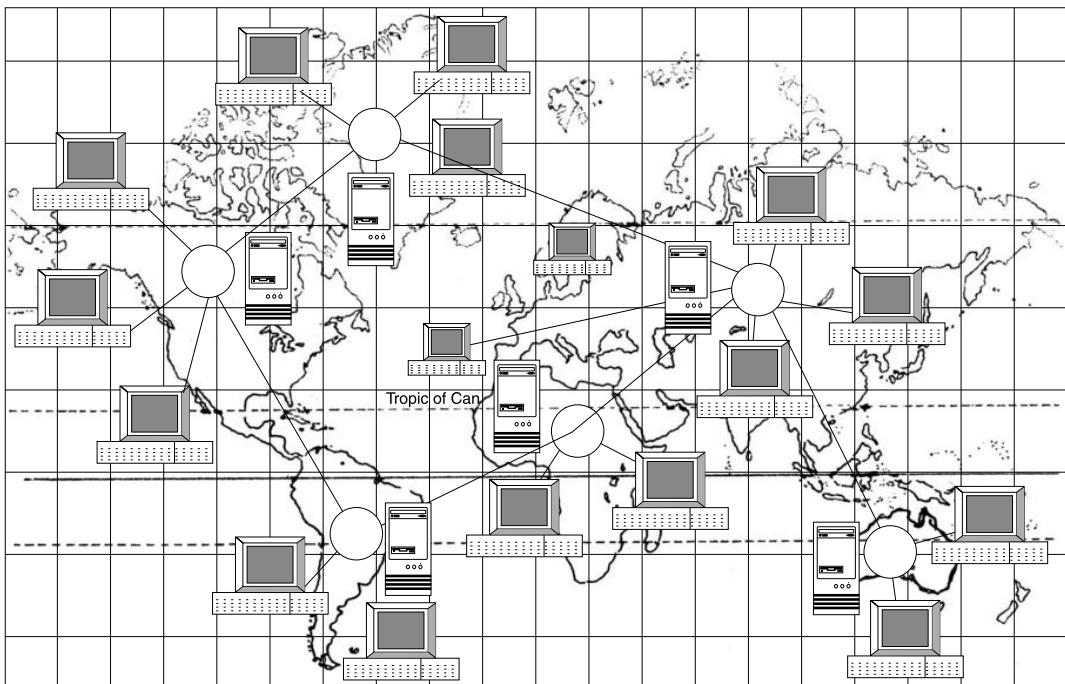
### 20.1 INTRODUCTION TO E-BUSINESS

One of the significant developments in the last decade of 20th Century was emergence and convergence of number of technologies, affecting the business in the style, culture and the processes of its execution. The four prominent technologies are Networking, Communication, Internet and Computing. These technologies put together helped seamless integration of systems, information sharing and delivery anywhere in the world, irrespective of the platform and the distance.

The E-business using these technologies changed the business scenario. The business suddenly moved from regional to global land because of access and reach of E-business. The business drivers shifted from capital and labour to knowledge. The products and services became more customised. The customers have become knowledgeable through web access and are in the position of configure their requirements. The business enterprise is now more virtual than physical. Figure 20.1 shows global business platform using different technologies.

E-business essentially means carrying out the business using electronic methods for business processes. E-methods using tools and technologies enable every process to run with greater speed, and precision in an automated manner, where decision making is embedded in the process itself. The E-methods transform the business from human driven to information driven where people play a role o knowledge worker.

In E-business, discontinuity of process marked with delays, on line waiting and storage is eliminated through on line integration of customers, partners, suppliers and employees.



**Fig. 20.1** Model of Global Business Platform and the Technologies

\*Technologies comprise Communications, Internet, Web, EDI, Workgroup, Information Technology, Video Conferencing, Multimedia.

It allows information sharing bringing transparency in business management processes. In E-business you may be anywhere in the world, but you are close to your business location, as access to information is possible from anywhere. In E-business you are like a mobile office available to anybody through electronic reach. In E-business you can access information, view it, download it for processing and upload it again for sharing with others.

The biggest beneficiary of E-business is the customer, who has access to information about the products and services and order it from any supplier located in any country. He has a wide choice to select from. The customer has become knowledgeable forcing the business to become customer centric.

The second beneficiary of E-business is the supplier or vendor who gets access to information on inventory, schedules, order status, etc. enabling to manage resources effectively to meet customer's, real time needs of raw material or services. Trusted vendors can become business partners without investing in customer's business when business is transformed to E-business.

In E-business environment, employees are empowered with intelligent support of DSS and information, making them more efficient and less expensive. They have access to distributed information from internal and external sources. The information is current, accurate

and available online to make business decisions. Their role has become more intelligent and responsive. The role of every employee is upgraded, as it is possible to play higher roles in organisation hierarchy. The work becomes collaborative due to use of workflow and work group technologies. The systems and applications have undergone architectural change, making them shorter in time, less resource hungry and faster in response.

When you transform the business to E-business you are making a fundamental change in the method the business is carried out. The first visible impact is that the business process becomes paperless. The messaging, ordering, receiving and issuing is made electronically making business operations dramatically efficient, and significantly less expensive. Any operation like order processing, scheduling and manufacturing, delivery, billing, payment, etc. is executed in a paperless way by coordinating number of activities across the organisation and outside through information sharing, messaging and electronic transaction processing.

In E-business, organisation structure crosses the boundaries of corporate structure. Through electronic channels of communications your key business partners become logically part of your structure, empowered by secured access to the relevant information. In terms of business and corporate law, they may be separate legal entities but when it comes to business relation, they are part of the organisation. In E-business environment, vendor, employees, transporter work for common goal of order fulfillment as promised by the organisation.

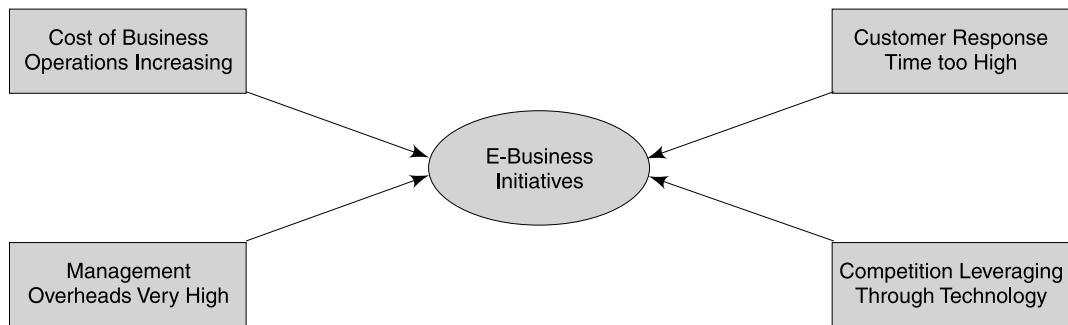
The business benefit the management gets with E-business is phenomenal. They have access to information on latest business status, be it order, deliveries, billing, receivables, lost orders, performance in terms of yield, profitability, cost and so on. Since, information support is accurate, they can watch the competitive position of the business vis a vis immediate competitors. The management is able to collect and analyse customer information, which throws light on pattern and trends in business forewarning the need of appropriate strategy implementation.

It also reveals business opportunities calling for new initiatives and strategies to exploit the opportunities. With customers becoming knowledgeable on the products and services needs and also expecting to get better service, most of the manufactures have lost on USPs, which they had created over a period of time. The only USP, E-business offers is fulfilling customer expectations in fastest way in least cost. The management, which is slow in transforming the business to E-business, will loose heavily and may not survive long.

Following are the characteristics of E-business.

- One global order management system.
- Global database, single or distributed.
- Paperless transactions.
- Customers select, configure the needs and enter their own orders.
- Suppliers manage your inventory.
- Dynamic order status — received, delivered and order balance.
- Collaborative working through Group-ware technology.
- Organisation works for 365 days, 24 hours a day.
- Business relationship with customer, vendor and business partner gets transformed to trust relationship.
- Employees become knowledge based intelligent workers.

- A management and operations overhead shows decline over a period of time.
- E-business initiatives are triggered through four driving factors as shown in Fig. 20.2.



**Fig. 20.2** Four Driving Factors of E-Business

The factors shown in Fig. 20.2 are

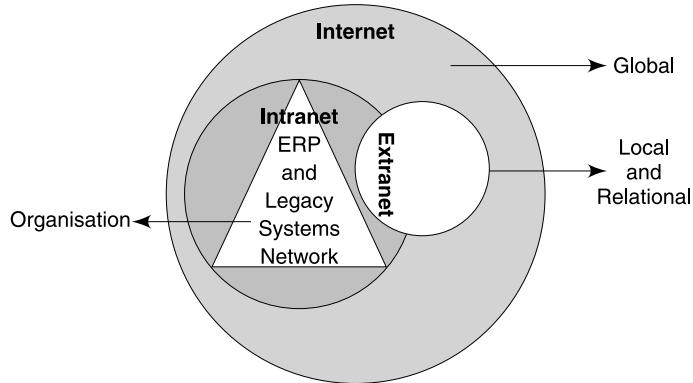
1. Cost of business operations
2. Customer response time
3. Management overheads
4. Competition leveraging on technology

The key indicators, which manifest poor business performance calling for E-business initiative, are the following.

1. Longer processing cycles
2. High inventory at all locations
3. Employees spending too much time in searching and accessing information
4. Critical resources idle
5. Rapid loss of market share
6. Organisation top heavy
7. Market share of loyal customers on the decline

E-business uses different technologies to transfer conventional business methods to E-enabled methods. It begins with intranet for in-company seamless integration of systems. It uses web enabled systems to deal with text based information. Along with supply chain management systems (SCM), customer relations management systems (CRM) are implemented. Intranet then is extended to trusted business partners with complete security measure to protect information from exposure to unauthorised people. When you extend intranet to trusted business partners, it is called extranet. Once the systems are stabilized on Intranet/Extranet, Internet connectivity is obtained for messaging and transaction processing applications. The internet is now accessible on wireless devices such as palm top computers and cell phones. Internet is used to develop web applications. Internet is a universal network and web is an application running over it.

A business organisation would manage its information needs in E-business environment as shown in Fig. 20.3. The details of these technologies are elaborated in the following sections.



**Fig. 20.3 E-Business Infrastructure**

E-Business requires hardware and software properly chosen and installed along with other technologies. The basic requirements are as follows.

*Hardware*

- Server(s) – ERP/CRM, Group ware, C++, VB
- Client(s) – Middle ware software
- Modem(s) – HTML, HTTP

Network – Web browser, Web server, Java Script, Pearl, NT, UNIX, TCP/IP, Windows

The technologies E-business requires are Communication, Intranet/Internet, Web, EDI, Work group, Video Conferencing and Multimedia.

## 20.2 MODELS OF E-BUSINESS

E-Business functions through four business models. The models are

- Business to Business (B2B)
- Business to Customer (B2C)
- Customer to Business (C2B)
- Customer to Customer (C2C)

In B2B model, the participants in E-business are two organisations with relations as buyer seller, distributor-dealer and so on. Hence the participants are two business entities.

The E-Business applications in B2B are of two types. One of information sharing and second of transaction processing.

- Issuing business circular
- Product catalogues publications
- News clippings

Information delivery applications

- Messaging
- Order processing
- Order execution
- Payment processing
- Money-transfer

Transaction processing applications

In B2C model, the participants in E-business are organisation and customer as individual. The customer is an individual consumer or employee. The E-business applications in B2C are the following.

- Organisation manual
- Database of knowledge
- Business information
- Service offers/contracts
- Payment to employee
- Issue of shares/bonds
- Delivery through courier

Information sharing application

Transactions processing applications

In C2B, the customer/consumer deals with business organisation in individual capacity.

- Down loading of information
- Viewing the bank balance
- Seeing manuals/drawings/pictures/images, etc.
- Requesting an item
- Obtaining travel advance
- Inquiry processing
- Credit card payment

Information sharing application

Transaction processing

In C2C both the parties are individuals and play the role of buyer/seller as the case may be.

- Messaging—Email
- Reports
- News groups
- Payment approvals
- Memos
- Sanctions and confirmations
- Issues and receipts

Information delivery application

Transaction processing

Broadly information-sharing application is built on back end systems, which collect data and process it to create information databases. The users of these database could be organisations or individuals in the capacity of buyer or seller. The participants have authorised access to information and have rights to read, write or use it in any of the application.

In transaction processing applications participants draw the information, use the business rules and implement a process to achieve the results. In transaction processing, information or material is transacted using electronic methods. The processing order, delivery, shares issues, receipts, approvals, etc. are transacted through electronic process using information and business rules. In transaction processing, there is a well defined input taken to produce predefined output using business rules satisfying certain conditions.

In more specific terms, ERP/supply chain management is a typical B2B model where information is shared and business is transacted between two organisations. The organisations could be manufacturer and vendor, manufacturer and courier service partner, manufacturer and bank, manufacturer and dealer or distributor. The business relationships of these two partners is formal and is built on trust and confidence. Hence, information is shared with confidence and business is transacted on the basis of agreed rules and regulations. In B2B model, procurement, inventory, distribution and payments are managed using E-business technology.

In B2C, messaging and information downloading for use is a big application. Inter organisation communication applications, like news bulletin, communicating change of rules, announcements, price revisions are very common in B2C. In case of bank, announcing new interest rates, financial products, opening of new branch, etc. is a communication application.

Crediting interest on fixed deposits, dividend on shares, refund of unused share amount are applications which fall in the domain of B2C, where partner 'C' an individual in B2C model is outside the organisation.

In C2B model, customer interacts with information databases such as product catalogues, price information, configure the product, compare the cost, place the order and have it delivered after electronic payment process. The products like computers, book, CDs, music systems and different services are purchased through E-business application. Bill payments are a big application of C2B model. The electronic mail, videoconferencing and news groups are other big applications where information is shared through electronic communications.

In C2C model, E-business revolves around two individuals who deal with each other in their individual capacities and play a designated role as buyer/seller, teacher/student, manager/officer, brother/sister. E-mailing, sending E-greetings, payments, ordering and sending gifts are the C2C model applications.

In all models basic business and communication processes are executed through electronic documents. Table 20.1 shows examples of the E-documents.

**Table 20.1** Information Vs E-Dокумент

<i>Information</i>	<i>E-document</i>
Product information brochures	Product catalogue document database
Order on paper	Electronic Order
Confirmation order	E-mail
Payment cheque	Electronic Cash, Credit Card, E-cheque

All transactions are paperless hence, confirmations, approvals, signatures are electronically carried out and the party is informed through E-communications.

The organisations, which are in E-business in a big way, are listed in Table 20.2.

**Table 20.2** E-business Organisation and Website

Service	Organisation/Website	E-B Model
Internet Banking	ICICI <a href="http://www.icicis.com">www.icicis.com</a> HDFC <a href="http://www.hdfc.com">www.hdfc.com</a>	B2C C2B
Complete Business Cycle	BHPUL <a href="http://www.bhpul.com">www.bhpul.com</a> Dalmia Industries <a href="http://www.dalmiaindustries.com">www.dalmiaindustries.com</a>	B2B B2B
Billing	Citibank	B2C
Bill payments	ICICI <a href="http://www.Billjunction.com">www.Billjunction.com</a>	B2B and C2B
News sharing	Time of India <a href="http://www.timesofindia.com">www.timesofindia.com</a>	B2C
Tendering	Guj.Refineries <a href="http://www.gujrefin.com">www.gujrefin.com</a>	B2B
Greetings/messaging	Through ISP VSNL, MTNL	C2C
Buying	Satyam Infoway <a href="http://www.satyaminfoway.com">www.satyaminfoway.com</a>	C2B
Selling	Gloster Cables Ltd. <a href="http://www.glostercables.com">www.glostercables.com</a>	B2B
Information sharing	IT space <a href="http://www.itspace.com">www.itspace.com</a>	B2B B2C
Servicing	LG Ltd	B2C
Configuring and complete business cycle	IBM/Dell/LG	C2B

It should be noted that B2B business models actually run with the help of B2C, C2B, and C2C models. These models work under the umbrella of B2B. The execution process using these models is assisted by Portals, Websites, E-mail, Web directories, Internet service providers (ISP). Each organisation in E-business environment has its Website and Email address and they are linked from Portals, which provide basic information. The Portal is a website dedicated to information about organisation. They essentially are information provider's to users to transact through E-business models. Some portals have a scope of buying and selling beside information source. Search engines like Yahoo, Alta Vista, Lycos are higher level

portals which help you to find web address of buyers and sellers for you to choose your E-business partner.

In E-business models, we have considered two parties who engage in business activity. But to perform these activities certain intermediaries are required to handle the communication traffic between two parties in B2B, B2C, C2B and C2C. The intermediaries are

Hardware Suppliers: Servers, clients, routers and network card providers

- Network access providers: ISP, EDI, DoT
- Information access providers: Browsers such as Netscape, Adobe and Internet Explorer
- Payment processors: First virtual, Digi Cash, Visa, Master Card
- Web site design providers: Consultants and web developing companies
- Web directory providers: Yahoo, Alta Vista, Lycos

E-business models are developed using these intermediaries. The components of E-business models are

- Intranet/Extranet (Internal communication)
- Internet (External communication)
- Network and TCP/IP protocols and tools (Delivery mechanism)
- Web server and Web browsers software (Access, process and download and send)
- Back end systems (Application processes)

The persons driving E-business model other than users are the following.

- Web master
- Web Designer
- Web Developer/programmer
- Content providers
- Content designers
- Web administrator

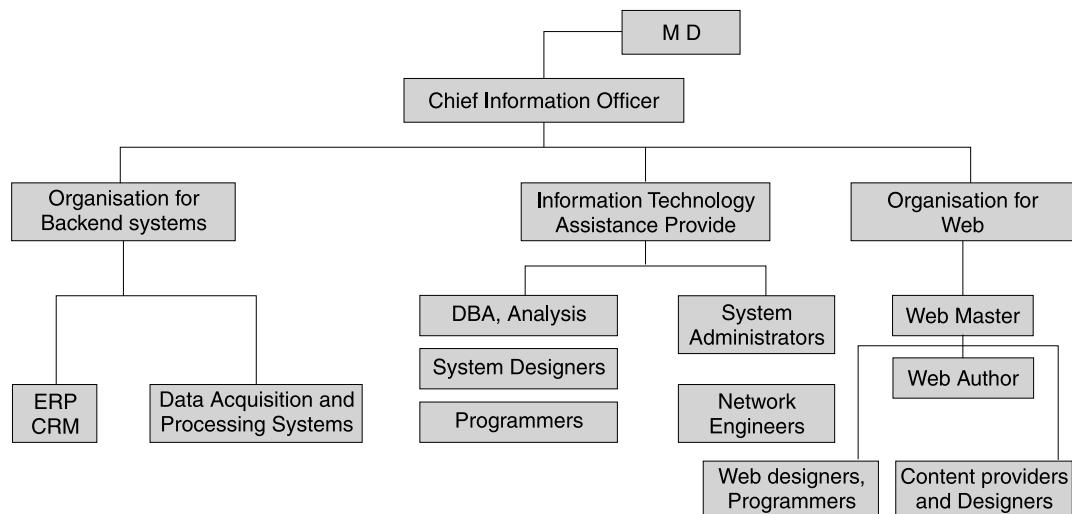
Web master controls the web site inflow/outflow information, content management and regulation of the traffic. The role is similar to DBA in RDBMS environment. Web designer conceptualises and visualises the requirement of the parties and creates a web design which is attractive, useful and easy to handle. He plays a role of architect and interior designer of the Web site.

Web Developer/programmer writes web pages using HTML, DHTML, XML, CGI script and other tools. They are also involved in program writing for transaction processing, information processing, providing links to other sites, writing interfaces for connectivity to other databases and to back end ERP or legacy systems.

The content providers are responsible to create text, images and a multimedia input to the site. These people are subject experts and key people in making a site a grand success. They have to write contents of the website looking into the needs of target website visitors. The contents should address the needs of users of the websites. The content designers give site layout, placement of icons, positioning and display ideas to deliver the contents to the site viewers immediately. They provide input in terms of aesthetics, colors, navigating through different information layers, etc.

Web administrator maintains the Web site. He is a trouble shooter, in case of any problem. He is the first contact point for users, viewers to solve their difficulties. His job is to keep the Web site very responsive and keep latest and up to date contents. He is responsible to make viewer analysis in terms of his visits to site, areas visited and business generated.

A typical E-business organisation structure model is given in Fig. 20.4.



**Fig. 20.4** *E-Business Organisaiton Structure*

### 20.3 INTERNET AND WORLD WIDE WEB (WWW)

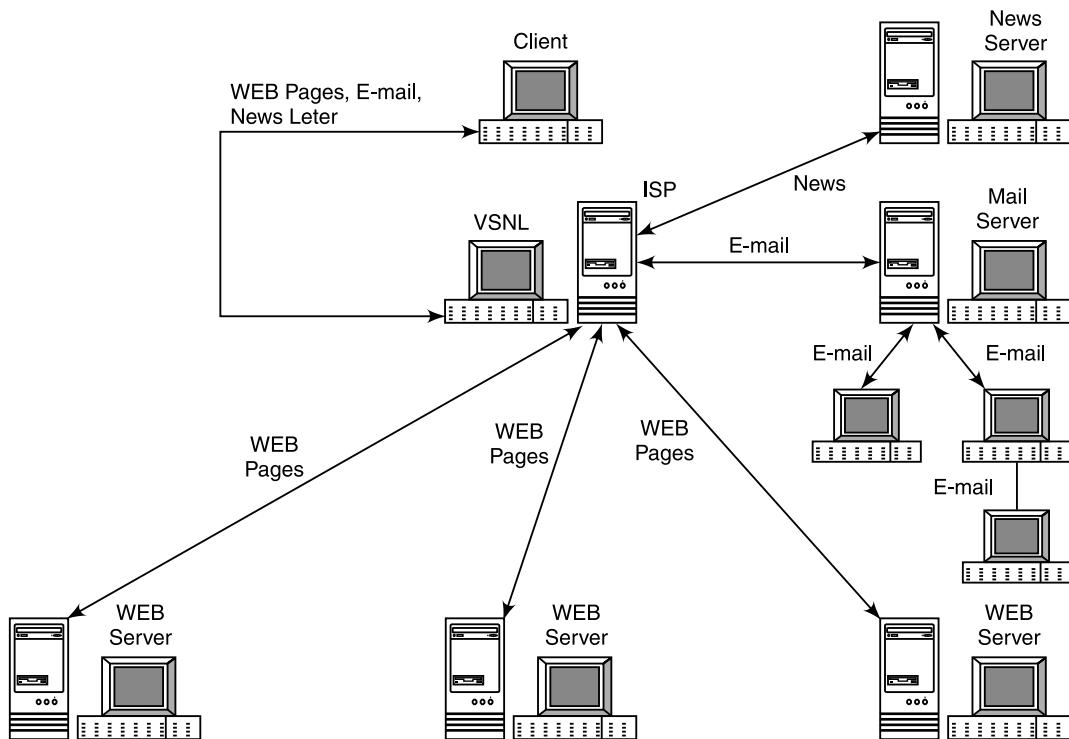
The internet is a global network of computers, working as servers or clients to exchange information. The internet is distributed over homes, business, schools and government offices all over the world. Millions of computers of different types—PCs, Macintoshes, big mainframes, minis and others are connected in through network.

Any type of computer from palmtop, PC to super computer loaded with TCP/IP protocol becomes automatically a member of the internet. It uses wide range of communications media. The “wire” that interconnects millions of computers on the internet include local area network, private data lines, local telephone lines, national telephone network carrying signals via wire, microwave and satellite and international telephone couriers. The internet is a single network which exchanges information from ‘anywhere to anywhere’ because it is platform independent due to TCP/IP and communication technology independent.

Internet is a network of clients and servers. The servers may be, dedicated or general, performing dedicated functions or serving general requirements.

Figure 20.5 shows client server architecture model of internet made of dedicated serve's such as News Server, Mail server and Web server in general.

The information, which you need, is stored on server computer and the program, which accesses the information, sits on client. For example browser (Internet Explorer or Netscape)



**Fig. 20.5 Client Server Architecture on Internet**

is a program which is used to communicate with the server and display the information stored there, on client's machine. Number of tools are available to do standard jobs of accessing, fetching and displaying information. Where job is non-standard, program is written in Java, Java script and used through client to the specific job processing. You can use internet for number of interactive information exchange. Information browsing is a major application on the internet.

You can use any browser program to communicate and display the information. The browser program fetches web page stored on the server. A web page is a file of information stored on the web server.

The browsing capability helps you to perform following functions.

1. Visit websites of companies, governments, museums, schools, colleges, universities and look for information.
2. Read news on any new agency say the Time of India, The Financial Express, India Today and many more.
3. Search library catalogues first before visiting the library.
4. Read the electronic books and learn the subjects or enjoy stories.
5. Download the software, middle ware which is offered free.
6. Shopping (buying and selling) through sending, ordering and payment.

7. Play games, watch videos.
8. Exchange messages through mail.
9. Form news groups of common interests and have electronic discussion.
10. Chat on internet is interactive. Using chat client programs, chat exercise is carried out through services of typical messages.
11. Hold voice and video conferences enabling to see each other.
12. Run programs on other computers through telnet program. Through telnet, you use a distant computer where program is residing and access its data as if you were there.

### **Hardware and Software of Internet**

Variety of hardware and software is used to make the Internet functional and effective. Number of people and agencies are involved in Internet working.

#### ***Modem***

Modem is a device that enables two computers to communicate with one another through phone lines. When you open an internet account and use it, you are using modem installed at your location to communicate through modem installed at internet service provider (ISP). VSNL, MTNL, MSN and many more are he ISPs.

Modem has a speed, which is measured in bits per second (Bps). Higher the Bps faster the modem. Modems are available in the range 9.6 Kbps to 56 Kbps. If you are on internet using modems the speed of exchange of information will be decided by slower rate of modem.

#### ***Computer***

In addition to a fast modem, you need a computer (client) capable of handling number of multiple data types. The best PC would be a multimedia PC of 32 MB RAM with very powerful CPU and 4GB onwards disk capacity. For normal E-mail applications standard PC of good speed is adequate. If your application requires multimedia capability, PC shall have all multimedia features such as sound card, speakers, PC video camera, etc.

#### ***Web TV***

Web TV is a terminal to be attached to your TV. The terminal uses your TV as display and you navigate the internet through the terminal's wireless remote control or an optional wireless key board.

Web TV cannot access all the internet activities, a computer can do. You cannot use it to get software online, to run Java programs or to chat.

#### ***Software***

You need two types of softwares to enable your PC as an Internet PC.

- Communication software to establish the TCP/IP connection to the server.
- Client software for each activity such as browsing, E-mail, news and so on.

When you buy Windows software the communication software, E-mail, telnet and FTP are provided as bundled softwares.

### **Browser Software**

Netscape and Internet Explorer are the most popular available in the market. PC vendor gives software of your choice. The features of these two browsers are given in Table 20.3.

**Table 20.3** Features of the Browsers

<i>Netscape</i>	<i>Internet explorer</i>
<ul style="list-style-type: none"> <li>• Navigator for browsing</li> <li>• Messenger for E-mail</li> <li>• Collaborationra for news reading</li> <li>• Conference for voice/video meeting</li> <li>• Page composer for webpage publishing</li> </ul>	<ul style="list-style-type: none"> <li>• Browser</li> <li>• Outlook express for E-mail</li> <li>• Net meeting for voice/video conference</li> <li>• Front Page Express for webpage publishing</li> <li>• Chat</li> </ul>

With hardware and software in place, you still need an internet service provider who provides you a gateway to internet. The large ISPs are VSNL, MTNL who have their own gateways. These ISPs, through their partners will provide total service to make your PC an internet PC.

### **Applications of Internet**

Internet is a powerful tool which can be used of number of applications. Major applications are as listed.

#### ***Search the Web Addresses for Access through Search Engine***

If you are interested in knowing some details about PC, you need to know some PC vendors. So you can search on Yahoo, Alta Vista sites, where you will find vendors, PC details, price, etc.

#### ***Downloading Programs and Files***

Internet offers through various websites, programs and data files which can be downloaded on your local PC for use. The downloading could be free or at nominal charges.

#### ***E-mail***

Major application of Internet is messaging through E-mail. You can receive and send messages to one or more persons. Address book is a built-in feature where you can store addresses required very often.

#### ***Mailing List***

You can join a mailing list group where you receive and send messages to interested members of the groups. You send a message and others reply you with their contribution.

#### ***Voice and Video Conferencing***

Conduct meetings through conferencing where you can hear and see each other.

### ***Chatting***

Conversation capability to speak with experts at predetermined time.

### ***Buying and Selling on the Net***

Through search engines you can find suitable item and vendor to place order, pay the bill and have it delivered to your home.

### ***Webpage Publishing***

You can publish yourself through webpage(s) on the net. With web address known to the users they can visit your homepage and learn more about you.

Applications mentioned here are basic and are very simple to use. Necessary tools are available to start such applications. Internet is a very powerful tool, which puts you on world market at very little cost. Its capabilities when used properly cuts down on costs heavily, major saving being in communication costs and business benefits through saving in business processing cycle across the organisation. When you are ready to use internet, you need a connectivity to internet. There are three types of connectivities:

- Dial-up (Shell account)      Home users/single users
- Digital Dial-up (ISDN)      Dedicated connectivity for commercial users
- Leased line                  High speed dedicated link. Point to point for commercial users.

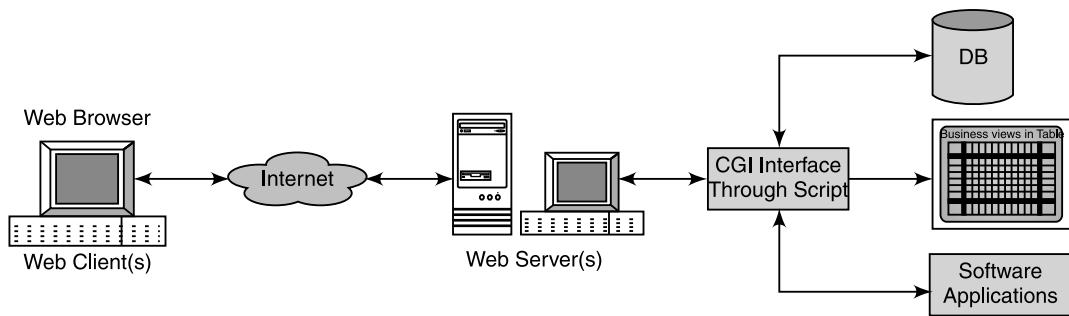
Your service provider will guide you on these connections. The speed and response time when you are on internet depends on bandwidth available for communication and speed of getting connected to ISP server. Overall performance of the internet depends on traffic intensity, bandwidth available, modem and network efficiency of ISP.

With high-speed communication and capabilities of handling multiple data types internet has changed radically the way business is carried out in 21st century. It has created new business opportunities and has brought radical changes in style and culture of the business. It has affected personal and social life of business community.

### ***World Wide Web (WWW)***

World Wide Web (www), popularly known as Web is quite distinct than internet. In simple terms internet is a network spread over the globe not knowing precisely the number of servers and number of clients located in the network. Internet is a carrier of data and information across the network. But web is a global information sharing architecture that integrates information stored on network is a global information sharing architecture that integrates information stored on servers. Web offers software foundation as a standard for navigating, publishing information in the particular format, known as web server. Internet holds and delivers the webpages and content stored on pages. The Web architecture is shown in Fig. 20.6.

Internet runs on TCP/IP protocol which helps to find two computers, introduce themselves and then conduct conversation. In simple terms, TCP/IP helps to establish connection between two computers and ensures that data sent from one end is delivered intact at the other intended destination. TCP/IP protocol is a low level protocol dealing with communication, the web protocol (HTMP, HTTP, CGI) deals with format and contents of data. Internet



**Fig. 20.6 The Web Architecture**

handles connectivity and web handles information across the internet. The web serves the following three functions.

- as a part of operating system Windows/Unix/NT.
- as a distribution channel for downloading applications on the operating platform.
- as a middleware between database servers and clients.

The web is a client/server architecture. The information is stored in files on web servers. The information is organised into distributed pages. The pages are stored in HTML format. A page stored in HTML format is called a web page. The links attached to pages help user to browse from internet. When you jump between pages, you are web surfing for quick information access. In normal course web page is a static page. It becomes dynamic when portion of the page changes dynamically. The web technology provides mechanism for fetching dynamic information from other sources and make it part of the webpage. For example home page of a stock exchange will show basic information of stock exchange with a portion showing dynamic share price index and real time changes in the share prices. The mechanism is standard interface called the common gateway interface (CGI) to execute a separate program that fetches the dynamic information, formats it into HTML, and forwards it to the server for storage and viewing by the clients.

Web is an application on internet built in client server architecture with components configured for specific role.

## Web Components

### Web Client Browser

A client node on the internet has a software called web browser which provides graphical user interface (GUI) for accessing and displaying the web page. Most widely used browsers are Microsoft's Internet explorer and Netscape's Navigator.

### Web Server

Web server stores documents and other accessible from web client using web browser. The most widely used web server are Microsoft's Internet Information Server and Netscape's Communications server/Enterprise server and Apache server.

### ***HTTP (Hypertext Transport Protocol)***

HTTP is language enabling communication between web browser and web server. The communication happens in the following way.

- Web browser establishes connection to server.
- Web browser then issues instructions to the server to fetch a web page.
- Web server processes the instruction and sends the web page to web client.
- On receipt and display of the web page browser/server connectivity ends and communication transaction is completed.

### ***URL (Uniform Resource Locator)***

URL is a address of the page which is used to find the web page. URL are used to jump from pages to page. URL contains three parts mentioned in the following sequence.

1. Access method http,
2. Computer location, www.domainname.com
3. File location (the last part of URL) Directory path and or a file name.

An example of URL is http://www.abc.org/careers/industry.html

URLs change with protocols. Some examples are shown in Table 20.4.

