UNIT 2 MANAGEMENT FUNCTIONS AND BUSINESS PROCESSES

Structure **Page No.**

2.0 INTRODUCTION

For successful and efficient operation of an organisation appropriate management is required is a well known fact. In the previous unit, you have learnt about organisations, their functions, structure and objectives and also learnt the commonalities of the organisations as well as how diverse requirements for their management can be there. In this unit, we will discuss how this requirement is met by understanding management functions, their hierarchical requirements and the business functionality requirements.

In this unit, we will also discuss how information system requirements can be worked out to assist and help the management in discharging their various roles for successful operation of the organisation.

2.1 OBJECTIVES

After going through this unit, you should be able to:

- understand the management functions at various levels of the management;
- define the business processes;
- work out the information system requirements of an organisation, and
- will become familiar with the latest tools and methods for working out the information system requirements.

2.2 MANAGEMENT FUNCTIONS AND LEVELS

"*Management*" (from Old French *ménagement* “the art of conducting, directing”, from Latin *manu agere* “to lead by the hand”) characterises the process of leading and directing all or part of an organisation, often a business, through the deployment and manipulation of resources (human, financial, material, intellectual or intangible). Early

twentieth-century management writer Mary Parker Follett defined management as "the art of getting things done through people."

One can also think of management functionally, as the action of measuring a quantity on a regular basis and of adjusting some initial plan, and as the actions taken to reach one's intended goal. This applies even in situations where planning does not take place. From this perspective, there are five management functions: Planning, Organising, Leading, Coordinating, and Controlling.

Management

Management is also called "Business Administration", and schools that teach management are usually called "Business Schools". The term "management" may also be used to describe the slate of managers of an organisation, for example, of a corporation. A governing body is a term used to describe a group formed to manage an organisation, such as a sports league.

In for-profit work, the primary function of management is to satisfy a range of stakeholders. This typically involves making a profit (for the shareholders), creating valued products at a reasonable cost (for customers), and providing rewarding employment opportunities (for employees). In nonprofit work it is also important to keep the faith of donors. In most models of management, shareholders vote for the board of directors, and that board then hires senior management. Some organisations are experimenting with other methods (such as employee voting models) of selecting or reviewing managers/senior managers but this is very rare.

In the public sector of countries constituted as representative democracies, politicians are elected to public office. They hire many managers and administrators, and in some countries like the United States, a great many people lose jobs when a new President comes into office. 2500 people serve "at the pleasure of the President" including all the top US government executives.

Public, private and voluntary sectors place different demands on managers, but all must retain the faith of those who select them (if they wish to retain their jobs), retain the faith of those people that fund the organisation, and retain the faith of those who work for the organisation. If they fail to convince employees that they are better off staying than leaving, the organisation will be forced into a downward spiral of hiring, training, firing, and recruiting.

Management also has a responsibility to innovate and improve the functioning of the organisation.

In all but the smallest organisations, achieving these objectives involves a division of management and labour. People specialise in a limited range of functions so as to more quickly gain competence and expertise. Even in employee managed workplaces such as a Wobbly Shop, where managers are elected, or where latitude of action is sharply restricted by collective bargaining or unions, managers still take on roughly the same functions and job descriptions as in a more traditional command hierarchy.

As has been said above management has been defined by various scholars, among them widely accepted definition by Koontz is '*Management is the art of getting things done through and with the people in formally organised groups*.'

Management Functions

The five basic *Functions*, which a manager has to perform as per classical model of management, which has been accepted since 1920's and is still popular, by early authors like Henry Fayol are:

- Planning,
- Organising,
- Coordinating,
- Directing, and
- Controlling.

To get an insight into Management let us understand these functions one by one.

Planning

Planning is a process of forecasting the future in advance. From where we are it leads to where we want to be. Planning requires rigorous analysis of input, output and costs. Let us suppose we want to establish a new factory or in a factory a new product. Planning for this will require collection of basic information such as expected sales, production capacity required, types of machinery, capital, foreign exchange requirement, organisation structure required to handle various jobs etc. Since planning is to chart the future course of action, it should answer the following questions and may be a few more:

- What to do?
- When to do?
- Who is to do?
- How is it to be done?
- Where is to be done?
- Why is to be done?

In an organisation for facilitating this planning process, goals are set, objectives are defined, policies, rules and procedures are laid down, programs are worked out, and budgets, strategies, and schedules are finalised.

Organising

Organising it the process of identifying the entire job, dividing the job into convenient subjects / tasks, allocating sub-jobs to persons or group of persons and delegating authority to each so that the job is carried out as planned.

Coordinating

Coordination is the process of putting the right person or group of persons at the right job. This function involves activities like defining the requirements with regard to the people for the job to be done, selecting suitable persons, training and developing them so that they can perform the desired job(s).

Directing

Henri Fayol has identified the function of Directing with command. However, modern management experts are of the view that directing includes:

- Communication,
- Motivation, and

- Leadership.

Directing is important because in order to achieve pre-determined goals and objectives people manning the organisation have to be guided, motivated and led by the manager.

Controlling

Controlling is the Function to ensure that things are going, as they should be. Actual performance must be compared with previously set goals. If there are any significant deviations, management must take the corrective steps to bring the things on track. Thus controlling is the process that involves:

- Fixing standards for measuring work performance,
- Measurement of actual performance,
- Comparing actual with standards and finding out deviations, if any, and
- Taking corrective actions.

To perform these functions management has to take a variety of decisions. In other words, *decision-making* is a fundamental pre-requisite for each of the processes talked above. As per Peter Drucker 'Whatever a manager does, he does it through decision making'. Thus decision-making is the Essence of Management.

To further understand functioning of a business organisation, let us briefly discuss the Levels of Management.

Levels of Management

Managers are organisational members who are responsible for the work performance of other organisational members. Managers have formal authority to use organisational resources and to make decisions. In organisations, there are typically three levels of management: top-level, middle-level, and first-level or operational level as shown in *Figure 1*. These three main levels of managers form a hierarchy, in which they are ranked in order of importance. In most organisations, the number of managers at each level is such that the hierarchy resembles a pyramid, with many more first-level managers, fewer middle managers, and the fewest managers at the top level. Each of these management levels is described below in terms of their possible job titles and their primary responsibilities and the paths taken to hold these positions. Additionally, there are differences across the management levels as to what types of management tasks each does and the roles that they take in their jobs. Finally, there are a number of changes that are occurring in many organisations that are changing the management hierarchies in them, such as the increasing use of teams, the prevalence of outsourcing, and the flattening of organisational structures.

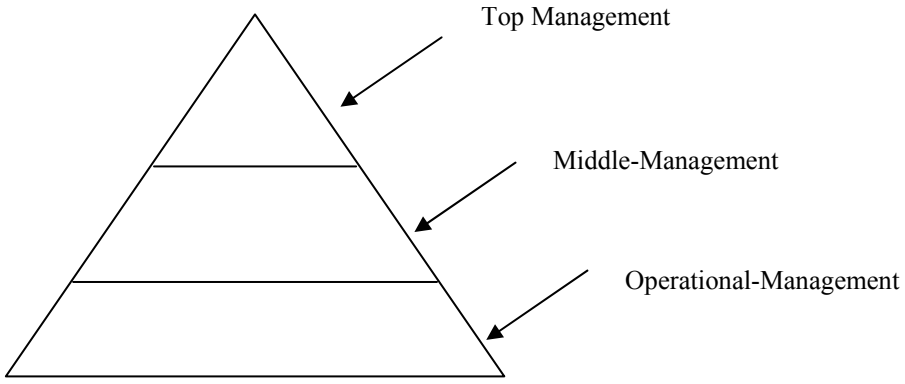

Figure 1: Basic levels of management

Top-Level Managers

Top-level managers, or top managers, are also called senior management or executives. These individuals are at the top one or two levels in an organisation, and hold titles such as: Chief Executive Officer (CEO), Chief Financial Officer (CFO), Chief Operational Officer (COO), Chief Information Officer (CIO), Chairperson of the Board, President, Vice president, Corporate head.

Often, a set of these managers will constitute the top management team, which is composed of the CEO, the COO, and other department heads. Top-level managers make decisions affecting the entirety of the firm. Top managers do not direct the day-to-day activities of the firm; rather, they set goals for the organisation and direct the company to achieve them. Top managers are ultimately responsible for the performance of the organisation, and often, these managers have very visible jobs.

Top managers in most organisations have a great deal of managerial experience and have moved up through the ranks of management within the company or in another firm. An exception to this is a top manager who is also an entrepreneur; such an individual may start a small company and manage it until it grows enough to support several levels of management. Many top managers possess an advanced degree, such as a Masters in Business Administration, but such a degree is not required.

Some CEOs are hired in from other top management positions in other companies. Conversely, they may be promoted from within and groomed for top management with management development activities, coaching, and mentoring. They may be tagged for promotion through succession planning, which identifies high potential managers.

Middle-Level Managers

Middle-level managers, or middle managers, are those in the levels below top managers. Middle managers' job titles include: General Manager, Plant manager, Regional manager, and Divisional Manager.

Middle-level managers are responsible for carrying out the goals set by top management. They do so by setting goals for their departments and other business units. Middle managers can motivate and assist first-line managers to achieve business objectives. Middle managers may also communicate upward, by offering suggestions and feedback to top managers. Because middle managers are more involved in the day-to-day workings of a company, they may provide valuable information to top managers to help improve the organisation's bottom line.

Jobs in middle management vary widely in terms of responsibility and salary. Depending on the size of the company and the number of middle-level managers in the firm, middle managers may supervise only a small group of employees, or they may manage very large groups, such as an entire business location. Middle managers may be employees who were promoted from first-level manager positions within the organisation, or they may have been hired from outside the firm. Some middle managers may have aspirations to hold positions in top management in the future.

First-Level / Operational Level Managers

First-level managers are also called first-line managers or supervisors. These managers have job titles such as: Office manager, Shift Supervisor, Department Manager, Foreperson, Crew Leader, Store Manager.

First-line managers are responsible for the daily management of line workers — the employees who actually produce the product or offer the service. There are first-line

managers in every work unit in the organisation. Although first-level managers typically do not set goals for the organisation, they have a very strong influence on the company. These are the managers that most employees interact with on a daily basis, and if the managers perform poorly, employees may also perform poorly, may lack motivation, or may leave the company.
In the past, most first-line managers were employees who were promoted from line positions (such as production or clerical jobs). Rarely did these employees have formal education beyond the high school level. However, many first-line managers are now graduates of a trade school, or have a two-year associates or a four-year bachelor's degree from college.

Knowledge Workers

Number of organisations in today's environment; also have another level for Knowledge Workers. Primarily, the knowledge workers are above the operational managers in the organisations. These workers deal more with Research and Development jobs and also with analysing data for Knowledge Extraction.

The interaction amongst the three levels of the management can be summarized as per Jerome Kanter (1996). The Top Management, which is also known as Strategic level, establishes the policies, plans and objectives of the company as well as general budget framework of the company under which the various departments will operate. These Factors passed down to middle management, where these are translated into specific revenue, cost and profit goals. These are reviewed, analysed and modified in accordance with the overall plan and policies, until agreement is reached. Middle management then issues the specific schedules and measurement yardsticks to the operating management. The latter level has the job of producing, and / or selling of the goods and services required to meet the revenue and profit goals, which in turn will enable the company to reach its overall plans and objectives. This interaction has been shown in the following *Figure 2*.

