Department of Computing
Bsc Computer Technology

BIT 2119:
MANAGEMENT INFORMATION SYSTEMS

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Management Information Systems

Aim
To equip the learners with appropriate knowledge on the role of Information Systems in managerial functions.

Learning Outcomes
By the end of the unit, a learner should be able to:

i) Explain how a firm can gain competitive advantage with Information Systems.
ii) Evaluate the roles of various types of Management Information Systems in business organizations.
iii) Understand the knowledge of the relationship between the decision making process, the organizational hierarchy, and the supporting Management Information System.
iv) identify the emerging technological issues facing management.

Course Description
As per the chapters

Methodology
Lectures and practicals.

Learning Resources
Whiteboard, computers and Resources, Journals and books.

References
1. Management Information Systems. Laudon K. C and Laudon. Pearson Education. 2004.
2. Information Technology for Management: Transforming the business in the digital Economy. Turban McClean, Wetherbe. John Wiley & sons. 2002.

Journal
Journal of Management Information Systems.

CHAPTER ONE: INTRODUCTION TO IS

After completing this chapter, you will be able to:

Define an information system

- Distinguish between computer literacy and information system literacy
- Explain why information systems are so important today and how they are transforming organization and management
- Identify the major management challenges to building and using information systems in organization

1.1 Why Information System?

The environment of business has changed from the traditional environment where management processes are treated as a face-to-face, personal art and not a far-flung, global coordination process. Information itself is not treated as an important asset for a firm.

But today, most of the organization recognizes the importance of information. For individuals, information systems are needed for entertainment and as an enlightment to their life. Meanwhile for businesses, information systems are mostly needed to help in decision making and problem solving. Besides that, it is used to gather, store and manipulate information. There are three main factors that contribute to the recognition of the importance of information to any organization.

The first factor is the emergence and strengthening of the global economy. Globalization of the world's industrial economies greatly enhances the value of information to the firm and offers new opportunities to businesses. Information system provides the communication and analytical power that firms need for conducting trade and managing businesses on a global scale.

The second factor is due to the transformation of industrial economies and societies into knowledge and information based service economies. In knowledge based economies, knowledge and information are key ingredients in creating wealth to an organization. Knowledge and information are becoming the foundation for many new services and products. Intensification of knowledge utilization in the production of traditional products has increased as well. New kinds of knowledge- and information-

intense organizations have emerged that are devoted entirely to the production, processing, and distribution of information

The third factor is due to the transforming of the business enterprise. Traditional firms was and still is a hierarchical, centralized, structured arrangement of specialist that typically relies on a fixed set of standard operating procedures to deliver a mass-produced product or services. But the business enterprises has change into flattened, decentralized, flexible arrangement of generalists who rely on nearly instant information to deliver mass-customized products and services uniquely suited to specific markets or customers

Besides the above mentioned three main factors, there are also several trends that have made the use of information systems very important in business:

- Computers' power has grown tremendously, while their prices have dropped.
- Computer programs' variety and ingenuity have increased.
- Quick and reliable communication lines and access to the Internet and World Wide Web have become widely available and affordable.
- The fast growth of the Internet has opened opportunities, as well as competition in global markets.
- An increasing ratio of the workforce is computer literate.

In this environment, organizations will quickly lag behind if they do not take advantage of this progress and use the technologies and skills to meet their goals.

1.1.1 What is an Information System?

Information system consists of physical and nonphysical components working together. A computer alone is not an information system. A computer combines with a software program may constitute an information system, but only if the program is designed to produce information that helps an organization or person to achieve a specific goal. Information system can be further defined as a set of interrelated components that collect or retrieve, process, store and distribute information to support decision making and control in an organization. Information systems can also help managers and workers to analyze problems, visualize complex subjects and create new subjects. It may contain information about significant people, places and things within the organization or in the environment surrounding it.

All information systems (IS) operate in the same basic fashion whether they include a computer or not. However, the computer provides a convenient means to execute the four main operations of an information system. The four main activities are entering data into the IS (input), changing and manipulating the data in the IS (data processing), getting information out of the IS (output) and storing data and information (storage). Besides the four main operations, feedback is also needed to return the output to the appropriate people or activities in the organization to evaluate and refine the input.