**Table 20.4 URLs Under Different Protocols**

<i>Example</i>	<i>Description</i>
• http.protocol for information http://host/directory/file http://host/directory/name http://host/cgi-abc/search	A file one HTTP server. A directory listing on the server. Cgi script abc on the server.
• ETP Protocol for file search ftp://hostname/xyz/file ftp://hostname/directoryname	A file on FTP server. A directory on the FTP server.
• Telnet protocol for data/programs telnet://host/	Log into remote host.
• SMTP protocol name for mail mailto:harish@hostname.org	Sent E-mail to user.mails.
• NNTP protocol (Netnews transfer protocol) news:newsgroupsname:hostname	News on the newsgroup.
• WAIS protocol (wide area information search) wais://hostname/directoryname and index	Wais search on the named index.
• Gopher Protocol for documents/scripts/forms gopher://hostname/	Top level menu at the host.

## **HTML**

HTML is a hypertext mark-up language used to display the webpage, containing text, graphics, audio, video. HTML contains several categories of tags known as mark-up tags. Markup tags are as follows:

**Titles** A title is generally displayed above the page and is used to identify it on other contexts.

**Headings** HTML has six levels of headings numbered 1 through 6, with 1 being most prominent. They are displayed in bolder fonts.

**Paragraphs** Web pages are made of paragraphs and browsers handle lengths of line in paragraph.

**Additional markup tags** A document can have various kinds of lists unnumbered and numbered which need to be nested. The document can have quotes, addresses and text pre-formatted with spaces, line borders. HTML provides additional markup tags.

**Character formatting** Text may have words, phrases, lines which need to be underlined, italicised. HTML allows formatting words or lines of words as per your choice.

**Linkages to other documents (hyper link)** HTML distinctive feature is the hyper link, that is link to other page. When you click on the link, it fetches referred page for display.

**Images, graphics, and other special features** HTML includes mechanisms to display non-text content such as graphics, animation, sound and other special files by invoking and external program.

HTML with these markup tags represents a document containing text, list boxes and graphics, audio, video clippings.

## **Common Gateway Interface (CGI)**

In information processing application, browser needs to fetch data/information from other servers. To reach these servers, server scripts are written, which obtains the data and gives it to the browser to process further. CGI is a standard interface between web servers and the applications. Server scripts are written in variety of computer languages or scripts that conform to CGI standard. Java, Perl are the CGL standard languages. CGI is also used to integrate databases with the web. The databases, for example, Oracle, Sybase are accessible on the web through sets of server scripts.

So essentially web is capable of handling multiple data types when it comes to reaching, fetching, processing and displaying them, wherever necessary. These capabilities give rise to number of opportunities for different application. Web offers following four distinct forms of information integration.

- Ability to link data residing in different servers located anywhere.
- Ability to provide clients with data from diverse sources.
- Ability to put together different types of data (text, audio, video).
- Ability to plug in other programs written for animation, graphics, audio clipping, etc. Acrobat reader for page description format, shock-wave for full motion animation and video files are the popular plug-ins programs used in web applications development.

Due to this integration capability and use of CGI to get data from other non-web server databases, web can be used for number of business applications.

Following are some typical applications of the web.

- *Distribution of data:* This application is used by scientific community to get data from various sources from R & D laboratories, universities. The data is distributed on demand to the client (Scientist)
- *Commercial processing:* The commercial use of web is an advertising, online shopping, information services and customer support services E-commerce is a single largest application of internet and web.
- *Education courseware:* The web's ability to handle multiple data types is used to produce courseware, technical manuals. The courseware has become more interesting due to rich contents comprising animation, audio, video and graphics. On-line E-learning is an application for distance learning.
- *Publishing:* The web is used for publishing E-books replacing paper based books. If internet proliferates to a very high level, newspaper publishing will be replaced by E-newspapers.
- *Public service Information:* Web will be used extensively by government and public institutions to broadcast information of public interest.
- *Business management applications:* Web is extensively used to widen the scope of supply chain management, demand chain management, retailing and customer relationship management.

### **Web for Business Applications**

Web's capability is used for conducting business through E-commerce. It affects all four business models stated earlier. It has also opened new opportunities of business in information management and sharing. It has drastically affected business functions such as advertising, marketing, sales and customer service. Banking and financial services, retailing, publishing and entertainment are going through a cultural change and also the manner in which these businesses are conducted is changing.

Within these industries, web is used for the following.

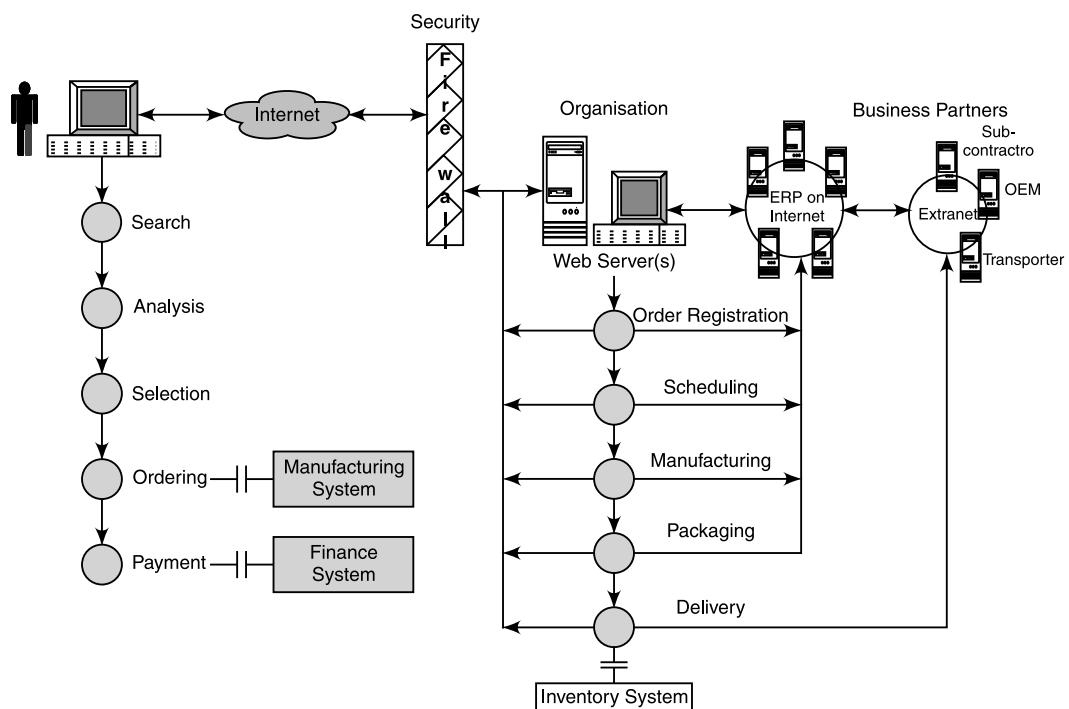
- Attracting new customers through E-marketing and E-advertising.
- Improve service efficiency through E-service and E-support functions.
- Enlarge the scope and reach through web by putting products and services on Web.
- Developing information based products.

When you install intranet/extranet within the organisation and put it on internet, you have converted traditional report based organisation to information driven web enabled organisation. The customers and vendors who interact offline interact online through internet when organisation becomes web enabled. Some typical applications are mentioned here.

- E-Banking              Internet banking ([www.icici.com](http://www.icici.com))
- E-Retailing             Buying and selling on net ([www.indiabazaar.com](http://www.indiabazaar.com))
- E-Publishing            Electronic documents ([www.microsoft.com](http://www.microsoft.com))  
                              ([www.timesofindia.com](http://www.timesofindia.com))

- E-Purchasing      Order Processing and Delivery  
([www.amazon.com](http://www.amazon.com))  
([www.rediff.com](http://www.rediff.com))  
([www.indiaproPERTIES.com](http://www.indiaproPERTIES.com))
- E-Selling           Selling goods on net  
([www.junnarkar.com](http://www.junnarkar.com))
- E-SCM              Interfacing Intranet based SCM to order processing initiated from web.

Most of the transaction based business applications can be handled through Web where Intranet and Internet are enabled. Figure 20.7 shows a model of E-business cycle from ordering to delivery.



**Fig. 20.7** Model of E-Business Cycle From Ordering to Delivery

### E-Portal

E-portal is a Website where multiple aspects of business are brought together. Portal is a place where information on dedicated subject is available. Besides this, it provides latest information support to the visitors to enhance the utility of the site. It allows users to seek information, post information for other and allows to perform basic commercial transactions. It provides links and hyperlinks to other websites where specific information in detail is available to the visitor.

It provides standard features like Chat, News, message boards and web directory of most useful and popular websites improving the utility of the portal. In broad terms website is for individual or organisation and portal is an assembly of information about the industry or subject.

[www.indiaproPERTIES.com](http://www.indiaproPERTIES.com) is portal for real estate business and industry providing information about all dimensions of real estate business. Reader is advised to visit [www.indiaproPERTIES.com](http://www.indiaproPERTIES.com) for understanding the concept of portal [rediff.com](http://www.rediff.com) is also a portal. Portal could be for information posting and or for commercial business transactions.

### **Search Engines**

The proliferation of web sites, (estimated in millions), poses the problem to industry. If web address (URL) is known then it is accessible through internet. Some sites give URLs of useful sites. Most popular method is to go on portal site, which has search engine. It also provides through efficient search engine a broad list of web sites. You are then expected to select few websites of your choice to process further for search, selection, analysis and ordering on specific website.

For example, if you are interested in purchasing a TV, you can visit one of the search engine and take on search on key word (s) TV mfg. The list will provide names of TV manufacturers with web-sites. From the list you can select Sony, Philips and BPL websites visit them to known product, specifications, features, price and availability. You may then be interested to know the dealer/distributor in your town to visit and take a look at the TV. On satisfying the TV features, you may select say BPL TV.

You will then visit BPL site and place or order on BPL who in turn will forward it to dealer in town who will complete the delivery and commercial transactions.

Search Engines/Directory are the parking lots for websites for public knowledge, and for those who do not know where to go and what to buy? In web environment, with the assistance of search engine sitting at home you can buy number of goods at no extra price and have them delivered at house. Through search engines you can discover information and through website you can complete buying and selling transaction. The popular search engines are

- <http://www.yahoo.com/>
- <http://www.lycos.com>
- <http://www.webcrawler.com>

## **20.4 INTRANET/EXTRANET**

### **Intranet**

E-Business requires a network platform, which is seamless and allows smooth flow of data and information in any form from any location to any other destination (s). The Intranet is essentially an internal company network that uses internet standards, namely HTML (Hyper text mar-up language,), HTTP (Hyper text transfer protocol) and TCP/IP (Transmission Control Protocol/Internet Protocol). The existing network (LAN/WAN) when loaded with these standards and supported by Web server and Web browser becomes Intranet for the organisation. Intranet is meant for users from the organisations. The Normal network (LAN/WAN)

is able to handle database applications in client/server architecture, the same network when converted as Intranet can handle text and multimedia applications. The Intranet is not accessible to the people outside the organisation.

The intranets are used within the organisation for following purposes. An example is given in the bracket.

- Access Manuals, contracts; Directories (HR Manual)
- Post Personal Web pages (Executive Profiles)
- Access product, customer Data (Product specs)
- Post job offers, Memos (Appointment letters)
- Revision, validation, approval of documents (Registrations)
- Access employee database (salary data)
- Access schedules, plan, calendars (Project plan)
- Access databases (Drawings, pictures)

Intranet adds value in the information of business due to its capability of handling text and multimedia data types.

Intranet deals with internal information needs of the people in an organisation. It does not give access to external world. Hence, people outside the organisation cannot access this information. Intranet is not internet. To explain in simple terms, intranet is private, within the organisation while internet is public available for global access requirement. The technologies used in Intranet and Internet are same. An intranet can be defined by the following definition.

An Intranet is a network of set of computers (servers) connected through TCP. IP communication protocols that store data in various locations accessed by computers (clients) distributed at various locations.

To run Intranet, we need one or more server, client workstations and a network connecting servers and clients. TCP/IP software should be present on servers and clients. Web server software should be on server while Web browser software should be on clients.

To run intranet, four software components are needed. They are — TCP, IP, Web server and Web browser. These are explained below.

### ***TCP (Transmission Control Protocol)***

A protocol helps to send data to any location to any hardware platform. TCP breaks the message into packets, puts them into envelopes and sends at receiving end, where it gets reassembled as the original message.

### **Internet Protocol (IP)**

Definition: IP is the primary network protocol used on the Internet, developed in the 1970s. On the Internet and many other networks, IP is often used together with the Transport Control Protocol (TCP) and referred to interchangeably as TCP/IP. IP supports a unique addressing for computers on a network. Most networks use the IP version 4 (*IPv4*) standards that features IP addresses four bytes (32 bits) in length. The newer IP version 6 (*IPv6*) standard features addresses 16 bytes (128 bits) in length. Data on an IP network is organised into *packets*. Each IP

packet includes both a header (that specifies source, destination, and other information about the data) and the message data itself. IP functions at layer 3 of the OSI model. It can therefore run on top of different data link interfaces including Ethernet and Wi-Fi. (Bradley Mitchell, About.com Guide to Wireless)

IP specifies the format of packets, (also called *datagram*), and the addressing scheme. Most networks combine IP with a higher-level protocol called *Transmission Control Protocol (TCP)*, which establishes a virtual connection between a destination and a source. IP by itself is something like the postal system. It allows you to address a package and drop it in the system, but there's no direct link between you and the recipient. TCP/IP, on the other hand, establishes a connection between two hosts so that they can send messages back and forth for a period of time.

### **Web Server**

- Processes a request from a client.
- Acts as a host to add on products, say search engine.
- Log all transactions.

### **Web Browser (Client)**

- Send the process request to server.
- Interpret HTML codes and convert into a display containing text and graphics.

These are basic software tools to run Intranet. As intranet grows, you will want to add a search engine to help users to find information very quickly. When you need intranet to run bulletin boards, chart areas or any form based applications, programming languages and components such as C++, Java, ActiveX are required. In advanced stage of Intranet use, you will need to cater a Database application where data is pulled from backend database, used and then report is made to update certain users in the organisaiton. In such cases you need to write special programs to run such applications. The basic process is described in Table 20.5.

**Table 20.5** Internet and Database Applications

Basic Process	Create links to database(s) to access core data of the business from within Web browser client.
Application	<ul style="list-style-type: none"> <li>• Check operational data</li> <li>• Query by search</li> <li>• Reports on demand</li> <li>• Create Intranet documents</li> </ul>
Procedure	<ul style="list-style-type: none"> <li>• Web browser sends request to web server for a document</li> <li>• Web server receives and passes the request to a program that retrieves data and creates HTML file for the document</li> </ul>
Programming languages	C++, Java, Perl, C, etc.

Intranet can be used to create online reports by taking predefined set of reports converting them to HTML documents and store them on the web server. It is also possible to create

online reports using report templates. These report templates (documents) offer dropdown lists, radio buttons, check boxes and text input fields to choose the data and put it in the templates to see the report. These reports are created dynamically to each user's view requirement. Hence, Intranet gives report on demand without online reporting system. Oracle's web server, Sybase's web-SQL and Informix's interface kits are web-enabled databases, that is when they are used one does not need to buy other products to write HTML documents. When your need is a complex application, it is better to use Web-enabled database. In other words, when you set-up a Intranet, you have created an internal web site. It is up for the users within an organisation.

### How to Set up Intranet?

Assume that you have a conventional LAN/WAN in place and now you wish to set up an Intranet for the organisation. The method for setting up Intranet is summarised in following points.

1. In Intranet each client must get an IP address. IP address is written in four segments divided by periods. Each portion is any number from 1 to 255. IP address typically looks like this: 219.44.189.10.
2. Install TCP/IP for server, clients and routers.
3. Select an Intranet web server. The web servers are available on Windows NT; Novel and IBM platforms. The servers have features. The features are encryption of data or text, database connectivity, search engine and HTML tools. All servers do not give these features in full scope. Hence, depending on your requirement, server should be chosen.
4. Set-up security features, namely.
  - Access control through authentication
  - Restrict access from certain addresses
  - Configure per directory configuration files for selective access
  - CGI and server passed HTML
  - Specify a directory of CGI programs
  - Specify a directory of WINCGI programs
5. Select a web browser. The popular web browsers are Internet Explorer and Netscape. The features of browsers are the following.
  - Cross platform capability to run one browser on all platforms.
  - HTML extensions to make documents look like original.
  - Plug-ins for other software applications. The browser should have capability to check an Auto CAD drawing, audio, video, files and documents from any other application.
  - Standard features such as print, bookmark pages navigation through pages and manipulation of web pages.
6. Make Intranet operational
  - (a) Convert exiting documents into intranet documents using conversion and editing tools.

- Add graphics to your web pages namely GIF, JPG, and Inline graphics images.
- Provide links to other documents.
- Create an Image map and put into a document.

The software which make this possible are 'Graphic Manipulation software, Image Map Software and Web page graphics.

- (b) Create forms using form creation software and text editors. Add processing capability to the forms, where necessary.
- (c) Add value to the intranet
  - Select a search engine to search quickly through the webpages and find information in the pages.
- (d) Form groups of intranet users
  - Form groups of the users having common interests, goals, etc.
  - Install group software whereby messaging and information sharing applications can be started.
  - Provided hyperlinks to other relevant groups, sites for added advantage.
  - Group software are YAPP, Caucus.
- (e) Extend the power of intranet
  - Install plug-in software for spreadsheet, object embedding. Adobe acrobat, ActiveX controls for extended applications.

7. Connect intranet to corporate data

- Provide links to corporate databases, if web enabled databases are not used. Such links give quick access to the data for checking, verification and for use in web application, if necessary.
- For example, you can send purchase order by accessing inventory database, send requisition for issue or purchase and so on. Simple processes, which need data from database, can be automated.
- Make a list of standard, most often asked reports, create templates and link them to database to create report on demand.
- Introduce data driven intranet pages. For example web pages are created for text, graphics, audio/video clippings with HTML tags in database. These pages are continuously updated. The user can assemble these pages as per his choice to create a new document.
- Build security features to control access and misuse of information.

Some tips for successful intranet implementation are the following.

1. Implement intranet pilot to keep the initial cost low.
2. Involve users from the beginning after brief exposure to intranet basics and its applications.
3. Design pilot on paper first for communication and discussion.
4. Provide a complete set of web pages for effectiveness of the intranet pilot.
5. Implement the pilot and get the feedback. Modify and get the approval.

6. Expand the scope of intranet.
7. Ensure that content is useful, up to date, and of good quality to add value to the users.

### Who Should Use Intranets?

Organisation with a requirement to constantly distribute information containing multiple data types to a large number of users of Intranet. Organisation, who has form based or text based document processing applications use intranets to serve these needs.

Traditional approach to information management of such nature is to print forms, mail them to users, process them on submission, retain transaction data, give information to users. The approach is centralized information management. This approach is costly and delays the data processing and information delivery. When one uses intranet, the user gets electronic form to put information. While entering information it provides linkages to various other contents, reducing data entry and assuring quality of data input. If intranet application needs data from legacy systems, it is possible to develop an interface for legacy system data base interface for quick access. The typical intranet applications are the following.

- |                            |   |
|----------------------------|---|
| • Publishing               | Manuals, Directories, online training manual.   |
| • Distribution             | Multiple users, user groups.  |
| • Form processing          | Leave application, Admission application.   |
| • Interactive              | Test and certification.   |
| • Transactions processing  | Order processing, delivery, billing.  |
| • Collaborative processing | Work group and workflow applications that is insurance policy, purchase order processing. |
| • Information sharing      | Messaging applications for common interest groups.  |
| • Query processing         | Database queries on data and queries on status of order, balance, value, etc.             |

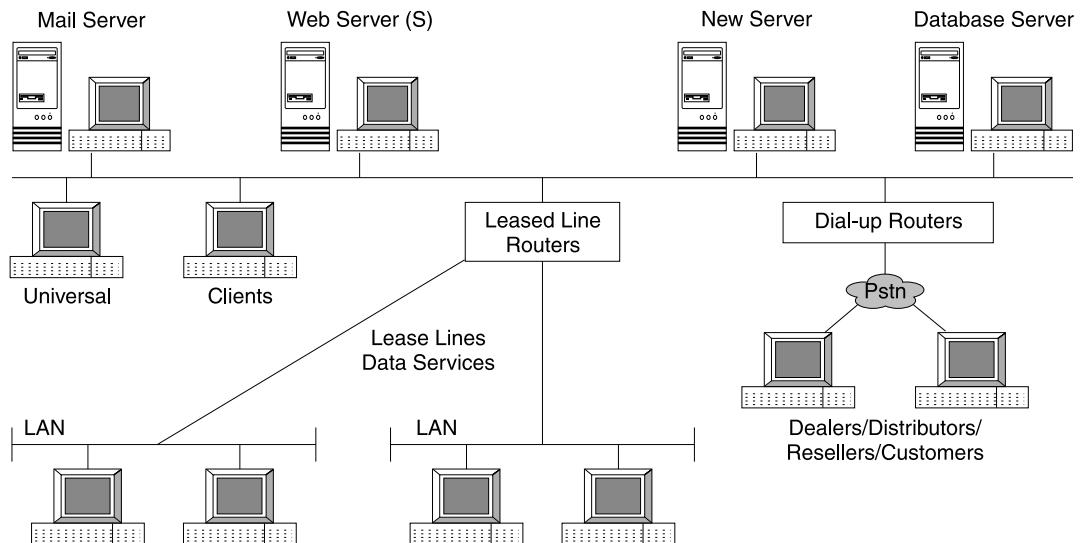
A typical intranet set-up is shown in Fig. 20.8.

### Extranet

Intranet is private to the organisation. Extranet is an Intranet for outside authorised users using same internet technology. The outside users are trusted partners of the organisation who have access to information of their interest and concern. For example, in auto-industry spare parts manufacturers have access to inventory database and production schedules used to plan and ship the required spares to factory location.

Dealer/Distributors have access to product files such as catalogues, products specifications, pictures, images, etc. to answer queries of the customer. When intranet crosses the logical boundary of the organisation and provides secured access to selected data and information of the organisation, the Intranet becomes Extranet.

The security in Extranet depends on organisation's policy on information management. If you treat your trusted partner like any other normal user of the organisation, then security can be ensured through access rights, authentication and certification procedure.

**Fig. 20.8** *A Typical Intranet Set-up*

If you want to treat trusted partners like outsiders to the organisation, you can build firewalls between outside users and intranet which will stop no unlawful and unauthorised access to information. The details of firewall and other security measures are described in the following sections of this chapter.

#### **Case Study of Intranet** (Source: Computer World, March 16, 2000)

The Times group has integrated various applications into its existing Response network. The group claims major benefits and cost savings due to paperless office running on the organisation's wide area network. The Times of India, with a turnover of Rs. 800 crore is one of the very few organisation in India to implement intranet and extend the intranet through extranet to other publications.

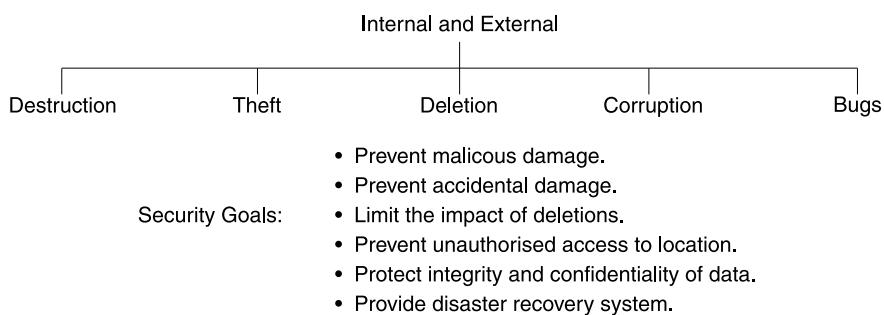
The Times of India (TOI) has 35 locations, with 7500 employees and 2500 desktops on a fully integrated group network. The information infrastructure of the TOI intranet is a mix of different platform. It uses silicon graphics platform and Netscape browser on the client side. The 35 locations have Silicon Graphics servers with Irix 5.3 and 6.2 and Ingres 6.4 backend database. The commercial applications are on HP 9000 at 12 locations and Intranet is used for response department's requirement of space booking for advertisements by data, by page and by columns. TOI's main revenue stream is advertisement publications hence response department's needs are critical. Response department uses data types, such as text, graphics, images and pictures. Therefore Intranet becomes logical platform for handling the space management across different locations. The space booking is central but publication is distributed. With intranet in place TOI gets more revenue due to better space management. The benefits to TOI apart from increased revenue are as listed.

1. Heavy cut in STD telephone billing due to E-mail and chat facilities on the Intranet.
2. Heavy reduction in photocopying as new Intranet is used to send copies to all locations.

The total savings due to these two benefits alone is around Rs. 30 million. The information now flows in real time and no photocopying is required. The customer gets fast response on their order and advertisement statuses. All middle level correspondence is eliminated. Functions such as data capturing for books of accounts and balance sheets with proper audit trails, are carried out on intranet. Today TOI group works on Intranet, Extranet and Internet.

## 20.5 SECURITY IN E-BUSINESS

Security concerns in E-business have been receiving highest attention both from designers and government. Since, shift is from paper to electronic media and transactions happen from remote and unknown locations, ascertaining the genuine nature of commercial transaction is difficult. The security threats and goals which are set for E-business are given in Fig. 20.9.



**Fig. 20.9** Security Threats and Goal

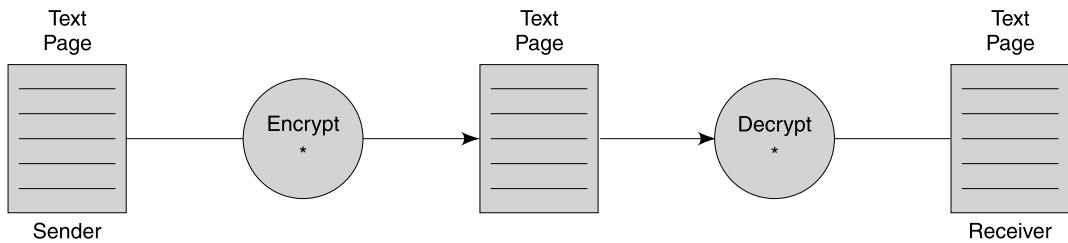
This difficulty of foolproof provision can be misused by criminal elements to their advantage. The concerns can be divided in three classes, one on internet user side, the second on data and transaction side and the third on electronic security side. Table 20.6 lists measures of security.

**Table 20.6** Measures of Security

Security item	Aspect of security	Measures
User access	Authorisation	Password, Encryption, Biometrics, Firewalls
Data, transactions, messages	Privacy, Integrity confidentiality	Secret key encryption, public/private key encryption, digital signatures.
Network	Internal and External threats	Firewalls, proxy servers

In all these measures of security we are ensuring that net user, is the genuine one. This is called authentication. Then it is necessary to ensure that message once sent is not accidentally or maliciously filtered or destroyed. Third is to ensure that entire system performs consistently at an acceptable level of quality to become a reliable system.

Password is possessed by an individual and is to be kept in secured condition so that it is not exposed to anybody for misuse. Encryption is a process of making information not understandable at all. The message is guarded through the process of encryption and decryption. Figure 20.10 shows the process of encryption.



\* Encryption algorithm converts normal text into cipher text through encryption. The decryption process reconverts cipher text to normal text.

Algorithm is a mathematical technique to transfer the data in coded form. It is supported by features such as user authentication, verification by the receiver and confirmation of proof of origin.

**Fig. 20.10 Process of Encryption**

An example of encryption and decryption to protect integrity of the message is as follows. Suppose company wants to convey the price to the customer by a sending the message.

- Original Message. Text:  
*'The price of coupling is ₹ 392/-'*  
The message is encrypted by using an algorithm of putting next alphabet after each letter in the word and next numeric digit in the price figure.
- Encrypted message using above algorithm is known as Cipher Text  
*Uif rsjdg gps dpvqmjoh jt st 403/-*  
When message is received by the receiver, it is automatically decrypted to original text
- Received original message after decryption  
*The price of coupling is ₹ 392/-*

### Firewall for Network Security

A firewall is defined as software or hardware that allows only those external users with specific access characteristics to enter into the network. The access will be allowed on the basis of user name and password, Internet IP address or domain name.

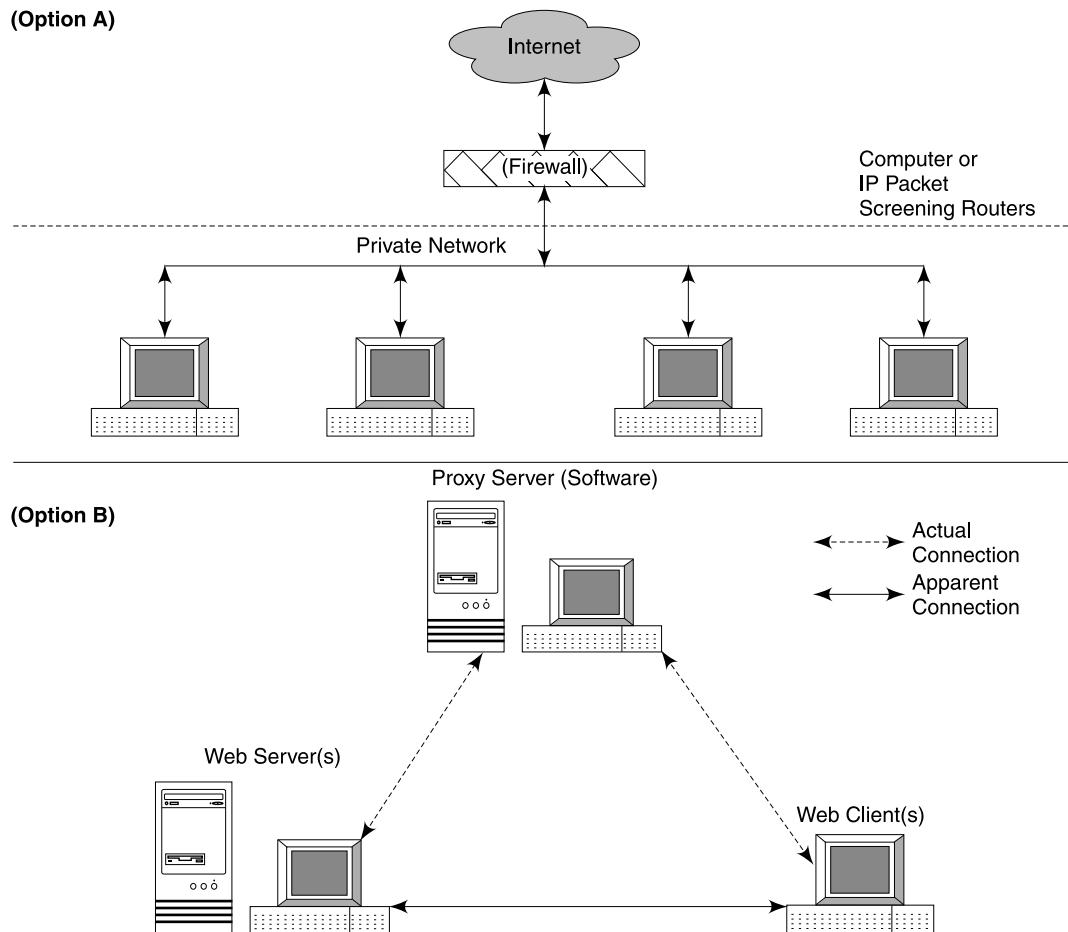
Firewall acts as a barrier between Intranet and Internet which operates selectivity and allows and disallows access after checking and verifying certain identity tags such as passwords, IP address, Domain name.

Firewalls can also be created through special software on Proxy Server which controls traffic of network in and out. Figure 20.11 shows firewall security model.

Firewalls work like filtering routers, examining each packet of information by subjecting it to system check of authentication, verification of source and destination and then allows or rejects the entry of the intranet or exit from intranet.

Security on web is implemented through a layered system each checking and protecting the flow of information. The layers are the following.

- Source and destination relation.



**Fig. 20.11** Firewall Security Model

- Authorisation of individual — password.
- Authentication.
- Encryption of message for integrity.
- Using of public key/private key for unauthorised exposure.
- Checking the access to intranet and access to other websites through internet.
- Finally but not less important is the physical security to Intranet.
- Use of fault tolerant system, disk mirroring, duplicating and use of Raid (Redundant array of inexpensive disks).

## 20.6 ELECTRONIC PAYMENT SYSTEMS

Internet and web are becoming popular due to easy payment systems protecting the interest of buyer and sellers. Different mechanisms and methods are developed to execute payment transactions. They are the following.

**Payments by Consumers:** Credit and debit cards, automated teller machines (ATM), stored value cards and electronic banking.

**Online Payments:** Digital cash, electronic cheques, smart cards, encrypted credit cards.

**Payments between B2B:** Interbank transfers through automated clearing houses.

Electronic payment systems are safe to a great extent through security mechanisms of password, ID check, cross check on collaborative data, and authentication by third party. The companies involved E-commerce, follow secure electronic transactions (SET) protocol, which when incorporated in payment system, offer confidentiality and integrity of information, consumer account authentication, merchant authentication and interoperability on variety of hardwares.

## 20.7 IMPACT OF WEB ON STRATEGIC MANAGEMENT

Internet and Web are making phenomenal changes in the management processes of business and industry. The complex cycle of process management, beginning with planning and concluding with execution and control still remains applicable, but it can be executed more efficiently with rich information resource due to internet. It adds more complexity in the process but also facilitates the process design with information support from various web sources.

The main objective of the process of management is to increase management effectiveness in business planning and execution. With web access through internet, management effectiveness has considerably increased. Firstly with better information the process has become more efficient. Secondly the control has become more effective due to prompt feedback on business status. The third factor, which has contributed to increase in the management effectiveness, is the speed of communication. With web access, access and communication is possible anywhere, any time and to any location.