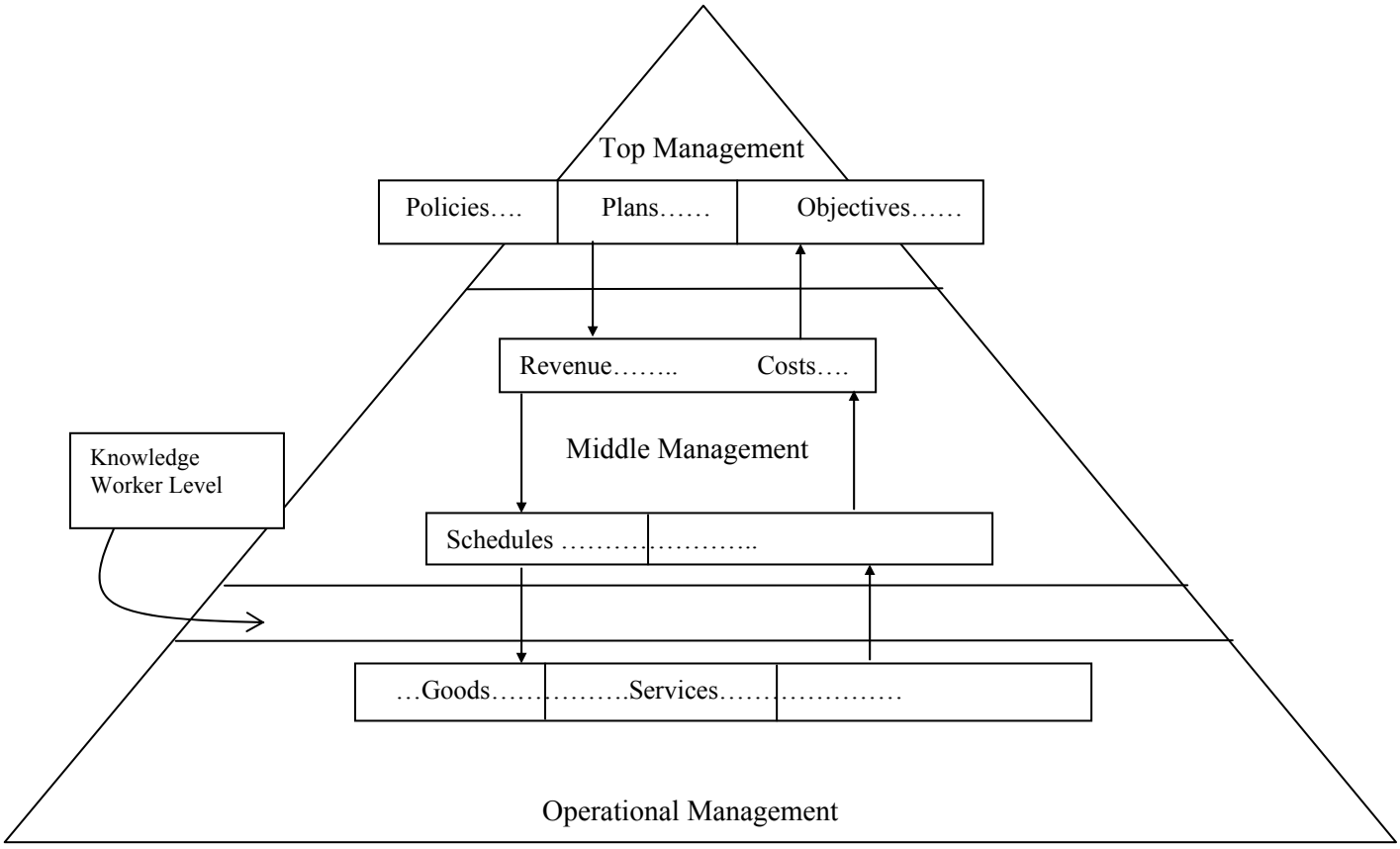

Figure 2: Management roles at various levels

2.3 BUSINESS FUNCTIONS AND PROCESSES

Business Functions

Business activities are grouped around functions such as production, finance and personnel, etc. resulting in department or an area of the business organisation. Each of these functional areas is interdependent and is part of the organisational system. A typical set of functions in a manufacturing organisation includes

1) Sales and marketing,
2) Manufacturing and production,
3) Finance and accounts,
4) Human Resource, and
5) Materials Management

Information Technology now is an integral part of all business functions. Some of the main activities for each functional area have been shown in the *Figure 3*.

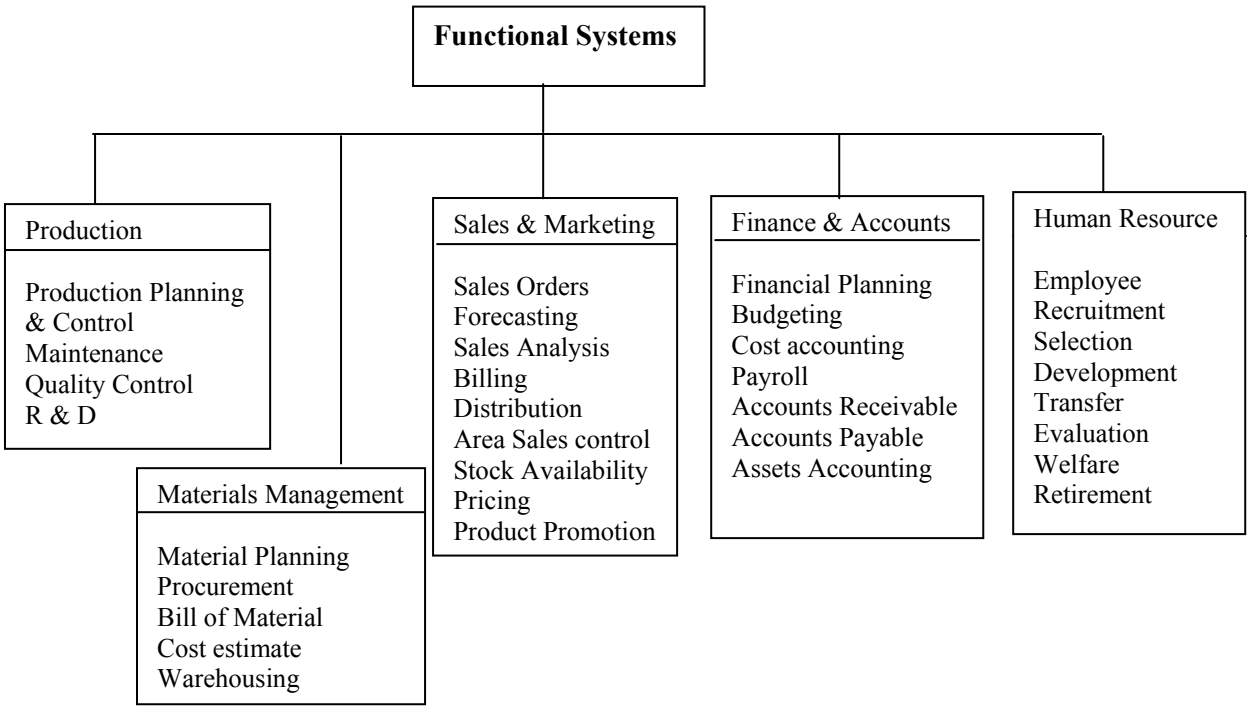

Figure 3: Main Activities of Functional Areas

2.3.1 Sales and Marketing

The sales and marketing function is responsible for selling the organisation's product or service. Marketing is concerned with identifying the customers for the firm's products or services, determining what they need or want, planning and developing products and services to meet their needs, and advertising and promoting these products and services. Sales is concerned with contacting customers, selling the products and services, taking orders, and following up on sales. Sales and marketing information systems are required to support these activities:

Table 1: Examples of Sales and Marketing Information Systems

System	Description	Organisational Level
Order processing	Enter, process, and track orders	Operational
Market analysis	Identify customers and markets using data on demographics, markets, consumer behavior, and trends	Knowledge
Pricing analysis	Determine prices for products and services	Management
Sales trend forecasting	Prepare 5-year sales forecasts Strategic	Strategic

Information systems are used in sales and marketing function in a number of ways as shown in *Table 1* above. At the strategic level, sales and marketing systems monitor trends affecting new products and sales opportunities, support planning for new products and services, and monitor the performance of competitors. At the management level, sales and marketing systems support market research, advertising and promotional campaigns, and pricing decisions. They analyze sales performance and the performance of the sales staff. Knowledge-level sales and marketing systems support marketing analysis workstations. At the operational level, sales and marketing systems assist in locating and contacting prospective customers, tracking sales, processing orders, and providing customer service support.

Figure 4 shows the output of a typical sales information system at the management level. The system consolidates data about each item sold (such as the product code, product description, and price) for further management analysis. Company managers examine these sales data to monitor sales activity and buying trends. The Window on Management describes some typical sales and marketing systems that might be found in a small business.

PRODUCT CODE	PRODUCT DESCRIPTION	SALES REGION	ACTUAL SALES	PLANNED	ACTUAL VS PLANNED
4469	Carpet Cleaner	Northeast	4.066.700	4.800.000	0.85
		South	3.778.112	3.750.000	1.01
		Midwest	4.867.001	4.600.000	1.06
		West	4.003.440	4.400.000	0.91
	TOTAL		16,715,253	17.550.000	0.95
5674	Room Freshener	Northeast	3.676.700	3.900.000	0.94
		South	5.608.112	4.700.000	1.19
		Midwest	4.711.001	4.200.000	1.12
		West	4.563.440	4.900.000	0.93
			18.559.253	17.700.000	1.05

Figure 4: Sales information system

The concept of marketing has undergone a sea change and today the traditional concept of marketing does not hold true. Whereas traditional practices of marketing start with production and consider marketing to be of use in selling and promotion to attain sales at a profit, modern marketing focuses its attention on customers / buyers. It gets profit through the creation of the buyer's satisfaction and further seeks to achieve it through an integrated, corporate wide set of marketing activities. These two views have been shown in *Figure 5*.

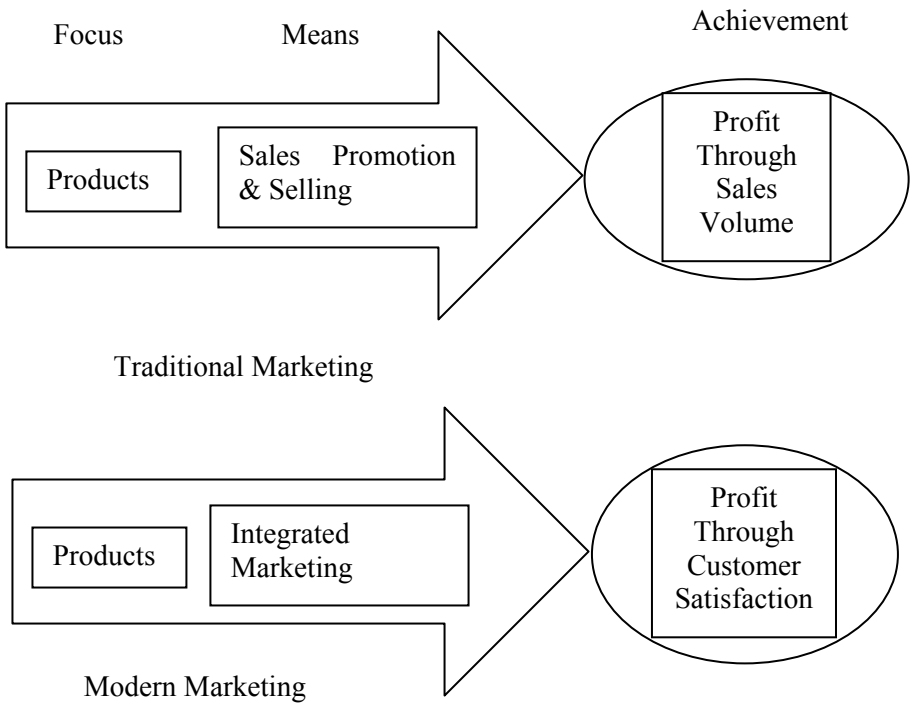

Figure 5: Traditional vs. modem marketing

Modern marketing does not remain confined to activities like advertising, selling and distribution but it also involves interaction of several other business activities with the objective of satisfying customers' needs and aspirations. The marketing activities start with exploring and understanding customers' need even before the product is produced, so that the product is designed keeping customers needs in mind. In case of traditional marketing, the product is produced and the product is pushed to the market with aggressive selling and promotional efforts.