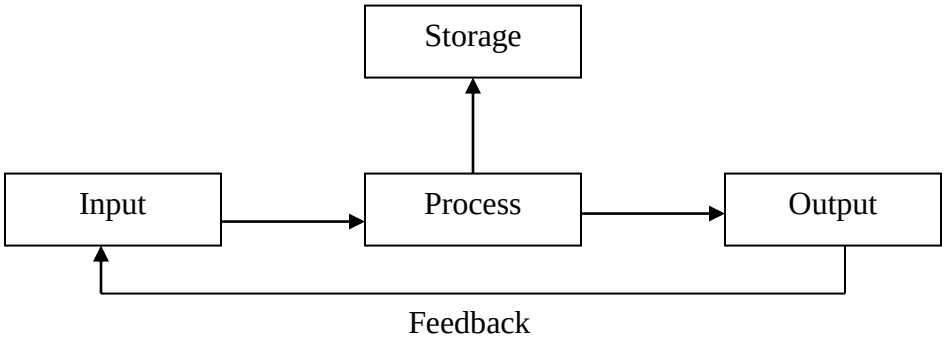


Figure 1.1 Diagram showing the four main operations

The first step in producing information is collecting and introducing data into the IS, known as input. Input captures or collect raw data from within the organization or from its external environment. Data are streams of raw facts representing events occurring in organizations or the physical environment before they have been organized and arranged into a form that people can understand and use. An input device is the tools used to enter data into an IS. Input devices include the keyboard, infrared devices that sense bar codes, and voice recognition systems.

The second step in producing information is processing. This is the step where computer contributes to the efficiency of the data processing, which is essential to a robust IS. In this step, computer helps in converting the raw input into a more meaningful form through various methods like conversion, manipulation and analysis. The computer's speed and accuracy let organizations process millions of pieces of data in several seconds.

Output is the information an IS produces and displays on an output device in the format most useful to an organization. Information is data that have been shaped into a form that is meaningful and useful to human beings. A good IS must be able to produce information that carries the following characteristics:

- Relevant – information must pertain to the problem at hand.
- Complete – partial information is often worst than no information.
- Accurate – erroneous information may lead to disastrous decisions.
- Current – decisions are often based upon the latest information available.
- Economical – in a business setting, the cost of obtaining information must be considered as one cost element involved in any decision.

The information needs to be transferred to the people or activities where it will be used. The most widely used output device is the video display, or video monitor, which displays output visually. However, computers can communicate output through speakers in the form of music of speech and can also transmit it to another computer or electronic device in computer-coded form for later interpretation.

One of the greatest benefits of using computers is their ability to store vast amount of data and information. Computer stores information on both devices that are internal to the machine and those that are external.

Feedback is output returned to appropriate people or activities in the organization to evaluate and refine the input.

The four basic components of the computer system within an IS:

- Input device that introduces data into the IS.
- The computer processes data through the IS.
- Output device that displays the information produces by the IS.
- Storage device to store data and information.

In addition to the above components, communication also occurs between computers. Communications technology lets users not only access multiple input, output and storage devices with a single computer, but access data and resources of more than one computer as well.

1.1.2 A Business Perspective on Information System

From a business perspective, an information system is an organizational and management solution, based on information technology, to a challenge posed by the environment. It emphasizes the organizational and management nature of information system: To understand information system – to be information system literate as opposed to computer literate – a manager must understand the broader organization, management and information technology dimensions of systems and their power to provide solutions to challenges and problems in the business environment