The planning, the first step in process for management has become more efficient. The first step in planning is forecasting of business, market, technology, commodity trends and other such factors affecting the business performance which form the basis for business planning. The forecasting is now more certain as information on all these factors is available. The uncertainty and error in forecast is now more controllable due to latest and precise information availability. The forecasting model can handle more variables and it can be processed quickly to give better vision of the future.

The second step in planning process is to evolve different alternative courses of action. The ability of business planner in this regard is considerably increased due to rich information of multidimensions which in turn helps to generate different courses of action. The action alternatives could be resources allocation, different pricing strategies, entering into new market segments, exploiting new business opportunities and so on. The choice of such alternatives and its evaluation to select and implement is now easily possible. With strong information support planning has become a more effective tool.

Organising the human resource is the second step in the process of management which has undergone a critical and radical change due to web. The organisation is now web enabled networked organisation. The organisation structure is designed on the basis of activity analysis, decision analysis, and relation analysis. All these are affected in web environment. The activities in the organisation are reduced and have become shorter in time duration. Decision

analysis is more complex but easier to handle due to information access. Due to information availability the business intelligence has increased making it possible to transfer number of decisions to business application systems.

New relation patterns have emerged with change in focus. The customer and vendor relations management is a new concept in web environment. The relationships are changing from commercial to trust relationship. All these changes have affected the organisation structure. Table 20.7 shows the effect on the organisation.

**Table 20.7** Effect on the Organisation

Factor	Effect
1. Organisation Levels	Less in number
2. Span of control	Increased and more efficient
3. Departmentation	Less as organisation has become smaller in size and functions
4. Relations of line and staff functions	More smooth due to transparency in business operations and access to information
5. Organisation Structure	Network as against hierarchical
6. Delegation of Authority	More real as empowering the people is now possible due to less risk in delegation
7. Roles and Responsibilities	More clearly defined decision making responsibilities

The effects mentioned in the Table 20.7 have made a major impact on the cost of running the business. The management overheads have considerably come down due to thin organisation.

Figure 20.12 shows the cultural and qualitative change in the Organisation system form preWeb to postWeb environment, provided the goals remain same.

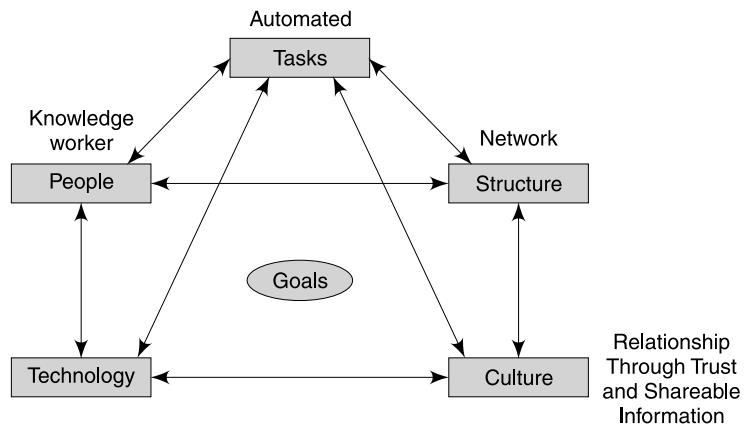
- Tasks : Manual to Automated/Mechanised through technology.
- People : Workers to knowledge workers.
- Structury : Hirachical to network (Visual)
- Technology : Manual/Mechanical to automated intelligent
- Culture : Burocatic to collaborative participative

As stated earlier, the second most critical step in process of management is control. Controlling is now possible more effectively as feedback mechanism has become more powerful due to information availability and its processing, as and when necessary. The control process is now quick in execution as it is possible to measure the results, evaluate and trigger the action automatically.

### Strategic Management Under Web

The management resorts to strategic business planning due to following reasons.

1. Market forces affecting the business performance.
2. Changes in technology threatening the business.
3. Competition leveraging on technology.

**Fig. 20.12** Effect on Organisation System

4. Complexity of business due to volatility of markets, products and customers.
5. Environment offers challenging opportunities for exploitation.

In pre web era, the information and analysis of each of these factors was almost impossible. The reason being non-availability of information and no access to such information. Today, research institutions, universities, government, federation of commerce and industry, financial institutions have their websites giving information on market, technology, products and services and analysis of environmental factors affecting the business. These sites provide industry analysis in terms of past performance, current status and forecasts. They also give technology trends and applications and the potential it offers for business. The sites also give information on threats and challenges to business and industry. All such information is a product of investment and research. It is available free or on charge. This information database is a greater asset for strategic management of business. If information on web is available it can be downloaded for processing further. Most important factor is that this information is valid as it is collected and processed by the reliable institutions. The information is available in ready to use form.

With information available on web, the process of strategic planning has become easier. First, setting realistic business goals and objectives is possible. The goals and objectives could be set in quantitative terms as they are evolved on the basis of facts and figures about the industry, business and technology. Since, goals and objectives are in quantitative terms, it is now possible to measure the progress towards its achievement.

With information support, business-modeling exercise is more realistic in terms of scope and detail. It is more scientific and less academic and highly representative of the ground situation. With high quality of information, generating strategic alternatives is possible which can be tested and evaluated on different criteria.

The strategic business plan so developed can be monitored and corrected based on on-line real time information given through web channel. The time gap between knowing success or failure and the reasons for it and response time to react on it, is now very small. It is possible, due to web, to locate the averse performance or strategy failure in a short duration through

you own network channels and through comparative analysis made by independent third party research and analysis institutions.

Information on web exposes the probable threat to business due to competition, technology or market changes making strategic business planner alert to number of business factors. It forces to think and implement alternative strategy or at least move on the correction path for strategy under implementation. With information support from web, strategic management of business is now an exercise whose credibility is high and its acceptance is with confidence.

## 20.8 WEB ENABLED BUSINESS MANAGEMENT

In Web environment, the business initiative is passed in the hands of customer. The customer has access to information on sources of product and services, their availability and price to pay. These are very basic for deciding the purchase of products and services. With internet and variety of E-commerce tools, it is possible to execute a secured purchase transaction where selection of the product is possible, payment to genuine parties is ensured and delivery of the item can be tracked till item is delivered to your doorsteps. The process of ordering, payment and delivery is very fast calling upon management to make sea changes in existing conventional and traditional processes of business management.

Information is a driving force for the management to run the business. It calls to improve the quality of decision making. Access to information being easy, it is now possible for manager to develop DSS of his own design. Since quality of information is very high due to up to date information from right source, the risk element in business decision is controlled to a great extent. It is now possible to develop business models, decision rules, decision algorithms using Web sources information and make them part of application system. The burden of decision making is now easily passed to the IT based management system relieving the manager for better quality of work. Most of the decisions in the area of business operations are taken over by Web enabled processes which use business rules and tools to execute the business process.

In web environment, system concepts have changed. The systems have become faster in response and delivery. Table 20.8 shows changes in the system concepts and components.

**Table 20.8** Changes in the System Components

Systems components	Pre web	Post web
Inputs	Data from paper transactions Incidence of error very high Physical transactions are processed in parallel without waiting for management process	Data from Electronic Transactions Incidence of error very low and controlled Physical transaction is initiated electronically
Process	Length, linear, full of checks, approvals and human centric controls Mistaken due to isolated information support and mismatch among these sets	Short, collaborative and check approvals built into the system Common information base with sharable feature hence no mistakes due to information mismatch

*Contd...*

*Contd...*

Output	Output of doubtful nature due to low quality of information	Output of high precision due to high quality of information
Feedback	Feedback mechanism is based on measurement of output of doubtful nature  Speed to feedback communication is very slow	Feedback mechanism is enabled in the application based on output of high precision  Speed of feedback is very high
Control	Most of the cases it is externally triggered based on human response	Control is a build in the process of the application scope of which is very wide due to extranet and internet

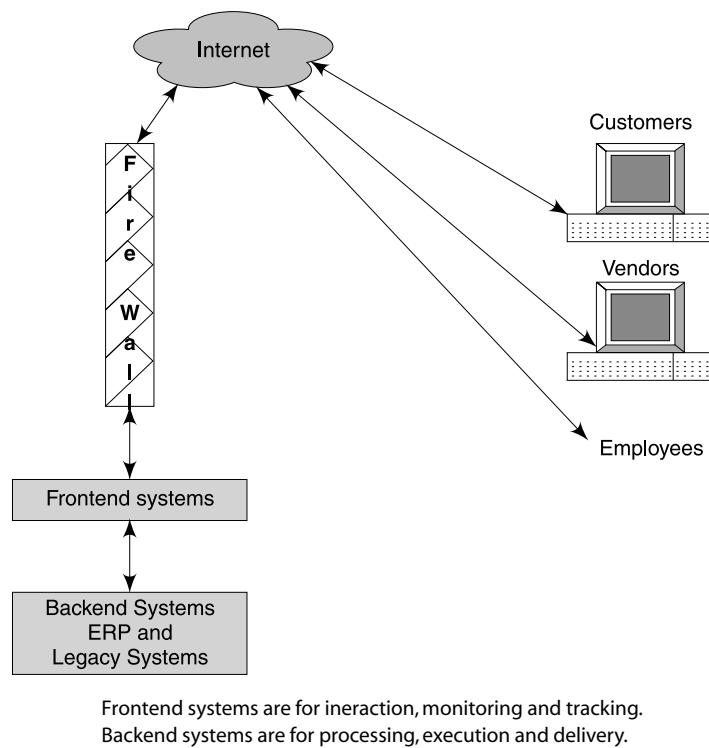
Due to internet and web technology the system scope is more wider as the players in the system care customers, vendors and employees. In pre web era, the players in the system were employees who use to trigger the operations. But web enabled system affect customer databases, vendor dispatch schedules and bank balances simultaneously without involvement of employees. Web enabled systems, therefore, call upon system designer to introduce more security checks which were unheard in the pre web system design and development.

All transactions being paperless, the conventions followed in paper-based transaction systems are no longer valid. Authentication, authorisation, which was confirmed through signature, is now done through digital signature using encryption technology and use of public and private key to decrypt the signature. In web, messaging and communication is a big application, where secrecy and confidentiality is absolutely necessary. The system design in web environment requires special feature to ensure that message integrity is maintained. The security on web is a subject by itself and can be understood through special books devoted to this subject.

Web has opened new avenues of conducting the business, which were not present in pre web era. The concept virtual organisation, virtual storefront is a new development in web environment. The web has made E-commerce possible. Typical order processing transaction can be handled through E-commerce tools on the web. The web is a platform independent technology, which is not affected by language or location. Web enabled transactions can trigger from anywhere in the world if you have internet access and relevant web address to interact. Web based systems are fast, transparent and secured compared to conventional paper based systems of business management.

In web environment system design is open and has capability to change as environment changes. In this environment new brand of IT professionals have come in. These are Web Master, Web Administrator, Web Designer, Web Developer/programmer and Graphic designer and Artists. Web has its own language and protocols. The entire business management is handled in two parts frontend and backend as shown in Fig. 20.14.

In Web environment, new additional applications systems are required to handle customer and vendor interactions which were absent in pre web era. In web transactions are processed in seamless integration method requiring in built checks, controls and security of data, information. The systems Analysis and Design in web environment requires additional dimension of security and control.



**Fig. 20.13** Business Management in Two Parts (Frontend and Backend Systems)

One distinctive feature of Web based system is its capability to handle multiple data types namely picture, images, graphics, audio and video. So designer of the system in web environment has to know how to capture these data types, store them and call them for application in a given system. In web enabled system, therefore, the scope of input is much more and varied, requiring specific software application. In web, the system design is more complex at all stages—input, process and output.

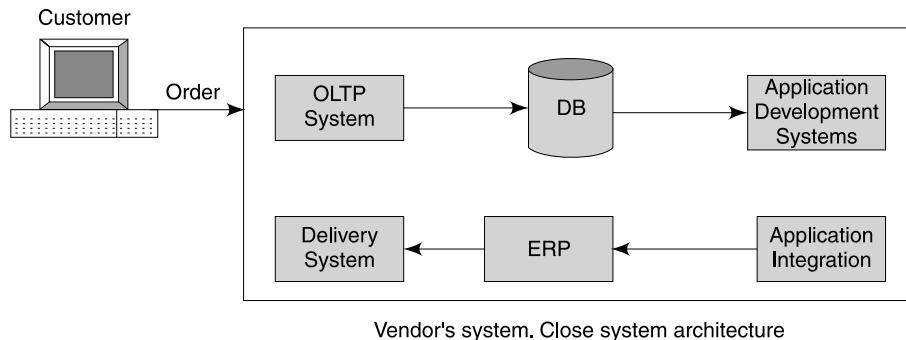
The underlying principles and practices in systems analysis and design as mentioned in Chapter 9, are still valid. The steps in systems analysis and design mentioned in Table 9.2 of Chapter 9 are not changed at all. It now seeks applications of new technologies namely internet and web with strong security features. In conventional system design in pre web era, information needs of in-company users are considered. In web environment in addition to in-company users customers and vendors information needs are also to be considered for efficient development of IS.

Website, which is a place for connectivity and interaction, is to be designed keeping its own requirement of access, response level and content management. A good web site which attracts thousands of hits (logins) is a necessity for web based business management process.

### Application System Architecture in Web

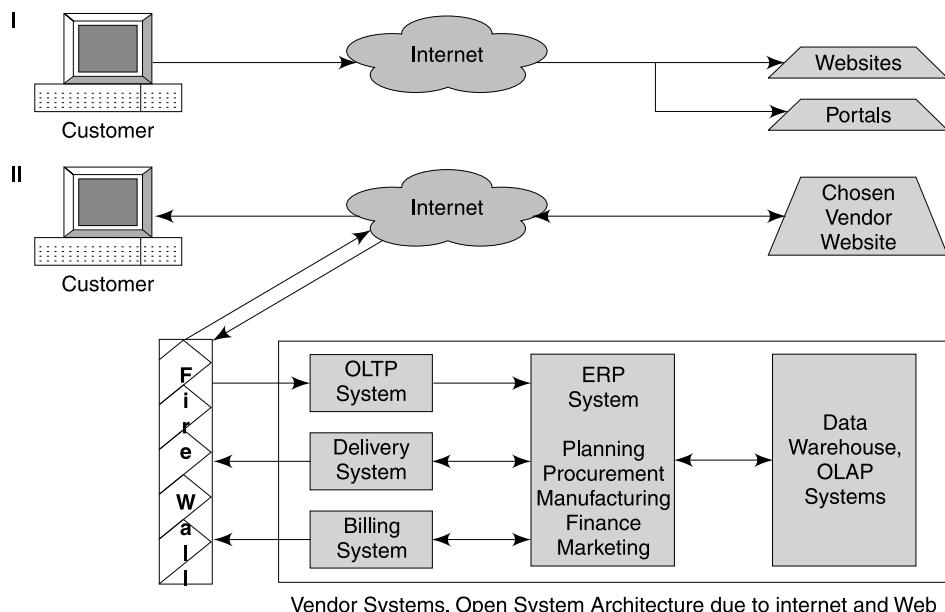
The application architecture is considerably changed due to web application. Due to web there is an integration of customer and vendor into corporate systems. Due to internet and

web technology applications have become platform independent and transparent to users. Data, Information and application integration is on the internet crossing the boundaries of the organisation. Application architecture in pre web era is shown in Fig. 20.14 and in post web era is shown in Fig. 20.15.



**Fig. 20.14** Application Architecture in Pre Web Era

The customer has become part of the system due to access to vendor's system through internet. The customer systems and vendor systems can interact through web, if needed. The systems though work on different platforms are rationalised and work on common web platform through internet network. The information on business latest, current is up to date anytime and is available in the ready to use form. Web and Internet made possible physical as well as logical integration of different systems and applications.



**Fig. 20.15** Application Architecture in Post Web Era

## 20.9 ENTERPRISE: CONTENT MANAGEMENT SYSTEM (CMS)

A Content Management System (CMS) is a computer application used to create, edit, manage, search and publish various kinds of digital media and electronic text. CMSs are frequently used for storing, controlling, versioning, and publishing industry-specific documentation such as news articles, operators' manuals, technical manuals, sales guides, and marketing brochures. The content managed may include computer files, image media, audio files, video files, electronic documents, and Web content. There are three main categories of CMS, Enterprise CMS ,Web CMS ,Component CMS operating in their respective domains. A CMS may have the following features:

- identification of key users and their management roles;
- the ability to assign roles and responsibilities to different content categories

An enterprise content management (ECM) system is concerned with content and documents related to the organizational processes of an enterprise. The purpose is to manage the organization's unstructured information content, with all its diversity of format and location.

### Web Content Management Systems (WCM)

A web content management system (WCM) system is a CMS concerned with content on the Web. It is designed to simplify the publication of Web content to Web sites and portals. It allows content creators to submit content of HTML for uploading of files.

### Component Content Management Systems (CCM)

A component content management (CCM) system is concerned with the content within documents. It can locate and link content at any level of organisation, and it is used to build publications out of re-usable fragments of content. CCM system manages structured content (usually XML), from which such documents are rendered and typically delivered to ECM and WCM systems.

Two factors must be considered before an organisation decides to invest in a CMS. First, an organisation's size and geographic dispersion must be considered especially if it is spread out over several countries. For these organisations, the transition to CMS is more difficult. Secondly, the diversity of the electronic data forms used within an organisation must be considered. If an organisation uses text documents, graphics, video, audio, and diagrams to convey information, the content will be more difficult to manage.

Typically, a CMS consists of two sub systems: the content management application (CMA) and the content delivery application (CDA). The CMA allows the content manager to manage the creation, modification, and removal of content. The CDA uses and compiles that information to update. The popular features of a CMS include publishing, format management, revision control, and indexing, search, and retrieval. It may have a feature of displaying one to one associated content when user is in search mode. For example, if the purchase manager is searching for a product then on search it displays also yellow pages and advertisements.

By using a content management system, an organisation provides access to employees to an up-to-date accurate information and applications at central location. This results in increased employee productivity.

The primary benefits of these technologies revolve around saving time of search and improving accessibility to information. The specific benefits are the following:

- Reduction of paper handling.
- Reduction of error-prone manual processes.
- Reduction of paper storage.
- Reduction of lost documents.
- Faster access to information
- Improved control over documents and document-oriented processes
- Security over document access and modification
- Provides reliable and accurate audit trail
- Improved tracking and monitoring of documents and its content.

### **Enterprise Content Management System (ECM)**

Enterprise content management systems combine a wide variety of technologies and components. The five ECM service components and technologies of the ECM model dealing with content are

- Capture
- Manage
- Store
- Preserve
- Deliver

The “Manage” service component connects Capture, Store, Deliver and Preserve and can be used in combination or separately. ECM handles following main tasks

- Document management
- Collaboration of needed software
- Content management
- Web portal Management,
- Records management
- Workflow
- Business process management (BPM)

#### ***Capture***

The “Capture” contains functionalities namely, generating, capturing, preparing and processing analog and electronic information. Manual capture can involve all forms of information, from paper documents to electronic office documents, e-mails, forms, multimedia objects, digitised speech and video, and microfilm. Automatic or semi-automatic capture can use EDI or XML documents, business and ERP applications or existing specialist application systems as sources.

Technologies used for processing captured information are

- Optical character recognition (OCR)  
*OCR converts handwriting or lettering into machine characters,*

- Handprint Character Recognition (HCR)
- Intelligent Character Recognition (ICR)  
*Uses comparison, logical connections, and checks against reference lists and existing master data to improve results.*
- Optical Mark Recognition (OMR)  
*OMR reads special markings in predefined fields with very high accuracy*
- Barcode  
*Barcodes on mailed forms allow for the automatic recognition and filing of returns.*
- Document imaging:  
*Capture, improve the quality of and to view images. Functions and features include rotation, zooming, aligning, separation of pages, annotations*
- Forms processing  
*Forms processing means the capture of printed forms via scanning. Recognition technologies are often used here largely for automatic processing.*
- Aggregation:  
*Aggregates contents from various sources to pass them on to storage and processing systems with a uniform structure and format.*
- Subject indexing.  
*Assigns index attributes to the subject by category.*
- Manage Databases *For administration and retrieval*
- Access authorisation systems. *Controls access to authorized persons.*

### **Document Management and Collaboration**

The special clarification is necessary on Document Management and Collaboration systems. DMS controls documents from their creation through to long-term archiving. Document management includes functions like:

- Check in/Check out for checking stored information for consistency.
- Version management to keep track of different versions of the same information.
- Search and navigation for finding information and its associated contexts.
- Visualising for showing information in structures like virtual files, folders, and overviews

Collaboration simply means “working together.” However, these solutions, which developed from conventional groupware, now go much further and include elements of Knowledge Management. Collaboration includes the following functions:

- Jointly usable information databases
- Joint, simultaneous, controlled information processing
- Knowledge based on skills, resources and background data for joint information processing
- Administration components such as whiteboards for brainstorming, appointment scheduling, project management etc.

### ***Web Content Management***

Enterprise Content Management claims to integrate Web Content Management.. Web Content Management includes the following functions, among others:

- Creation of new or editing of existing information in a controlled environment.
- Delivery and administration of information for the web presentation.
- Automatic conversion for various display formats, personalised display and its versions.
- Secure separation of access and authorisation to public and non-public information
- Visualisation for Internet presentation (browser, HTML, XML etc.)

### ***Records Management: File and archive management***

Records Management refers to the pure administration of records, important information and data that organisations are required to archive. Records management is independent of storage media, and can also manage information stored otherwise than in electronic systems. Among the functions of records management are:

- Visualisation of file plans and other structured indexes for the orderly storage of information
- Unambiguous indexing of information
- Management of record retention and deletion schedules
- Protection of information in accordance with its characteristics.
- Use of meta-data for the unambiguous identification and description of stored information

### ***Work Flow Management***

Workflow and Business Process Management differ substantially in content and application. There are two types of Workflows, the “Production Workflow” which uses predefined sequences to guide and control processes and “Ad-Hoc Workflow” in which the manager determines the process sequence.

Workflow management includes the following functions,

- Visualisation of process and organisation structures.
- Capture, administration, visualisation, and delivery of grouped information with its associated documents or data to the work place location.
- Incorporation of data processing tools, such as office products.
- Parallel and sequential processing of procedures to save process time.
- Reminders, deadlines, delegation and other administration functionalities.
- Monitoring and documentation of process status, routing, and outcomes.
- Tools for designing and displaying process for learning and training.

The objective is to largely automate processes by incorporating all necessary resources.

### ***Business Process Management***

BPM or Business Process Management goes a step further than Workflow. BPM aims at the complete integration of all affected applications within an enterprise, with monitoring of

processes and assembling of all required information. In simple terms It is an integration of different work flows contributing to a larger system goal. Main BPM's functions are:

- Complete workflow functionality
- Process and data monitoring at the server level
- Enterprise Application Integration, to link different work flows and applications
- Generate business intelligence, with rule structures, integration of information warehouses, and utilities that assist managers in their work.

### **Preserve and Preservation Strategies**

The preservation of content is a long term necessity. It is archiving, more than just storing. The "Preserve" components of ECM handle the long-term, safe storage and backup of static, unchanging information of the organisation. This is handled through electronic archiving. Electronic archiving systems consist of a combination of administration software like, Records Management, Imaging or Document Management, Library Services like Information Retrieval System and storage subsystems.

### **Security Management Technologies**

The information in CMS is sensitive needs preservation, security and protection. Some contents would have Intellectual Property Rights.

Electronic signatures are used in all processes of access, exchange. PKI (Public/Private Key Infrastructure) is a basic technology for electronic signatures. It manages keys and certificates, and checks the authenticity of signatures. Other electronic signatures demonstrate the identity of the sender and the integrity of the sent data, i.e. that it is complete and unchanged. Finally, there is Digital Rights Management and Watermarking. This is used in Content Syndication and in MAM (Media Asset Management) for managing and securing intellectual property rights and copyrights. It works with techniques like electronic watermarks that are integrated directly into the file, and seeks to protect usage rights and protect content that is published on the Internet.

Watermarks are used for protecting or hiding the image, audio, video or information. These content carrying entities are widely available on the Internet and in CMS, it may sometimes be desirable to use watermarks to hide and protect them. A watermark is a secondary image which is overlaid on the primary image, and provides a means of protecting the image. The watermarks could be visible or invisible.

#### **Visible Watermarks**

A visible watermark is a visible semi transparent overlaid on the primary image. Perhaps consisting of the logo or seal of the organisation which holds the rights to the primary image, it allows the primary image to be viewed, but still marks it clearly as the property of the owning organisation. It is important to overlay the watermark in a way which makes it difficult to remove, if the goal of indicating property rights is to be achieved.

#### **Invisible Watermarks**

An invisible watermark is an overlaid image which *cannot* be seen. Different applications of this technology call for two very different types of invisible watermarks:

- A watermark which is destroyed when the image is manipulated digitally in any way may be useful in proving authenticity of an image. If the watermark is still intact, then the image has not been “doctored.” If the watermark has been destroyed, then the image has been tampered with. Such a technology might be important, for example, in admitting digital images as evidence in court.

An invisible watermark which is very resistant to destruction under any image manipulation might be useful in verifying ownership of an image suspected of misappropriation. Digital detection of the watermark would indicate the source of the image

## 20.10 ENTERPRISE PORTAL

A web portal presents information from diverse sources in a unified way. Apart from providing information, web portals offer other services such as e-mail, news, stock prices, infotainment, and other features. Portals provide a way for enterprises to provide a consistent look and feel with access control and procedures for multiple applications, which otherwise would have been different entities altogether. Two broad categorisations of portals are Horizontal portals (e.g. Yahoo, Google) and Vertical portals (or Vortals, focused on one functional area, e.g. salesforce.com). A web portal can be integrated with many systems of the organisation.

It is designed to use distributed applications, different numbers and types of middleware and hardware to provide services from a number of different sources. Business portals are designed to share information and knowledge to support collaboration in workplaces. A further business-driven requirement of portals is that the content be able to work on multiple platforms such as personal computers, personal digital assistants (PDAs), and cell phones/mobile phones. In addition, most portal solutions, if designed correctly, can allow internal and external access to specific corporate information using secure authentication or single sign-on.

Enterprise Information Portals are applications that enable organisations to release internally and externally stored information, and provide users a single gateway to personalised enterprise information needed to make informed business decisions.

The benefit of enterprise portal is its “competitive advantage” derived from providing access to distributed information stored in enterprise systems. Information access to all is convenient, reliable, and its delivery is inexpensive. Portals increase employee productivity as less time is spent searching the web as information is organised and available at one place. Their effectiveness is also increased due to fast information driven decision making.

### Corporate Web Portals

Corporate portals, besides displaying their profile, are offering new value-added capabilities for businesses. Capabilities such as managing workflows, increasing collaboration between work groups, and allowing content creators to self-publish their information are added. Web portals are also designed to perform E-Commerce, E-Business transactions. As web portals have risen in popularity their feature set has grown to include hosted databases, document management, email, discussion forums and more.

## Domain Portals

A number of portals have come about, that are specific to the particular domain focusing on domain information content. It also offers link to related companies and services, a prime example of this trend would be the growth in property portals that give access to services such as estate agents, removal firm, and solicitors that offer legal and document registration services. A number of portals have come about that are specific to the particular domain, offering access to related companies and services. Along the same lines, industry-specific news and information portals have appeared.

The global economy is currently undergoing a fundamental transformation. Market dynamics and business rules are changing at an ever increasing speed. The business management processes are now knowledge driven. The need is for high quality knowledge, sourced from inside and outside the organisation and stored at one location. The work culture is becoming more collaborative team work pooling expertise from within & outside organization.

## Knowledge Portals (KP)

Knowledge Portals represent a solution to this challenge, as they provide a flexible knowledge environment to a potentially large number of users. The mission of a Knowledge Portal is not only to provide a library-like pool of information, but to actively support the user in execution of business processes.

Lew Platt of Hewlett Packard takes the view that “successful companies in the 21st century will be those who do the best job in capturing, storing, and leveraging what their employees know”. Knowledge Portals are a web-based solution for closing this gap.

Currently, organisations rely on a set of diverse tools to meet their needs for a corporate portal, a document management system, and an aggregate search solution. SharePoint Portal Server is a flexible portal solution for knowledge workers to easily find, share, and publish information.

### *Some Illustrations of Knowledge Portals*

- Accenture is a global management consulting, technology services, and outsourcing company. Committed to delivering innovation, the company collaborates with clients to help them become high performance businesses. Accenture needed to simplify access, improve search, and streamline content management for their consultants. Accenture Knowledge Exchange Portal is a corporate portal for publishing and sharing information and knowledge to authorised users.
- B.E.A., Inc. manufactures sensors and door building products relating doors and windows. BEA Systems, Inc ensured the worldwide sales force had ready access to all of its internal tools, customer information, and most current company and product information on design , quality, recommendations and so on. BEA deployed a knowledge management portal-known as Knowledge Express-on a service-oriented architecture SOA. It is built on BEA WebLogic Platform.
- Wipro Technologies is a global information technology company offering world-class solutions to its customers. Wipro needed a way to collate the knowledge gained by

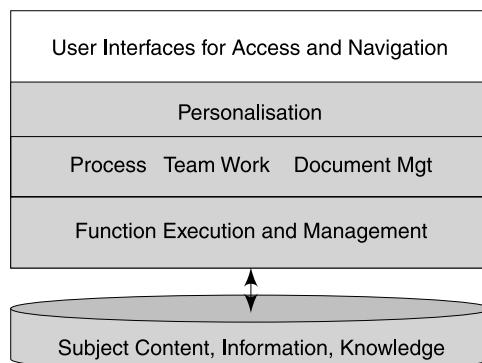
its employees so that other employees could access this information easily. Wipro wanted to provide a unified repository of various knowledge artifacts to its sales, marketing and technical personnel. Knowledge Management Portal saves time and money, improves productivity of developers, designers, and consultants at Wipro

- Knowledge portals are more important to organisations today than ever before. The more than 120,000 employees, contractors, and vendors at Microsoft create an increasing amount of digital information that pertains to their job responsibilities. Employees access much of this information through the Microsoft primary knowledge portal.
- ICICI Bank is a combination of information and knowledge portal offering online services to customers. The portal provides information on services offered by the bank and how to avail them. The Portal provides total support on all queries, news and alerts, forms, information on different products and so on.
- Institute of Chartered Accountants of India Knowledge portal '[www.pdicai.org](http://www.pdicai.org)' provides information and knowledge on opportunities, new circulars, news, judgments, Forum for Q & A, Reckoner, Tax Information and guidance.

KP needs Process service oriented technology platform to meet the users' requirement. These requirements are three fold

- Access to static Organisation information about the business, products, different offerings, and important links to alliance partners, process manuals, brochures etc.
- Knowledge created and stored in knowledge database about problems and solutions, case studies, Templates and models, technical problem solving information and links to other knowledge portals.
- Functionality to conduct business transactions like ordering, tracking, billing, payment and support and so on.

Knowledge Portals have to be flexible and easy to use and should provide almost any kind of content or functionality the user needs. To structure the architecture of a Knowledge Portal, the following five layer component model is being used.



- Data base layer:

Subject Content, Information, Knowledge:

- Subject content Provides focused specific information on a topic of interest of the user. This information brings clarity to the user on the subject before any action is taken.

- Specific information used directly in the process invoked by the user.
- Contains problem specific Knowledge to resolve it.

- **Personalisation layer**

This is for the user's personal support. Services like do list, directory, schedules, user manager for task mgt, history or personal notes etc

- **Support and service layer**

Process support: check lists, templates, process diagram PM tools, process application links.

Team work: Planning tools, message boards, E-mail, conferencing, expert profiles, community groups, conferencing and discussion facilitation.

Document Management: Access and subscription, Search and selection, editing, content sharing, content rating.

- **Execution layer**

Processes to access database and seek support from support layer to execute a requirement: query, downloading, process execution, verification, sharing and display of the process output.

- **Access layer**

It is a user interface and navigation layer. It should be user friendly and simple to operate. The general well accepted standards of User interface design should be followed.

Web portals, information or knowledge have become an integral part of MIS of the organisation. They are used to share information and are a platform for transacting business with vendors and customers. They also act repositories of Information and knowledge.

## 20.11 WEB 2.0

We begin with Web 1.0 before we discuss Web 2.0. The first implementation of the web represents the Web 1.0, which, according to Berners-Lee, could be considered the "read-only web." Web 1.0 allowed searching for information and reading it. There was very little in the way of user interaction or content contribution by the user. Their goal for a website was to establish an online presence and make their information available to anyone at any time. The core principle of web 1.0 is top-down approach over the use of the WWW and its user interface. The users can only view web pages, but cannot reflect on the content of the web pages.

Shopping cart applications, which most ecommerce website owners employ in some shape or form, basically fall under the category of Web 1.0. The overall goal is to present products to potential customers, much as a catalog or a brochure does — only, with a website, you can also provide a method for anyone in the world to purchase products.

Web 2.0 is the term given to describe a second generation of the World Wide Web that is focused on the ability for people to collaborate and share information online. Web 2.0 basically refers to the transition from static HTML Web pages to a more dynamic Web that is more organised and is based on serving Web applications to users.

Other improved functionality of Web 2.0 includes open communication with an emphasis on Web-based communities of users, and more open sharing of information. Over time

Web 2.0 has been used more as a marketing term than a computer-science-based term. Blogs, wikis, and Web services are all seen as components of Web 2.0.

**Web 2.0** is a loosely defined intersection of web application features that facilitate participatory information sharing, interoperability, user-centered design, and collaboration on the World Wide Web. A Web 2.0 site allows users to interact and collaborate with each other in a social media dialogue. It allows users to generate content , in contrast to websites (Web 1.0) where users are limited to the passive viewing of content that was created for them by others. Web 2.0 websites allow users to do more than just retrieve information. By increasing what was already possible in "Web 1.0", they provide the user with more user-interface, software and storage facilities, all through their browser Mashups are an exciting genre of interactive Web applications that draw upon content retrieved from external data sources to create entirely new and innovative services.