Some of the important functions covered in the modern marketing processes as are:

Identification of the potential market: The potential market and customers are located with the target questions like:

- Where are the potential buyers located?
- When do they buy?
- How much they buy?
- How frequently they buy?
- What are the preferences of the customer for the intended product?

Identification of purchase motivation factors: Assessment is made regarding social, economic and psychological factors influencing purchases by the potential customers.

The distribution and transportation factors: are reviewed to optimization cost by integrating movement and warehousing.

Product design adjustment factors: Based on the preferred products in the market, product design is reviewed.

Communication factors: Advertising, personal selling, sales promotion, publicity and packaging are reviewed to enable most optimum communication to the customer.

Transaction functions: Order booking, invoicing, billing, credit realisation etc. are reviewed to make them more customer friendly.

Post-transaction factors: After sales service is given due attention to ensure repeated purchases by the customers.

The marketing information system, which can provide assistance / support to correct decision is very important for success of all above factors.

2.3.2 Manufacturing and Production

The manufacturing and production function is responsible for actually producing the firm's goods and services. Manufacturing and production systems deal with the planning, development, and maintenance of production facilities; the establishment of production goals; the acquisition, storage, and availability of production materials; and the scheduling of equipment, facilities, materials, and labour required to produce the finished products. Manufacturing and production information systems support these activities.

Table 2 shows some typical manufacturing and production information systems arranged by organisational level. Strategic-level manufacturing systems deal with the firm long-term manufacturing goals, such as where to locate new plants or whether to invest in new manufacturing technology. At the management level, manufacturing and production systems analyse and monitor manufacturing and production costs and resources. Knowledge manufacturing and production systems create and distribute design knowledge or expertise to drive the production process, and operational manufacturing and production systems deal with the status of production tasks.

Table 2: Examples of Manufacturing and Production Information Systems

System	Description	Organisational Level
Machine control	Control the actions of machines and equipment	Operational
Computer-aided design (CAD)	Design new products using the computer	Knowledge
Production planning	Decide when and how many products should be produced	Management
Facilities location	Decide where to locate new production facilities	Strategic

Quality Control, Environmental Control and Safety are the other factors, which are required to be controlled as part of present day Production Functions. More and more organisations are going in for International Standards (ISO 9000 for Quality, ISO14000 for Environment). These standards require control of raw material, equipment maintenance and performance in an integrated manner, which is possible only through good information system and analysis.

2.3.3 Finance and Accounts

The finance function is responsible for managing the firm's financial assets, such as cash, stocks, bonds, and other investments, in order to maximize the return on these financial assets. The finance function is also in charge of managing the capitalisation of the firm (finding new financial assets in stocks, bonds, or other forms of debt). In order to determine whether the firm is getting the best return on its investments, the finance function must obtain a considerable amount of information from sources external to the firm.

The accounting function is responsible for maintaining and managing the firm's financial records — receipts, disbursements, depreciation, payroll — to account for the flow of funds in a firm. Finance and accounting share related problems — how to keep track of a firm's financial assets and fund flows. They provide answers to questions such as: What is the current inventory of financial assets? What records exist for disbursements, receipts, payroll, and other fund flows?

Table 3: Examples of Finance and Accounting Information Systems

System	Description	Organisational Level
Accounts receivable	Track money owed the firm	Operational
Portfolio analysis	Design the firm's portfolio of investments	Knowledge
Budgeting	Prepare short-term budgets	Management
Profit planning	Plan long-term profits	Strategic

Table 3 shows some of the typical finance and accounting information systems found in large organisations. Strategic-level systems for the finance and accounting function establish long-term investment goals for the firm and provide long-range forecasts of the firm's financial performance. At the management level, information systems help managers oversee and control the firm's financial resources. Knowledge systems support finance and accounting by providing analytical tools and workstations for designing the right mix of investments to maximize returns for the firm. Operational systems in finance and accounting track the flow of funds in the firm through transactions such as paychecks, payments to vendors, securities reports, and receipts.

2.3.4 Human Resource

The human resources function is responsible for attracting, developing, and maintaining the firm's workforce. Human resources information systems support activities such as identifying potential employees, maintaining complete records on existing employees, and creating programs to develop employees' talents and skills.

Strategic-level human resources systems identify the support requirements (skills, educational level, types of positions, number of positions, and cost) for meeting the firm's long-term business plans. At the management level, human resources systems help managers monitor and analyse the recruitment, allocation, and compensation of employees. Knowledge systems for human resources support analysis activities related to job design, training, and the modelling of employee career paths and reporting relationships. Human resources operational systems track the recruitment and placement of the firm's employees (see *Table 4*).

Figure 6 illustrates a typical human resources record keeping. It maintains basic employee data, such as the employee's name, age, sex, marital status, address, educational background, salary, job title, date of hire, and date of Training. The system can produce a variety of reports, such as lists of newly hired employees, Areas in which employees have been trained etc. employees are classified by job type or educational level, or job performance evaluations. Such systems are typically designed to provide data that can satisfy income tax, Provident fund and other statutory requirements and record keeping requirements for Equal Employment Opportunity (EEO) and other purposes.

Table 4: Examples of Human Resources Information Systems

System	Description	Organisational Level
Staffing, Training and development	Track recruitment, employee training, skills, and performance appraisals	Operational
Career plan	Design career paths for employees	Knowledge
Compensation analysis	Monitor the range and distribution of employee wages, salaries, and benefits	Management
Human resources planning	Plan the long-term labour force needs of the organisation and succession planning	Strategic

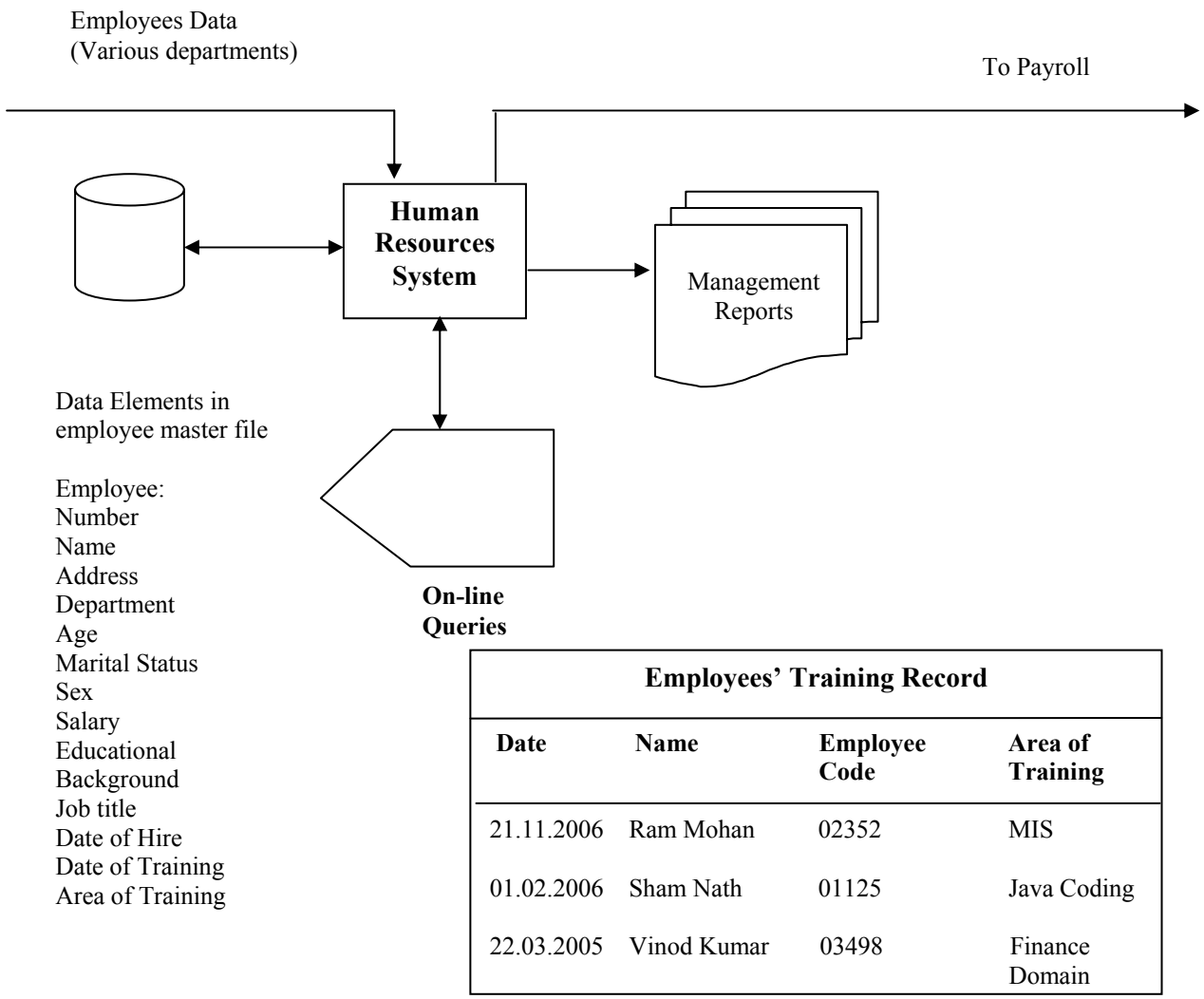

Figure 6: An employee record keeping system. This System Maintains Data on the Firm's Employees to Support the Human Resources Function

2.3.5 Materials Management

The materials management function is responsible for procurement of raw materials and other items like plant and equipment and spare parts etc. For typical manufacturing companies about 50-70 % of the total cost is on account of materials. Therefore, for continued successful operation of any organisation in the competitive environment, good materials management and information system is very important. Information system is required because materials management is more dependent on flow of information. Strategic level system for materials management identifies long

term sourcing of raw materials and other supplies. The management system provides for the selection of the vendors meeting the quality and cost requirements. Knowledge system provides the trends on supplies. The operation system keeps track of the supplies with the vendors as shown in *Table 5.*

Table 5: Examples of Materials Management Information Systems

System	Description	Organisational Level
Inventory system	Track receipt of materials with the vendors and stock position in store.	Operational
Trends	Design vendor evaluation and Inventory control system.	Knowledge
Vendors selection	Monitor the vendors performance and Inventory control for cost optimisation.	Management
Long term sourcing of materials	Plan long-term sources for raw materials, plant and equipment. Procurement policy review.	Strategic

Inventory system is essential for most of the manufacturing and production systems. As illustrated in *Figure 7*, data about each item in inventory, such as the number of units depleted because of a shipment or purchase or the number of units replenished by reordering or returns, are either scanned or keyed into the system. The inventory master file contains basic data about each item, including the unique identification code for each item, the description of the item, the number of units on hand, the number of units on order, and the reorder point (the number of units in inventory that triggers a decision to reorder to prevent a stock out). Companies can estimate the number of items to reorder or they can use a formula for calculating the least expensive quantity to reorder called the *economic order quantity.* The system produces reports such as the number of each item available in inventory, the number of units of each item to reorder, or items in inventory that must be replenished.