### Comparison of Web 1.0 vs. Web 2.0

While most of Web 2.0 runs on the same manner as Web 1.0, there are some key differences. Our goal is to identify the primary differences distinguishing Web2.0 from Web 1.0. Web 2.0 sites have different structures, richer methods of user interaction, new technologies, and fundamentally different philosophy. Table 20.9 identifies few such differences.

WEB 1.0	WEB 2.0
<ul style="list-style-type: none"> <li>• Reading</li> <li>• Organisations</li> <li>• Client/Server</li> <li>• HTML</li> <li>• Home pages</li> <li>• Interaction</li> <li>• Advertising platform</li> <li>• Use internet</li> <li>• Web pages driven</li> <li>• Web pages static</li> <li>• Needs expert support to use</li> <li>• High cost of web development</li> </ul>	<ul style="list-style-type: none"> <li>Writing</li> <li>Communities</li> <li>Peer to peer</li> <li>XML</li> <li>Blogs</li> <li>Conversion</li> <li>Word of mouth publicity</li> <li>Interact with internet.</li> <li>Community, User driven</li> <li>Web content dynamic</li> <li>No specific experties</li> <li>Substantial cost reduction</li> </ul>

Web 2.0 can be described in 3 parts, which are as follows:

Rich Internet application (RIA) — defines the experience brought from desktop to browser whether it is from a graphical point of view or usability point of view. Some buzzwords related to RIA are Ajax and Flash.

Web-oriented architecture (WOA) — is a key piece in Web 2.0, which defines how Web 2.0 applications expose their functionality so that other applications can leverage and integrate the functionality providing a set of much richer applications (Examples are: Feeds, RSS, Web Services, Mash-ups)

Social Web — defines how Web 2.0 tends to interact much more with the end user and make the end-user an integral part.

As such, Web 2.0 draws together the capabilities of client- and server-side software, content syndication and the use of network protocols. Standards-oriented web browsers may use plug-ins and software extensions to handle the content and the user interactions.

Web 2.0 websites include the following features and techniques for which Andrew McAfee used the acronym SLATES:

- **Search through key word:** Finding information through key word search.
- **Links provides information:** Connects information together into a meaningful information ecosystem model of the Web, and provides low-barrier social tools.
- **Authoring to collaborate:** The ability to create and update content leads to the collaborative work of many rather than just a few web authors. In wikis, users may extend, undo and redo each other's work. In blogs, posts and the comments of individuals build up over time.
- **Tags to search information:** Categorisation of content by users adding "tags" one-word descriptions—to facilitate searching, without dependence on pre-made categories.
- **Combination of platform and document server:** Software that makes the Web an application platform and a document server. These include software like Adobe Reader, Adobe Flash player, Microsoft Silverlight, ActiveX, Oracle Java, Quicktime, Windows Media, etc.
- **Signals content changes:** The use of syndication technology such as RSS notifies users of content changes.

While SLATES forms the basic framework of Enterprise 2.0, it does not contradict all of the higher level Web 2.0 design patterns and business models. In this way, a new Web 2.0 is quite effective and diligent in interweaving the story of Web 2.0 with the specific aspects of Enterprise 2.0. It includes discussions of self-service IT, the long tail of enterprise IT demand, and many other consequences of the Web 2.0 era in the enterprise.

Web 2.0 offers an opportunity to engage consumers through marketing strategies. Web 2.0 tools are used to collaborate with consumers on product development, service enhancement and promotion. Web 2.0 acts as a platform to share ideas on product and services. Companies can use Web 2.0 tools to improve collaboration with both its business partners and consumers.

Among other things, company employees have created wikis—Websites that allow users to add, delete, and edit content — to list answers to frequently asked questions about each product, and consumers have added significant contributions. Another marketing Web 2.0 lure is to make sure consumers can use the online community to network among themselves on topics of their own choosing.

Small businesses have become more competitive by using Web 2.0 marketing strategies to compete with larger companies. As new businesses grow and develop, new technology is used to decrease the gap between businesses and customers. Social networks have become more intuitive and user friendly to provide information that is easily reached by the end user.

For example, companies use Twitter to offer customers' coupons and discounts for products and services.

### **BT Case Study**

(Source: richarddennison.wordpress.com/bt-web-2.0-adoption-case-study)

**Note:** The case illustrates how Web 2.0, social media platform can be used for internal communications in business organisation. The case describes the process of its introduction and successful implementation.

#### **Taking the 'Social' Out of Social Media**

The power of social software is undeniable in the free, anarchic world of the global internet. But what happens when you bring these tools into the constrained, policy-driven, risk-averse world of the corporate intranet where the user population is small, where expressing oneself as an individual and on a personal level can feel threatening, and where management is watching your every move?

Well, that's just what one of the world's leading providers of communications solutions, BT, has chosen to do. Richard Dennison, BT's Internal Programme Manager, tells the story.

It was inevitable that the unprecedented and explosive growth of social media tools on the internet would eventually start to seep through firewalls onto corporate intranets. However, reading the increasingly negative stories in the media about employees 'wasting time' on social media sites such as Facebook, one could be forgiven for thinking that they are an evil to be resisted at all costs, transforming focused and highly productive employees into a morass of lazy, good-for-nothings who spend their days competing with one another to collect the most cyber-friends.

At BT, we take a different view. While some companies begin the impossible task of shutting out social media tools, at BT, we have just completed a web 'liberalisation' project to make sure all our employees can access social media sites. Why? Because we see social media tools as a huge opportunity to transform the way our employees interact with each other, with 'the company', and with our customers, partners and suppliers. When over 4,000 of your employees voluntarily join a Facebook group called 'BT', it's time to take note.

#### **Winning Over the Policy Makers**

Having taken the 'philosophical' decision that we should use these tools internally and externally, the first step was to persuade the HR, security and legal policy makers that we weren't about to open a can of worms for them. That's where we made our first mistake. Initially, caught up in the hype surrounding these tools, we began shouting from the rooftops that the world was about to change, that these new tools would effect a seismic shift in everything we did. Unsurprisingly, the policy makers ran a mile! Being the people in the business who are often left to pick up the pieces, HR, legal and security policy makers are understandably cautious.

Having calmed ourselves, we took a different and probably more realistic approach. In reality, these tools are not actually 'new'. They are, in essence, simple content management systems. What makes them different from their predecessors is that they are intuitive, simple,

offer no technical barriers to participation, reflect social behaviour rather than try to distort it, and crucially have become incredibly fashionable.

So, we went back to the policy makers and explained this more clear-headed perspective on what we wanted to do. Together we looked through our existing policies around use and abuse of the internet and intranet and found that the use of these tools was actually pretty well covered by existing policies already. This went a long way to confirming our suspicions that these tools were not as new as the hype suggested and gave the policy people much more confidence. The final reassurance was that we agreed that all tools that allowed user-generated content would be behind our single-sign-on application to prevent any anonymous publishing. The ethos we would engender was one of allowing BT people to say anything they want, in the knowledge that they would be held accountable for what they say.

The final policy hurdle was persuading the BT Communications Council, made up of the directors of internal and external communications from around the business, that letting BT people say what they want internally and externally was a good idea. In August 2006, approval was given for all internal activity, but the main stumbling block was whether or not to let BT people blog externally about the company and their work. Initially, the proposal was rejected outright.

We agreed to a nine-point action plan that involved things like: reviewing who in BT was already blogging; what the blogosphere had to say about BT; and what peer organisations were doing.

In January 2007, we returned to the Communications Council with our findings and the external blogging proposal received a warmer reception. The balance was finally tipped by Ben Verwaayen, BT's chief executive, who expressed publicly his support for the more liberal approach. The policy was approved.

### Introducing the Technology

In parallel with negotiations around policy, we released some pilot social media tools quietly on the intranet. We didn't publicise their existence, but let people find them and the news of their presence spread virally. The tools were based on a single platform, called JotBox, which was cheap to buy and easy to customise. Our view was that these tools would take off or wither away based on how useful they were to BT people. Whatever the outcome, we would have succeeded or failed quickly and cheaply.

The tools we launched initially were an enterprise-wide wiki called BTpedia based on the concept of Wikipedia, which allows any BT person to publish articles or edit articles published by others. We also launched a blogging tool. Both were well received and within a matter of weeks we had several hundred articles in BTpedia and around 300 blogs.

## 20.12 MIS IN WEB ENVIRONMENT

In internet and web environment the traditional role of MIS as a system to generate information for decision making and to meet reporting requirements of the organisation has remain unchanged. But in this role, one more dimension is added due to business becoming customer centric. The business in internet and web has changed from push to customer—to pull from the customer. One more function is added into battery of functions, namely customer man-

agement or more precisely customer relations' management. In information driven business, employees (knowledge workers) become assets and in customer centric business customers become the assets. The business management now concentrates on creating loyal customers and builds strategies to retain them. It is well known that new customers bring revenue and loyal customers bring profit. Like other assets, customer as an asset has future sales value. It has history, and it depreciates. In other words, customer-base has current and future business value. Customer buying history is a value for business. The customer base gets eroded if not managed properly. If customer base as an asset should increase in value and should not get eroded, then customer relations should be of high order. A new class of systems, called Customer relations' management (CRM) is now developed to manage customer relations. The standard packages like Sibel, Clarify are widely used.

The customer relations can be build and improved through effective contact management. The effective contact management is achieved in following business systems.

1. Build target profile of the customer and use it across market potential.
2. Track sales and marketing campaigns to measure response and effectiveness of the campaigns.
3. Share customer related information with all staff and channels, related to sales and marketing.
4. Create a powerful data mart on sales and marketing for evolving marketing and sales strategies.

The information support these systems will give the capability to improve the relationship with the customer and serve the customer better through more proactive measures.

**Table 20.9** Difference Between Application System Architectures

	<i>Conventional application Architecture</i>	<i>Internet and Web based Application Architecture</i>
Customer Technology	Outside the system LAN/WAN, OODBMS,C/S,VB,D2-K,VC++ i.e. closed	Part of the system Internet/Web, Groupware, OODBMS, C/S, Java i.e. open
Order Processing	OLTP and Database platform dependent application	OLTP and Web based platform independent application
Order Execution	ERP application	Web enabled supply chain application (SCM and CRM)
Delivery	Delivery application with no tracking on delivery process	Web enabled delivery application with built in tracking on delivery process.
Billing	Billing application mostly outside ERP system	Integrated with delivery system
Customer Information Exchange	Not Possible	Automatic through CRM system or through limited access to vendor systems
Type of System Integration	Close system architecture Through interface application	Open system architecture Smooth due to open system technology

MIS is build with customer focus to improve the service based on following applications.

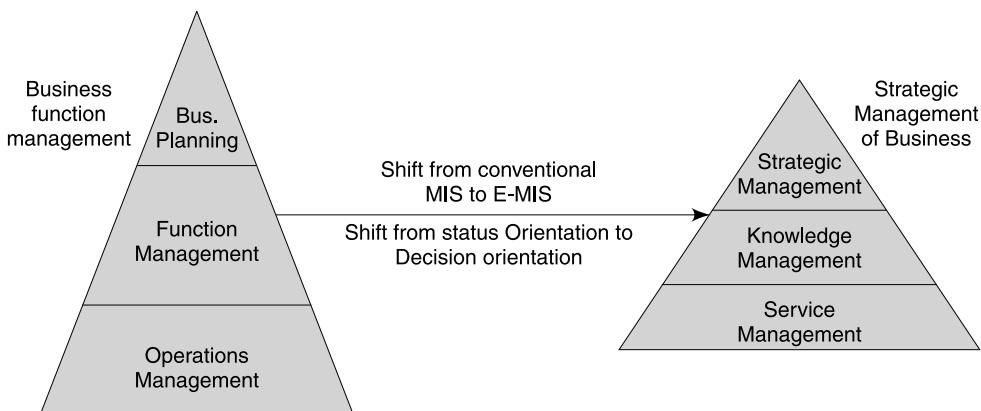
- Order processing management
- Real times services management
- Product configuration management
- Sales force management
- Post sales service management

These applications with functional applications at the backend will provide following information.

- Market Potential
- Market contacts
- Sales contacts
- Number of market leads
- Number of orders received processed and executed
- Order fulfillment analysis
- On-line customer service calls nature, problems and solutions
- Service efficiency
- New business and repeat business
- Market intelligence
  - Competitor information
  - Trend analysis
  - Response analysis
- Market and sales analysis by channel, products and market segments.

## MIS and E-business

In E-business, nature of MIS has changed completely because the role of people running the business has undergone radical qualitative change. The organisation structure itself has undergone the change as shown in Fig. 20.16. The organisation has become smaller with less overheads. Every employee's role is information driven. Linear work methods have given way to collaborative working requiring different type of MIS.



**Fig. 20.16** Organisation and MIS Structure Change

- MIS reporting has become more online and real time which is linked to business status at point in time.
- More non-standard reports through query system have come in to unearth the business status at point in time.
- Nature of MIS is more customer focused and performance focused.
- With E-business, scope of business is larger and global, inviting more competition. This gave rise to MIS where strategic information content is higher.
- MIS in E-business talks more about trends, patterns, analysis, causes and effects.
- MIS information has more knowledge value and can be used for leveraging certain advantages for improving key result areas of the business.
- More and more organisations are implementing Data Warehousing, knowledge management and knowledge based decision support system to aid top management in managing the business.
- MIS information content is more on customer requirements and less on internal user's requirements.
- The management style has changed to manage customer pull than pushing products and services to the customer. The management strategy has changed from Push to customer to Pull of customer. This requires different kind of MIS information content.
- It has changed from report based to view based information. It allows customisation of business view than one static predetermined view of business.
- MIS in E-business forces managers to be more dynamic and quick in response to changing scenario. There is more action and interaction on external front of the business.
- MIS in E-business reduced stress of vendor management and helps to contain the stress of customer demand management.
- MIS scope now incorporates more external information along with internal information.
- MIS reports is number have come down in E-business as concerned users have access to information without anybody's permission or approval.

MIS in E-business therefore calls for complete restructuring of conventional MIS to be effective in new global E-business environment.

## KEY TERMS

E-business Infrastructure: Model and Technology  
Portal  
Disaster Recovery  
Security Measures  
Global Business

Intranet/Extranet/Web  
Security Goals  
E-business Models  
Firewall, Proxy Server  
Security threats  
Search Engine

## REVIEW QUESTIONS

1. State the technologies, which have enabled E-business.
2. Identify E-business initiatives, which will drive companies to switch to electronic methods of managing the business. What are the typical characteristics of the business, where E-business will give large benefits?
3. What is the distinct advantage of going over to E-business? List the advantages in various functions of the business organisation.
4. There are four models of E-business, identify them and give one example of each.
5. What is the difference between Network and Intranet? What is the value addition in information processing when organisation builds Intranet?
6. What is the difference between Intranet, Extranet and Internet?
7. When is it not a must to go on internet?
8. Which applications can be developed on intranet?
9. What are the benefits of Intranet applications? What additional benefits you get when you take these applications on Internet?
10. State clearly the difference between Internet and World Wide Web (Web).
11. What applications are possible on internet using Web technology?
12. What are the different components of Web and their role in Web applications?
13. What is role and application of CGI in web application development?
14. Describe the components of following URL.  
<http://www.microsoft.com/windows2000/upgrade>
15. Explain the following terms.  
Webpage, Website, Hyperlink, HTTP, HTMP, TCP/IP, Encryption.
16. Attempt to place an order through a Website. Try [www.Indiabazaar.com](http://www.Indiabazaar.com) for any item of your choice.
17. What is a search engine and its role in web applications? Visit any search engine site and make search for following activities.
  - (a) Purchase or computer
  - (b) Search for Music CDs of Asha Bhosale
  - (c) Hospitals in Delhi
  - (d) IITs in India
18. Visit [www.icici.com](http://www.icici.com) and know about internet banking.
19. Explain the role of Firewall in security systems of web applications.
20. Explain how you would handle recruitment process on Web. List all steps to develop web application for recruitment.
21. Explain, why in Web Enabled organisation, the organisation levels are reduced, and span of control is increased?
22. In Web enabled business, there is a greater need of knowledge workers. Explain
23. In Web era, why there is a more threat to business but also more business opportunities to exploit?
24. What is the meaning of virtual organisation?

25. With increasing use of internet web, why business is becoming more customer centric and customer driven?
26. Due to extensive use of internal and web, which new systems and applications are now possible to improve the business performance?
27. In  $24 \text{ hours} \times 7 \text{ days}$  business operations, conventional role of MIS as standard Information Reporting System has changed to Real Time Information Support System. Explain

# P A R T   V

## Comprehensive Cases on Management Information Systems

### CASE STUDIES

1. Management Information Systems in a Digital Firm
2. Techno-Cases in E-Enterprise Management
3. Case Digest of SCM
4. FS Square Infotech (FSIT)
5. Home Land Groceries and Stores (HLGS)

# Management Information Systems in a Digital Firm

Sandvik is a high-technology engineering group with advanced products and a world-leading position in selected areas. The Group is represented in 130 countries and has about 50,000 employees and sales of approximately SEK 93 billion (₹ 6120 Crore). Operations are based on unique expertise in materials technology and knowledge of the customer's processes.

Through Sandvik's close cooperation with customers, Sandvik can offer optimal solutions to enhance customer value. The Group's comprehensive global organization ensures that customers have a reliable partner in Sandvik. Sandvik has highly developed specialist knowledge within its business areas, which work close to customers to develop the best solutions in cooperation with them.

Sandvik Operations are divided into three core areas:

- Tools in cemented carbide and high-speed steel for metal cutting, blanks and components in cemented carbide and other hard materials
- Equipment and tools for the mining and construction industries
- Stainless and high-alloy materials, special metals, resistant materials and process systems

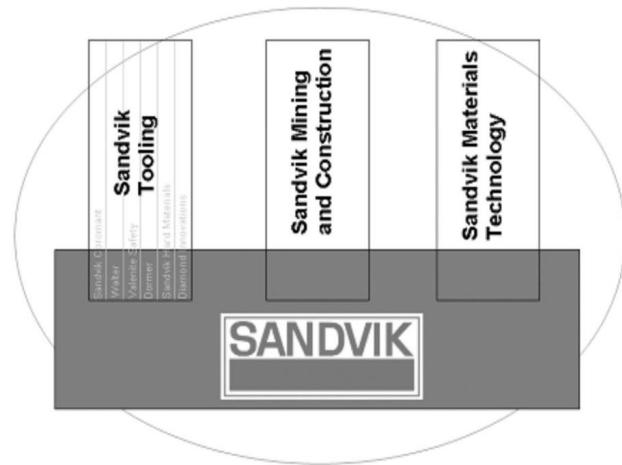
Sandvik consists of three world-leading business areas in a decentralized organization. Sandvik is one cohesive group which is stronger than the aggregate value of the three business areas.

The business areas have full operational responsibility and are responsible also for goals, strategies and acquisitions as well as sales, results and balance sheet for their respective unit.

There are a great number of common processes and denominators between the business areas. A strong focus on materials technology, obvious R&D orientation, highly refined products, a global presence, a large internal recruitment base and the aim of working close to

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customers create comprehensive synergy possibilities. Coordinating financing, acquisition know-how and marketing experience are other strength factors which increase the competitive approach of the group.

### Culture and Core Values

Sandvik's 50,000 employees speak many different languages and have varying ethnic backgrounds. However, they all share a common platform in Sandvik's three core values – Open Mind, Fair Play and Team Spirit.

### Specialization and Decentralization

Sandvik has highly developed specialist knowledge within its business areas, which work close to customers to develop the best solutions in cooperation with them. Key business decisions are made within each business area.

### Sandvik's Business Concept

Sandvik's business concept is to develop, manufacture and market highly processed products and solutions that contribute to improve the productivity and profitability of the customers. Sandvik's business focus is in the area where Sandvik has a potential to become a world leader. The concept has offered 10% annual growth over the past ten years, based on slightly more than 5% organic growth and the remainder through acquisitions. Our ability to adapt and change is a key success factor.

Sandvik's R&D is goal oriented which means use of leading-edge technology, strong patent activity, high added value and maximum customer value. Through Sandvik's close cooperation with customers, we can offer optimal solutions to enhance customer value. The Group's comprehensive global organization ensures that customers have a reliable partner in Sandvik.

Sandvik business philosophy is driven by

- Global Leadership And Niche Focus on customer
- Productivity And Profitability

- Long-Term Approach And Willingness To Change
- Offering of Customer Value And Product Reliability
- World-Class Production
- Speed And Breadth in product offering
- Goal Oriented & targeted R&D for gaining high value for customer.

Sandvik Asia Limited commenced its operations in Pune, India in 1960, a maiden venture in Asian continent, as a subsidiary of the Swedish Company, Sandvik Group. The current personnel strength covering all Sandvik operations in India is approximately 2500.

The Indian company is subsidiary of Sandvik, which is a global industrial group with advanced products and world-leading positions in selected areas – tools for metal cutting, machinery and tools for rock excavation, stainless materials, special alloys, metallic and ceramic resistance materials as well as process systems and sorting systems. The Group had at the end of 2008 about 50,000 employees and representation in 130 countries, with annual sales of approximately SEK 93,000 M. The activities focus on products and solutions with high technological contents, offering distinct added values to the customers.

The Sandvik organization is a ‘Matrix Structure’ where Product business units are independently assisted by support functions, namely Finance, Information systems, Human Resources & plant engineering. Support Service functions report to President & Managing Director.

### **Recognitions**

- Sandvik has been awarded “Brand Leadership Award” for excellence at 16th Asia Brand Summit at Mumbai.
- Sandvik Asia Limited has been ranked as number 1 in the Industrial comparison and number 3 amongst ‘Transitioning Medium Enterprises’ in the survey research undertaken by Citigroup. The finding is a first of- its-kind research exercise in India: “India’s 500 Best Performing TMEs”. TMEs have been termed as “a select group of enterprises that are real pioneers and drivers of the trends of employment, entrepreneurship and innovation and are the backbone of any vibrant industrial economy. These are the companies which are not only growing but ‘transitioning’ to the next level.”
- Sandvik Asia has been awarded FIRST amongst Fastest Growing Equipment Instrumentation Companies in India as per CONSTRUCTION WORLD – NICMAR study for the year 2005-06. Sandvik Asia has won this award for the fourth time in succession.
- Business World Magazine-July, 2007 has ranked Sandvik as Number 32 amongst 100 in revenue and Number 3 in returns.
- Best Factory Garden Award to Cobalt Manufacturing Plant, Chiplun in Jan 2009
- The factories of Sandvik Asia Ltd are equipped with state of the art machinery and have ISO 9001 and 14000 systems functioning. ISO 18001(Occupational Safety and Health) has also been implemented and integrated with the operating ISO 14000 system.

## Sandvik Business Areas

### *Sandvik Tooling*

Sandvik Tooling is a business area within the Sandvik Group and a global market-leading manufacturer of tools and tooling systems for cutting operations as well as of blanks and components. Annual sales 2008 were about SEK 26,000 M with 17,000 employees. Approximately 4% of the turnover is invested in R&D.

Products are manufactured in cemented carbide, high-speed steel and other hard materials such as diamond, cubic boron nitride and special ceramics.

### *Sandvik Mining and Construction*

Sandvik Mining and Construction is a business area within the Sandvik Group and a leading global supplier of machinery, cemented-carbide tools, service and technical solutions for the excavation and sizing of rock and minerals in the mining and construction industries. Annual sales 2008 amounted to about SEK 38,700 M, with approximately 16,800 employees.

### *Sandvik Materials Technology*

Sandvik Materials Technology is a business area within the Sandvik Group and a world-leading manufacturer of high value-added products in advanced stainless materials, special alloys, metallic and ceramic resistance materials, as well as process plants. Annual sales 2008 were about SEK 21,500 M with 9,300 employees. The product areas comprises Tube, Strip, Wire, Kanthal, Process Systems and Sandvik MedTech.

## Sandvik in India

Sandvik in India is a global base for Manufacturing, Sourcing, Design & Engineering, Research & Development; Training & Competence building. It has been marketing the above assortment of products in the Indian market and has also built manufacturing bases in 5 factories at Pune (Cemented Carbide & HSS Tools, Rock Tools, Solid Carbide Tools, Rock Processing Equipment, Design Centre for Material Handling), Mehsana (Stainless Steel Extruded Tubes), Hosur (Kanthal Heating elements), Hyderabad (Rock Tools) and Chiplun (Cobalt Powder). Some of these products are manufactured at Export Oriented Units established for global sourcing for Sandvik Group-including two units for Tooling Supply.

Company's production units in India are adjudged as among best in the world in quality, delivery performance and cost through the Group's international benchmarking system.. Environmentally, the Pune and Chiplun plants are considered as 'Indian landmark' with zero effluent discharge. The eco-gardens at Chiplun, Pune and Hosur have unique eco-accounting systems. Over the years it has evolved an effective matrix of technology and man management, including flow groups. The company emphasizes training and education; it has already established a Productivity Centre for Coromant customers and a Training Academy for service engineers for Mining & Construction equipment in Pune –a first in India. Sandvik Asia Limited's Research & Development is currently concentrating on product design and development.

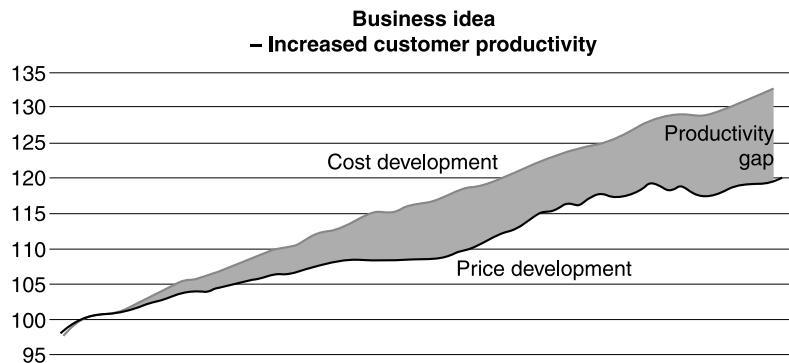
## Business Idea

Sandvik's Business idea is to develop, manufacture and market highly processed products, which contribute to improve the productivity and profitability of our customers. Operations

are primarily concentrated on areas where Sandvik is – or has the potential to become – a world leader.

Increased customer productivity in the customers' processes can be achieved by

- Cost savings
- Process efficiency
- Reliability



### Sandvik's Business Philosophy

1. Sandvik's Vision has a very clear customer focus.  
Industries worldwide need to constantly improve their productivity. Sandvik makes this possible. Sandvik is dedicated to help customers fulfill – and even exceed – their targets. Sandvik want to be seen as customers' Productivity Partner.
2. Sandvik's Mission is to be the first choice of the customer.  
Sandvik shall be the obvious first choice and provide the best possible value for our stakeholders – customers, shareholders and employees. At the same time Sandvik acts as a good global corporate citizen characterized by sustainable leadership in all actions and business decisions.
3. **Sandvik Objectives.**  
**Share of market:** Sandvik aims to be perceived as the No. 1 partner by customers in providing productivity. In practice, this means that Sandvik shall have the largest market shares, measured in sales.  
**Share of mind:** Sandvik want customers to see them as their preferred first choice as a partner and supplier. This is measured in perception.

### Financial Objectives

Sandvik's financial objectives are aggressive and are based on the Group's world-leading positions in its product areas, on a widespread geographical presence, strong R&D programs and efficient production and logistics. It is also highly dependent on the quality of employees and ability to live up to Sandvik's strategy.

The objective for organic growth – 8% per year, on average, over a business cycle – is high considering the fact that the underlying market growth rate is, on average, between 3 % and 4 %. The higher objective is based on:

- increased market shares in present and new markets
- new products
- new application areas with higher than average growth potentials

### Social Objectives and Targets

Sandvik shall offer working conditions that stimulate employees to perform effectively assume responsibility and continue to develop in their personal and professional pursuits. Equal opportunities should always be provided, regardless of age, sex, race, color, national origin, religion, disability or other characteristics protected by applicable law.

### Environmental Objectives and Targets

For Sandvik, concern for the environment is a natural element in all our operations, whether they involve production, investments, changes in processes or the development of products. As a minimum, we always observe the local environmental regulations in each country.

### *ICT at Sandvik*

The purpose of Information Communication Technology (ICT) at Sandvik, is to support business development and the fulfillment of business objectives by transforming every process to digital medium. IT is a strategic tool and a key contributor in:

- Strengthening Sandvik's position as the Productivity Partner to its customers.
- Improving current as well as developing new business offerings.
- Increasing Sandvik's efficiency, agility and flexibility.

ICT is used to realize business strategies. The chosen business strategies have consequences on the ICT. Sandvik's vision for various technological platforms is to exploit the Systems & ICT Infrastructure to the fullest ability to help Business areas & also supporting services to work more effectively & efficiently, & achieve common company objectives. Sandvik has systems on a number of different platforms. Sandvik Systems Development (SSD) maintain and support approx. 70% of these systems, the rest are maintained and supported by external suppliers. The systems flora consists both of systems developed by SSD as well as purchased systems. Some systems are common for the Sandvik Group, while others are BA (business area) specific.

Various packages used by Sandvik & their application to achieve desired vision are given below.

- Sopic: **Sopic** stands for Sandvik Order Processing and Inventory Control
- PeopleSoft - Human Resource Management System
- Lotus Notes: Intranet application for knowledge sharing.
- M3 (Movex): ERP (Enterprise Resource Planning) system for
- Supporting production in the different business areas.
- System 21: Financial management & control

- Time & Attendance Monitoring application
- Payroll processing software applications

## IT Impact on Business Performance

### *Work Culture Change*

- Employees have become knowledge workers supported by IS & KMS.
- Paper driven to Paperless e- driven digital processes.
- Enhanced team work through Collaboration & coordination.
- Quality & speed of response has increased due to access to information & knowledge
- Sharing enabled by organization wide IT network.
- Employees are empowered by technology, information & knowledge
- Employees are able to connect themselves to vision, mission & goals of Sandvik.

### **Sandvik, a Digital firm**

It is difficult to describe the entire organization as a digital firm & its advantages to the organization. To illustrate the point, Human Resource function is chosen for discussion on going digital & its business advantages to self to others

### **HR function at Sandvik**

The Sandvik HR organization vision is to provide:

"...the best HR support to all managers and employees in the organization regardless location or belonging in order to develop all employees to their fullest potential and have the best competence available for each job in the organization to make sure that:  
...Sandvik achieves its strategic objectives and continues to be world-leading in its chosen segments".

### **Common Principles**

Based on a combination of business requirements and leading practices, Sandvik HR has defined common principles for the operations, processes, responsibilities and structure of the HR function.

### **Continuous Improvement**

Sandvik considers objectives and measurements important tools for assuring continuous improvement within HR. The objectives are relevant for all Sandvik units and are set on Group level. The five global Key Performance Indicators (KPIs) for HR are:

- Diversity: Monitored by measuring employee groups in terms of management/ supervisors, office staff, workers; Blue and white collar; men and women allocations per employee group; etc.
- Mobility : Monitored by measuring; external hires outside of Sandvik group, Inter- and intra-business area movements in terms of transfers/promotions, etc.

- Employee Turnover: Monitored by measuring terminations out of Sandvik, internal transfers/promotions sending to other business area/groups, etc.
- Competence Development Days: Monitored by measuring competence development days invested for each employee/per employee group/per business area, on the basis of and supported by performance management documents.
- Formal Review Discussions : Monitored by measuring performance review discussions and performance output recorded for each employee/per employee group/per business area, on the basis of and supported by performance management documents. All yearly salary increments, performance pay based are on these documents.

The continuous Improvement follows HR Business cycle

## HR Processes

To provide high-quality HR support to all units and avoid duplication of efforts HR has deployed a set of common core processes across the whole organization with dedicated process owners to drive excellence in HR.

1. Change management: - systematic approaches to conducting change successfully, achieving desired outcome in the optimum time, accuracy, cost, and quality.
2. Competence Development & Performance Management:- designed to drive competence development, learning and high performance throughout the organization at all levels and in all business areas.
3. Industrial Relations:- the practices and policies which the organization seeks to apply in all business areas, to encourage high quality working relationships, mutual trust and understanding with all its employees.
4. Resourcing: - Workforce and succession planning, talent management and a proactive recruitment process directly linked to the needs of the business, enables us to attract the right people.
5. The Reward & Recognition: - To provide global policies, guidelines, structures and tools in the area of Compensation & Benefits. The objectives have several dimensions for both the employees individually and for the company.
6. Workforce Administration: - to enables the HR processes access to accurate and organized data so that each process efficiently can perform their given task.

## HR Information System: PeopleSoft

A key and visible part of the new way of working in HR and one of our most crucial enterprise resource planning systems in Sandvik is our human resource management system (HRMS). PeopleSoft is the global IT-system Sandvik Human Resources have chosen to support the business in HR issues. It is a globalized, standardized and harmonized way for employees and managers to perform system actions and to search and maintain HR data in the common HR Management System (HRMS). In the HR way of working the self service transactions is one of the three fundamental means of finding and maintaining HR information for managers and employees.



### PeopleSoft system provided online HR processes & related transactions as per below.

- Workforce Admin : Transfer, Promotion, Reporting Change, Contract Administration, Expatriate Handling, Change Job Data, Request new Modified Report, Disciplinary Action, Monitoring Disciplinary Action, Mass Reorganization, Manage MRD change, Manage Contingent Workers, Retirement Administration, Exit Administration
- Resourcing : Job opening Management., Assessment and Selection process, Offer administration, Post offer administration, Direct hire, Management candidate pool, Follow up with new employees, Campus Recruitment.
- Reward & Recognition : Individual Salary Change, Mass Pay Change, Ad hoc Salary Change, Annual Variable Salary (AVS), Expatriate Handling, Full/Part Time Status Change, Leave of Absence, Manage Benefit Enrolment & Termination, Service Award Program
- Competency Development and Performance Management : e-training, Job descriptions & Competencies, Performance Management toolkit, online performance management, Enterprise learning management

PeopleSoft & HR Portal has generated on line HR support services for employees

- HR Portal - provides HR information, such as policies, guidelines, tools etc. The HR Portal gives access to Manager Self Service (MSS) and Employee Self Service (ESS).

### HR Intranet Portal

HR portal shows detailed information about HR policies, procedures, routines & regulations, and documents.

**Welcome to Your India HR Portal**

All Sandvik Employees in India should find it much easier now to locate HR information such as; current HR policies, HR processes, HR forms and other important HR information.

**News**

- SMC Supply - Environment Day Celebration 06/11/2009
- AGM - Sandvik Employee's club 06/08/2009
- Job Opening : Sandvik Tooling Engineering Centre 06/05/2009
- Job Opening : SMT Field Sales Engineer 05/29/2009
- 2009 PeopleSoft Training Calendar 03/04/2009
- 2009 Fairplay Training Dates 02/03/2009

**Sandvik HR Way of Working - The Four Cornerstones of HR**

**HR Processes**: To provide high-quality HR support to all units and avoid duplication of efforts HR has deployed a set of common core processes across the whole organization to drive excellence in HR. Read more...

**HR Systems**: We hope that you will be using the HR portal as your "One-Stop Shop" for all of your HR needs and HR information. Read more... PeopleSoft is the global IT-system that Sandvik HR have chosen to support the business in HR issues. Read more...

**HR Advisors**: The generic name adopted throughout Sandvik globally to describe this new strategic HR role. To know more about your HRAs role, Click here... This team will carry out all the HR administrative work for all Sandvik India companies. In addition, they will provide the helpline service 'HRdirect'. Read more...

**HR Service Centre**

**Highlights - What's new in HR Portal**

- All Policies on a single click
- All Forms & formats on a single click
- HRdirect Performance
- SAL Contact Details
- Feedback & Suggestions Box for HRdirect...
- Ask HRdirect a question...

**Feedback & Suggestions**

If you would like to give Feedback & Suggestions for India HR Service Centre... [Click here](#)

Or if you have a question to ask... [Click here](#)

**Quick Links**

- India Policies • India Forms & Formats • Vacancies • Interactive System • HR Documents & Tools A-Z • Global HR Portal
- ESS login (Employee Self Service in PeopleSoft) • MSS Login (Manager Self Service in PeopleSoft)

Comment Add to Favorites Print Send Link

### **Manager Self Service (MSS)**

MSS is a tool for performing transactions like transfer, promotion or initiate a recruitment. In MSS you can for example, view and update employee personal information, View compensation history and total compensation, Work with recruiting activities, Raise job requisitions, Individual salary changes, Full time/Part time changes, Transfers and promotions, Reporting changes, Job code changes, Request for reports, Store and keeping track of employee objectives, competencies and individual development plans related to the yearly performance cycle . The manager is responsible for ensuring that the system contains the correct information about their employees. The manager is also responsible for making a number of transactions in PeopleSoft regarding their employees. A set of PeopleSoft reports will continuously be developed to support the managers in their daily job with their employees.

### **Employee Self Service (ESS)**

ESS is a tool for updating personal information and apply for jobs. In ESS the employee can access your own information, Maintain personal information like address change, name change, phone and e-mail, etc.. Maintain emergency contacts, View base salary, Search for open positions and apply for jobs, Update objectives, competencies and individual development plans related to the yearly performance cycle.

### **How HR Provides Support to Business?**

Sandvik is growing rapidly, both organically and through acquisitions. This imposes heavy demands on all elements of operations, particularly the HR function.

#### **(1) An Important Part of Operations**

HR issues have been assigned high priority in the Group and comprise a strategically important and integral element of business operations. At present, comprehensive and global reorganization and rationalization work is under way in the HR area involving the introduction of common processes and IT support. The coordination of administrative resources ensures that all parts of the Group receive the best possible service in the HR area, where skills provision is the primary element. Sandvik's employees and their skills create the customer value that is decisive for continued growth. It places substantial demands on the Group's ability to attract new employees, integrate them in the company and utilize and offer possibilities to strengthen the skills of each individual. The Group's competitiveness is highly dependent on how well the right skills can be secured today and in the future. This is particularly relevant in view of the fact that the labor market in which Sandvik operates is characterized by intense competition. Active work with skills and leadership development, in addition to various reward instruments, strengthens efforts to attract, develop and retain employees with the desired skills. All managers shall receive solid support in their work to satisfy the skills requirements. The aim is to appoint an employee with the right qualifications to each position and to give each individual the opportunity to grow with the work assignment.

#### **(2) Skills Provision – A Project at Many Levels**

Based on Sandvik's business goals and strategies, an annual inventory is taken of the Group's collective needs. What type of skills development is required? Within what areas must the

company recruit? What is the status of the Group's replacement planning? The process results in specific goals and action plans to fulfill the requirements that have been identified. Requirements are primarily matched against the global internal labor market, which was established by Sandvik a number of years ago. The stated goal is "70-20-10," that is, 70% of recruitment shall be conducted internally within the relevant business area, 20% shall be internal, but across business area boundaries, and 10% shall be recruited externally. In addition, the Group's goal is that the proportion of women in the company shall be not less than 25% by year-end 2010. The high level of ambition relating to internal recruitment imposes large demands on skills development. There is a continuous focus on reviewing the substance of the work and placing this in relation to the current and future demands on the operation. When possible differences are identified, specific development plans are prepared. The aim is to allow employees to grow within Sandvik instead of changing employer. The Group represents an extensive labor market, which contains many opportunities for new, stimulating work assignments. Over the years, the method and substance of work has changed for many employees in pace with the ongoing structural development in the various business areas. To meet future challenges, change and flexibility are key features of the Group's HR work. A particular emphasis is placed on the development of leadership skills in the Group. Of course, external recruitment to the Group must also take place. Far-reaching and systematic work is conducted to show that the Group is an attractive and exciting workplace with unique career possibilities, both for recently graduated and already established professionals. In certain countries, Sandvik is establishing its own schools for the purpose of training employees in the required expertise.

### (3) Diversity Provides Versatility

Sandvik is a Swedish MNC and about 75% of Sandvik's employees work outside Sweden. Employees in subsidiaries are active in many countries and represent a range of nationalities and cultures. Accordingly, there is great diversity in the Group. This is entirely in line with Sandvik's philosophy – diversity is important to ensure that the right competence is available at the right time and in the right place, based on the demands placed by customers. A high level of diversity is ensured by offering equal terms and opportunities for all employees, irrespective of age, ethnic origin, skin color, nationality, religion, gender or functional impairment.

#### *Impact of ICT on Human Resources Function*

- **Impact on functioning of HR Operations:** One of Sandvik's core focuses for HR operations was to reduce the administrative burden and improving productivity. **A lot of automation was required at country level to facilitate this improvement.**  
**Implementation of HRIS in Sandvik India has led to**
  1. Reducing Labor cost due to digitization of most of the backend HR work.
  2. Increasing productivity within HR fraternity. With entire HR database on line, Leave management, Statutory requirement processing (like provident fund, ESIC, gratuity, etc.)
  3. With employee information on-line, managers are better equipped to take decisions on/about workforce.

4. Employee's entire organizational history is now recorded, irrespective of which business area/location, he/she belongs to. There facilitating valuable & important HR decisions.
5. IT has extensively been used in automating HR processes, along with re-engineering the existing processes.
6. From centralized decision making structure, Sandvik managers & HR community are more empowered with enhanced information-processing capacity.
7. HR structure has become flat & flexible and more accessible to employees. This has resulted due to ease of information availability, better clarity within different HR processes and its accountability. The structure has become leaner from more than 10 levels to less than 5 layers.
8. HR policies, processes, documentation are all provided online via HR intranet for faster and better information sharing with employees at all levels

- **Impact on HR's internal customer (Employee) service orientation**

1. With PeopleSoft HRMS, employees are responsible for their own data. If there's any correction to be done, they can either do it on their own through Self-Service modules or get in touch with Shared Service Centre (HRdirect). Hence response time to customer queries has drastically reduced.
2. Service Level Agreements : With HR transformation in Sandvik, SLAs are in place for each business area, resulting in better and faster HR services to all customers. Employee has a quick access to the SLA.
3. There is a very thin line between decreasing the administrative HR tasks and increasing the burden on Line managers with HRIS.
4. Availability of all technical and non-technical training material globally to all employees through intranet for employee development
5. Because of the nature of its diverse and expanded business, each business area maintains its own intranet with detailed information of its way of functioning, business philosophy, product details, organization, HR details, etc. This acts as an extraordinary tool of sharing information and best practices, globally.

- **Impact on Organizational Transformations**

1. Sandvik has extremely mature matrix reporting structure, and technology plays an important collaborative role in improving productivity, efficiency of employees irrespective of location and time zone.
2. ICT is playing an important enabler role in reengineering current work processes.
3. Sandvik due to its core business area functionality operates as independent business units and one of the challenges is talent management. Entire staffing, Talent management and succession planning is currently done effectively due on HRIS.
4. Ease of Integrating HRIS with other systems has ensured storing organization transactional history.
5. Basis business objectively of growth, the current systems have the capacity to grow and scale with the organizational requirements.

- **One of the process Descriptions in detail**

The global process '6' is workforce administration and 6.01 is a process of transfer. Sandvik has mapped all business processes in this fashion as a standard practice. This process is chosen to illustrate this approach.

One of the online process descriptions, employee transfer with all details is given in the process flow diagram.

### **Business Purpose of the Process**

This process is used to update the PeopleSoft system with changes related to an employee changing department. The process could start from a variety of reasons mainly sprung from the resourcing process. The process might also be used, when employee movements are initiated outside of the resourcing process or where the resourcing process is not applicable, such as minor reorganizations, business transitions etc. The transfer process must not be used for promotion purposes.

Definition of Transfer and Promotion is found in process specific documents:

- Guideline Usage of Transfer, Promotion and Reporting Change.

Prerequisites for Transfer process:

- If the receiving department is a new one, then the new department must be created before entering the transfer process. This links in with Application Management processes.
- Ensure that the receiving manager has MSS before entering the transfer process.
  - If not, contact HRA to arrange MSS for the manager.

### **The Condition for Triggering the Process**

- A vacancy in the organization.
- The transfer is either requested by employee or the Sandvik organization.

### **Overall Process Output**

- Transfer performed and employee moved to a new department.

#### **6.01.1 Take Business Decision**

A business decision for transferring an employee must be made by stakeholders, i.e. current manager, receiving manager, grandparent and HRA. Union representatives can be involved based on local regulations. HRA must validate for each transfer that occurs. HRA needs to decide if the transfer requires a new contract, if so the **6.06 Contract Administration** process has to be followed.

#### ***Entry Criteria***

A business decision has been reached for a transfer to take place. This could be for the following or similar reasons:

- Internal recruitment – Done by HRSC due to the Resourcing process
- Employee request
- Reorganization
- Temporary personal development

#### ***Exit Criteria***

- Approval of all transfer conditions by the following Stakeholders:
  - Receiving Manager
  - Receiving Grandparent
  - HRA
  - HRSC

#### **6.01.2 Enter Transfer Data**

The current manager will now use the MSS Change employment data page to trigger the process Transfer in Peoplesoft.

### **Data to be Entered**

- Date - Date when transfer will occur.
- Business Process - Type of process - Transfer.
- Reason - Reason for transfer.
- Country - The country of which the Employee will be transferred to.
- Business Area - Applicable if there is a transfer to another Business Area.
- Manager Name - Name of the new manager for the Employee.

**Workflow trigger:** An automatic e-mail is sent to the receiving manager requesting review.

**Workflow trigger:** A Work list item is created for the receiving manager in PeopleSoft for review of transfer.

**Workflow trigger:** An automatic e-mail is sent to the initiator with confirmation of request.

The Transfer request process model is shown here for quick grasp. The process details are explained here step by step.

#### **6.01.3 Review Transfer Request**

The receiving manager reviews the request for transfer. When approving the transfer, the manager reviews the following fields to validate if the correct values are entered. If not, the manager edits the values to fit the new organization:

- Country
- Business Area
- Product Area
- Company
- Department
- Location

**Note:** By default the manager of the receiving department will become the new manager of the employee.

The receiving managers will not be able to change the transfer date. If the receiving manager wants to change the transfer date, the manager has to deny the transfer and make a comment in the comment field.

If an employee's Full Time Equivalence will change, the change can be done within the transfer process but has to be made according to the process **6.12 Full-Part Time Status Change**.

The receiving manager needs to verify that the correct cost center is assigned to the transferred employee. If the employee should be assigned to a cost center other than the default cost center for the department, the new cost center(s) must be entered into the Earnings Distribution section. This data will be visible for the manager and HRA in **View Job Summary** and the **Select Employee** view in MSS. Responsible of entering correct cost center is the receiving manager.

Salary changes are applicable in the transfer transaction. If an employee's salary will change, the process **4.39 Administer individual salary change** has to be followed. The grandparent has to be a part of the decision making process and transaction. If not, a tick box has to be checked to skip the grandparent approval step.

#### **6.01.4 Inform Stakeholders of Denial**

When the action of denial is taken, an automatic notification is sent to initiator. As the decision to transfer is generally made in advance, this process step is mainly to capture mistakes made in the MSS transaction. It could also be used as fall back option, if there should be reasons for why the transfer can not take place, e.g. receiving manager is not the correct receiving manager. The employee is to be informed by the current manager if the reason is another one than fall back.

**Workflow trigger:** An automatic e-mail is sent to the initiator and HRA to notify of the denial of the transfer.

If the review result is an approval of the transfer:

#### **6.01.5 Review Transfer**

The receiving grandparent reviews the information provided by the receiving manager and makes sure that the transactional data is correct. No information can be added or updated by the receiving grandparent other than the comments field. If the review result is a denial of the transfer: The transaction can be pushed back at this stage and will then appear at the previous approver as a Worklist item.

#### **6.01.9 Validate and Correct Transfer**

HRSC must validate the entered data and make any corrections if necessary. Once validated, HRSC submits the transfer to the database. HRSC will not have the opportunity to deny a transfer request. If HRSC has any questions they should contact the originator by phone or e-mail. The transaction can be pushed back at this stage and will then appear at the previous approver as a Worklist item.

Any corrections made by HRSC will be displayed in the workflow e-mail triggered upon submission.

#### **6.01.10 Inform Stakeholders of Approval**

When HRSC submits the transfer request, an automatic notification is sent to the stakeholders.

HRSC will also provide the receiving Manager with information about the resourcing new joiner checklist/program which is also applied on transfer to the new department. HRSC will also provide the current Manager with information about the exit checklist which also applies on transfer from the department.

**Workflow trigger:** An automatic e-mail is sent to the stakeholders, to notify of approval and completion of the transfer.

#### **6.01.11 Inform Employee**

The manager informs the employee verbally about the transfer.

#### ***Benefits of Going Digital***

The critical study of 16 processes points out the impact of migrating from Manual paper based systems & processes to Digital processing systems using IT. The benefits are across the organization in terms of Time, Cost, and Speed of delivery.

**Brief Description of some benefits achieved through PeopleSoft (MSS + ESS) & HR portal Implementation**

Sr.No.	Process/ Activity	Benefit Achieved	Earlier Concerns
1.	Organizational Structure	<ul style="list-style-type: none"> <li>All &amp; any changes in the organization is maintained</li> <li>Proper approvals for each organizational change.</li> </ul>	Updated organization was not maintained.
2.	Recruitment	<ul style="list-style-type: none"> <li>On line CVs sent to Managers (Time saving, Paper Saving)</li> <li>On line availability of Candidate status e.g. call for interview, hire, offer letter etc.</li> <li>Recruitment history for each position available in one page e.g. no. of profiles sent, interviewed etc.</li> <li>On line data moved in system.</li> <li>On line measurement of recruitment targets. (Time saving, clarity &amp; transparency in measurement)</li> </ul>	<ul style="list-style-type: none"> <li>No traceability of hard copy documents.</li> <li>Time needed to prepare status report in excel</li> <li>Assumptions for cycle time calculations</li> </ul>
3.	On boarding Process	<ul style="list-style-type: none"> <li>Structure approach to joining documentation</li> <li>Employee integration plan ensured PC, Mail ID, User ID, Desk, Office stationary etc. availability prior to joining date of new hire. Additionally it introduced exhaustive follow-up for orientation &amp; induction plan.</li> <li>Time bound closing of all joining subprocesses e.g. I-Card, Bank account, Superannuation, PF etc.</li> </ul>	<ul style="list-style-type: none"> <li>No Structured follow-up &amp; closing of activity with appropriate intimation to new hire.</li> <li>Lack of employee integration plan, so Lack of clarity in responsibilities.</li> <li>New hire use to spend lot of Time in getting access to PC, Mail ID, office place etc.</li> </ul>
4.	Superannuation	<ul style="list-style-type: none"> <li>Initiated Superannuation policy ID intimation to employee.</li> <li>Increased awareness about superannuation scheme &amp; its benefits</li> <li>Initiated once in a week help desk for employees in company premises thru service provider.</li> <li>Initiated systematic annual statement distribution method.</li> </ul>	<ul style="list-style-type: none"> <li>Lack of employee awareness about his superannuation policy ID, benefits etc.</li> <li>Many times employee not received his annual statement.</li> </ul>
5.	Medical Insurance	<ul style="list-style-type: none"> <li>Delay in nomination processes reduced.</li> <li>Initiated once in a week help desk for employees in company premises thru service provider.</li> <li>Cycle time for cashless cards distribution &amp; corrections (if any) in cards reduced.</li> </ul>	<ul style="list-style-type: none"> <li>Nomination use to get register only after a month.</li> <li>Employee use to receive cashless cards after 6 months of joining or sometime never use to get it.</li> </ul>

Contd...

*Contd...*

6.	Gratuity	<ul style="list-style-type: none"> <li>Online nomination initiated, which benefited in early term insurance coverage under gratuity scheme.</li> </ul>	<ul style="list-style-type: none"> <li>Nominations used to get register only after a month so losing on term insurance.</li> </ul>
7.	I-Card	<ul style="list-style-type: none"> <li>Employees started receiving I-card in 15 days to 1 month time frame.</li> </ul>	<ul style="list-style-type: none"> <li>Employees used to receive I-cards after 6 months post joining.</li> </ul>
8.	PF	<ul style="list-style-type: none"> <li>On line information on PF balance initiated.</li> </ul>	<ul style="list-style-type: none"> <li>Initiated systematic annual statement distribution method.</li> </ul>
9.	Bank Account	<ul style="list-style-type: none"> <li>Initiated immediate account opening.</li> <li>Systematic process for bank account changes.</li> </ul>	<ul style="list-style-type: none"> <li>Delay in bank account opening, used to reflect in delay in getting salary.</li> </ul>
10.	Probation - Confirmation	<ul style="list-style-type: none"> <li>Systematic follow-up for Probation/ Confirmation initiated</li> <li>Resulted in drastic reduction in intimations to employees.</li> </ul>	<ul style="list-style-type: none"> <li>Employee used to get confirmation letters after 1 year, 1.5 year.</li> </ul>
11.	Information, Forms & Documents availability.	<ul style="list-style-type: none"> <li>HR portal ensures all information availability at one place.</li> </ul>	<ul style="list-style-type: none"> <li>HR information was available at various places with different formats.</li> </ul>
12.	Increments, Incentives, Bonuses, Promotions, Transfer etc	<ul style="list-style-type: none"> <li>On line approvals.</li> <li>Availability of historical data</li> <li>Exporting data in excel</li> <li>Online reports</li> </ul>	<ul style="list-style-type: none"> <li>Hard copy approvals sometimes resulted in misplacing important records.</li> <li>Appropriate communication at for each stakeholder was missing</li> </ul>
13.	Performance Management	<ul style="list-style-type: none"> <li>Online monitoring of employee's performance</li> <li>Availability of historical data</li> <li>Transparency in performance appraisals.</li> <li>Paperless management</li> </ul>	<ul style="list-style-type: none"> <li>Difficulty in Maintaining history regarding employee's performance.</li> </ul>
14.	Variable Pay administration	<ul style="list-style-type: none"> <li>On line approvals.</li> <li>Availability of historical data</li> <li>Exporting data in excel</li> <li>Online reports</li> </ul>	<ul style="list-style-type: none"> <li>Hard copy approvals sometimes resulted in misplacing important records.</li> <li>Appropriate communication at for each stakeholder was missing</li> </ul>
15.	Query Resolution	<ul style="list-style-type: none"> <li>All queries recorded online</li> <li>Resolution tracked for maintaining turn-around-time</li> <li>Clear escalation channels</li> <li>Structure approach</li> </ul>	<ul style="list-style-type: none"> <li>Earlier it was ambiguity regarding to whom HR query to be raised</li> </ul>
16.	Exit Administration	<ul style="list-style-type: none"> <li>Reduction in ambiguity</li> <li>Structured follow-up on closing all dues e.g. PF, Superannuation Gratuity.</li> </ul>	<ul style="list-style-type: none"> <li>Delay in getting full &amp; final dues 6 months to 1 year.</li> </ul>

- Decision support information a click away.
- Reduction in ambiguity due to access to information, current & historical, and clarity & transparency on process flow.
- On line approvals saved hard copy & ensured instantaneous simultaneous communication to all who matters.
- Reduced exit administration cycle from 6 months/one year to few days.
- HR portal provided the benefit of single point information Repository eliminating different formats, forms, definition and increasing Information integrity.
- Drastic reduction in time of issuing the appointment letters, Confirmation letters etc.
- On line CVs & Recruitment history and other documents eliminated the problem of traceability when needed & saved time in Decision making.
- All 16 processes became efficient & effective due to saving in cycle time, cost of transaction/event processing; complete transparency in process.
- Employee confidence in the organization increased due to empowerment.

The benefits realized by HR department are also realized by the other business functions such as Marketing, Manufacturing, Finance, R&D and so on. The systems & processes in these functions are IT enabled and are integrated to produce quick business results. The users anywhere in the organization have an access to the information. The users have become information & knowledge worker demonstrating efficiency & effectiveness in their working.

# Techno-Cases in E-Enterprise Management

Traditional methods of conducting business and industrial operations have undergone a sea change due to globalisation of business, extensive use of internet, and telecommunication networks and use of information technology. There are structural changes and changes in work culture affecting social and personal life of everybody. In general, technology has taken front seat in shaping business operations impacting on cost, time, resource in a positive way. The processes namely communication, transportation, production, conversion have become shorter, intelligent and automated. Decision-making response is now driven by knowledge and not by information alone. Information technology has empowered society to work proactively, efficiently and effectively. The business model of nineties has changed from 'Make and Sell' to customer centric 'Sense and Respond' model. We now work in real as well as in virtual world.

To illustrate this radical change in the way business is done, certain scenarios are described below termed as 'Techno-Cases'. Each case is an example of how technology has made a difference in many aspects of business operations and performance. Techno – cases together have number of lessons to learn for the application in business and industry.

## 2.1 ENTERPRISE RESOURCE MANAGEMENT

### (ERP for Productivity Gains)

Today's business environment is complex and dynamic, calling for information technology support for real time decision-making to save costs and time, improve customer service, assess risk and manage, it and add value in the business for a competitive advantage. Present study by IDC, a IT research firm predicts that IT spending in India will grow by 80 per cent or more. Due to pressures on resources, budgets are tight and spending in IT calls for substantial returns on investment and sustainable competitive advantage. This is possible only with ERP implementation. Numbers of companies are benefited by ERP solutions. To name the few are BPCL, Mahindra and Mahindra, Marico.

(Source: Business Today, March 28, 2004)

**BPCL:** Saved 7.5 million euro.

### **Mahindra and Mahindra**

- (a) Reduced inventory by 30 per cent.
- (b) Reduced dealers from 12000 to 6000.
- (c) Reduced employees from 7000 to 3500.
- (d) 50 per cent reduction in lead times.

### **Marico**

- (a) Reduced lost sales due to stock outs by 28 per cent.
- (b) Rise in revenue by 1.5 per cent.
- (c) Reduced cost of supply chain by 25 per cent.

### **ABB**

- (a) Increase in operational efficiency by 15 to 20 per cent.
- (b) Revenue rise from 160 million euro to 198 million euro.

**L and T:** Recovered investment in ERP within 2 years.

More than just investment in ERP for business benefits with assured ROI, organisaiton must appreciate; ERP is an IT enabled management system to improve collaboration between its internal process centers and business partners. ERP with Internet featured implementation sees a process beyond the enterprise boundaries. It also helps to automate the same reducing time, cost and overheads. Automation reduces time, improves decision-making quality and controls human errors in processing.

The success of automated processes of an organisation is possible due to higher level skills and motivation of the people in the organisation. This is possible through training and supporting them through just-in-time information. Just-in-time information decision-making is possible in business processes and IT processes are aligned to achieve common business goal. IT processes must contribute to business goal. ERP solution makes this possible.

**MTR Foods**, a Bangalore based packaged foods manufacturer had ambitious growth plan. And it was a right time to think of IT and ERP to back the growth plan. MTR Foods implemented SAP, an ERP solution to support business growth plan. With ERP implementation, MTR solved a few problems and got the business benefits. The problems faced by MTR were the different view of data across the organisation due to different systems for different business locations. There was no control on receivables. Also managing a range of 250 products manually was difficult. On implementation of SAP ERP, MTR got following benefits.

- Better control on inventory due to monitoring and tracking.
- Accounts for the year finalised much early compared pre-ERP period.
- Real time information for decision and action.
- Single view of data across the organisation for all viewers.
- Transparency and consistency of information.
- More receivable collection.

**Nicholas Piramal India Ltd. (NPIL)**

A pharma major had different set of problems. NPIL has distributed IT environment with different software solutions at each distributed location. No integration of data and very little control over processes. NPIL went for my SAP ERP for pharmas. The expected benefits of ERP for NPIL were:

- Adherence to US FDA norms for drug manufacturing.
- Improved quality of processes and products.
- Accurate demand forecast improving planning scheduling of manufacturing resources.
- Intelligent view of inventory, accounts receivables enabling informed decision-making leading to reduction in cost of holding inventory and better asset management.

**At Oil and National Gas Commission (ONGC) the Benefits were**

- Elimination of redundant data.
- Standardisation of business processes.
- Same view of data across the enterprise.
- Better management control of key reasons.
- Integration across the organisation.

ERP has several benefits in all areas of business technical, commercial and operations. It helps decision-making at all levels. It cuts the cost of operations, raises productivity, and shortens process cycle times of products or service. It provides support of data and information to build add on systems or DSS specific to business and industry. The design, architecture and technology are such that changed management decisions can be executed effectively. ERP is an IT enabled resources management system. It is to be implemented as a management system and not as a software solution.

## 2.2 IN-HOUSE DEVELOPED SOLUTION VS. ERP

**(Readymade ERP Fits Well)**

Software applications for the organisation can be developed separately such as finance, HR, manufacturing and then integrated as an enterprise solution. Alternative approach is finding a suitable package and deploy it faster for quick benefits. While in-house home grown developed integrated solution fits exactly well, it suffers though from rigidity of business process and the software program. As business these days is dynamic, calling for changes in processes and features, homegrown in-house solution loses heavily on utility scale because of its rigid specific architecture.

When we go for ERP package, you are buying a solution for today's requirement with capability of meeting tomorrow's requirement. ERP package has best practices programmed as components ready for fitment when required. ERP package helps you to change business process easily as corresponding processes/practices are readily available for deployment. ERP package enables you to remain dynamic and flexible in business operations.

ERP package also has extended utility due to variety of features which in-house solution lacks and is not capable to change in short duration. ERP package as a solution is successful

in retail business like Pantaloon, in manufacturing at Mahindra and Mahindra, Godrej, and in stock exchange. IT overheads would be very high in case of in-house solution but in ERP package/solution, overheads are low and returns are higher and faster. A good ERP solution also paves way for expanding the IT application scope to SCM, CRM and PLM.

## **2.3 INTEGRATING PALMTOPS (PDA) WITH ERP**

### **(Improving Functions and Operations Beyond ERP)**

Arab Beverages Est. was facing a typical problem that systems were not keeping pace with the rate of business growth. The company manufacturers and sells fruit juices in UAE, Oman and other countries. Arab Beverages needed a growth solution and that too very fast. The company appointed ICICI Infotech to solve the problem through IT strategy implementation. Arab Beverages main functional requirement was manufacturing, warehousing, distribution, sales and accounting. ICICI Infotech chose Orion ERP for the company and implemented it successfully. Besides the normal benefits of ERP, the company got greater control on the sales process and got better sales realisation.

Convinced that technology gives strategic and competitive advantage, as experienced through Orion ERP, the company then wanted to integrate palmtops with Orion to take its sales and distribution data online from the field. This integration will pave way for tracking invoices and collections on a daily basis. With integration, a salesman carrying palm device is able to do invoices and collections directly without any delay. Palmtops at the end of the day are plugged into a computer and entire day's transactions are downloaded and transferred to Orion ERP for further processing. With this connectivity a salesman is empowered with the access to information on customer outstanding, stocks, orders placed and so on.

## **2.4 CUSTOMER RELATIONSHIP MANAGEMENT (CRM)**

### **(Making of Customer Driven Organisation)**

Tata Telecom, a PBX — selling company, has transformed itself in to a customer focused communication solution provider company. The company now claims that it understands the customer requirements better. Till the late nineties, Tata Telecom was a manufacturer of PBX equipment with a focus on cost efficient manufacturing. The government changed the import policy and allowed the import of PBX equipment. Import turned out to be cheaper than manufacturing. This change forced Tata Telecom to change the business strategy to be a solution provider. This was possible only with SAP R/3 and mySAP CRM. Tata Telecom invested ₹ 200 million in IT infrastructure and SAP R/3 ERP and mySAP CRM. On implementation of SAP, solutions management expected following benefits:

- 10 per cent improvement in inventory turnover.
- Rise of 10 per cent revenue per service employee.
- 20 per cent increase in remote resolution of service issues.
- Reduced stockouts due to more accurate demand forecast.
- Two day (3 per cent) reduction in order-to-delivery time.

CRM features, which helped Tata Telecom to service better, are:

- Every lead is entered in the system and managed effectively.
- Provides pipeline visibility through accurate demand and revenue forecast. Helps to be proactively ready to serve the customer.
- Customer calls captured centrally and distributed to suitable service engineers after call analysis and skills required to solve the problem are ascertained.

CRM has helped Tata Telecom to understand customer needs better and have them delivered in most profitability way. MySAP helped Tata Telecom to move from a manufacturing to a customer centric service company.

## 2.5 CUSTOMER RELATIONSHIP MANAGEMENT

### (Moving a Prospect to a Loyal Customer)

A leading car distribution Company of Maruti Udyog Ltd. (MUL) believes that customer relationship is a driver to business growth. The distributor has an all India network for sales and service of the MUL cars. The company offers a broad spectrum of services to the prospect and customer. It offers guidance on selection, assists in loan financing, gives comprehensive service at single window including billing, RTO registration, payment and contract preparation. A prospect is taken through a series of process steps to convert him into a customer with long lasting relationship. The company follows CRM process model.

When a prospect makes a first call, the entire information is collected and the prospect is analysed for success rate. If the next call from the prospect does not come in a reasonable time, sales representatives make a follow-up call on phone or by personal visit. In this interaction more information about a possible options of car models with comparative analysis is given to build the confidence in the choice prospect is likely to make. Sales representative carries a laptop with all the information technical, commercial, performance and so on to satisfy almost all queries of the prospect. The sales representative is trained to assess a prospects' capacity, financial options such as self-finance, loan finance, payment schedule comfort and so on. The sales representative also carries a collaborative information about the owners of Maruti cars in the locality or in the office to create confidence in buying decision of Maruti car.

After the follow-up call, the prospect is persuaded to enjoy demo-ride of a car for live feel of the car comfort and ease of driving. In the next meeting perform a proposal of buying the car is presented to the prospect. Care is taken to identify the prospect's choice of colour, features, and payment arrangements. A prospect in 40 per cent cases makes the decision of buying a car of specific make and model from the company. A car choice is then booked and scheduled for delivery. If the prospect wants a specific date of delivery, registration number and so on, it is also taken care of.

In the post purchase period, the customer is kept under surveillance to check whether any problems are faced in using the car. The customer is reminded promptly well in advance to schedule mandatory servicing after certain kilometers driving. A customer is asked to submit a feedback form on use of car, servicing interaction, any suggestion and so on. This data is continuously analysed over a period to find the weaknesses in CRM processes of taking a

prospect to a customer. The company periodically publishes the results of this analysis for information of public at large to create a brand image of the company – “A Company of Service Excellence.”

IT backbone of the company is very strong. It has an extranet connection to Maruti Udyog Ltd. (MUL) production schedule. The company can book and post the order on UML order board for MUL to comeback quickly with confirmation. All distribution centers are networked and are on Internet. All CRM processes are web enabled and a prospect or a customer can see the status of the proposal. It also uses data warehousing, OLAP and knowledge management systems for evolving strategy, and decision-making.

The company uses a CRM package of a reputed vendor to manage following functions:

- Proposal management.
- Proposal building, documentation and conclusion.
- Booking the order and obtaining confirmation.
- Delivery management; payment, car documents' registration, insurance, and tax certificates and handing over the keys to the customer.
- Post purchase follow-up, problem solving, complaint resolution, scheduling of mandatory services.
- Obtaining feedback and analysing for improvement.
- Marketing campaigns with various incentive schemes.
- Response management.

The company has a database of all the customers with every details for analysis and follow-up. It is the experience of the company that 30 per cent customers come back with the proposal to buy a new car or a new model with buy-back arrangement. The enterprise software, which supports CRM processes, is a customised ERP solution comprising following modules:

- |   |   |  |
|---|---|--|
| <ul style="list-style-type: none"> <li>• Marketing and Sales</li> <li>• HR and Personnel</li> </ul> | <ul style="list-style-type: none"> <li>• Purchase</li> <li>• Inventory</li> </ul> | <ul style="list-style-type: none"> <li>• Finance and Accounts</li> <li>• Distribution and Delivery Management</li> </ul> |
|---|---|--|

It has a central server in Pune with distributed server network at all locations. It maintains databases for employees, and cars sold. Customer information is private and personal and is secured through a firewall security mechanism. The company believes that HR interfacing the customer, prospects and other agencies are key drivers and enable to bring more business. The management takes specific efforts to train the HR in soft skills, computer skills, commercial and contact management and in basic finance. With economy booming, business prospects are very high. The company with CRM processes in place is confident to maintain its leadership with lion's share in the market.