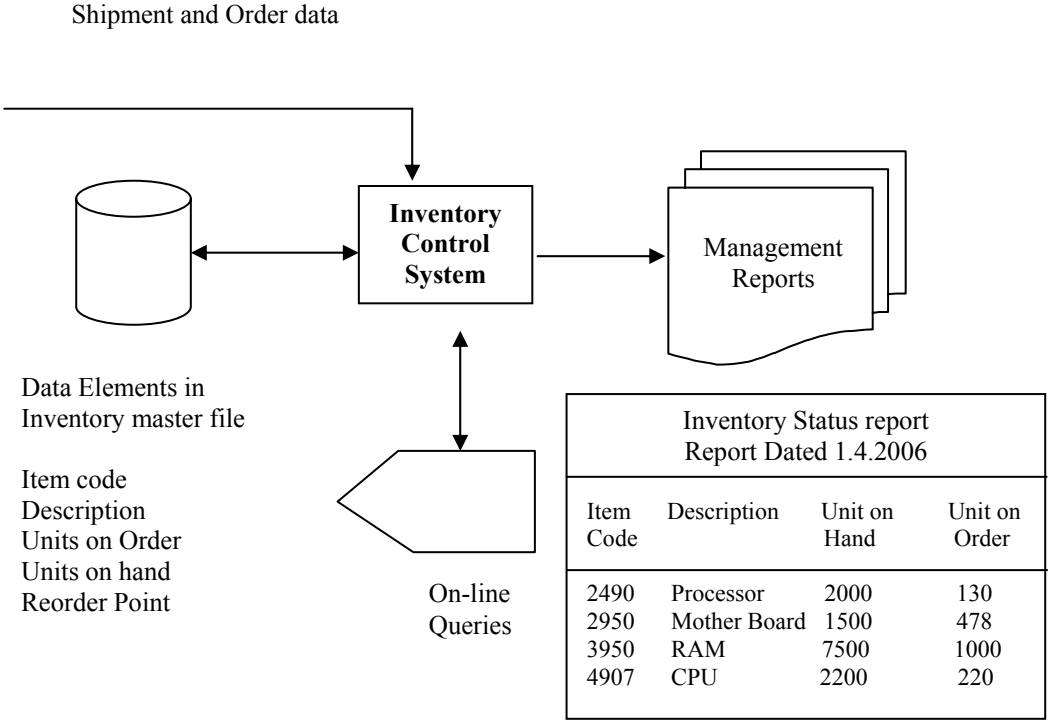

Figure 7: Overview of an inventory system. This System Provides Information about the Number of Items Available in Inventory to Support Manufacturing and Production Activities

Business Processes

A *Business Process* is best defined as any function within an organisation that enables the organisation to successfully deliver its products and services. A simple analogy would be to look at an organisation as a wheel and the individual Business Processes are the spokes to the wheel. Having just one or two spokes loose can make a wheel out-of-balance. The longer a wheel runs out of balance the more damaging the effect to the organisation. When the wheel on a cart becomes so unstable that its primary function fails, you would simply replace the wheel. Obviously, an organisation cannot simply replace itself... but your customer can and will replace the wheel (you the Supplier) if you fail to perform to the customers' needs and expectations. Obviously, this is a very simplistic and extreme analogy about the operation of an organisation. But, when you step back and look at the products and services you purchase yourself, it actually becomes a little more understandable. You wouldn't maintain a business relationship with a supplier if the suppliers' own internal Business Processes prevented the supplier from performing its best. You would probably go to another supplier.

A *Business processes* can be defined as a unique manner in which work is organised, coordinated, and focused to produce a valuable product or service. On the one hand, business processes are concrete workflows of material, information, and knowledge– sets of activities. On the other hand, business processes represent unique ways in which organisations coordinate work, information, and knowledge, and the ways in which management chooses to coordinate work. *Table 6* describes typical business processes for each of the functional areas.

Table 6: Functional Area and Business Processes

Sl. No.	Functional Area	Typical Business Process
1	Sales / Marketing	Identifying customers Familiarising customers with the product Selling the product
2	Manufacturing / Production	Assembling the product Quality checking Making bills of materials.
3	Finance / Accounts	Paying creditors Managing cash Creating financial statements
4	Human Resource	Hiring employees Working out compensation plan Employee performance evaluation.
5	Other types- Materials	Issuing tender enquiries Awarding purchase orders Carrying out inventory control

Although each of the major business functions has its own set of business processes, many other business processes are cross-functional, transcending the boundaries between sales, marketing, manufacturing, and research and development. These cross-functional processes cut across the traditional organisational structure, grouping employees from different functional specialties to complete a piece of work. For example, the order fulfilment process at many companies requires cooperation among the sales function (receiving the order, entering the order), the accounting function (credit checking and billing for the order), and the manufacturing function (assembling and shipping the order) as shown in *Figure 8*.

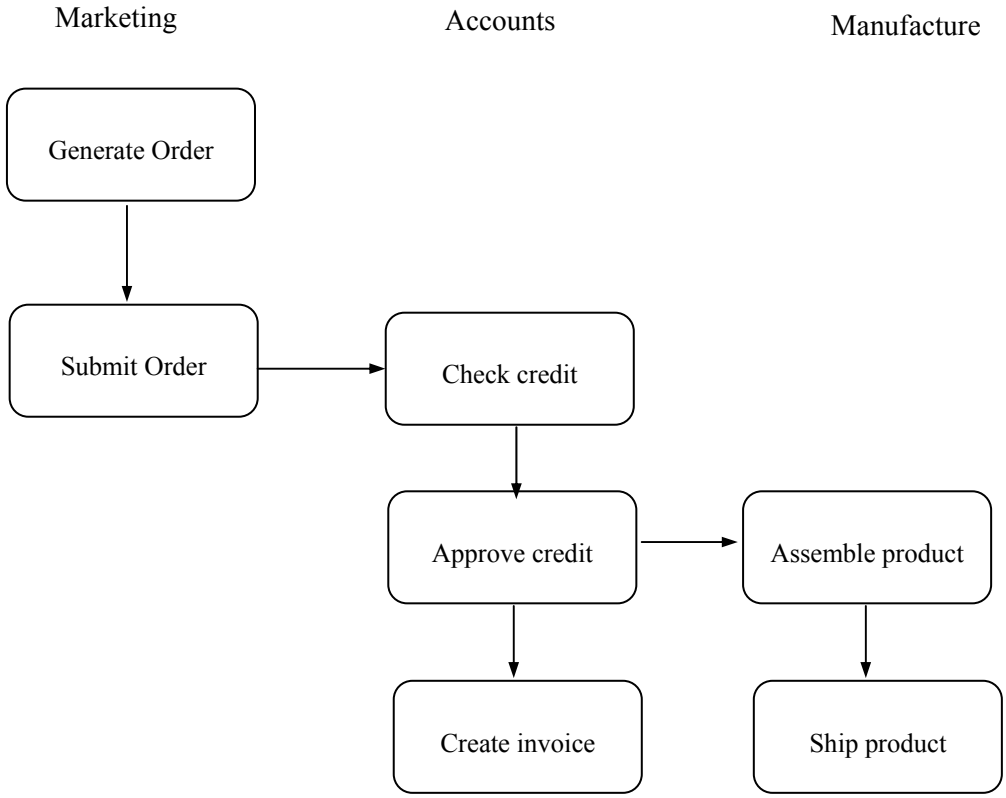

Figure 8: Cross functional business process

Organisational structure throughout the many diverse industries varies, but for the most part, all organisations perform similar Business Processes. Whether you are from a large or small corporation, government agency, or a non-profit association, to a large extent, you share common Business Processes with other industries. The Business Process of Human Resources for one industry can be very similar to another. In fact, the Human Resource Business Processes may even be a Critical Success Factor for some of the industries.

Today ready-made solutions for Common Business Processes are available, which require little bit of customisation for using in variety of organisations. Some of business processes for which such packages are available are given in the *Table 7*.

Table 7: Common Business Processes

Activity based costing	Employee - benefits	Inventory management	Project management
Accounting	Employee - communication	Internship	Public relations
Acquisitions	Employee - compensation	ISO	Purchasing
Assembly	Employee - development	Knowledge management	Quality
Asset management	Employee – evaluation	Leadership	Quality assurance
Balanced scorecard	Employee - incentive programs	Logistics	Quality improvement
Benchmarking	Employee – recognition	Loss management	Records management
Billing budget	Employee- recruiting	Maintenance management	Recycling
Calibration	Employee - retention / turnover	Manufacturing	Reengineering
Call centres	Employee - satisfaction	Marketing	Refurbishing

Charity	Employee - suggestions	Material management	Regulations
Complaint handling	Employee - training	Mentoring	Repair
Configuration management	Engineering	Mergers	Reliability
Contracting	Environment	Operations	Research & development
Cost controls	External communications	Order fulfilment	Restoration
Cost measuring	Facility management	Order processing	Risk management
Creativity	Failure analysis	Outsourcing	Sales
Credit management	Failure measuring	Payroll	Security
Customer - requirements	Failure monitoring	Performance improvement	Self directed teams
Customer - satisfaction	Finance	Performance measurement	Service
Customer – service	Fleet management	Planning	Service delivery
Customer - training	Franchising	Policy	Stewardship
Debt collection	Freight	Process improvement	Staffing
Delivery	Health & safety	Process management	Strategic planning
Direct mail	Help desks	Procurement	Supplier management
Disaster recovery	Human resources	Product delivery	Telecommuting
Distribution	Information management	Product design	Testing
Document control	Information systems & technology	Product development	Vendor relations
Donating	Innovation	Product management	Volunteering
Emergency preparation	Inspection	Waste management	Warehousing
Employee - attendance	Internal communications	Workforce diversity	Warranty

Check Your Progress 1

1) Answer the following:

i) Which are the basic functions of the management and what are the levels of the management? At what level of the management following are decided?

a) Selling of the products to the specific customers.
b) What markets or businesses the company should be in at present?
c) What should be the overall production plan?

ii) What are the significant differences between conventional marketing and modern marketing?

iii) What are business processes? Identify a business process for each functional area.

2) Mark the correct answer.

a) Deciding where to locate new production facilities is an example of a manufacturing and production information system operating at the:

i) operational level. ☐
ii) management level. ☐
iii) knowledge level. ☐
iv) strategic level. ☐

b) Preparing short-term budgets is an example of a finance and accounting information system operating at the:

i) operational level. ☐
ii) management level. ☐
iii) knowledge level. ☐
iv) strategic level. ☐

c) Tracking employee training, skills, and performance appraisals is an example of a human resource information system operating at the:

i) operational level. ☐
ii) management level. ☐
iii) knowledge level. ☐
iv) strategic level. ☐

d) Assembling a product, identifying customers and hiring employees are:

i) transactions. ☐
ii) phases. ☐
iii) business processes. ☐
iv) business functions. ☐

2.4 INFORMATION SYSTEMS REQUIREMENTS

At the turn of the nineteenth century industrial revolution took place. This Industrial Age focused on the role of the *Management*. At present with the rapid development of the Information Technology, a new industrial revolution is in the making, similar to the one that took place at the turn of the nineteenth century. The world is advancing from the *Industrial Age* to the knowledge age. The new challenge to the management which surrounds us requires profound change; profound change in the way we consider the organisations; may be those are part of the Government or civil administration or business enterprise, the way we develop our businesses, the way we manage, and the structures within which we manage.

Productivity and efficiency of business to reduce cost of products and services, and to use technology to continually innovate is nothing new except that the competition is much more fierce than ever before. Globalisation of the marketplace, and means of accessing the same, through national and global information superhighways have given a new dimension to the concept of information. Information and knowledge are critical to mange change, which is the salient feature of the Information Age. Businesses do not have sufficient time to consolidate as there are continuous changes to be handled due to changes in technology, raw materials, customer needs, legislation, rule and regulations.

Information Age is thus knowledge-based. This challenge of providing rapid changing information and thus knowledge base requires a system. As we see thus this Information Age requires focus on *Management* and the *Information Systems,* therefore, we will focus on how the information system needs of the management can be fulfilled.

Information

Information is a necessary and vital input for the Management. Any Management decision-making has to be based on information. Information need to be TRUE. Making use of its acronym we may say information must be Timely, Reliable, Useful, and Explicit.

Timely: It should reach the recipient *in time* and *up-to-date*. For effective decision making information must reach the decision maker at the right time so that he can take the desired action. The delayed information at times can even lead to loss of purpose itself or in substantial loss.

Reliable: Any information can be reliable only if it is *factual, accurate* and *complete.*

Useful: *Relevance* and *adequacy* of the information for the need for which it is required makes it useful to purpose.

Explicit: Quality information is said to be explicit if it does not require further analysis by the recipient for decision-making.

In other words information can be defined as processed data.

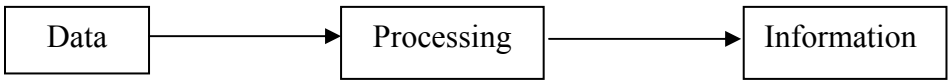

Figure 9: Information processed data

System

In our everyday life, the word 'system' is used quite often. We talk about an educational system, computer system, organisational system, political system, solar system, railway system etc. On analysis we will find we use the word system to mean a collection of elements integrated to achieve a common definable goal. For illustration, a business organisation can be considered as a system, in which the parts (departments, sections and units etc.) are joined together for a common goal. An information system can be a set of collection of elements starting from collection of data, its processing and presentation for achieving a defined or set goal.

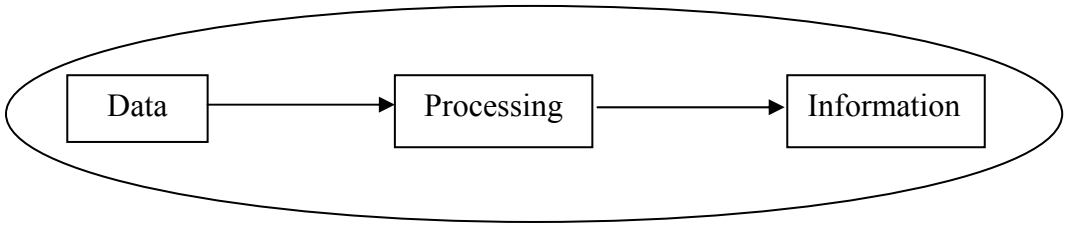

Figure 10: Information system

In business, information systems support business processes and operations, decision-making, and competitive strategies.

Information System

Information System is a set of processes that helps in collecting the data, storing the data, processing the data and disseminating information to support decision making process of key managers.

2.5 REQUIREMENT ANALYSIS

Requirements analysis, in software engineering, is a term used to describe all the tasks that go into the instigation, scoping and definition of a new or altered computer system. Requirements analysis is an important part of the software engineering process; whereby business analysts or software developers identify the needs or requirements of a client; having identified these requirements they are then in a position to design a solution.

Requirements analysis is also known under other names:

- requirements engineering
- requirements gathering
- requirements capture
- operational concept documenting
- systems analysis
- requirements specification.

During most of the history of software engineering it has been considered to be a relatively easy part of the process. However, in the last decade or so, it has become increasingly recognised as being the most vital part of the process; given that the failure to properly identify requirements makes it virtually impossible for the finished piece of software to meet the needs of the client or be finished on time.

The challenge

Successfully completing a “requirements analysis” task is a challenge. In the first place, it is not easy to identify all the stakeholders, give them all an appropriate form of input, and document all their input in a clear and concise format. And there are constraints. The requirements engineer is expected to determine whether or not the new system is

- feasible
- schedulable
- affordable
- legal
- ethical.

In the rush of enthusiasm associated with a new project, there is always a temptation to downplay the importance of requirements analysis. However, studies of various projects reveal that costs and technical risks can be reduced through rigorous and thorough up-front requirements engineering.

General problem

The general difficulties involved with requirements analysis are increasingly well known:

- the right people with adequate experience, technical expertise, and language skills may not be available to lead the requirements engineering activities;
- the initial ideas about what is needed are often incomplete, wildly optimistic, and firmly entrenched in the minds of the people leading the acquisition process; and
- the difficulty of using the complex tools and diverse methods associated with requirements gathering may negate the hoped for benefits of a complete and detailed approach.

Stakeholder issues

Steve McConnell, in his book Rapid Development, details a number of ways users can inhibit requirements gathering:

- Users don't understand what they want.
- Users won't commit to a set of written requirements.
- Users insist on new requirements after the cost and schedule have been fixed.
- Communication with users is slow.
- Users often do not participate in reviews or are incapable of doing so.
- Users are technically unsophisticated.
- Users don't understand the software development process.

This commonly leads to the situation where user requirements keep changing even when the software development has been started. Because new requirements may sometimes mean changing the technology as well, the importance of finalising user requirements before the commencement of development should be made very clear to the Business Users. Knowing their objectives and expectations regarding the solution beforehand and documenting agreed requirements is fundamental to the success of a project.

Developer issues

However, developers are often equally at blame. Typical problems caused by software developers are:

- Software developers and end users often have different vocabularies. Consequently, they can believe they are in perfect agreement until the finished product is supplied. The duty to bridge that gap is often assigned to Business Analysts, who analyse and document the business processes of business units affected by the proposed business solution, and Business Systems Analysts, who analyse and document the proposed business solution from a systems perspective.
- Software developers often try to make the requirements fit an existing system or model, rather than develop a system specific to the needs of the client.
- Analysis is often carried out by programmers, rather than business analysts. It is often the case that programmers lack the people skills and the domain knowledge to understand a business process properly.
- Software developers have pre-conceived notions about the problem.

Solutions

One of the solutions to these problems are to recognise that requirements analysis is a specialist field best carried out by experts, i.e. business or system analysts, who could bridge the gap between the business and IT (Information Technology) world. While this approach has helped, it has often been difficult to find staff who possess equally good people and technical skills. In addition, the techniques used to analyse requirements have not proven sufficiently effective in all situations. Techniques introduced in the 1990s like Prototyping, Unified Modeling Language (UML), Use

cases, and Agile software development are often put forward as a promising solution to this issue.

More recently, however, attempts have been made to address these difficulties with the establishment of the International Institute of Business Analysis, whose main goals are the creation of a common Body of Knowledge for Business Analysis, and to use it as basis for certification of Business Analysis Professionals.Also, a new class of application simulation or application definition tools have entered the market. These tools are designed to bridge the communication gap between business users and the IT organisation — and also to allow applications to be 'test marketed' before any code is produced.

The best of these tools offer:

- electronic whiteboards to sketch application flows and test alternatives
- ability to capture business logic and data needs
- ability to generate high fidelity prototypes that closely imitate the final application
- interactivity
- capability to add contextual requirements and other comments
- ability for remote and distributed users to run and interact with the simulation.

2.6 TOOLS AND METHODS FOR REQUIREMENT ANALYSIS

Requirements analysis can be a long and arduous process. The requirements specialists do their work by talking to people, documenting their findings, analysing the collected information to discover inconsistencies and oversights, and then talking to people again. This process can go on for anywhere from a week to a year or more, and may continue throughout the life cycle of a system.

New systems change the environment and relationships between people, so it is important to identify all the stakeholders, take into account all their needs and ensure they understand the implications of the new systems. Frequently, this objective is not met because:

- there is not enough communication up front and important needs are overlooked when the system is implemented; and/or
- there is not enough ongoing communication during system development and the users are disappointed by the new system's characteristics.

To keep all these discussions well organised and efficient, the evolving requirements must be documented.

Analysts can employ several techniques to get the requirements from the customer. Historically this has included such things as holding interviews, or holding focus groups (more aptly named in this context as requirements workshops — see below) and creating requirements lists. More modern techniques include Prototyping, and use cases. Where necessary, the analyst will employ a combination of these methods to establish the exact requirements of the stakeholders, so that a system that meets the business needs is produced.

Methods for Requirement Analysis:

Stakeholder interviews

Stakeholder interviews are obviously necessary in requirement specification. However, in any large system a number of individuals need to be interviewed which

increases the time and cost. This often leads to pressure to shorten the analysis phase despite the impact incomplete requirements can have on a project. Stakeholder interviews also often reveal major shortcomings with regard to how existing business processes works and identify how to improve this in the future. While this is ultimately a positive for the business, it will also lead to previously unforeseen increases in time and cost. This can be further compounded by the discovery that different users have differing or even contradictory requirements.

Requirement workshops

To overcome these issues, where systems are complex the usual method is to conduct requirement workshops. The analyst brings the main stakeholders in the system together in order to analyse the system and develop the solution. These workshops are more properly termed Joint Requirements Development (JRD) sessions, where requirements are jointly identified and defined by stakeholders.

Such workshops are ideally carried out in a controlled environment, so that the stakeholders are not distracted. A facilitator can be used to keep the process focused and these sessions will often benefit from a dedicated scribe to document the discussion. Facilitators may make use of a projector and diagramming software or may use props as simple as paper and markers. Often multiple workshops are required to bring the process to a successful conclusion.

Requirements workshops are considered to be a very useful technique which can save significant time. However, it can be hard to get all the required stakeholders together at one time.

A more general weakness is that some stakeholders do not contribute forcefully enough in workshops and their requirements will not receive the appropriate attention, inevitably producing a limited solution. Additionally, while requirement workshops are an excellent technique for modelling the existing system, they are not so useful for defining the nature of the solution.

Contract-style requirement lists

One way of documenting requirements has been contract style requirement lists. In a complex system such requirements lists can run to hundreds of pages. An appropriate metaphor would be an extremely long shopping list. Such lists are very much out of favour in modern analysis; as they have proved spectacularly unsuccessful at achieving their aims; but they are still seen to this day.

Strengths:

- Provides a checklist of requirements.
- Provide a contract between the project sponsor(s) and developers.
- For a large system it can provide a high level description.

Weaknesses:

- Such lists can run to hundreds of pages. It is virtually impossible to read such documents as a whole and have a coherent understanding of the system.
- Such requirements lists abstract all the requirements and so there is little context
    - This abstraction makes it impossible to see how the requirements fit together.
    - This abstraction makes it difficult to identify which are the most important requirements.
    - This abstraction means that the more people who read such requirements the more different visions of the system you get.

    - This abstraction means that it's extremely difficult to be sure that you have the majority of the requirements. Necessarily, these documents speak in generality; but the devil, as they say, is in the details.
- These lists create a false sense of mutual understanding between the stakeholders and developers.
- These contract style lists give the stakeholders a false sense of security that the developers must achieve certain things. However, due to the nature of these lists, they inevitably miss out crucial requirements which are identified later in the process. Developers use these discovered requirements to renegotiate the terms and conditions in their favour.
- These requirements lists are no help in system design, since they do not lend themselves to application.

Prototypes

In the mid-1980s, *prototyping* became / seen as the solution to the requirements analysis problem. Prototypes are mock ups of the screens of an application which allow users to visualize the application that isn't yet constructed. Prototypes help users get an idea of what the system will look like, and make it easier for users to make design decisions without waiting for the system to be built. When they were first introduced the initial results were considered amazing. Major improvements in communication between users and developers were often seen with the introduction of prototypes. Early views of the output led to fewer changes later and hence reduced overall costs considerably.

However, over the next decade, while proving a useful technique, it did not solve the requirements problem:

- Managers once they see the prototype have a hard time understanding that the finished design will not be produced for some time.
- Designers often feel compelled to use the patched together prototype code in the real system, because they are afraid to 'waste time' starting again.
- Prototypes principally help with design decisions and user interface design. However, they can't tell you what the requirements were original.
- Designers and end users can focus too much on user interface design and too little on producing a system that serves the business process.

Prototypes can be flat diagrams (referred to as 'wireframes') or working applications using synthesized functionality. Wireframes are made in a variety of graphic design documents, and often remove all colour from the software design (i.e. use a greyscale colour palette) in instances where the final software is expected to have graphic design applied to it. This helps to prevent confusion over the final visual look and feel of the application.