## **2.6 E-BUSINESS AND THE SUPPLY CHAIN**

### **(E-business Advantage to SCM Performance)**

India Foods and Grocery Ltd. (IFGL) is a provider of foods and grocery items to retail chain stores, canteen stores, leading local grocery shops in metros and B category cities. It manufacturers many of these items, and also markets other non-competing popular brands. It has a

separate procurement division, which evaluates the products before they are brought in IFGL product catalogue.

IFGL uses ERP package and has gained a substantial management advantage in the business. IFGL has over 100 retail sale points that contribute to 80 per cent revenue of the company. IFGL plans to go over E-business strategy for these retail sale points for the entire procurement cycle; a broad IT enabled supply chain management, a B2B model is being considered. After the supply chain B2B model, the company plans to go for 'Retail Store Relationship Management', a CRM implementation.

A supply chain scope in B2B E-business model is very comprehensive and beyond the operations of supply, it manages the flow of information, products and funds. Through this B2B supply chain strategy, IFGL wants to give these 100 organisation, managing retail sale points, and a status of trusted business partner.

The supply chain transaction would include primarily the following:

- Generate, store, provide information across the supply chain.
- Negotiate contracts, terms, prices, schemes.
- Order placement by the customer.
- Order tracking by the customer.
- Delivering the orders.
- Billing and recovering.
- E-communications for problem solving and complaint resolution.

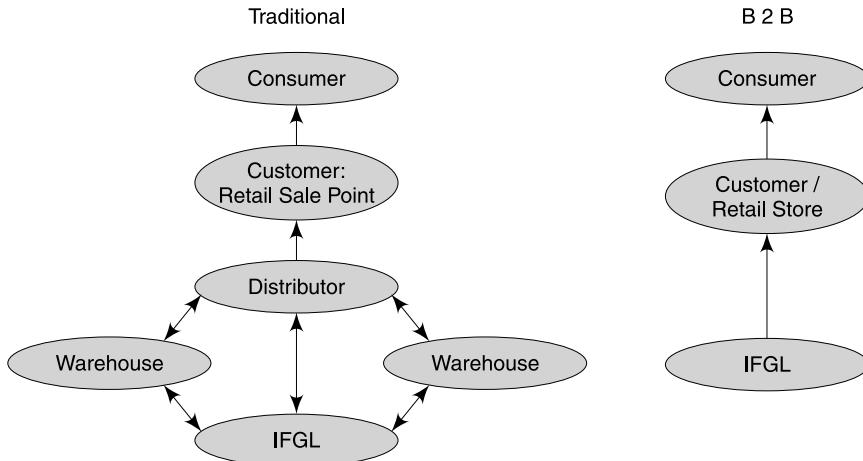
IFGL expects the impact of this strategy on revenue and cost business operations to be positive. It expects E-business SCM will open up new avenues to increase the revenue and reduce the cost of operations.

- Revenue impact due to:
  - Direct sales to retail sales point.
    - Saving on inventory, and faster turnover.
  - 24 by 7 access cutting down the time cycle.
    - Higher sales turnover per period.
  - Increase in sales due to price manipulation.
  - Improved response management to pull business operations.
- Cost reduction impact due to:
  - Less product handling due to reduced supply cycle. Reduction in product damages, and handling and transportation cost.
  - Reduce inventory-carrying cost due to 'Just-in-Time' like inventory
  - Product configuring, packaging only after order received, reducing cost of unwanted supplies, loss of sales elsewhere.
  - Gain on delivery transportation and servicing.
  - Improved coordination and collaboration between IFGL and retail sales points due to:
    - Aggregating and sharing information.

- Advantage of receiving personalisation and customisation of information.
- IFGL's knowledge – based sharing by the retail sales points.

IFGL has decided to go for Application Service Provider (ASPs) for setting up B2B supply chain model. The conceptual model of B2B of IFGL is given here.

With B2B implementation, IFGL claims that financial performance would improve due to better funds utilisation, reduced cost of business operation, and increased sales.



**Fig. 2.1** Conceptual Model of B2B

## 2.7 CENTRALISED CORE BANKING AS OPPOSED TO BRANCH COMPUTERISATION

### (RBI Initiative Broadband Service to Customer)

Reserve Bank of India (RBI) has taken a policy initiative in the field of IT to improve the efficiency of banking system and to facilitate a better customer service. RBI from time to time issues guidelines to public sector banks with regard to standardisation, information system security, audit, multi delivery channels and Any time anywhere banking and so on. IDRBT (Institute for Development & Research Banking Technology), an autonomous center, is established to serve the banking industry. It plays multiple roles besides research and development. It offers academic training and consultancy services to the industry. It maintains the Indian financial network, the multimodel common communication backbone for banking and financial sector. It is also a certification authority under the IT act 2000 and offers digital certificate. IDRBT has also installed a National Financial Switch for interconnecting ATM networks and other e-commerce payment gateways.

For example, UTI Bank moved to centralised banking with branches connected to central computing facility by implementing core-banking solution – Finacle from Infosys' on oracle database and network of IBM UNIX servers connecting all branches. Rapid expansion of branches from 40 to 280, speedy introduction of new products at all branches simultaneously is advantageous to UTI. In addition to this, it has facilitated marching on new avenues

such as Internet banking, call centers, mobile banking, and rapid expansion of ATMs to 4500. President – IT of UTI believes that integrating technology into business can best leverage IT. Strategic initiatives in banking are to be backed by strategic initiatives in IT. IT should not be considered for only speed, efficiency, reach and convenience but IT is to be seen more as a strategic tool to get the right kind of information, customer knowledge and using it for customer centric business expansion.

The three major parts of IT implementation in banking are: transaction processing, information system, and strategic IT infrastructure management. The IT system architecture design is influenced by bank's business character. The principles on which the architecture is built are:

- Capability to process high volume data at very high speed.
- Scalability and high availability to meet expansion, growth requirement and uninterrupted service.
- Separation of data management, application services and user interfaces for efficient maintenance of IS infrastructure.
- Access to data warehouse.
- Independent and flexible platform to migrate to other technologies.
- Adoption of message based architecture.

## **2.8 ADDING VALUE TO CUSTOMER**

### **(Technology for Transforming Banking)**

HSBC is second largest bank of the world. HSBC takes pride in calling itself world's local bank. While it is international, it still meets the local conditions, rules and laws of the country. This is achieved by following common management and business practices standards in all its branches across the world. HSBC IT strategy is to follow same solutions, technology standards and rules of governance across the branches to maximise the return on investment. For example, HSBC has standardised on IBM series computers. HSBC introduced first ATM series in 1987. Since, then HSBC leads the crusade of using IT for adding customer values. IT application focus is to understand customers to serve them better. The bank uses data warehousing and data mining applications to understand customer in terms of behavior, choice of investments, and so on customer demographics. This knowledge of customers is used to advise customers how to manage finances for consumption and investment, and get better returns. Bank advises on loan options, investment holiday and so on to the customer after studying their expenditure behavior, and type and class of the customer. HSBC goes for standard banking operations to help out the customer to add value in his decision. HSBC uses IT for efficiency and cost cutting but also claims that it offers better value to the customer.

HDFC another big private sector bank, listed in Forbes global list uses CA's (computer associate) Unicentre to provide uninterrupted (24x7) customer service delivery. Stable and secured IT infrastructure managed through CA's Unicentre predicts and identifies potential bottlenecks in advance for corrective action. Thus ensuring lower downtime and improved service level. HDFC business benefits are single window solutions, lower down time, higher productivity, higher security, improved services and higher net return on investment.

## 2.9 MEETING CUSTOMER EXPECTATIONS

### (Adopting Technology to Create Differentiation)

Bank business culture has undergone a radical sea change due to the ever-changing customer expectations. Customer now looks for guidance in personal finance and not just in managing financial transactions and operations. This expectation fulfillment is only possible through the uses of information technology for evolving the innovative solutions in order to deliver personalised services customised to each customer segment. Technology provides software tools to predict needs to assess them in tangible terms, and automate processes intelligently to provide value added services to the customer. The banks that achieve this, create differentiation in the eyes of the customers.

While creating differentiation through services, banks need to ensure profitability of the service to the customer. If service to the customer is a leveraging factor and technology is a key, then each IT investment must contribute to this goal. Each investment must enable banks to give more products, different channels of delivery, better customer service, and reduce cost of operations. In delivering services of this nature, two aspects from customer's point of view are important – one is an uninterrupted service and second the security of infrastructure, data and information.

Computer associates (CA) offer end-to-end solutions in infrastructure management, security, storage and application of life cycle management.

HDFC head of IT is happy to say that CA helps them to provide uninterrupted service to the customer. Banking industry has a lot to gain by using such end-to-end solutions. It can create differentiation through quality of service, enhance productivity and reduced cost of operations.

As a customer service scope, SBI offers following services on [www.onlinesbi.com](http://www.onlinesbi.com).

- View accounts
- Setup SMS alerts
- Stop payment
- Funds transfer
- Bill payment
- Accounts statement
- Request cheque book
- Apply for an account
- Third party transfer
- Inquiry cheque status
- Request draft
- Deposit renewal
- Credit to PPF accounts

## 2.10 CUSTOMER RELATIONSHIP MANAGEMENT AND CUSTOMER INTELLIGENCE

### (DWH Based Knowledge Driven Customer Services)

Responding to customer needs require a deep knowledge about customers including corporate clients. Banks put data and information drawn from internal sources together with the data and information drawn from external sources to build a data warehouse. Data warehouse is a repository of key information, which has a strategic importance and value. If data warehouse information is analysed and put together in different perspectives it reveals and predicts something for decision maker to decide and act. A body of knowledge so evolved is called 'Customer Intelligence'. Customer behavior and the nature of transactions spending habits, performance in finance management and such other attributes of customer are known as customer intelligence. Viewing various data sets in data warehouse and analysing them

to get insight into customer characteristics helps build customer intelligence. Once customer intelligence is known relationship management is easy and effective through customer centric. Customer intelligence is also used for customer acquisition and business growth through increased cross selling.

## 2.11 E-BANKING

### (Fully Secured and Virtually Transparent)

As per an international report on Internet banking, a banking transaction through legacy system costs \$1.07, \$0.27 via ATM and just one cent on the Internet. Using Internet for electronic bill presentation and payment saves cost considerably. Use of Internet is no more a technical issue. Besides its use is advantageous to the customer and the bank as well. Traditional bank model works on trust but in e-banking, being paperless and not human interaction, 'trust model' is ineffective and risky. Technology offers various solutions to make every transaction secured on Internet.

Banks use Encryption/Decryption technology in all communications supported by PKI (Public Key Infrastructure) security technology. Firewalls and proxy servers are used as security gates to check every access to bank servers. All such measures deployed correctly give bank a total control on security environment. As costs and security issues are settled, Internet banking becomes best choice for the customer.

There are five reasons for switching to Internet banking. From banks' points of view, physical presence is not necessary as website of the bank gives virtual presence with practically no investment. Second, building and operating new branches is not necessary saving large investment in infrastructure. Third, time to introduce new products at all locations is reduced drastically. Fourth, marketing cost is reduced and cost incurred is to create effective user friendly website. Fifth, volume of transactions is not a technical limitation hence corporate banking can easily be carried out on Internet. A good example of net banking is HDFC.

HDFC Net Banking welcomes you to take the benefit of following services:

- Consumer banking
- Consumer loans
- Demat accounts
- Stock broker accounts
- Corporate banking
- Cash management
- Correspondent Banking
- Treasury and capital markets
- NRI services
- Equities and private banking

Net banking offers total comfort and privacy assured by 'VeriSign' a certification and authentication agency. To conclude, Internet offers a potentially attractive way to serve customers without any heavy costs. It is fully secured and virtually transparent to all parties involved in any bank transaction.

## 2.12 E-RECORDS

### (Legally valid supported by Electronic Commerce Act)

The Internet as a medium for business transactions is well accepted but security, legal validity of contracts, judicial comprehension of disputes is the aspects that business community is

concerned about. Electronic tracking in securities is mandatory in law. All transactions are termed as 'electronic record' (E-record). E-record is defined as any record generated, sent, received or stored by electronic means for use in information systems. Law that if parties involved in, transaction agree to commercially and technically reasonable security procedure and also verify that record has not been altered since sent, such record shall be treated as a "Secure electronic record" expects it.

An electronic signature is defined as any letter, characters, numbers or other symbols or their combinations in digital form attached to re-record with the intention of authentication and approval.

E-record with electronic signature and handled through security net software is a safe bet for successful transaction. It is recognised as valid re-record in the court of law.

Institutions like The National Stock Exchange (NSE) are already in this business. With confidence, NSE links all exchanges across the country through its dedicated VSAT network that legally recognises purchase and sale orders for securities, auctioning of liabilities, issuance of notices to brokers and so on.

## **2.13 LIFE INSURANCE CORPORATION (LIC)**

### **(Productivity Gains through Networking)**

LIC has one of the largest customer records in the world. It employs over 1.25 lakhs employees, over 800 thousand commissioned employees and has 2050 branches nationwide. Number of transactions LIC handles per day is over a million related to insurance policies and another half million towards payment against commission, loans, agents payments and so on. In the last financial year, growth rate was 65 per cent. Premium income gone up by 270 per cent. All this is possible because LIC went for robust communications and technology backbone. It has implemented front – end applications dealing with routine customer interactions related to life insurance policy proposals, policy issues, queries about premium paid or not paid and so on. Employees backed by IT infrastructure and dedicated software is happy as they can answer customer queries instantly. It is now possible to send post-dated cheques in 90 per cent proposals. LIC has come long way from the days of mainframes and tedious processing systems to managing data online.

LIC framed IT strategy and implemented it in a phased manner. The strategy steps are listed below:

- Completed LAN in all branches in record time.
- Automated all processes related to customer services.
- Standardised on hardware, system software and application software.
- User Internet for messaging services to policyholders, and agents.
- Policyholder can get online services such as policy status report, premium payment, loan quotations and so on.
- Implemented Metro Area Network (MAN) linking main centers and offices.
- Installed Interactive Voice Response System (IVRS) to enable customers to receive information over the phone. IVRS is used for informing premium amount, loan amount, due dates, accumulated bonus and so on.

- Established 100 computer-training centers to upgrade employees skills, motivation and drive for going aggressive on IT as economy is thrown open to competition.

LIC needed, therefore, a reliable system current in technology and suitable to LIC'S business environment. Major concern was to select a IT vendor who will serve LIC for a decade or more. Then the vendor must have a solution to operate remotely from rural areas. The solution must run on an operating system, which is installed at all nodal points of LIC organisation, that is branches, zonal offices, agents, business partners and so on. LIC needed a solution that was cost effective, reliable and stable, robust and dependable requiring very little maintenance, virtually no downtime, and continuous support after the solution implementation.

On weighing different options, LIC selected Caldera UnixWare to run its servers. Technical reasons, which made choice of Caldera UnixWare to run its servers, are:

- Ability to integrate huge data and operating system functions
- Intel compatibility
- Much less resources compared to other operating systems
- Internet usage

IT strategy impact on LIC is:

- Employees became productive and efficient
- Accuracy of data improved considerably
- Improved quality of serving
- Cost of servicing a policy reduced
- LIC continues to be a dominant player in the competitive market

The impact in terms of business benefits to LIC is on premium. Premium income growth rate became 270 per cent. New premium income grew at rate 65 per cent.

## 2.14 3D MODELING WITH UNIGRAPHICS NX

### (Improving Product Developed Cycle)

Matsushita electronic was loosing customers due to too long a development cycle of products. Electronics industry's pace of growth was so high that customer could not wait for long delivery cycle. The old 2D design process had outlived its utility for design and development. Need of the time was to change IT strategy, and approach to new product development in such a way that:

- Drawing and drafting is more efficient and time saving.
- Design reviews become more efficient eliminating the need of prototype design.
- Design problems are known much earlier in development cycle.

The strategy and approach chosen to achieve is:

- Go for 3D design software for solid and surface modeling.
- Build lifelike digital models to understand design better.
- Go for digital prototypes and eliminate physical prototypes.

Matsushita chose Unigraphcis NX from EDS, a proven product in tooling, functionality, and free form solid and surface modeling for accelerating the product development cycle.

Use of Unigraphics NX raised design productivity by 20 per cent due to automation of labor-intensive tasks, and instantaneous design changes due to superior 3D visualisation. Most important benefit to Matsushita is that the product development cycle became 30 per cent faster.

## **2.15 PORTALS OF INFORMATION AND KNOWLEDGE**

### **(Enhancing Efficiencies through Knowledge Driven Decisions)**

The India division of Cable and Wireless is a part of a global group of Cable and Wireless. Its core competency is in high-end system integration and network management for enterprise markets. India division has a central hub for providing back office support in managing extensive telecom network of the enterprise customers. The company has over 6000 customers, spread in 33 countries including the customers in India. It has a virtual support team spread across 70 countries. The knowledge developed and possessed by these teams is highly useful in managing company's operations. The collaboration amongst the onsite and offshore teams is critical for the operations and service to customer. Knowledge sharing and collaboration and key success factors for efficient operations.

In the process of managing the networks huge amounts of data is developed and stored in disparate forms. This data stored properly is an asset for efficient operations. Processing this data for information generation and storing it in blocks to build further knowledge assets is a key to high-level service to the customers. To achieve this following key requirements were established:

- Real time access to information and knowledge.
- Easy and quick access to vast amount of data.
- Intelligent filtering of the information to meet a focused need.

The need was of a solution, which can handle vast data, process it for information blocks and convert them into knowledge points. Such solution leverages on lessons, gained in serving customers across the world, and exchanges this learning as information and knowledge amongst the service engineers. Key issues faced while building such solution are:

- Management of complex networks, each having typical service requirement.
- Islands of information and information stored in disparate forms posing problems in exchange, processing and communication.

The critical care process in solution is to identify data in various locations, analyse it with business goal, process data sets to form information of value, and store it in the form which is easily accessible for use from any location. What is being sought is a 'Complete Knowledge Management Solution' focusing on collection of critical information, and knowledge built out of learning and use of best practices, and provide real time live access to this intelligent assets. The company called it 'Wisdom Portal'. The company chose MS share point portal server, MS Exchange 2000 and Windows 2000 as a technology platform to build the wisdom portal. The business benefits of wisdom portal are reduction in communication costs, faster access to customer's networks, global knowledge and document repository, reduction in service cycle time and improved customer service.

The solution enabled the integration of Exchange 2000, instant messaging and net meeting features with one-to-one voice and video chat. Wisdom portal integrated all information about

company's functions, details of global operations, and portfolio of services on to company's intranet. The solution also facilitated the integration of voluminous data from customer case studies.

The net gain of integration of technology, data information and knowledge enabled service engineers to access faster reducing response time to less than 30 seconds. Wisdom portal offered two more advantages, one capability to manage documents and second collaboration between employees, customers and service teams. Advanced documents management system of Wisdom Portal can:

- Configure folders.
- Route documents for approvals.
- Authenticate and validate documents before it is added to folder.
- Automatically track documents and the stages: creation, approval and storage in folder.
- Identify content through powerful search engine.

Collaboration between various team members, employees, clients is made possible through instant messaging, discussion forums online data conferencing with features such as chat, white boarding, file transfer and applications sharing. The business benefits to Cables and Wireless are:

- Higher document management capability.
- Single information and knowledge repository.
- Faster customer service.
- Improved business processes in efficiency and effectiveness.
- Increased customer satisfaction
- Increased employee productivity.

With wisdom portal, the company has a distinct competitive advantage, and has gained tremendous business benefits. Managing and supporting the complex network and providing customised solutions is a much easy task now besides improving efficiencies across the operations.

(Source: Adapted from DATAQUEST, March 2003)

## 2.16 RADIO FREQUENCY IDENTIFICATION DEVICE (RFID)

### (Asset Tracking and Inventory Management)

RFID technology is fast substituting Barcode/Scancode technology. RFID has a number of advantages over barcode technology. First RFID, used for tracking and management of item, is most secure and reliable. RFID technology does not need an item within line of sight for identification. Item could be behind or in corner in the stack and would be still visible to RFID. RFID driven system can give additional functionalities such as automatic reading, sending e-mail communications about any event about the item. Item could be inventory, employee, machine, vehicle and so on.

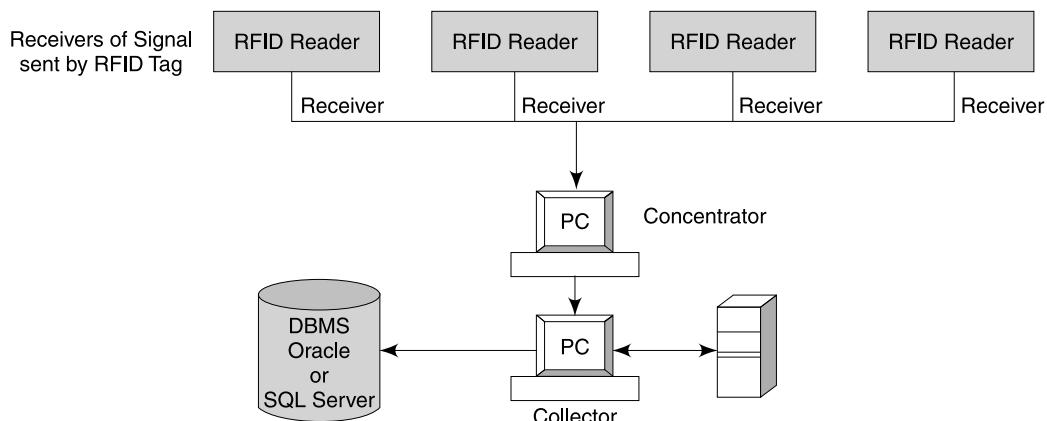
In RFID system, each item is fitted with RFID tags. The tag is an electronic radio transmitter comprising of a micro-chip and an antenna and tiny battery fixed on thin plastic sheet.

This plastic sheet can easily be attached to a variety of items directly. They can be embedded inside identity cards and put on people or animals in a farm or on any item in which you are interested in locating tracking its movements and so on. RFID tag has a small memory in which its unique identification number is stored and it periodically sends out a radio signal carrying and conveying unique identification number.

A receiver device, called as Reader, detects the signal as soon it enters into its radio range and decodes the number for interpretation. RFID tag fitted with battery can be traced and read from a distance as long as 100 feet. Each RFID reader has a defined area and the tag, which picks the signal, is an area where the item is located. RFID system architecture has four components, namely RFID Reader, Concentrator, Collector both powerful desk top systems and backend database.

### RFID Process Architecture

The data captured by the Receiver/RFID Reader are sent to a software called as concentrator. It processes them through a specified program and holds the data for predefined period. Another software, collector, collects the data from concentrator buffer and processes further and finally puts the processed data into the database server.



**Fig. 2.2** *RFID Process Architecture*

The database is designed for an application. In case of inventory management, functionalities required for inventory management are programmed and stored in concentrator and collector. The system scope the identification of the item and its storage area, read and interpret the identification number and its quantity. Asset tracking and inventory management needs an additional software to work upon the data collected in the collector. RFID does basic item hunting and counting after finding its location. Further processes need to be automated through a software program depending upon the need of information and its application elsewhere.

RFID technology can be gainfully deployed in manufacturing, service and in retail stores. Its application can be feasible in any scenario where 'tracking' something is most essential and is a beginning of an application.

In hospitals, RFID tag can be attached on the wrist of the patient. Patients' movements and present location can be known through the system. RFID tags can be used on livestock to track their movements.

RFID tags of an employee can be used for controlling his access to sensitive areas of the company. In fact any personal movement can be tracked and controlled using RFID tag. In airlines and shipping, RFID technology can be used for baggage tracking. RFID tags can be used on vehicles on special critical duties like ambulance, police van, VP vehicles with the view that when they reach a signal they get a priority to go ahead while others wait. It can be used on shop floor to track the movement of job, lot, and it can be used to locate machine and its subsystems. Applications of RFID are plenty if you can think innovating.

Common areas of applications include logistics, inventory control, surveillance, access control, and item tracking.

## 2.17 DATA WAREHOUSING

### (Understanding Customer Buying Behavior)

The decision makers are required to react quickly to mission critical needs due to rapidly changing, volatile and competitive markets. They need a multidimensional support of information. The decision makers now need the information for strategic decisions and not for routine operational decisions as they are automated now. The character of their needs have changed from data to information and now to knowledge. The decision maker is a specialist and needs the information urgently from internal and external databases, which gives a larger view of the problem scenario. The features of such needs are fundamental in nature calling cross-functional analysis of the business. It is not atomic in nature but looks for patterns and trends and also requires an enterprise view as against the functional localised view of the subject. The data warehouse, designed to meet these needs, delivers the same effectively.

Number of companies is using data warehousing applications to know the customer behavior, buying patterns, and knowledge about customer known as 'customer intelligence'. Following cases would make a point:

- Life insurance data analysis shows 'Life is at premium' but mostly for men revealing gender inequity in the country. Only 17 per cent of those insured for life are women. Another revealing findings is that parents take insurance policies for daughter below age 15 for their further needs, may be for education. It is also found that in female in higher age bracket incidence, percentage of policy holding goes down considerably. In the age group between 25 and 45 years, the percentage of women insured for life is 17 per cent. This could be partly for availing tax benefits. Average sum assured for female is ₹ 50 thousand plus, less than male. The female – male ratio for life cover is 1 to 5.
- It is observed by a leading 'fashion and style' store that high value shoppers account for 20 per cent of the total retail purchases. The business class made up 31 per cent of total purchases while homemakers' share was only 12 per cent. Senior and middle management executive and self-employed professionals are the three largest categories of shoppers. Average purchase value per customer varied between ₹ 3000 and Rs. 5000. Apparels and lifestyle products are favorites of shoppers.

- All leading retail chains have implemented IT solutions for all business operations, frontend and backend. They have networked their stores. Data is collected from all stores and processed for functional applications like purchase, inventory, accounts, sales and so on. But this data is then processed further using OLAP tools, Business Models and Knowledge Management Systems to come out with revealing facts beyond data and information. Data warehousing and data mining tools and knowledge generating systems are extensively used by these companies to understand the customer and evolved a strategy to win a customer, the customer loyalty and repeat business.

## Questions

1. Identify the benefits of ERP and classify them into managerial, operational, and financial benefits.
2. Explain the difference between system and packaged system like ERP. Why packaged solution like ERP is more advantageous than sticking to home grown legacy system? Where does ERP package score more over home grown solution?
3. Identify technologies and explain their role in transforming the banking in to customer driven banking.
4. Explain, how technology is used for business differentiation? Visit [www.onlinesbi.com](http://www.onlinesbi.com) and study the site to learn more about – banking.
5. What is customer intelligence? How does it helps to improve customer relationship?
6. Explain how centralised core banking has helped banks to improve their efficiencies as opposed to branch computerisation. Which aspects of banking have influenced the information system architecture?
7. Why banking transaction on Internet is cheapest? Why the bank is encouraging it? What are the benefits to bank and customers?
8. What is E-record? Explain how it is secured?
9. What considerations influenced LIC's decision of selecting IT solution and architecture? What benefits LIC got out of the solution? What steps LIC took to make information technology succeed?
10. What is the meaning of customer driven organisation? What characteristic changes in business made Tata Telecom to move to a customer driven organisation?
11. Draw a process flowchart of customer service scope and at which points in the flow, relationship aspect is taken care of?
12. Explain how E-business model makes the difference in supply chain?
13. Explain the phases in product development cycle and which phases are affected most by using 'Unigraphics NX'?
14. What is the difference between a website and a portal? What different roles the portal can make to impact business?
15. What specific additional benefit Arab Beverages Est got by using PDA? Apart from technology, which aspects of change made the difference?

16. Suggest how RFID technology can be used in following environment?
  - Library
  - Custom's warehouse
  - Airport
17. Explain how data warehousing system helps to understand
  - Customer
  - Customer behavior
  - Knowledge about customer

How can one use this knowledge in improving relationship with customer, business operations and building business strategies?
18. What was the missing link between project office and site office, and how palmtop PDA has helped to link the two offices? Where is the impact in project management?
19. Explain following key terms:
  - Legacy system
  - Electronic signature
  - Digital prototype
  - Knowledge portal
  - Knowledge management system
  - Data driven CRM
  - E-record
  - Integration across the organisation
  - Message based architecture
  - Customer intelligence
  - Process driven CRM
  - Customer centric
20. Write a note on the impact of IT on each of the following:
  - Business process
  - Business productivity
  - Competitive advantage
  - Customer relationship
  - Building strategies for differentiation
  - Protecting information

## Case Digest of SCM

Supply chain integration is not possible in India owing to our uncertain telecommunication structure and road transport system. You must have heard this statement often. Now hear this:

HLL saves \$125 million from its supply chain in India. Despite its network of 80 manufacturing sites, 56 distribution centers and 3,400 wholesalers, HLL's distribution resource planning system (DRP) was able to reduce stock levels from six weeks of sales to less than three weeks. The volume of finished goods inventory at the distribution centers was reduced from three weeks to one week. The level of stockouts for its 1,000-plus SKUs has reduced from 25 per cent to less than five per cent.

Maruti Udyog has brought down inventory levels for indigenous items from inventory levels for indigenous items from nine days in 1996 to 2.9 days at present. Pune-based UGC logistics supplies inventory to Kirloskar Oil Engines Ltd. on 8-hours shift basis.

While you were yawning through those supply chain conferences or cursing Indian infrastructure, there were those who sat down and did something. They saw a business opportunity with handsome profits. These people used IT-enabled supply chains to improve co-ordination with vendors, reduce inventory, cut costs, outsource services, speed up product development and improve services.

You might not have taken any action so far, but you cannot afford to delay action any more. With the implementation of the WTO regime and the breaking down of barriers, there will be better opportunities and grave threat across the entire spectrum of the industrial world. You already see the trailer with the opening up of consumer goods such as toys, electronic items, garments and ceramics for imports. There is more to follow. Even exporters have to worry as their customers in more advanced economies will switch to IT-enabled supply chains.

Indian industry, with a few exceptions, has not been able to exploit the productivity potential of the IT-enabled supply chain in business. The excuses may have been the poor IT infrastructure and transportation network, but the bigger problem is that of mindset of business managers. In fact a supply chain solution is required more in countries such as India where the level of uncertainty across the chain is very high.

Supply chain is a generic term that incorporates a set of business solutions, many of which are also relevant to business situations which Indian business face almost everyday because

of infrastructure and communication constraints. Normally, product development and test-marketing is a long process as the objectives and the considerations of the design, purchase and engineering departments are different and it is difficult to co-ordinate with the vendors for new parts.

A solution may enable the designer to know the cost of different components so that a more cost-effective product may be designed or lesser time taken for development by improving interaction between the designer and the vendor (as the primary attention of purchase is not on procuring parts for new designs).

Similarly, 'sell side' solutions may improve distribution network planning by enabling simulated scenarios for factory and distribution center locations. Forecast collaboration, promotion planning, campaign management and order management can be done through a sell improved route and container load planning. A 'buy side' solution enables superior supplier commodity and contract management, material rationalisation, catalogues and content service. Virtual marketplace solutions enable the establishment of private and public marketplaces for global marketing of their requirements and products. It offers various options such as reverse bidding, online quotation building and so on.

The benefit of a supply chain solution is unlike that of traditional enterprise resource planning (ERP) systems. These are based on the following principles:

**Concurrent planning:** All functional business processes are planned simultaneously, resulting in synchronised and globally optimal solutions for the entire enterprise.

**Global visibility:** Plans are created by considering the impact on all resources throughout the extended enterprise, leading to 'globally good' and feasible solutions.

**Accurate marketplace representation:** Modeling techniques provide a more accurate representation of actual organisational and market conditions, placing less reliance on approximations and improving management decision support.

**Constraint-based planning:** Resource constraints of all types throughout the extended organisation are identified and managed for maximum throughput.

**Bi-directional change propagation:** The impact of a change is propagated both upstream and downstream, so other affected business plans are immediately adjusted, and the impact of the change is mitigated.

**High-speed scenarios:** Concurrent, memory-resident planning technology enables vast improvements in speed, resulting in faster comprehension and responsiveness to changing business conditions.

If Indian companies embrace these solutions and can suitably position themselves in the global supply chain for the manufacturing sector, they stand to gain immensely. After the demonstration of advantages accruing to the service sector due to labor rate arbitrage between developed and developing countries, the manufacturing sector is looking to shift labor-intensive activities to the developing world. Tier II and Tier III manufacturing is shifting to developing countries and India could be a destination especially in the auto, garments and consumer goods sector. Similarly, clinical trials in the pharmaceutical sector could be outsourced to India if it could demonstrate its willingness and ability to be part of the global product development chain. If the Indian establishment responds favorably combining a global

scale of operation and competitive prices with the head-start India has had over other Asian nations to IT exposure, the next wave of outsourced manufacturing could come to India. Otherwise Indian manufacturers will not be able to retain their markets even in India.

(Source: *The author is Manager, KSA Technopak, New Delhi, Business Line and indiaserver.com*)

### **Questions**

1. Explain, why supply chain management assumes more importance now?
2. What is sell side and buy side solution? What are the benefits?
3. What is a virtual market place and solution to serve it?
4. What is the link between SCM and outsourcing to India?

FSIT Software is a fully owned business of RQ Systems International Limited, Software solutions and Services Company Head Quartered in India Sacramento, California. Along with being on ISO 9001:2000 certified company. FSIT has also been assessed at Software CMM Level 5. FSIT represents the 'financial services' vertical of the RQ Systems Group, which has 3 modern 'state of the art' development centres in India. The 'Core competencies lie in 'Consumer' lending, and bring to our customers business domain experience of fourteen years from a legacy of implementations in more than 30 countries across the globe. FSIT has well developed and established Project Management infrastructure and functional departments to be also to deliver quality and within stipulated time the requirements of its customers.