Use cases

A ***use case*** is a technique for capturing the potential requirements of a new system or software change. Each use case provides one or more *scenarios* that convey how the system should interact with the end user or another system to achieve a specific business goal. Use cases typically avoid technical jargon, preferring instead the language of the end user or *domain expert*. Use cases are often co-authored by software developers and end users.

Use cases are deceptively simple tools for describing the behaviour of the software. A use case contains a textual description of all of the ways that the intended users could

work with the software through its interface. Use cases do not describe any internal workings of the software, nor do they explain how that software will be implemented. They simply show the steps that the user follows to use the software to do his work. All of the ways that the users interact with the software can be described in this manner.

During the 1990s use cases have rapidly become the most common practice for capturing functional requirements. This is especially the case within the object-oriented community where they originated, but their applicability is not restricted to object-oriented systems, because use cases are not object oriented in nature.

Each use case focuses on describing how to achieve a single business goal or task. From a traditional software engineering perspective a use case describes just one feature of the system. For most software projects this means that multiple, perhaps dozens, of use cases are needed to fully specify the new system. The degree of formality of a particular software project and the stage of the project will influence the level of detail required in each use case.

A use case defines the interactions between external actors and the system under consideration to accomplish a business goal. Actors are parties outside the system that interact with the system; an actor can be a class of users, roles users can play, or other systems.

Use cases treat the system as a "black box", and the interactions with system, including system responses, are as perceived from outside the system. This is deliberate policy, because it simplifies the description of requirements, and avoids the trap of making assumptions about how this functionality will be accomplished.
A use case should:

- describe a business task to serve a business goal
- be at the appropriate level of detail
- be short enough to implement by one software developer in single release.

Use cases can be very good for establishing the functional requirements; however they are not suited to capturing Non-Functional Requirements.

Software Requirements Specification

A ***software requirements specification*** (SRS) is a complete description of the behaviour of the system to be developed. It includes a set of use cases that describe all of the interactions that the users will have with the software. In addition to use cases, the SRS contains functional requirements and nonfunctional requirements. Functional requirements define the internal workings of the software: that is, the calculations, technical details, data manipulation and processing, and other specific functionality that shows how the use cases are to be satisfied. Nonfunctional requirements impose constraints on the design or implementation (such as performance requirements, quality standards, or design constraints).

Stakeholder identification

A major new emphasis in the 1990s was a focus on the identification of **stakeholders**. This first step is now seen as critical. In the early days systems were built for the projects sponsor(s), who were usually management types. Many systems have been designed by managers with little or no contributions from the eventual users; these systems have tended to fail horrendously. So within the field of software engineering, in the 1970s and 1980s, the understanding of the term stakeholder widened to the main users of the system, and then peripheral users. However, since the 1990's the search for stakeholders is taking on a more whole system approach. It is increasingly

recognised that stakeholders do not just exist in the organisation the analyst is hired by. Other stakeholders will include:

- those organisations that integrate (or should integrate) horizontally with the organisation.
- any back office systems or organisations.
- higher management.

Successful identification of the stakeholders ensures that analysis will take into account the right elements.

Tools for Requirement Analysis

Use of proper tools for requirement analysis helps in avoiding rework, which typically accounts for 40% of a development organisation's total spend — time, and money that organisations cannot afford in today's highly competitive business landscape. Most of this rework effort focuses on correcting requirements defects, which could cost 50 to 200 times as much as defects that, are corrected close to the point of creation.

It is important for IT organisations to deliver software Requirements Definition and Management Solution at less cost by getting requirements right the first time and ensuring business IT alignment throughout the software lifecycle. In addition the approach needs to be that it takes into account an organisation's process maturity and leverages industry best practices to evaluate current performance and identify specific areas for improvement. The tool should provide a scalable, integrated Software Requirements Definition and Management solution that enables IT organisations to:

Define: Produce accurate and complete requirements by eliciting, specifying, analysing, and validating requirements early, reducing costly rework later in the development lifecycle.

Manage: Deliver the right product the first time, every time by tracking progress, communicating changes and focusing resources.

Verify: Ensure quality by tracing requirements though implementation to testing.

The tool should help organisations answer the following key questions:

How can we define accurate and complete requirements?
How can we document or specify requirements to communicate them without ambiguity?
How can we perform impact analysis and prioritisation on changing requirements?
How can we effectively manage project scope?
Process-Led Approach for Improving Software Requirements Definition and Management.

The tool should help meeting the following Five *Critical Process Areas in Software Requirements Definition and Management:*

- Elicitation
- Analysis
- Specification
- Validation
- Management.

Elicitation

To eliminate rework, steps need be taken to help organisations mature their existing requirements elicitation process by:

- Selecting appropriate stakeholders,
- Identifying appropriate elicitation techniques,
- Training team members, including business partners, business analysts, systems analysts, architects and others, to use the preferred techniques with the appropriate stakeholders,
- Customizing templates for elicitation, and
- Capture user scenarios in a simple visual form that users readily understand.

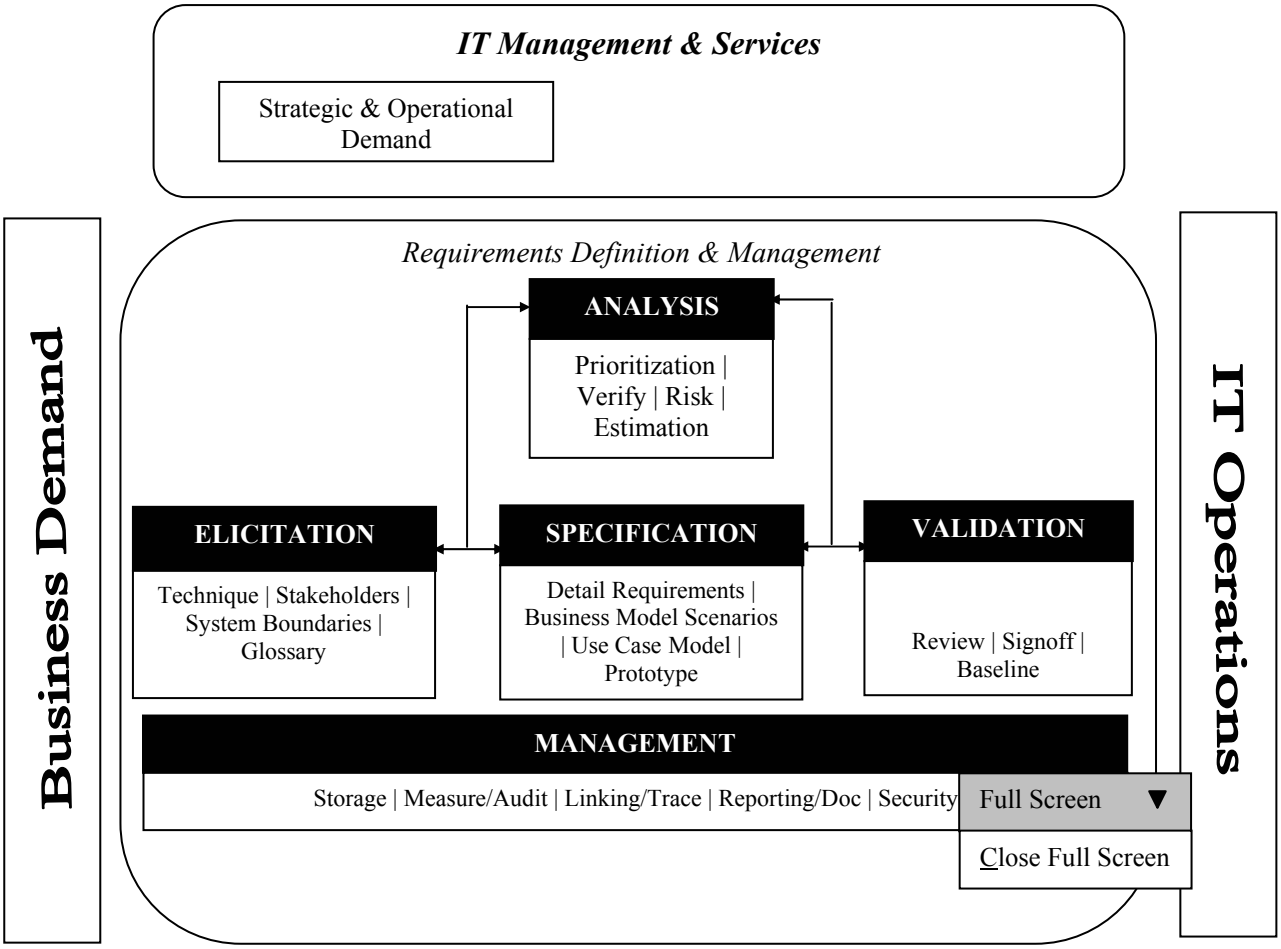

Figure 11: The five critical requirements definition and management process areas analysis

Analysis

To ensure the most important business requirements are delivered, steps need be taken so that organisations mature their existing analysis process by:

- Implementing an effective approach for evaluating and prioritising requirements,
- Enhancing the skills of analysts for analysing and clarifying requirements, and
- Enabling a robust, requirements-based estimation and planning process.

IT organisations deliver increased value to business stakeholders based on greater alignment between business and IT, while business stakeholders deliver more value to their customers because priorities are aligned with IT. The organisation also gains better estimation and thus, improved predictability of system deliveries.

Specification

To improve accuracy and relevancy, organisations may mature their existing requirements specification process by:

- Defining a consistent hierarchy of requirement types, attributes and traces, so all stakeholders can easily find, filter and sort on the most relevant data,
- Developing standard templates for each requirement scenario to ensure completeness,
- Identifying various specification techniques (e.g., use case models, business process models, prototypes, and traditional requirements specifications) and their appropriate use so that requirements are captured in a meaningful, easy-to-understand way,
- Configuring a tools infrastructure to support custom templates and integrations,
- Training development teams in the appropriate use of the tools,
- Providing automated trace ability across the various requirements types,
- Training team members to leverage traces throughout the lifecycle to achieve overall project control, and
- Leveraging selected technology to detail requirements with attributes, trace ability, screenshots, images, office documents and more to make requirements clear and understandable to drive development most effectively.

Validation

To improve accuracy and completeness, organisations may mature their existing requirements validation process by:

- Defining and implementing a verification process with clear quality metrics to reduce defects,
- Automating validation and verification processes through the storyboard execution to drive process adoption and enforcement and improve consistency and quality, and
- Defining and implementing a process for validating requirements with stakeholders that ensures requirements signoff.

Management

To maximize responsiveness and control, organisations may mature their existing requirements management process by:

- Establishing processes for managing changes to existing requirements, including a standard process for requesting changes to enable better control of scope and commitment, improved impact analysis and more reliable project planning, and
- Defining procedures for evaluation and acceptance among stakeholders — in some cases establishing a Change Control Board.

With the use of the appropriate tool, organisations are expected to improve their ability to handle ongoing changes, maximizing business impact, while minimizing schedule and scope impact, gain greater ability to manage the ever-increasing requests from business teams in a collaborative, factual way, and increase business stakeholder satisfaction because development is more responsive, delivering the right software on time and within budget.

Requirement Analysis Tools

Large numbers of Requirement analysis tools are available commercially as can be seen in the following list (in alphabetical manner). This list also indicates the suppliers of these tools as well as the Salient features of the tools have been described.

Accept 360° from Accept Software Corporation is a requirements management tool that also supports product planning. Tools help users to define and track feature dependencies with tree diagrams, and to relate these to the market, project plans, implementation considerations and competitor analyses.

Active Focus from Xapware supports the software application life cycle.

Agility from Agile Edge is a tracking database for user requirements, issues, tasks and bug tracking, permitting tracing between these items. There is a simple user interface displaying a table of items with status, symbols and text.

AnalystPro from Goda Software supports requirements editing and trace ability, change control, diagrams including use cases, and other features of full RM tools at a low price per seat.

Kris of Goda Software, Inc: Analyst Pro is an affordable, scalable and collaborative tool for requirements tracking, trace ability analysis and document management. It is easily deployable and customizable to the project needs."

Caliber-RM from Borland is a well-known requirements management tool. It is intended for large and complex systems, and provides a database of requirements with trace ability. This tool views requirements as part of the software quality management process, which it considers and also includes testing and defect tracking. Caliber is Internet-based, and it handles document references, user responsibility, trace ability, status and priority.

Chip Carey of Starbase (former owners of Caliber): "The exciting thing about RM and Caliber RM in particular is that it brings all departments together within the software development lifecycle and puts them all on the same page — it provides a mechanism for communication and collaboration and effectively provides a synergy where before they were perhaps separate efforts and maybe counter-productive."

C.A.R.E. from Sophist Group is a Lotus Notes-based tool which provides a database-like view of requirements. The website is in German but the tool's GUI is in English. Using the hypertext-like Lotus Notes is an interesting approach to organising requirements with obvious practical advantages, and the Sophist Group is noted for its Object-Oriented thinking. The tool provides a wide range of features and produces both textual and graphical outputs.

Cradle from 3SL Cradle is a multi-user, multi-project, distributed and web-enabled requirements management and systems engineering environment. It is intended for all sizes of requirements and systems development projects. Cradle can link to corporate PDM/EDM systems. It offers configuration management, edit histories and version control. It automates document production and can manage the generated documents. Through its web interface, it can integrate disparate stakeholder groups by creating customizable read-write portals to all project data.

Mark Walker of 3SL Cradle can deliver unlimited requirements and systems modeling scalability to the desktop through web and non-web methods that allow capture and parsing of requirements and their traceability through every part of all C4ISR, ISO, DoD and INCOSE recommended processes.

Clear Requirements Workbench (CRW) from LiveSpecs Software helps specify, verify, and manage detailed requirements. CRW supports four detailed specification techniques (glossaries, action contracts, test procedures, and precise use cases) for the clear description of definitions, behaviour, and usage. David Gelperin of LiveSpecs Software: Clear Requirements Workbench is the first system to actively support the detailed requirements that put customers, users, managers, marketers, developers, testers, and technical writers on the same page.

DocuBurst from Teledyne Brown Engineering is a package that discovers requirements and headings in text documents, and structures them into objects for use in requirements and other tools. It runs on Windows, and generates XML, TSV, CSV, and other file types. It is compatible with most tools including TBE's own XTie-RT.

Sherry Adlich Using DocuBurst to 'burst' a text document into pieces eliminates days of effort typically spent to analyse documents for information gathering or requirements gathering.

Doors from Telelogic Doors is a tool primarily for large organisations which need to control complex sets of user and system requirements with full trace ability. It provides good visualization of such documents as hierarchies, and its extension language enables a wide range of supporting tools to be built, and many are provided as menu commands and examples. Further options include DoorsNet which allows controlled interaction over the Internet, and the Change Proposal System which automates the requirement review cycle. There are live interfaces to many CASE tools, and the promise of tight integration with Telelogic's market-leading Tau toolkit for specification, design, and testing based on UML and the SDT approach to real-time systems development centred on telecommunications. Its use is therefore moving towards integrated project support.

Nancy Rundlet of Telelogic says: With DOORS, we provide worldwide support, Word-like ease of use, scalability from 1 user to several hundred, and ease of establishing traceability and displaying it to multiple levels.

Focal Point (now owned by Telelogic) is a market-driven requirements management tool. It incorporates customer collaboration, prioritization and visualization and decision-making and planning processes inside a tailorable web-based platform. It links requirements to market segmentation, competitor analysis, release planning and other processes in product life cycle management.

Gatherspace is a free requirements management and use case development tool that offers multi-user and team functionality. The system is an online solution with different user-tiered packages. There are a variety of reports from basic functionality reports to use case models.

1) Gatherspace is totally online, no software to download;

2) Designed and coded by analysts and project managers who full understand the process of gathering requirements;

3) With an intuitive GUI, Gatherspace also provides a todolist of "what's next" to create in addition to defining analyst-based terms.

GMARC from Computer System Architects GMARC was one of the earliest RE methods (conceived 1982) and has been continuously developed ever since. Its development was sponsored by the UK's DTI in 1990 together with the CAA, the MoD, NERC, City University and Kings College London. GMARC is claimed to be unique in its ability to reduce project/programme risk.

Brian Hunt of CSA writes: GMARC was initially developed to be able to accumulate multi-layer generic requirements knowledge for subsequent re-use, via automated elicitation, in any application domain. The latest version is able to use such knowledge to progressively improve its ability to understand the semantics of, and capture new requirements in, each domain. To aid the process of understanding an application, GMARC provides a suite of powerful requirements animation facilities. These are able to be used to verify and explore the functional aspects of any specification. In

order to take subjectivity out of the process (a universal problem!), GMARC employs a multitude of objective quality metrics to guide requirements development activity.

iRise from iRise.com is a tool for previewing or prototyping a software application before doing any coding. In the process, the requirements are "completely and unambiguously fleshed out - including application and page flows, user interfaces, business logic, data structures and other requirements."

IRqA from TCP Sistemas e Ingeniería IRqA is a Requirements Engineering (RE) tool specifically designed to support the complete RE process. In IRqA the complete specification cycle including requirements capture, analysis, system specification, validation and requirement organisation is supported via standard models.

Antonio Monzón, then of TCP Sistemas e Ingeniería: "with IrqA, we cover the full requirements specification cycle, not only RM and capture but also analysis, specification — features related to the construction of a specification; we have graphical, visual features like State Machines, Use Cases, graphical structuring of specifications — functional, non-functional, test cases, diagrams of review processes, information models, link matrices."

Jalsoft from Jalsoft is a web-based RM tool. The tool contains a database (DB2, Oracle or SQL/Server) and an ordinary web server at the server end; the thin client is simply a web browser, so installation is trivial and learning is said to be a matter of minutes. The tool integrates with Word, MS Office and MS Project; there is an XMI interface to other tools, and CSV file import and export. The tool can therefore be used 'from anywhere in the world'. RM functions like trace ability, history, base lining and reporting are provided.

Leap SE from Leap Systems Leap SE is a requirements engineering CASE tool that produces object-oriented models directly from a system requirements repository or specification (SRS). A 30-day trial version is available.

Brian Smith of Leap Systems writes: "By translating English into logical models for software development, Leap SE achieves RAD from the source, dramatically shortening the systems analysis phase for software projects."

MKS Requirements 2005 from MKS MKS Requirements 2005 is a 'right-weight' RM tool built as an integral part of a Configuration Management system (MKS Integrity Manager, via its process/workflow engine). It integrates with Microsoft Word, organizes requirements hierarchically, provides history, metrics, traceability to source code, suspect links, etc. Low cost of ownership is claimed.

The vendor claims: "the clear connection between requirements, development activity and development artifacts delivers an unprecedented level of audit-ability, something every IT organisation must demonstrate for Sarbanes-Oxley compliance."

MockupScreens from Igor Jese MockupScreens is a rapid User Interface prototyping tool. You create screen mockups and organise them into scenarios, complete with buttons, fields, lists etc. Free evaluation copy from website.

Objectiver from Cediti Cediti is a spin-off from the University of Louvain, Belgium (UCL), and the tool is based on the KAOS method of analysing goals devised by Prof. Axel van Lamsweerde. The tool thus has a solid foundation (capable of formal proof) for modeling goals, requirements, agents, entities, events relationships, actions, etc., with all the relationships between them (cause-effect, conflict, instance-of, goal refinement, etc.), supported by editable diagrams.

The vendor claims that key advantages of Objective are:

- it enables analysts to elicit and specify requirements in a systematic way,
- it produces well structured, self-contained, motivated, easily understandable, standard requirements documents,

- it provides highly effective way to communicate about the requirements,
- it ensures trace ability from requirements to goals and from high-level, coarse-grained behavioural specifications to requirements.

OPEN Process Framework (OPF) from Firesmith Consulting:

This remarkable toolkit contains a repository of reusable process components for building project-specific processes for software-intensive systems — complete, hook, line and sinker. There are numerous reusable process components including work products (from requirements, diagrams, models, documents to components), work units (activities, tasks, and techniques), producers (roles, teams, organisations), enterprises (projects, programs, enterprises), and stages (development cycles, phases, milestones). Requirements are supported in detail including document content and format standards, templates, inspection checklists, and guidelines.

Rally from Rally Software Development This is a tool intended specially to support Agile software development.

RDT from IgaTech Systems RDT is a relatively simple tool from an Australian company. It is based on Microsoft Office, but with numerous custom forms (pop-up windows) for entering settings, attributes, etc., and for displaying results. Thought has been given to getting requirements in from ordinary Word documents, and to producing documents as reports by filtering, selecting attributes, and formatting. This seems to make it intermediate between 'light' products like Require IT and Requisite Pro, and 'full' products like DOORS and RDD. 'Capture' is interpreted simply as 'import and extraction'. The tool wisely encourages users to record design rationale.

Gordon Brimble of IgaTech: RDT provides highly capable document handling for parsing input documents and creating output documents, capture of derivations that link derived requirements to record the logic behind requirement flow down and integration with requirements modeling tools.

Reconcile from Compuware This is one of a suite of tools focused on quality assurance and change management.

Reqtify from TNI-Valiosys This is one of a suite of tools designed to assist the development of mission- and safety-critical software (in C, C++, Ada) for aerospace, defence, and industry.

Rectify is a low-cost traceability and impact analysis tool. It is said to take just 1/2 a day to learn. It interfaces to Word and other word processing tools, the other TNI-Valiosys modeling tools, Simulink, etc. It has been applied on Airbus A380 computer projects (alongside RTM) with thousands of requirements and links. Interestingly, the tool is document-centric: requirements are tagged by the user in the source documents; the tool searches for these tags each time a source document is saved, and makes a snapshot of the requirements so discovered.

Lionel BURGAUD of TNI-Valiosys: For project and quality engineers who need to track requirements across the development cycle, Reqtify (tool) is a low-cost, highly customizable and easy to use tool that manages requirements traceabitity, impact analysis, filtering and versioning. Unlike other database tools, Reqtify (tool) processes information directly extracted from the source files (text processing, Excel, PDF, UML, analysis & modelling, code, etc.) without requiring any modifications, and therefore can be very quickly deployed even on projects already started.

RequireIT from Telelogic DOORSrequireIT is Doors' little sister. It is effectively a rival to Requisite Pro, as it is a Microsoft Word tool in which users edit and mark up a Word document with hidden fields that function as custom attributes (owner, status, date, etc.) and as traceability links between requirements. RequireIt is simple to use and does not involve the complexity of reliance on a database as well as on Word, so it

is easier-to-use tool than its rivals, and may be more reliable. It is implemented entirely separately from Doors (it uses Word macros not compiled code) and is intended for use on small projects.

Requisite Pro from IBM Rational Requisite Pro aims especially at managing change in requirements, with traceability for software and test specifications. It is closely linked to Microsoft Word, and Rational is a Microsoft Development Partner. The tool permits the use of Oracle on Unix or Windows as the back-end database, and also supports SQL server on Windows. Rational in 2003 merged with IBM which might mean many things, such as a greater focus on research and consultancy, perhaps.

Jim Heumann of Rational (former owners of RequisitePro): Rational is about tools but also about services, lots of teams locally that serve people, best practices and thought leadership, and of course our goal is to help people write better software — in a nutshell.