FSIT provides Products and Services to the Banking sector, focusing on Retail Lending—an innovative and vibrant business that is evolving continuously. FSIT has provided comprehensive solutions to the reputed organisations, including Fortune 500 Companies spread across 35 countries and is a reliable business partner to its customer. FSIT, a true trans- National works across all geographics, cultures and time zones. We follow a customer centric approach and continuous efforts are taken for innovation in providing improvement in our offering to customers.

## FSIT Technology Infrastructure

FSIT has an in-depth Technical expertise in the following areas

- **Technology Platform**

Internet/Component Technologies, Visual Age, MTS, IIS, COM/DCOM, ASP, JAVA, JDK, CORBA, Component Broker, Web logic, JAVA Beans, CGI, IBM HTTP Server, JAVA Web server, JDBC, ODBC RDBMS, MS SQL server, Oracle.

- **Development platform**

VC++, Visual Basic, Visual Age Tools from IBM, Magic, C++, JAVA, VJ++, Lotus Domino.

- **Hardware Platforms and Operating Systems**

Windows NT Servers, UNIX Servers (HP-UX), AIX, LINUX), RISC, AS – 400, Sun Solaris

## FSIT Main Product and Services

- Lending solutions from FSIT (LSF) comprising of three major modules as Loan origination system (LOS), Repayment Management System (RMS) and Bad Debt Collections.
- Collections have three different modules as Early collections, Late or legal collections and fraud collections.
- eFASS, Finance against Securities
- Asset management system
- Workflow Automation and e-Digitisation
- Intra-office Workplace Knowledge Portal/Management
- Service and cross selling module to sales.



**Fig. 4.1**

**Lending Solutions from FSIT (LSF)** is the flagship products of FSIT. FSIT Software has an excellent proven track record of implementing LSF across more than 30+ countries.

### 1. BUSINESS INFRASTRUCTURE

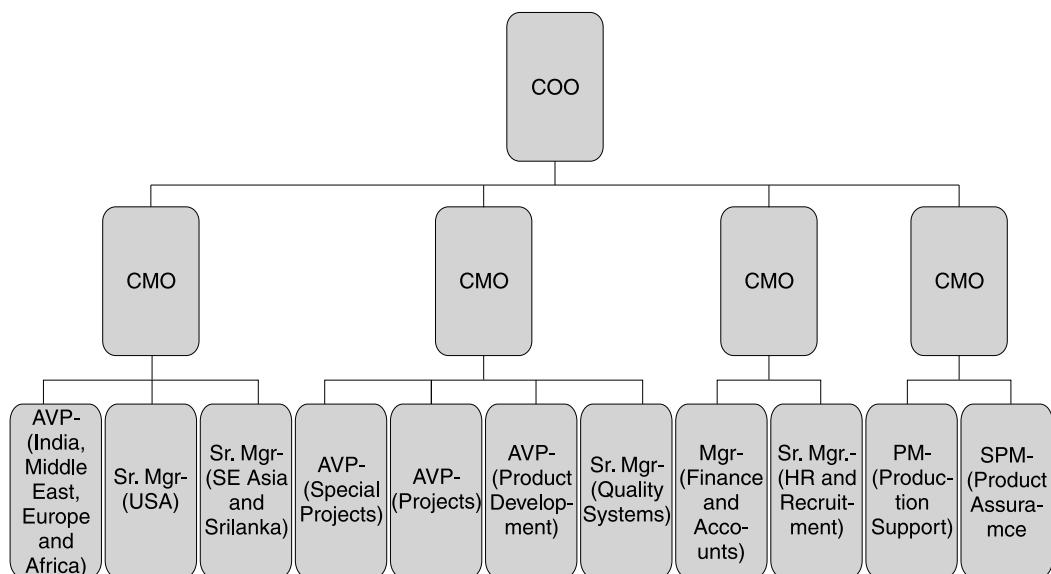
FSIT Software operates from both the Pune and Bangalore centres. Bangalore is a Centre of Excellence for the Lotus Domino platform, having developed many products on this technology. They also deal with few projects around the same technology. Pune office is also in product development mainly in J2EE platform and does projects around the same technology.

FSIT Software is an Accredited Global Development Centre for ABC Capital Finance USA, We implement out state of the art lending solution from FSIT at the required ABC Business

across the globe. The requirements come through various RFPs (Requests for proposal) for lending solution and other development work.

FSIT has dedicated business development team who does sales and marketing around LSF (Lending Solution from FSIT) product and projects. Business development team have tie-ups with different business partners in various countries. Some of the LSF project engagements and proposals are managed through these business partners.

## 2. BUSINESS ORGANISATION MODEL



**Fig. 4.2**

### Abbreviations

COO – Chief Operating Officer, CMO – Chief Marketing Officer, CFO – Chief Finance Officer, VP – Vice President, AVP – Associate Vice President, SPM – Senior Project Manager, PM – Project Manager, Mgr. – Manager, Sr. Mgr. – Senior Manager

## 3. BUSINESS SYSTEM MODEL

See Figure 4.3

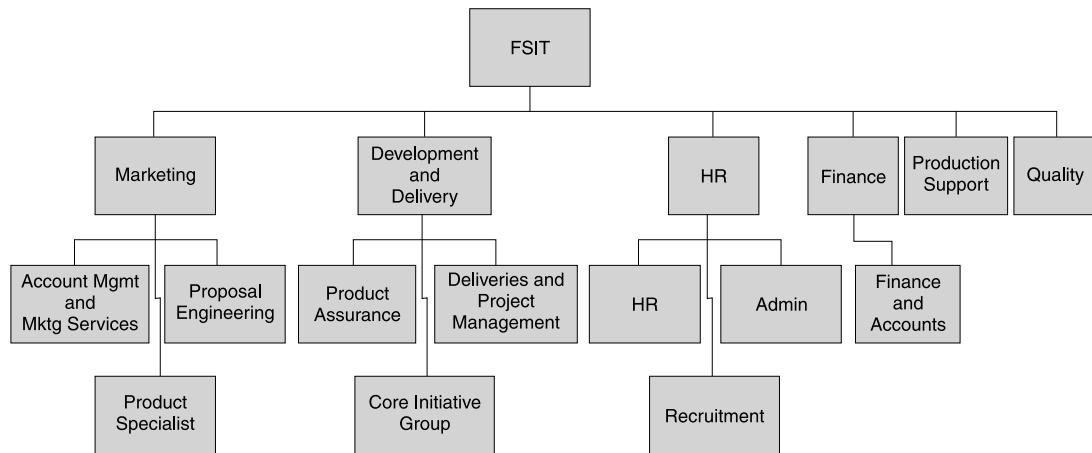
## 4. IS INFRASTRUCTURE

- **Administrative systems**

Payroll, Accounting (Solomon), e Travel, Purchases, Network and Security

- **Marketing systems**

Lead Management, Proposal Building, contract and order processing.

**Fig. 4.3**

- **Project management systems**

Planning, monitoring and control, billing systems (eBilling), resource management, configuration management, support and services.

- **Knowledge management systems**

- **Quality management systems**

- **Communication systems**

Chat and Net Meeting, email, Discussion threads.

## Critical Functions

### 1. Marketing and Presale

- Business development team manages the sales and marketing for our LSF and surround sytems.
- Pre-sale activity is managed by Business Development and Technical team members depending upon the requirements and state and strength of the prospect.

### 2. Requirement Study/Gap Analysis

- This is carried out by a business analyst mostly on site. The duration of this activity depends upon the requirements analysis and its gap between LSF.
- The result of the requirements analysis is to prepare detailed RA documents which will help prepare functional specifications for development.
- RA document is explored in Functional Specification document either onsite or offsite. The document is called Requirement Definition and Description (RDD)
- Business analyst with the help of technical person or project manager then does the resource and time estimates for the entire development and implementation

### **3. Development**

- Development goes through six different stages like requirement analysis, functional specification preparation, design (high level/low level), code development, integration testing and quality assurance testing.
- As a practice, we follow as FSIT standard development method based on Boehm's model across all the project deliveries.  
Depending upon the requirements, exceptional deviations are handled through this method.
- Product selection is conducted to identify a "base product" which will meet maximum functionality, thereby reducing the customisation effort and cascading efforts related to testing and implementation.
- Required resources both for product and project are deployed depending upon the platform and the skills required.
- Programme specifications, unit test and integration test scripts and plans are prepared as per the standards and the quality practices required.

### **4. Configuration Management (CM)**

- Each and every component/object of development including all the documents is configured in the configuration tool.
- Revision and release of each of the component is maintained and is configured.
- Product development and production support releases are managed simultaneously with the help of the CM tool
- QA prepared the build of products and various modules of the product with the help of the CM tool and releases to the customer.
- All the issues reported by QA while doing QA testing, user acceptance testing and production issues are also managed through configuration tool. This helps in 'issue-based change control'.

### **5. Quality Assurance**

- Quality Assurance team member is identified early in the project, and initiated into all meeting thereafter. This early involvement helps in better quality delivery.
- Quality assurance performs the quality check on the product delivered by the development team after doing a thorough integration testing.
- QA performs 2-3 cycles depending upon the scope of the deliverables.
- QA prepares the test plans, test scripts and test scenarios as per the requirement.
- QA finally releases the product to the customer with the release note.
- QA also performs regression and stress testing as per the requirement QA uses tools like Mercury load runner and QTP to perform such tests.
- All the QA issues are tracked through tacking tool.

- QA publishes defects analysis and it's tracking reports on monthly and quarterly basis. Defect prevention board uses this data to introduce new standards and tools to improve the quality.

## 6. Implementation

- System Integration testing (SIT)-and-user acceptance testing (UAT) is performed by the customer's business team and IT team jointly.
- UAT is supported by the onsite FSIT team, which is supported by an identified offshore team.
- All the SIT and UAT issues are logged and maintained in the issue tracker tool. The QA team depending upon the resolution status of the issues and the agreed release criteria makes releases to the customer.
- Implementation may also migration of legacy data. This is completely handled by a separate team in co-ordination with the development and business teams.
- Business Project Manager in co-ordination with FSIT Development project manager helps drive UAT and SIT.

## 7. Post Implementation Support

- Post implementation support is provided as warranty and as product support. Warranty varies from Business to business and the product delivered.
- We have service level agreement (SLA) with customers to whom we provide application support post implementation.
- A dedicated team having different skills required manages the product support as per SLA norms.
- The product support team mainly works upon the implementation issue fixes. This team also supports enhancements to the product on a very small scale.
- Each and every release of the issue (s) resolved goes through QA cycle.

## 8. Quality Management System

- FSIT is an ISO 2000 and CMM level 5 certified company.
- We have a team of people who look after all quality aspects of the product development, process requirements, and customer satisfaction matrices.
- Process change board implements different ideas received from different people to improve the processes and the quality.
- This team performs quality audits to control and improve the quality of the processes, people, product and projects.

## 9. Customer Relationship Management

- Business development and customer relationship group manages the relationship at all levels.

- Customer is updated on the weekly basis through dashboards on the projects and other development.
- Regular conference calls are arranged, besides whenever required especially to resolve the disputed issues.
- Information is exchanged between FSIT and customers on initiatives taken to improve quality, relationship, productivity, receivables ageing, six sigma rigour to name a few.

### ***Critical Success Factors***

- Overall business strategy and direction
- Very effective sales and funnel management
- Strong budgeting and financial planning and analysis (FP & A)
- Improving Market Share
- Very rich knowledge management system
- Very rich domain knowledge.
- Building skills, capabilities and systems to remain in project cost and time norms.
- People management
- QMS based quality systems and costing,

### ***Business Goals and Performance***

- Revenue growth of about 30-40 per cent per annum and profit margin of 20 per cent.
- Addition of at least three new clients.
- Adding new modules/product to leverage marketing presence.
- Adding 1 new market.

### ***Business Strategy to Achieve the Goals***

- Review efficacy of sales and revenue generation activities
- Constantly review achievement against goals
- Match deliverables with billing targets
- Grow Domain and technical expertise in people
- Continuous improvements in productivity of resources and processes and system
- Enhance reach by alliances with consulting firms, compliment product companies and large system integrators

### ***Business Performance Parameters***

- Sales Funnel review versus targets
- Market Share versus goals
- Monthly Billing and Resource utilisation
- Constantly review achievement against goals
- Return on Investment

***Information Systems/Reports***

- Sales/Pipeline Reports

**FSIT**

<i>Pipeline</i>			
<i>Buying Platform</i>	<i>Est value (USD)</i>	<i>Segment</i>	<i>Product</i>
ABC, Korea	25000	Bank	LSI
ABC, Philippines	25000	Bank	Corebanking
PQR, Thailand	80000	Bank	Leasing
<b>Total Buying Platform</b>	<b>130000</b>		

<i>Working Platform</i>	<i>Est value (USD)</i>	<i>Segment</i>	<i>Product</i>
ABC, Mexico	200000	Bank	Corebanking
ABC, Brazil	50000	Bank	Corebanking
PQR, Russia	200000	Bank	Corebanking
<b>Total Working Platform</b>	<b>450000</b>		

<i>Market Platform</i>	<i>Est value (USD)</i>	<i>Segment</i>	<i>Product</i>
ABC, Hungary	25000	Bank	FASS
ABC, Poland	50000	Bank	FASS
ABC, India	50000	Bank	FASS
ABC, Indonesia	50000	Bank	Corebanking
PQR, Korea	500000	Bank	Coll
<b>Total Market Platform</b>	<b>675000</b>		

<i>Universe</i>	<i>Segment</i>	<i>Portfolio</i>	<i>Val/Non-Validated</i>
ABC, Austria	250000		
PQR, Kuwait	100000		
<b>MP + WP + BP</b>	<b>1255000</b>		

- Sales General and Admin Expenses (SG and A)
- Financial Planning and Analysis (EP & A)
- Billing: eBilling (Invoice generation, Invoice tracking, ageing)

- **Quality Management Systems, Reports and Audits.**
- **Workplace– Knowledge Management Systems**
- **Accounting – Solomon**
- **Team Tracker**

Logging and tracking all the issues related to quality assurance, user acceptance testing and production issues. Users can directly log the issues and monitor till closure. Monthly defect analysis report is generated to come up with new standards and reduce the issues. This also helps make any necessary process change or suggesting use of any tool.

- **Project By Net (PBN)**

Project Planning, Monitoring and Control, Dashboards, Resource Utilisation.

#### **Sample Dashboard**

Document Name:	<b>Weekly Dashboard</b>
Document #:	<b>SW/T04/11.0.0</b>
Security Classification:	<b>FSIT-Internal</b>

**Current date** 02-Jan-06

#### **Triggers to Replan:**

Prepared by:	xxxxxx
Date:	31-Dec-05

Project Name:	<b>Lending Solutions</b>
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<b>Size Tracking</b>
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If the variance is > 10 % between the current size from last re-plan, then re-plan.

<b>Size Methodology:</b>	<b>SMC</b>
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<b>End of stage</b>	<b>Size</b>	<b>Remarks</b>	<b>Summary</b>	
RA	95 – Simple units	SMC	Description	Actuals
FS	95 – Simple units	SMC	Per cent Work completed	34%
Design	95 – Simple units	SMC	Percent effort used	36%
Development	100 – Simple units	SMC	Saving (Hrs)	-68.6544601
PA Testing				
UAT				

### Sample Dashboard (Continued)

										Abbreviation							
										PSV	Planned Schedule Variance						
										RSV	Revised Schedule Variance						
										PAV	Planned Absolute Variance						
										RAV	Revised Absolute Variance						
Task ID.	Event Module/ Task	Status	Plan St. Dr	Planned End date	Revised start date	Revised End date	Actual End date	% Comp- leted	Work Comp- leted	PSV (Days)	RSV (Days)	Planned Person hrs.	Actual Person hrs. to date	Planned Effort Variance (%)	Revised Effort Variance (%)	Remarks	
G1	F5 Preparation +	In progress on track	01-12-05	31-12-05	01-12-05	31-12-06	35%	63	61	30	180	41	-63	-35%			
G2	Design	Completed	07-11-05	06-12-05	07-11-05	06-12-05	100%	150	0	0	135	150	153.5	19	4	14%	2%
G3	Setup Module Development	In progress on track	01-12-05	31-12-05	01-12-05	06-01-06	92%	368	5	-1	270	400	377	140	10	52%	2%
G4	Security Module	In progress on track	01-02-06	28-02-06	01-12-05	15-01-06	75%	240	-67	-2	165	320	268	92	37	17%	12%

*Contd...*

Triggers to Replan:  
 If the Schedule variance is > 7 for Project whose Schedule is <= 3. Calculate Months  
 If the Schedule variance is > 15 for Project whose Schedule is > 3. Calculate Months  
 If the % Effort Variance > 15% for any Project OR if the % Effort Variance <=25% for any Project

Con'd...

			01-12-05	31-12-05	01-12-05	31-12-05	28-12-05	100%	50	-3	45	50	54	9	4	20%	8%	
G5	Origination Interface Development	Completed																
G6	Asset Maintenance	In progress late	05-12-05	15-01-05	05-12-05	15-01-05		72%	173	363	363	175	240	190	89	24	51%	10%
G7	Insurance Module Development	In progress on track	01-12-06	28-02-06				30%	63	-127	-127	175	210	75	75	40	43%	19%
G8	Repossession Module Development	Not started on track	01-01-06	31-01-06				0%	0	0	37818	610	610	0	0	0	0%	0%
G9	Remarking Module Development	Not started on track	01-01-06	31-01-06				0%	0	1	38718	310	310	0	0	0	0%	0%
G10	Interface and Audit Module Development	Not started on track	01-01-06	31-01-06				0%	0	1	38718	210	210	0	0	0	0%	0%
G11	Legal Module Development	In progress on track	01-12-06	28-02-06				15%	76	-227	-27	505	505	90	95	95	19%	19%
G12	Test Script Preparation	In progress on track	01-12-05	31-12-05				95%	62	4	4	60	65	62	5	0	9%	0%
G13	PA Testing	In progress on track	26-12-05	15-03-06				5%	18	61	61	350	350	14	-71	-70	-20%	-20%
G14	Project Mgmt + CC + other	In progress on track	01-12-05	3-03-06				21%	95	33	33	450	450	95	2	2	1%	1%
G15	Technical + Domain help to new users	In progress on track	01-12-5	30-3-06				50%	105	-55	-35	100	210	120	140	30	140%	14%
															0			
															0			
		Total						34%	1461				3740.0	4260.0	1539.5			

**Sample Dashboard (Continued)**

Resource and skills:

Name	Role	Utilisation	Required from/ Release Date	Effort Last Week (Hrs.)	Efforts till Date (Hrs.)	Remarks	Skills Required for the Role	Skills Available	Skills Needed	How to Close the Gap
A	Project Manager	100	07, Nov 2005/ 30, Mar 2006	27.5	172.0		Project Management	Project		
B	Team Leader	100	15, Nov 2005/ 30, Mar 2006	34.0	219.0		Java, Oracle, J2ee, PVCS, X Framework	Java, Oracle, J2ee, X		
C	Oracle Developer	100	07, Nov 2006/ 24, Nov 2006	0.0	51.0	Released on 24 Nov 05	Oracle	Oracle		
D	Oracle Developer	100	05, Dec 2005/ 30, Mar 2006	40.5	156.0		Oracle	Oracle		
E	J2EE Developer	100	05, Dec 2005/ 30, Mar 2006	41.0	164.0		J2EE	J2EE		
F	J2EE Developer	100	05, Dec 2005/ 30, Mar 2006	30.0	122.0		J2EE	J2EE		
G	J2EE Developer	100	05, Dec 2005/ 30, Mar 2006	35.0	159.5		J2EE	J2EE		
H	J2EE Developer	50	05, Dec 2005/ 30, Mar 2006	15.5	110.0		J2EE	J2EE		
I	J2EE Developer	80	05, Dec 2005/ 30, Mar 2006	45.0	178.0		J2EE	J2EE		
J	PA 50		05, Dec 2005/ 30, Mar 2006	18.0	76.0		Testing	Testing		
K	J2EE Developer	50	19, Dec 2005/ 30, Mar 2006	27.0	72.0		J2EE	J2EE		
L	J2EE Developer	100	19, Dec 2005/ 30, Mar 2006	33.0	60.0		J2EE	J2EE		
			<b>Total</b>	<b>346.5</b>	<b>1539.5</b>					

**Sample Dashboard (Continued)****Defect Data:**

<i>Life Cycle Stage</i>	<i>Defects Found</i>	<i>Defects Closed</i>	<i>Defects Open</i>	<i>Remarks</i>
Requirements/ Functional Specification	2	2	0	
Design	5	5	0	
Development	14	10	4	
Integration testing				
Product Assurance testing				
User Acceptance test				

**Inter-Group Coordination/Critical Resource:**

<i>Group</i>	<i>Type of Coordination Required</i>	<i>By Date</i>	<i>Status</i>
Product Assurance	Testing	15-Dec-05	Integration test script for all modules from Product Assurance
Quality	Software Quality Assurance	10-Mar-06	

**Defect Prevention:**

<i>Identified Defect Type</i>	<i>Root Cause</i>	<i>Preventive Action</i>	<i>Person Responsible</i>	<i>Closure Date</i>	<i>Review By</i>	<i>Review Date</i>	<i>Review Status</i>
Processing Logic	Code Review not done for all components	Code Review should be done for all components	A, B	NA			
Screen Standards	Screen standard document not being followed	At the time of development start one form of each developer will be tested by Product Assurance along with the developer	P, Q	NA			

**Sample Dashboard (Continued)****C. Phase-wise Data**

<i>Phase</i>	<i>Planned Effort (Hrs.)</i>	<i>Effort Actual – person Hrs. (including review effort)</i>	<i>Actual Start Date</i>	<i>Actual End Date</i>	<i>Review Defects</i>	<i>Testing Defects</i>	<i>Review Effort (Hrs.)</i>	<i>Rework Effort (Hrs.)</i>
FS and Review	0	0		0				
Design and Review	50	34	12/06/2003	20/06/2003	3			
PS and Review	269	256	NA	NA	27		77	
Code and Review	483	470	NA	NA	19		87	
UST and Review	118.5	102.5	NA	NA	12		27.5	
ITS and Review	27	0	NA	NA	0		0	
User manual	0	0	NA	NA			0	
Unit Testing	118	115	NA	NA			0	
Link Testing	64	71	14/07/2003	25/07/2003	5		71	
Intg. Test Cycle 1	50	74	23/07/2003	08/08/2003			13	60
Intg. Test Cycle 2	0	0	NA	NA			0	14
PA Test (Testing + Rework + support and analysis) UAT	50	140.5 (93 + 18 + 29.5)	04/08/2003	11/08/2003			15	93
Project Management	125	154.5	23/06/2003	14/08/2003				18
Configuration management	25	21	16/06/2003	14/08/2003				
Technical Management	0	0	NA	NA				
Other (Team Meetings + Interface with other system + W/P Review)	45	103.5						
Total- Project	1431	1552						

UAT Sign-off				
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#### D. SQA

<i>Effort-Person Hrs.</i>	<i>Number of Issues/NC reported</i>	<i>Number of Issues/NC open</i>
11	6	0

#### Best Practices Noted

- A detailed document for setting up the application is being made which will be given to PA and customer. This will reduce the set up related issues and also reduce the unnecessary efforts spent.
- Tractability matrix is modified for its optimal use. New sections added to capture report related details.
- Preparations of Install Shield found to be helpful in reducing complex installation of CS Server, Application Server, Client and Database.

#### E. Risks, Issues, Crises faced and Learning

<i>Events</i>	<i>Remarks/Learning</i>
Link Testing/Integration testing	Link Testing with Communication server and Integration testing took more time than estimated. For such type of projects (linking with communication server) and Non-ABC product, Testing time should be increased.
PA Testing	PA testing also took more time than estimated. For Non-ABC projects PA time should be increased. It will help better understanding of the functionality of the new project/product.
PA Testing	Almost 50% of the defects were introduced in the Communication server components.

#### Remarks/Learning

- Detail SAM documents and installed shield prepared for installation of Application server, communication server and client which helped PA in testing as well as on site resource for SIT.
- Critical functionality testing checklist was prepared and handed over to PA for in-depth testing of the product.
- The projects taking/referring foreign programmes (such as CS) in their projects and to follow some protocol.

Technical Training to Developers, Technical Documentation explanation such as ERDT/Table structure needs to formalise.

## F. Estimates and Actuals of the Project

### Estimates

<i>Estimate Stages</i>	<i>Date of Estimate</i>	<i>Size</i>	<i>Effort (Hrs)</i>	<i>Project Start Date</i>	<i>Project End Date</i>
	12/06/2003	1142	1431	12/06/2003	13/08/2003
Design					

### Actuals

Final Size–A	1142
Scope increase due to customer SCR–B	0
Scope increase due to estimation inaccuracy–C	
Effort–D (Development)	1002
Effort–D (Project)	1552
Productivity (hrs/size)–E = D/A (Development)	0.87
Productivity (hrs./size) (Project)	1.35
Schedule slippage (days)–F = Actual end date–	-3
Planned end date	

Prepared by:xxxx

Date: 20/08/2003

Reviewed by:x

Date:xx

(The case is written by Ashok Jagtap, Vice President of FSIT Pune. He has over 25 years of valuable experience in product development and project management in the domain of providing IS & IT solutions in banking and finance. Author is grateful for his contribution to the book).

# Home Land Groceries and Stores (HLGS)

Home Land Groceries and Stores Ltd (HLGS) is a chain of modern grocery store in Pune, popularly known as HOMELAND. It is a chain of six stores, located in middle and higher income group residence colonies in Pune. All stores are very popular and grocery business is showing a sign of a good business proposition. The competition in this retail business is increasing. The annual turnover of HOMELAND is over Rs.300 million.

A typical HLGS store has over thousands of items for sale, categorised in different classes. Each class would have at least ten items of different variety, each having three or four stock keeping units (SKU). A store is manned by six billing counter clerks, ten line supervisors, four line (Merchandise) managers, two customer help desk manager, twenty store boys, and six managers in charge of Stores Space Management, Accounts and Administration, Purchase, Contracting and Disposal, Customer Relations and marketing, and House Keeping and Display. Each store is headed by a Chief Executive Operations (CEO). A typical store makes a business of over Rs. two lakhs per day and would have human resource strength of around fifty persons.

HLGS stores are modern stores where layout, display, shelf arrangement, customer guidance is as per best practices prevailing retail stores management. The customer centers in the store, picks a bag or a cart and moves in the store to collect the items of interest. The store supervisor in case of doubt guides the customer. All items have price tag and barcode. The discount information is separately displayed on the rack and is applicable to all the items on that rack. The customer brings the cart at the billing counter for billing and cash payment.

The store operations are measured daily through a report on bills made, cash collected, customer returns, quality complaints, stock outs and customer requests for new items. A separate count is done of footprints to know number of visitors to the store. Most of the decisions are based on ad hoc basis and not on analysis of information.

HLGS has a Store Management System with standard features and facilities. Purchase, Administration, Contacting, Merchandising are handled separately by a desktop system. HLGS has plans of integration of these systems and looking for a solution provider to implement.

HLGS success so far is due to its effective and efficient service management and absence of competition. It stocks all those items which families would need. It covers a range of class

of items such as grocery, milk and milk products, cosmetics and toiletries, vegetables, fruits and frozen foods, school books and stationery, pickles and spices and small gift items and so on. Store supervisors keep an eye on stock movement. They talk to customers and give a feedback on customer response to CEO for action.

The key success factors of HLGS are excellent customer relationship and fulfilling the purchase needs at a reasonable price. Management of HLGS sees that buying in HLG store is a pleasant experience to all customers. HLGS accepts orders on phone and through E-mail and offers home delivery at no extra cost. The incidence of such purchases is small and HLGS honours the request for few of its old loyal customers.

It also arranges seasonal festivals like Rice, Mango, Wheat, Ganesh, Maker Sankrant, School Book & Bags, winter, summer, and New Year to attract more visitors. It encourages food, cosmetic vendors to put up a demonstration stalls for the benefit of visitors. It has provided a bulletin display board for local community to communicate message, announce the programmes or put the needs of some services. HLGS takes every step to build relationships with local population. The bulletin board is positioned near billing counters.

Recently, HLGS has started a membership scheme to increase the customer base. In this scheme, a customer becomes a card member of Homeland club by paying Rs. 500. A member customer is entitled to additional 2 per cent discount on net value of the purchase bill. The member is given priority for billing through a separate billing counter. HLGS membership programme is catching up slowly.

HLGS respects local brands and provides shelf space along with national or international brands. This is done to meet some of the requirements of its members and loyal customers. Management believes that Retail business operates on the "everyday low prices" principle. This principle is easily met by keeping local brands which are cheaper to national or international brands. HLGS has thirty odd vendors who supply such items and the list is likely to grow in the near future.

A market research agency published results of the survey which indicates that a middle class household spends Rs. 250 on house cleaning items and over Rs. 200 on packed foods. This segment is price sensitive and local brands in this category of items have such attractive prices. So promoting local brands along with national brands makes a lot of business sense. Besides, local brand vendors offer favorable terms of credit and delivery.

As business is increasing and more stores are coming in the vicinity, the management feels the immediate necessity of a professionally designed Billing System for efficient use of resources and to improve customer service.

The billing counter is equipped with billing system with backend DBMS for purchase and inventory management. HLGS management also wants to modernize the stores operations with IT applications for improving customer service, loyalty and relations. The billing system is a critical system where customer involvement is highest. Management also believes that this system alone can not give a very intelligent information input for strategic and operational decisions.

The present customer billing is a legacy system of four years developed on desktop PC. IT does basic and rudimentary support operations at the billing counters. In the view of future expansion programme, the management of HLGS wants to develop and implement a sophisticated system for billing the customer with all features.

The main features of the system include recording of all billing data such as item name, code, quantity, and price as labeled on the item package, Bill printing with record of cash offered by customer, item value with discount, gross value, additional discounts, special discounts, net value and cash returned to customer. It should also print a message of the day for customer to note.

Further as soon as billing is over, the item record and customer record should be updated for inventory and customer status. This data HLGS wants to use for analysis of inventory, feedback to vendors, customer preferences, and customer buying behavior. In case of member customer, HLGS wants to build a transaction record for reward offer and encouraging customer loyalty.

At the end of the day, the system should give billing summary of total sales of the day and top 20 per cent items by sales value in each class, such as cosmetics, frozen foods and so on. The management expects billing system design should provide information and knowledge needs of retail stores business management and should go much beyond the information support for store operations.

Once the proposed billing system is stabilised at one location, HLGS wants to network all stores in the town for integrated billing System with additional functions and features. The system should also be then integrated in HLGS accounting system.

HLGS management wishes to invest more in IT and IS infrastructure to improve information gathering and analysis, for supporting business decisions. It is looking for an efficient MIS backed by Information Systems helping business operations. HLGS has two MIS reports produced daily at the end of the day, one on daily operations and the other Billing summary. The report formats are enclosed. Senior management is of the view that a good and efficient MIS is possible only after an integrated Enterprise Information Management System (EIMS) is in place.

Homeland Groceries and Stores Ltd (HLGS) solution guidelines:

### **Business Environment**

- Retail Business
- Highly Competitive
- Customer driven
- Focus on Customer service
- Low margin, High velocity volume business

### **Business Goals of HLGS**

- Raise per day collection from Rs. 2.0 lakhs to Rs 4.0 lakhs in a year's time.
- Raise the % of number of customers to number of visitors from 70 per cent to 95 per cent.
- Raise average bill value by 20 per cent.

### **Critical Success Factors of the Business**

- Shortest Customer turnaround time.
- High availability of goods.

- Competitive and attractive Pricing.
- Self relying purchase process.
- High service level.
- Ensure Success of membership programme.
- Improve Customer Relationship.

### **Business Strategy to Achieve the Goals**

- Reduction in every transaction processing cycle.
- Reduce Stock-outs from 3 per cent to 0.01 per cent.
- Customer turnaround time to be reduced by 20per cent.
  - Reduce number of queries
  - Faster Billing to reduce customer waiting
  - Improve Shelf space utilisation
- Promote e –buying and collection.
- Promote e buying and home delivery.
- Collect customer feedback on service.
- Collect feedback from non billing visitor.
- Increase the range of products of local interests.

### **Business Decisions Supporting Business Strategy**

#### ***1. Operational Decisions***

- Product Class and space allocation.
- Brand and space allocation.
- Vendor and space allocation.
- Sales Price/Discount schemes.
- Choice and Design of Promotion scheme.
- Ordering and procurement.
- Stocking Policy and SKUs.
- Determining Stock parameters.

#### ***2. Management Decisions***

- Membership offer.
- Credit limits: Vendors.
- Credit limits: Members.
- Product Mix in each class.
- Brand Mix.
- Choice of Products.
- Festival/Events Planning.

- Service Boys allocations.
- HR training customer relations.

### ***3. Strategic Decisions***

- Adding a class of Product.
- Discontinuing a class of product.
- Space allocation to products.
- Sales: Clearance, Distress.
- Pricing/Discounts and schemes.
- Customer profile vs. Product/Brand stock provision.
- Decision on Product/Brand/SKU mix.
- Credit and risk management.

## **Information Needs Supporting the Decisions**

### ***1. Sales***

- Number of Visitors per period
- Number of visitors vs. Number of customers.
- Customers ABC Analysis by Bill value.
- Bill per day, a profile for period.

### ***2. Information through Sales Analysis***

- By Class/Product/Brand
- Sales: Members and Non Members.
- Direct at store vs. Indirect through e-buying.
- Normal/discount/clearance/Distress.

### ***3. Information through Inventory Analysis***

- Movement: Fast/Medium/Slow by Brand.
- Stock: Stock outs/Excess Stocks/Less than safety stock by period.
- Inventory Mix: Space utilisation and sales.
- Life analysis: Expiry date or usage date.
- Relationship: Relation Analysis of movement trends among different products.

### ***4. Goods Returns Analysis***

- Quality, Price, Damage, Substitute, Exchange by value.
- Product/Vendor details.
- Vendor, Distributor, Brand
- Replaced By vendor.