RETH, a freeware prototype owned by Siemens, created by Dr. Hermann Kaindl RETH (Requirements Engineering Through Hypertext) is a simple RM tool that demonstrates some powerful aspects of RE. It constructs a set of goals, scenarios, and requirements, each fully-documented with built-in and custom attributes, and inter-connected with hyperlinks. Models can be exported to documents and to HTML.

Rhapsody from I-Logix Rhapsody is an Object-Oriented Analysis and Design tool for embedded software. The emphasis is rather on design, with analysis using UML to describe objects for subsequent detailed design and code generation.

ScenarioPlus ScenarioPlus for Use Cases is a set of free add-on tools for use with Doors. It installs as a menu on the Doors menu bar, and provides for editing and analysing a set of UML-style use cases. Metrics and checklists are provided. There is a strong emphasis on requirements elicitation with easily-understood graphics, generated automatically. The toolset is closely integrated with Doors allowing for complete flexibility in filtering, traceability and reporting.

The site also offers a suite of Microsoft Office templates for scenario-based requirements engineering; tools for editing a range of software engineering diagrams, and tools for functions such as filtering and constructing Doors templates.
Ian Alexander writes: my aim with Scenario Plus is to improve the engineering of systems (not just software) by encouraging the use of state-of-the-art techniques for requirements elicitation, specification, and validation, including means such as scenarios, graphics, metrics, and templates.

Free Prototype Educational Tools for Systems and Software Engineering from SEEC

The Systems Engineering & Evaluation Centre at the University of South Australia (UniSA) offers a suite of free tools that “can be used in the classroom and in the workplace”. The tools include the fancifully-named TIGER, ACE, ET, CARP and RAT (ahem. I recall the immortal line from another project back in 1991 “RAT tool is mouse-driven”). These stand for:

Tool to InGest and Elucidate Requirements (TIGER), i.e., free text extraction with keywords
Acceptance Criteria Elucidator (ACE), i.e., editing the criteria in a database
Requirement Enhancing documentation Tool (ET), i.e., attribute editing
Comparison Analysis of Requirements Priority (CARP), i.e., prioritization
Risk documentation and profiling Tool (RAT), i.e., risk attribute editing.
It can be seen that these form a single basic RM environment. They have “a similar user interface”.

Serena RTM from Serena is an RM tool providing Word and Web Browser interfaces, discussion threads and change requests, traceability analysis and change management. Any life-cycle method can be supported. The data reside in an Oracle database. The tool forms part of a suite including TeamTrack, a process management tool; ChangeMan, a change management tool; Serena Professional, a configuration management tool; and Collage, a web content management tool.

SpeeDEV from SpeeDEV This product takes the approach that requirements in a distributed project need to be developed on the Web. It is claimed to be suitable for hardware as well as software, and covers requirements gathering, "scrubbing", approving, prioritizing, assigning to version releases, task management, testing, bug tracking and other functions. This sounds as if the toolkit will suit some kinds of project very well, but might prove restrictive if the way the tasks are supported isn't what your project wants. The Web is clearly the way more tools will go, so expect hot competition in this area.

Irene From of SpeeDEV: SpeeDEV operates in a completely Web-based environment to promote the free exchange of information and project team participation. SpeeDEV's solution is the only commercial browser-based solution for local or remote software development collaboration, available as enterprise software.

Statestep from Statestep is a free specification tool based on a state model. The user interface allows required behaviour to be defined in decision tables. The tool helps to check systematically that all unusual cases are considered. The resulting model is a finite state machine, which can be checked automatically for completeness and consistency, e.g., that no undesirable state is reachable. The tool has been used commercially to specify consumer electronic systems.

Michael Breen writes: "As a relatively specialised tool based on creating a model of behaviour, it's a bit different to most of the tools in your list... Anyway, one sentence could be:
"Among other things, Statestep features a unique colour-based interface which makes it feasible to deal systematically with (for example) millions of possibilities — and so to find obscure problem cases otherwise likely to be overlooked in a specification."

Steeltrace (formerly Catalyze) from Steeltrace takes a structured view of requirements, breaking them into Functional (in the form of a Use Case-like storyboard structure of main flow, alternative flows etc.) and non-functional requirements (qualities and constraints). These map seamlessly to functional test cases, UML activity diagrams, requirements based milestones in project plans etc. Ease of use is emphasised.

"SteelTrace lets everyone work together easily to define, communicate and understand project requirements so that business, development, and test deliver quality software faster. Reduce over-runs, re-work and time to delivery. Maximize project quality and ROI." -- Tadhg O'Brien

Teamcenter from UGS includes a requirements tool (formerly Slate): "Industrial Strength Groupware for managing requirements, architecting systems, and accelerating product development". Tools cover design and testing as well as requirements. The examples on the website include radar and aircraft carrier, so there is a perceptible military-industrial orientation. The tool provides for conventional box-and-arrow diagrams, but also allows document and object hierarchies, and arbitrary traceability linking. An interesting feature is a budget which provides a recursively added hierarchical spreadsheet for each attribute ('technical allocatable' in Slate jargon) which is to be budgeted. Slate is apparently genuinely object-oriented and as such should suit large industrial projects that want to use OO analysis and design.

Some systems engineers see Slate as a tool that mainly supports the life-cycle after the requirements phases. It provides limited support for requirements capture.

Harold Knight of SDRC (an earlier owner of Slate): Slate is fundamentally different in Systems Engineering because we manage all components of the design in true Object-Oriented fashion — not documents or paper but information, so we are a system design tool — system engineers can design and view systems from any perspective.

Team-Trace from WA Systems is a requirements management tool released in 2002. Ben Sutton of WA Systems: We believe that Team-TRACE is a breakthrough in cost-effective requirements management. It offers all of the relevant features found in other tools at a fraction of the cost. Behind an intuitive interface lies an impressive platform that enables you to capture, analyse, evaluate and trace complex requirements. **Tiger Pro** is one of the free tools.

Truereq from Truereq Inc.

Truereq is a web-based requirements management tool. There is an open (XML) data interchange format, and the API permits custom integration and scripting. Currently (Feb 2004) Truereq offer a free single-user license.

Todd Berger of Truereq writes: Using Truereq, you can manage your product development process in a centralised workspace shared by all your team members. Truereq's integrated toolkit helps you focus on making better products, more quickly, efficiently, and at a dramatically reduced cost.

Vital-Link from Compliance Automation

Ivy Hooks' company produces a database-centred requirements management tool that seems to be well liked.

The **Volere** Template from The Atlantic Systems Guild

The Volere Template is a comprehensive list of all the components that the Robertsons recommend should go into a requirements specification. It is closely associated with the Volere method described in their book, but contains many useful suggestions that could enhance any requirements method. The template can be used with any general RE tool or simply with word-processed documents.

WIBNI from Project Toolbox

(Wouldn't It Be Nice If ...?) is a very low cost RM tool based on Microsoft Access, (like Requisite Pro and DoorsRequireIT). It records priority, status, type, and other attributes, documents links between requirements, keeps an audit trail, exports to Word, and enables sorting and filtering like much heavier tools. Interestingly it also supports event-driven and use-case analysis. There is a free evaluation version.
John Richards of Project Toolbox writes: "I've been managing projects for many years and could not find a requirements database I wanted to use at a price I could justify. I knew what I wanted though, so in the end I developed it."

XTie-RT from Teledyne Brown Engineering (TBE)

TBE released XTie-RT commercially in July 1996. The tool was initially developed for in-house use to assist with proposal development, regulation compliance on environmental programs and large complex systems for the US Army and NASA. It encourages users to document the reasons for decisions.

Users are equally divided between Government contractors and Commercial industry, and between hardware and software. The tool is claimed to be simple to learn, robust and full featured. TBE consider Doors their primary competitor.

Check Your Progress 2

1) State True or False.

i) An information system can be a set of collection of elements starting from collection of data, its processing and presentation for achieving a defined or set goal. True ☐ False ☐

ii) Software developers and end users have same vocabularies. Consequently, they can believe they are in perfect agreement and accordingly the finished product is supplied. True ☐ False ☐

iii) Contract-style requirement lists for requirement analysis are few in number even for a complex system. True ☐ False ☐

iv) Each use case focuses on describing how to achieve several business goals or tasks. True ☐ False ☐

v) Use cases are simple tools for describing the behaviour of the software. True ☐ False ☐

2) Answer the following:

a) What are the challenges and problems of Requirement Analysis?

……
……
……

b) What are the tools and methods for carrying out Requirement Analysis?

……
……
……

2.7 SUMMARY

This completes our discussion regarding management functions and requirements it has to meet at various levels for managing the organisations. We also completed the discussion on business functions and business processes. This understanding was further carried forward to understand system requirements and how different tools and methods can be used for this so that system developed with this understanding meets the desired requirements and needs of the organisation.

This discussion will be carried forward in the next unit for further understanding the types of management systems and what systems are being used for meeting the present day challenges.

As said earlier at end of the unit 1, it is once again suggested that the students must supplement this study with the case studies on these topics.

2.8 SOLUTIONS / ANSWERS

Check Your Progress 1

1)

i) The basic functions of the management are:

- Planning,
- Organising,
- Coordinating,

- Directing, and
- Controlling.

Levels of the management are:

- Top/Strategic
- Middle Management
- Operational level

The level of the management at which the following are decided are as indicated before each:

a) Operational Management.

b) Top/ Strategic level.

c) Middle Management.

ii) The significant differences between conventional marketing and modern marketing are:

a) Used of traditional marketing, the product is produced and the product is pushed to the market with aggressive selling and promotional efforts while in modern marketing activities start with exploring and understanding customers' need even before the product is produced, so that the product is designed keeping customers needs in mind.

b) As per traditional practices, marketing start with selling and promotion to attain sales at a profit, while modern marketing focuses its attention on customers / buyers. It gets profit through the creation of the buyer's satisfaction and further, seeks to achieve it through an integrated, corporate wide set of marketing activities.

iii) The business process can be defined as any function within an organisation that enables the organisation to successfully deliver its products and services.

One typical business process for each functional area is given in the following table:

Sl. No.	Functional Area	Typical Business Process
1	Sales / Marketing	Selling the product
2	Manufacturing / Production	Assembling the product
3	Finance / Accounts	Creating financial statements
4	Human Resource	Hiring employees
5	Other types- Materials	Carrying out inventory control

2) Mark the correct answer

a) Deciding where to locate new production facilities is an example of a manufacturing and production information system operating at the:

i)	operational level.	
ii)	management level.	
iii)	knowledge level.	
iv)	strategic level.	Y

b) Preparing short-term budgets is an example of a finance and accounting information system operating at the:

i)	operational level.	
ii)	management level.	Y
iii)	knowledge level.	
iv)	strategic level.	

c) Tracking employee training, skills, and performance appraisals is an example of a human resource information system operating at the:

i)	operational level.	Y
ii)	management level.	
iii)	knowledge level.	
iv)	strategic level.	

d) Assembling a product, identifying customers and hiring employees are:

i)	transactions.	
ii)	phases.	
iii)	business processes.	Y
iv)	business functions.	

Check Your Progress 2

1) i) True, ii) False, iii) False, iv) False, v) True

2) a) The challenge for requirement analysis are due to the fact that:

i)

- it is not easy to identify all the stakeholders,
- it is not easy to document all their input in a clear and concise format, and

ii) it is required to be to determine whether or not the new system is:

- feasible
- schedulable
- affordable
- legal
- ethical

The problems are due to:

- Difficulty in availability the right people with adequate experience, technical expertise, and language

- the initial ideas about what is needed are often incomplete, wildly optimistic, and firmly entrenched in the minds of the people, and
- the difficulty of using the complex tools and diverse methods associated with requirements gathering

b) The tools and methods of requirement analysis are:

- Stakeholder interviews
- Requirement workshops
- Contract-style requirement lists
- Prototypes
- Use cases
- Software Requirements Specification
- Stakeholder identification.

2.9 FURTHER READINGS/REFERENCES

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