### ***5. Customer Information Needs***

- Availability.

- Shelf location.
- Price/Discounts.
- When Available.
- Comparative Opinion.
- Manner of Usage, application.
- Complaints and resolution.

#### **6. Vendors Information Needs**

- Movement: Area/City/Customer Segment.
- Sales.: HLGS vs. other.
- Customer Feedback.
- Customer Complaints.
- New products and competition.
- New schemes/Offers.

#### **7. Information Needs of Knowledge Database**

- Buying Behaviour: Product/Period/Class.
- Most like products.
- Products bought together.
- Product Preference by category of customers.
- Demographic and Infrastructure changes around the HLGS Location.

#### **Build Business Performance Indicators for Monitoring and Control and Exception**

- Visitors Vs Customers Customer complaints vs number of Customers
- Goods returned vs Sold, Sales vs lost sales Customers vs sales, Sales Vs Period, Space vs sales.
- ABC analysis of space ABC analysis of sales.
- Brand Profiles by period and sales, Sales by Channels.
- Product sales vs Market sales, Inventory vs sales.

#### **MIS Support Systems Generating the Required Information**

- Functional Systems: Purchase, Accounts Payroll, Maintenance, HR, Sales.
- Supply Chain Management System.
- Inventory Management System.
- Billing (POS) system.
- Transport and Fleet management system
- Data Capturing systems.

#### **Multi Dimensional Analysis**

- Sales Analysis, Product Analysis.

- Inventory Analysis, Customer Analysis.
- Profiles Analysis and so on.

### **Business Economics Analysis for Profitability**

- Sales vs Space vs Inventory vs Margin.
- Brand vs Inventory vs Space vs Margin.

### **Customer Research and Analysis**

- Profiling of Visitors vs customers vs sales.
- Members and Non-members.
- Cash, Credit, Member cards.
- Buying Behaviour by period, products.

### **Operations Management: Planned vs Actual Achievement**

- Customer Turn around time. Average length of queue at the counter.
- Inventory Replacement Cycle. Customer waiting in the lanes.
- Number of questions raised and answered. Number of Complaints lodged and disposed.
- Home deliveries within 24 hours.

### **Built in Queries for users on**

- Product Availability, Member Id, Reward Points, Stock, Price.
- Location, Order status: Product/Vendor.

### **Customer Feedback and Response Recording**

- Product, Usage, Application, Vendor, Quality.
- Price, Complaints, Suggestions, Product Requests.

### **Fixed Period MIS Reports on Basic Business Results**

- Sales By Period and Summaries, Sales Register and Summaries.
- Purchase Register and Summaries, Stock Statement and Summaries.
- Budget/Target control Statements for Sales, Product, Inventory, Receivables, Payables.
- Monthly Income statement.

# Glossary

**Active-X** It is a program code that teaches the browser how to display a file.

**Alpha Testing** If a software is developed as a product for many customers, it cannot meet the specific requirements of a typical customer. However, when the test is carried out at the developer's site to identify deviations and/or errors with respect to the specific customer's need, it is called Alpha Testing. The tests are carried out under the developer's controlled environment.

**Applet** A self contained internet program designed to be used in a specific environment. Applets are used to each data, perform calculations and other commonly required applications.

**Application Programme Interfaces (API)** A set of standard software interrupts, calls and data formats used by the application programmes to start the network services. For example, the application uses API to call the services that transport data across the network.

**Architecture of Information System** It defines major subsystems and applications along with major information outputs. It also mentions hardware, system software, interfaces and such other details of the platform.

**Artificial Intelligence (AI)** It is an artificially built intelligence in the computer to be used to perform the tasks through a computer. The intelligence is based on the knowledgebase built into the computer system. With AI, computer is expected to perform the way human being would perform. The AI is used in expert systems to solve the problems where an expert is required. Expert system reduces the dependence on the expert person.

**Asynchronous Transmission** A method of data transmission that uses start bits and stop bits to coordinate the flow of information. Parity is used to check the accuracy of the data received.

**Audit Trail** An Audit Trail maintains orderly information on changes made in the applications with specifications as when, why and by whom. Such help through the audit trail supports the change in management of the software. It helps to maintain the design integrity even through changes are instituted.

**Backbone** The portion of network that manages the bulk of the traffic between locations such as between building where high speed communication system are used.

**Bandwidth** The transmission capacity of communication is measured in bits per second. Ethernet has bandwidth of 10 mbps and FDDI has 1000 mbps.

**Baud Rate** The Baud Rate is number of bits transmitted serially in one second which gives the user the speed of the serial communication. The RS 232 C serial interface standard recommends a communications speed about 19200 Baud Rate with the distance limitation of maximum 15 meters.

**Bar Code Technology** It is the technology used in many applications as a method to enter alpha numeric data in a highly reliable manner. The technology is used to identify any entity which can be bar coded. The entity could be a person, a product or a document. The basic concept of the bar code is to represent the identity number of an entity in a series of parallel black bars and white spaces. The information about an identity is structured through the width of bar spaces. The systems are available to generate a bar code, then print it on the item, read it and then decode it for use. The bar code technology is used in personal, inventory, manufacturing and document management applications.

**Benchmarking** Benchmarking is a method for finding out ways to improve the processes quickly by learning from the others, other dealing with similar processes. A benchmark is recognised as a reference of the excellence to achieve.

**Beta Testing** The beta testing of software is done at the customer's site by users of the software. The user then records the problems for modification by the developer.

**Binding** The linking of the received message to the appropriate operation for execution is called binding. If this linking operation is compiled beforehand (possible if the message and operations type is known) then it is called a static binding. But when the linking operation takes place while execution when message and appropriate operation are decided, it is called a dynamic binding.

**Bits** The data in computers is represented in "bits" (binary digits). The computers perform all operations with the elements which have only two states. These two states are represented symbolically by 0 and 1. They are called the binary digits or the bits. All kinds of the data are represented by using strings of "0" and "1". The coding schemes which use "0" and '1' are ASCII (American Standard Code for Information Interchange).

**Bit Mapped Image** The process of scanning a document is used to produce a bit mapped image representing the original document. The higher the resolution of scanner the better would be the quality of the image. A Bit Mapped Image captures all information typed or handwritten in the document. A Bit Mapped Image replicates all the information contained in the original document, i.e., the line art, the signatures, etc. and it requires a large storage for each images as against the ASCII representation. A Bit Mapped Image is a two dimensional array of points that represents a picture of the original page. Each point in the two dimensional array is stored as either a white or a black point.

**Black Box System** The system is termed as a Black Box when the inputs and the outputs are known while the process which converts inputs to outputs is not known.

**Blue Tooth** It is a wireless networking standard that is useful for creating personal area network (PAN) linking up to eight devices within a 10 meter area. Largely used in small office and home.

**Bounded Rationality** The rationality is limited due to the individual differences such as age, education, attitudes, experience, etc. Hence, the information processing and problem solving is bound by the rationality of the specific individual.

**Buffers** Buffers are used in the systems to compensate or balance the unequal rates of inputs and outputs.

**CGI/Script** Common gateway interface scripts are most common type of executable script (programmes) on the web. CGI scripts are used to fetch specific data, display banner, perform calculations.

**Chaining** It is a process of using rules and guidelines with reasoning in a sequential manner. The process, when begins from the goal to search an initial state, is called backward chaining. When the process begins with an initial state to a probable goal, it is called forward chaining.

**Change Control** All softwares undergo a change over a period of time. The uncontrolled change can create a confusion and a chaotic situation. Hence, a change control is implemented as a procedure to ensure that the change is authorised and properly carried out not losing the software quality and integrity.

**Class** A class represents a template for the several objects describing their internal structure. All the objects of this class would have the same definition for their operations and for their information structure.

An abstract class acts as a template for other classes. It is positioned at the root of the class hierarchy. A superclass provides behavior and attributes to the classes inherited from it. The subclass reuses the design and the code from its superclass.

**Concurrency** In the real time information systems, the use of distributed databases raised the requirement of the database being concurrent at all the locations for correct information output. The concurrency is required in terms of the date, time transaction, status, etc. In a conventional approach the concurrency is achieved by the data locking and time stamping. In real time processing, the concurrency is achieved through speeding, updating and using the data replication methodologies.

**Cognition Theory** The cognition refers to the steps and the methods the individual uses to resolve the differences between the internal view of the environment or situation and that which is actually perceived or seen. Since the cognitive ability of the individuals differ, the decision making style of the individuals also differ. The cognitive ability can be improved by a suitable information support to an individual and his cognitive style, reducing the gap between real/actual vs. perceived.

**Cookie** It is a small amount of information server store on your computer for latter reference. Cookies are used to verify certain data for checking.

**Dedicated Line** A communication circuit used for one specific purpose. An ISDN connection qualifies as a dedicated line.

**Data** Data is a raw entity which has to be processed to be meaningful. A meaningful data is an information when understood in the context of something else.

**Data Abstraction** Data abstraction is a process of representing an object in a model form where the irrelevant low level details are ignored and high level details are put in a generalised form. The data abstraction is used to describe an object by using the important data entities and responding to that set by one object DATA name.

**Data Design** Data design is the first activity in any design development. The data required as an input into the application(s) must be defined, modelled and structured for record, access and application anywhere in the information requirement domain. All the three facts of data design are then put in the data dictionary.

**Data Definition Language (DDL)** The database scheme is specified through the DDL statements. When the DDL statements complied, it gives rise to the set of tables which are stored in a special file called the data dictionary or directory. The data directory stores the data about the data.

**Data Dictionary** The data dictionary is a repository of the information about the data. In this dictionary, for each data, its name, description, source, where used and the key words are stored for easy access and understanding of the user.

**Data Flow Diagram (DFD)** The Data Flow Diagram (DFD) is a graphical technique used for demonstrating the flow of data and its transformation stage by stage as an input to the output.

**Data Flow Oriented Design** The design follows the data flow direction and sequence by establishing the flow, its boundaries and control matching exactly to the programme structure.

**Data Integrity** Integrity of the data means its accuracy, completeness, consistency and concurrency is correct and acceptable.

**Data Manipulation Language (DML)** The Data Manipulation Language is a language that enables the users to access or manipulate the data stored in the database. Manipulation means retrieval, insertion, deletion and modification of the data stored in the database.

**Data Model** On abstraction of the data, a data model is built. The data model defines how the items in the data are organised and related to each other. Graphs, mathematical formulae and tables are used for

representing a data model. There are a few classes of data models. The logical Data Model is the model of how the users view the data. The physical model describes how the data is stored in the computer.

**Data Modelling** In a data intensive application it is necessary to represent the relationship between the members of the data set. In data modeling first the data objects are defined in the application and their attributes describing the data object are chosen and then the relations between such objects is determined. The relation could be one to one, one to many, or many to many.

**Datapacket** One unit of information transfer as a discrete entity from one node to other node sitting on the other network.

**Database System Components** The different components of a database system are as follows:

- (i) A file manager for a space allocation and a data structure handling.
- (ii) A database manager for management of the data for the application programs.
- (iii) A query processor for translating the user requests in the low level instructions that the database manager understands.
- (iv) The DML, a precompiler to convert the DML statements in the application programme to normal procedure calls in the host language.
- (v) The DDL, a compiler to the DDL statements to a set of tables containing the data about the data.

**Data Structure Oriented Design** Contrary to the Data Flow Oriented Designs, in the Data Structure Orientation the information hierarchy is considered and built into the design. For example, in the calculation of 'pay amount' a structure is build for the earnings information and the deductions information. In the earning information the basic and the incentive amount is built. The programs are build around this information and structured in the hierarchy to bring out an output 'Pay amount'.

**DBMS** The DBMS is a collection of the programmes that allows the users to define, construct and manipulate the database in a systematic and an orderly manner.

**Default Value** A value used when no other value is specified.

**Design** It is a process of applying techniques and principles for the purpose of creating a system to realise the expected results. In a software design the data design transforms all the information into a data structure. The architectural design defines the relationship between the structural components of the program. The procedure design or the process design converts the structural components into the instruction set written in a descriptive manner to be used for generating a "source code" written in a particular language. The interface design deals with the human machine interaction which established the layout and the interaction mechanisms between the two.

**Dial-up Line** A non-dedicated communication channel established by dialing a code number.

**Digital Cash** When cash amount is expressed in series of numbers, it means real cash than credit card. Through digital cash you can transfer money and use it. It is also called E-cash.

**Digital Signature** Digital signature is an encrypted text of sender to authenticate the electronic message. It assures the recipient of an electronic message that message is from the right party.

**Disk Mirroring/Duplexing** It is a technique used by the system fault-tolerant network to write the data simultaneously to two hard disks using the disk control system.

**Distributed Processing** It is the divided processing of computing task through a simultaneous use of the several computers located on the network across the company with the tasks broken down into sub-tasks. The task is distributed over several computers instead of processing it on one large central computer system.

**Document Management System (DMS)** The DMS uses a variety of technologies such as bar code, scanning, optical storage, image processing and storage and retrieval to handle a document for various

purposes. The DMS used in banking, manufacturing and insurance for document identity, processing and viewing it for business operations. The DMS offers advantage of speedy processing of the transaction and a very little storage space to file the documents. The DMS are extensively used in work flow automation systems.

**Domain Name** Domain name is a structured chain of words or letters specifying the IP address. The structure is hostname. Followed by organisation followed by domain, such as com, net, edu, org.

**Domain Knowledge** In decision making process you are required to generate a number of alternatives. The ability to generate the alternatives depends on the creative ability of the person. The creativity is dependent on an adequate knowledge of the problem area and its boundaries. The knowledge is called the domain knowledge.

**EDI** The electronic Data Interchange (EDI) is a computer to computer exchange of the document into two companies or two locations in a standard electronic format. The EDI speeds up the information exchange, improves the accuracy of the data at both ends, eliminates the manual processes and cuts down the processing cycle of a document. In the EDI execution there are three players the sender, the EDI service provider and the receiver.

**EDI Process** The process begins with the creation of an electronic file where the EDI document is filed. The next step is to translate this electronic file into a standard EDI format for storing in the sender's mail box given by the EDI service provider. The EDI service provider processes this file and pushes it to the receiver's mail-box. The receiver then fetches this file to his computer system which will do the reverse translation creating a document in the format required by the receiver.

**E-Mail** The Electronic-Mail operates between two computer systems joined by the communication network. The time, and benefits depend on what kind of communication not you are using. If you have a dial-up modern facility at both the ends, through telephone net you can send the E-Mail by dialing the telephone number.

In case of using the Internet for E-Mail the route is longer but available for twenty four hours. You use the direct connectivity to send the E-Mail to your mail box in the electronic service provider. Te service provider then sorts out the messages and sends to the addressee's mail box. The addressee from time to time keeps on checking his E-Mail box to scan for the fresh E-Mail.

**Embedded Software** Embedded software resides in ROM (Read only memory) and performs designated functions. Such softwares are used to control the product and the system in the category of consumer goods. It performs limited functions.

**Encapsulation** The encapsulation is a process of packaging a set of attributes and behaviour into an object. With this packaging, the functionality of an object is grouped into a single integrated package. The purpose is not be expose the developer to the details of functionality and the manner in which it is executed.

**Encryption** In order to protect the data from unauthorised access encryption is used. It is not possible to read the encrypted data unless it is decrypted. There are a number of techniques for encryption of the data which use the encrypting algorithm.

**Entropy** Entropy is a phenomena of running down of the systems over a period of time. To arrest entropy and to maintain the system, the input is repaired and replenished. Every system has manifestations of entropy and the system designer provides a negative entropy to correct the system.

**E-R Diagrams** E-R diagram helps to identify data objects and their relationship using a graphical notation. The relationship between the two data objects could be one to one, one to many, and many to many.

**Ergonomics** Ergonomics is the science of human factors in engineering. It is used for designing the user interface for human beings.

**Factoring** Factoring is a process of breaking a system into subsystems and sub-subsystems for understanding their relations. Factoring also helps to view the system and then to develop the strategy of development.

**Feedback Control** To keep the system stable, a feed back control is integral to all the systems. The control system measures the output of the system, compares it with the standard and takes actions on the basis of comparison. The feedback which seeks action to reduce the adverse comparison is called as a negative feedback. The favourable comparison reinforces the system in eh same condition. The feed-back which advise continuity is called a positive feedback.

**Fiber Optic Cable** A transmission technology that send spulses of light along specially made optical fibers. Fiber optic cable is lighter and smaller than traditional copper cable. It is immune to electrical interference and has better signal transmitting qualities.

**File Server** A networked computer which places its resources at the disposal of other computers for printing, disk control and the other back-up duties for the net is a file server. The server serves the demands of clients (i.e., other computers)

A file server is a computer with a large storage to store data and text in a organised manner to be made available to the clients connected to the servers.

The servers could be specified like a print server, a mail server, etc. or could be data servers. The file servers are configured as back-end devices in the network systems.

**Fill-out Forms** It is a form in which you can supply information that will be sent back to the web server, Registration form, Feedback form are the examples.

**Fourth Generation Language (4GL)** The first generation languages were machine readable languages and the second and third generation language were formula or procedure or algorithm-based. The fourth generation languages do not require formula or algorithmic representation and are very close to natural language representation. From the first to the fourth generation, the languages have moved from machine understanding to human understandable language. The 4GLs used with the database are known as query languages for manipulation of the data to answer specific queries.

**Functions Point Method** A function point method is used to estimate the manpower efforts in system development. The point measure is used on zero to five scale to assess the complexity of the system where the complexity is judged through the fourteen complexity adjustment values. The application domain uses a number of user inputs, a number of user outputs, a number of user inquires, a number of files and a number of external interfaces.

**Fuzzy Logic** It is the logic developed on imprecise knowledge and probability to handle the uncertainty. It uses a multi-valued logic, artificial intelligence and neutral networks. Fuzzy Logic is digital control methodology that simulates human thinking.

**Gateway** A gateway is a system that sits between two networks and provides access and control from one to the other.

**Goal Displacement** A good system design builds a fairly good match between business goals, people goals and system goals supporting the management efforts to achieve the business goals. When the environment changes, people change and the respective goals undergo a change, while the system goals remain unchanged. When such a situation arises, it is said that the goal displacement has occurred. The systems then need correction to achieve new set of goals.

**Growth Cycle** A cycle between birth and death is called a growth cycle. A general phenomena of such a cycle is that it passes through four phases, viz. initiation, growth, maturing and leveling and declining to become dead. All the product systems follow this pattern. It is popularly known as the sigmoid or S curve. The business organisation also has such a life cycle.

**Help** User of the system needs an on-line help while using the system. The Help facility is provided at a number of places to know the command correctly, to correct the error properly, to access the documentation, to know more details and so on.

**Heuristics** When formal decision making approaches do not help in decision making, the heuristics approach is used to solve the problem. This process does not follow any algorithm but develops an approach based on experience, inductive inference and uses rules of thumb to decide on the possible solutions. Since, the whole approach is governed by the individual's ability the quality of solutions depends on the individual and bounded rationality.

**HIPO** HIPO means Hierarchy-Input-Process-Output.

The HIPO technique is used in the top-down design explaining the system in the hierarchy, its process and documentation. The HIPO chart identifies the control modules and the modules serving the control module.

**Home Page** Home page is a web page that the browser is configured to display automatically.

**HTML (Hyper Text Mark-up Language)** HTML is the language of the Web. It describes how the documents are laid out. The language is easy but to create a good documents through HTML, the skill of the graphic design is essentially required. HTML describes the placement and organisation of the text and the number in a page.

**HTTP** Hyper Text Transfer Protocol. A protocol used by intranets and internet to define, format and transmit the messages.

**Human Engineering** Human engineering is a multi-disciplinary activity to design human-computer interaction. It helps to design analysis methods for human beings based on the ability to understand, interpret and decide. It also helps to design user environment at workplace.

**Hyper Text** A method of presenting information on web so that the user can use or view it.

**Icons** Graphical symbols used to convey certain functions or subject are called the icons. The icons are displayed on screen and the user selects one of them through cursor movement and clicks the mouse key. The series of icon selection and its execution generates a process and a result.

**Inference Engine** It is a part of the experts systems that controls the choice of the rule, its application and decides the quality of the result.

**Information Architecture** Information architecture provides the details and the specifications of the organisational information requirement and supports the application systems with the boundaries and interfaces with a clarity on the data flow, process flow and reports.

**Information Overload** Humans have limited capacity to accept information inputs and produce information based mental response. Beyond a limit, the mental response degrades very fast. When the response degrades, it is said that the user has reached information overload limit.

**Information Super-Highway** Just as a national highway has number of lanes, the information super-highway has five lanes each for Voicephone, ASCII Data/binary format files, Audio still photos/images and Full Motion Video.

**Inheritance** It is a mechanism to define new classes from the existing classes. A class, inherited from its parent class, has all the behavioural and informational characteristics of its parent class plus something unique of its own.

When a class defined using inheritance principle, from more than one parent class, then it is called multiple inheritance.

**Instance** Instance is one object created from a class. It has the same behaviour and information as the class and a specific value.

**ISDN** An acronym for Integrated Services Digital Network, A standard for digital communication network to replace completely digital synchronous, full duplex transmission system.

**Java** Java is a computer programming language introduced by Sun microsystems. It has the ability to operate across virtually all computer systems in a secured manner. One important feature of the Java language is that the small software programs, known as "Applets" owing to their size, can be downloaded from server computers to work on individual computers. It is an object oriented language that follows the developers to create platform-independent applications. This characteristic of Java offers the developers of the applications a power to add a dynamic and an interactive content to Web pages. It is used to develop the Internet-enabled applications on the World Wide Web.

**Joining Tables** A table in database represents a logical view. If one wants to create a new logical view it calls bringing more than one table to create a new table showing a desired new view.

The process of joining the tables helps to create new views. The joining process uses the SQL (Structured Query Language) for creating new view and information.

**Key Fields** Key field relates to a record which contains several data fields. It is a unique identifier which puts unique distinguishing identity to the record.

**Knowledge Base** Similar to the database, a knowledge base has data and decision rules which represents expert knowledge. For example, medical knowledge base contains symptoms, possible causes and probable prescriptions for diseases. Knowledge is used for predictions.

**Knowledge** Tacit knowledge is an expertise and experience of people that has not been formally documented. Explicit knowledge is an expertise which is formally coded and documented to share.

**Knowledge Engineering** It deals with building, assessing and application of the facts and figures leading to expert knowledge.

**Lewin Model** The Lewin Model deals with handling organisational change. The model has three states, namely, first unfreezing where you create a climate for change, then analyse, design, develop and implement the change and lastly freeze the change and formalise through management declaration.

**Links** You surf web by using URL. But you can also jump from site to site without typing URL. You are provided with links to click. Links would be another URL, a word or logo.

**Live Lock and Dead Locks** When the user has to wait in a queue to obtain a lock then it is a live lock situation.

When the user is not able to process due to the lock-on, then it is a dead lock situation.

**Locking** You need locks to enforce concurrency on the data status across the database. Hence, locking is a control mechanism in the DBMS. A variable describing the status of the data items is a lock. The locks are put during the course of transaction and released at the committed point. The DBMS has a lock manager to control the status of the lock.

**Lock Manager** Role of the lock manager is to handle the live lock and dead lock situation quickly and release the system for further execution. In case of a deadlock situations, the lock manager detects the dead lock automatically and one of the users transaction is aborted with an error message triggered for the application program to deal with.

In case of the live lock, the lock manager automatically detects the live lock. It manipulates the user waiting in the queue for locks. As scheme can be evolved to handle the users on the basis of "First in first out", time out for waiting, etc.

**Management by Objectives** It is a method of managing the business through people. The goals and the objectives are set by the people and they are used as a motivator to improve the performance. In this approach, peoples' participation is highest, right from determining the goals and objectives to achieving them.

**Manipulation of Data** Data manipulation means creating tables from the existing tables, inserting new rows, updating the existing rows, deleting unwanted rows and deleting unwanted tables, etc.

**Mobile computing** It is an interaction with mobile device such as Phone,I-pad or tablets etc.. Mobile computing involves mobile communication, mobile hardware, and mobile software. Hardware includes mobile devices or device components. Mobile software deals with the characteristics and requirements of mobile applications. Mobile computing systems are constrained in number of ways ways, relative to static systems.

**Mobile Commerce** It is defined as “any transaction, involving the transfer of ownership or rights to use goods and services, which is initiated and/or completed by using mobile access with the help of an electronic device such as Phone, tablets etc.”

**Multimedia Technology** It is a blend of the various technologies, viz., the touch sensitive displays, full motion video, still photographic-quality images images, voice and music audio, graphics and text, etc.

**Network** It is a connection of a number of desk top computers and servers with the aim of optimising the use available resource, viz., computing power, data storage capacity and communication capability with the advantages of flexible operations, no communication barrier, data security and seasonables, integration across the hardware/software platforms. LAN, WAN and WEB are the typical networks. The topology of the network could be tree, busbar and star with the communication protocol standard as the TCP/IP or IPX/SPX.

**Newell-Simon Model** This model represents the human information processing system consisting of a processor system having a processor, receptor, effector and memory. This system interacts with the environment and processes information. The processes operate in linear and serial fashion. Hence, human can perform only one information processing task at a time.

**Newsgroup** A discussion group dedicated to a subject to exchange information or documents among the group members.

**Nolan Stage Model** It deals with the growth dynamics of an organisation which moves from various stages. The stages are initiation, expansion, formalisation and maturity. The model assumes that the stages cannot skipped. The organisation learning and the use of technology has a positive impact on these stages.

**Normalisation** It is a process of bringing the entities and their relationships in a final table format where there is a single non-full value at the intersection of any row and column, no information is missing, and in the event of update or delete, information integrity is maintained by way of complete update or no loss of any data. The noramlisaiton process ensures the stability of the database.

**Object** It is a representation of a real world entity. It is described by attributes, parts and behaviour. It is characterised by a number of operations and states created by these operations.

**OCR Systems** The Optical Character Recognition (OCR) technology is used to extract printed material from a page. The page may contain a text, a picture or a drawing. The OCR uses the pattern recognition technology that isolates each individual printed character in the page and produces a series of alphanumeric characters (ASCII). The OCR systems perform with varying degree of accuracy. A reliable technology for hand-written character recognition is not yet available.

**OLE System** The OLE system means Object Linking and Embedding System, used for viewing the compound documents. The OLE integration is a joint undertaking of the DEC and Microsoft. It is a common object model (COM). The OLE integration ensures that the objects written by the different programmers in different organisations behave in a consistent manner so that they can operate together. It provides a single, flexible object model, object environment and object communications mechanism among the industry standard server platforms.

**Organisational Culture** It represents the value system of people, their attitude towards work, customers and fellow workmen. It is driven by the vision of the organisation, that is, if the vision changes the culture should also change.

**Pareto Chart** It represents in a graphic form the cause and relationship on any aspect. On 'Y' axis percentage is shown and reference entity is shown on the 'x' axis.

**Parallel Interface** Parallel interface is mainly used in cases where the data transfer rate is the main consideration. It is recommended over the serial interface by making use of more number of data lines thereby increasing the data through-put.

**Parallel Processing** Parallel Processing means dividing the work among the multiple processors operating simultaneously resulting in faster completion of task. Parallel processing is advantageous where the application can be replicated at several locations and where the tasks in applicants can be broken into smaller tasks which can be handled concurrently and combine and execute the mixed workload of multiple applications on one system.

**Perception Error** Mental processing of information is different in each individual. It depends on the knowledge storage and the storage of frames of references of each individual. When any communication passes from one to other and then to somebody the errors of perception arise due to omissions, distortions and inferences of communication from one stage to the other.

**Persistence** It is an ability of data to exist after its creation by a program. Their existence in OODBMS is for universal purpose. Hence some objects are persistent and some are not.

**Polymorphism** The word originates from Greek and means 'many forms' or 'many types'. Since the receiving object may have several operations, it is not possible to know while sending the object which one to select. The sending object only sends the message while the receiving object selects the operation. The ability to apply the same operations to different classes of objects without knowing the classes themselves is called the polymorphism. Based on the receiving object context, the message will be received, interpreted and executed.

**Partitioning (Horizontal and Vertical)** For the precise representation of the applications, the system is portioned in two directions, viz., horizontal and vertical. The horizontal portion shows the applications of the various systems and subsystems while the vertical portion shows the slow powers and functions performed in them. The representation is hierarchical.

**Prescriptive Model** A decision making model which tells the decision maker how to make a class of decision or decisions similar in nature, is called as a prescriptive model. It is also known as a normative model.

A model which describes the actual process of decision making is called a descriptive model.

**Processing Design** There are two designs, viz., serial and parallel. In a serial design the data transfer, arithmetic on it and its processing is always one item bit by bit at a time. In a parallel design, 32 bits or a word is transferred, the arithmetic is done on all bits and concurrent processing is executed on all bits.

**Process Owner** Process owner is an individual in the organisation owning a process in terms of the responsibility, its improvement and maintenance. They have an authority to handle all the aspects of the process across the functions in the organisation.

**Protocols** Protocols are 'standard' or rules that define how devices on a network can communicate each other.

**Proxy Server** Proxy server allows to fetch documents that are on other web servers. Most common use of proxy server is made to access data on the server which is behind a firewall. It is also used as a cache to store a page temporarily. They are also used as checks to authorise the entry to web servers.

**Recovery** Recovery is a process of acquiring and restoring the data to latest status. The recovery procedure is followed when there is an extensive physical damage to the database due to, say, disk crash or system crash creating an inconsistent state of the data in the database.

The procedural steps are taking backups of the database regularly to restore in the event of damage then restore the data from the latest backup and apply the latest changes in the backup status to make it current. The process is called as 'rollforward'.

**Redundancy** Redundancy means superfluous or excessive. The redundant information reduces efficiency in transmission and degrades the response to the display. Some redundancy is useful for control and to confirm the correctness of the information.

Redundancy of data is not a welcome feature. It raises the problems of update and maintenance of the concurrency and consistency.

**Referential Integrity** Referential integrity means coexistence of two entities because of their dependent relationship. Hence, while doing any operations on one entity, care should be taken that the other entity is not disturbed. The DBMS feature provides referential integrity which the conventional file system does not provide.

**Requisite Variety for Control** For a proper control of the system, all possible situations making system out of control must be considered to provide the corresponding control mechanism and control responses.

**Router** Router is a network device that links two or more networks together.

**Search engines** are programs that search documents for specified keywords and displays a list of the documents where the specified keywords were found. A *search engines* popularly in use are Google (Google chrome), Bing and Yahoo!

**Scripts** Both browsers namely Netscape and Windows Internet Explorer support programs called scripts written in Java script and VB script. The scripts are written to support the web application to process the data in database elsewhere.

**SQL** The SQL means Structured Query Language belonging to the Fourth Generation developed by the IBM to manipulate the data in the database.

It can be used to manipulate and retrieve the data and develop the applications or simple queries. It can be embedded in the host language or can be used as a stored procedure in batch mode.

**Strategic Alignment of Information Technology** It is a model where the relationship of business strategy to information technology strategy is displayed. It shows further interface between the organisation infrastructure and information technology infrastructure.

**System Fault Tolerance (SFT)** System Fault Tolerance (SFT) provides a capability in the computer system to recover from system crash. The recovery methods are transaction tracking system where a log of systematic roll-back disk mirroring or duplexing where the data is simultaneously written on two hard disks with complete integrity.

**Testing (Alpha and Beta)** Like in all processes, product testing is also applicable for a software product. If a software is tested at the developer's site it is called Alpha Testing and if the testing is carried out at the customer's site it is called Beta Testing. Such testing helps to remove the bugs which are not possible to detect on the small sample data. The software is formally released after Beta Testing.

**Testing (Black Box)** Black box testing ensures that the input is properly accepted and the output is correctly produced maintaining the integrity of the external files used in the system.

**Testing (Performance)** The performance testing deals with the performance of the integrated system in terms of speed and response and also functionality and features. Performance testing assures that the system results are precise and correct and are available in time as per the response standards.

**Testing (Recovery)** The system must recover from its faults and resume processing within a prescribed time. Many a times, the systems are designed as fault tolerant systems where the system operations do not cease. Recovery testing allows the software to fail and verifies and confirms that the recovery is being properly performed without affecting the system's function. If the system is designed for an automatic recovery, it is tested for the entire process to confirm that it is faultless.

**Testing (Security)** Security testing ensures that system access is protected from unauthorised users. It tests the soundness of the security features built for protection of the password, data access and editing, interfacing and so on.

**Testing (Sensitivity)** Sensitivity testing is carried out to assure breakdowns arising out of the limitations of the size of the data, length of processing, the length of input data and resource.

**Testing (White Box)** White box testing ensures that all process paths are tested in a procedure for 'true' or 'false' decision, and all limit conditions are tested and the data structure is tested for validity.

**URL** Uniform Resource Locator (URL) is a method of accessing internet resources. URL contains information about both, the access method to use and the resources to use. Browsers use them to connect you directly to specific home page of site.

**User** There are two types of users, primary user and secondary users. The users who are benefited by the information system are the primary users. The persons who input the data or operate the system are the secondary users. At many places the users are primary as well as secondary.

**Utilities/Utility** In decision making when there are non-monetary considerations which need to be weighed, its unit of measure is called a utile. This utility of an outcome of a decision is varying in range, i.e., the value of the outcome and its utility is not linear but is non-linear over the range of the values. In such situations, the utilles are used to rank the decision alternatives. The utile is a combined representation utility and the associated money amount.

**VAN** Value added netwarless are private, third party managed networks that offer all services to subscribing firms.

**Virtual organisation** Organisations where work is not tied to go graphic location. Virtual organisation links people annd assets throughh network/Internet.

**VRML** Virtual reality modelling language.

**VPN** Virtual private netowrk is a secure connection between two points. Across the interent eabling private. Communication to travel securly over public infrastructure.

**Web Personalisation** It is a technology used for connecting web pase to the interest of specific user. Technology keeps track of type and kind of user and presents the page allindingly.

**Wi-Fi** It stands for Wireless Fidelity and can transmit up to 11 negabits per second.

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