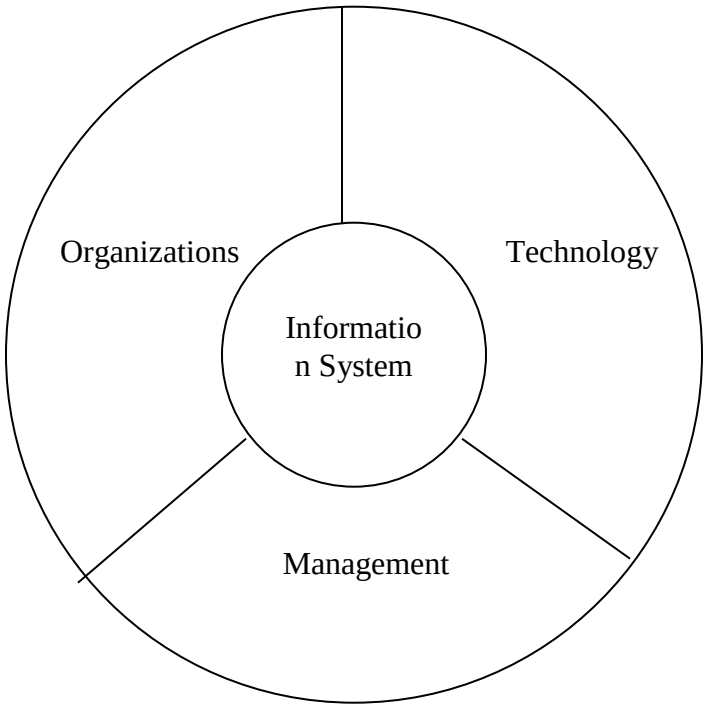


Figure 1-2

The key elements of an organization are its people, structure and operating procedures, politics and culture. An organization coordinates work through a structured hierarchy and formal standard operating procedures (SOPs). SOPs are formal rules for accomplishing tasks that have been developed over a long time. These rules guide employees in variety of procedures. Most of the procedures are formalized and written down, but many others are informal work practices. Major organizational functions are like sales and marketing, manufacturing, finance, accounting and human resources

Management's job is to make sense out of many situations faced by organization and formulate action plans to solve organizational problems. A substantial part of management is creative work driven by new knowledge and information. Information technology can play a powerful role in redirecting and redesigning the organization. Managerial roles and decisions vary at different levels of the organization.

- Senior managers – make long-range strategic decisions about products and services to produce.
- Middle managers – carry out the programs and plans senior management.
- Operational managers – responsible for monitoring the firm's daily activities.

Information technology is one of many tools available to managers for coping with change which consists of computer hardware, computer software, storage technology and communication technology. Computer hardware is physical equipments used for input, processing and output activities in an information system. Computer software is detailed, preprogrammed instructions that control and coordinate the work of computer hardware components in an IS. Storage technology is physical media and software governing the storage and organization of data for use in an IS. Lastly, communication technology is physical devices and software that link various computer hardware components and transfer data for use in an IS. A network links two or more computers to share data or resources such as printer.

1.2 Contemporary Approaches to Information Systems

Multiple perspectives on IS shows that the study of information systems is a multidisciplinary field, where no single theory or perspective dominates. Figure 1.3 shows the major disciplines that contribute problem, issues and solutions. In general, the field can be divided into technical, behavioral and socio-technical approaches.

Technical approach emphasizes mathematically based, normative models to study information systems as well as the physical technology and formal capabilities of these systems. Three disciplines that contribute to this approach are Management Science, Computer Science and Operation Research.

Behavioral approach is more concern with development and long-term maintenance of information systems, which emphasizes on issues like strategic business integration, design, implementation and utilization. Three disciplines that contribute to this approach are Psychology, Economics and Sociology.

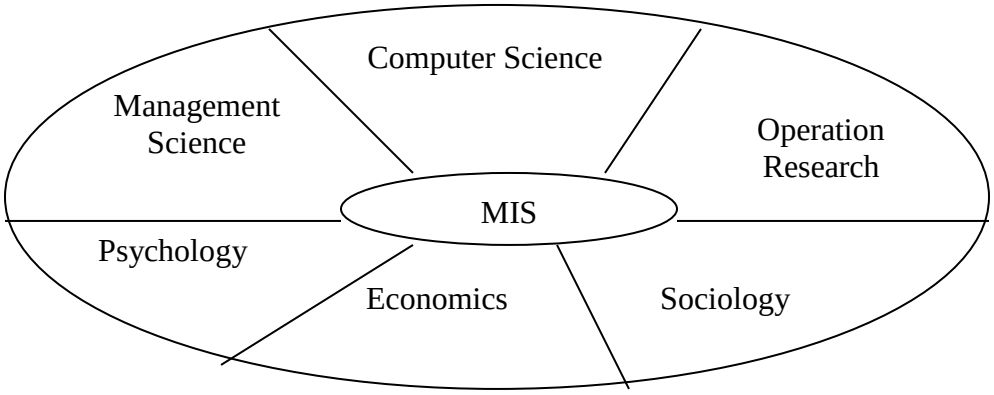


Figure 1-3

Socio-technical approach avoids a purely technological approach to information systems. This approach stress the need to optimize the performance of the system as a whole where both the technical and behavioral components needs attention, which means that the technology must be changed and designed in such a way as to fit organizational and individual needs meanwhile organization and individual must also be changed through training, learning and planned organizational change in order to allow the technology to operate and prosper.

1.3 The New Role of Information Systems in Organization

The new relationship (as illustrated in Figure 1.4) between organization and IS shows that there is a growing interdependence between organizational business strategy, rules and procedures on the one hand and information system software, hardware, databases and telecommunications on the other. The changes in strategy, rules and procedures require changes in hardware, software, databases and telecommunications. This relationship becomes critical when management plans for the future.

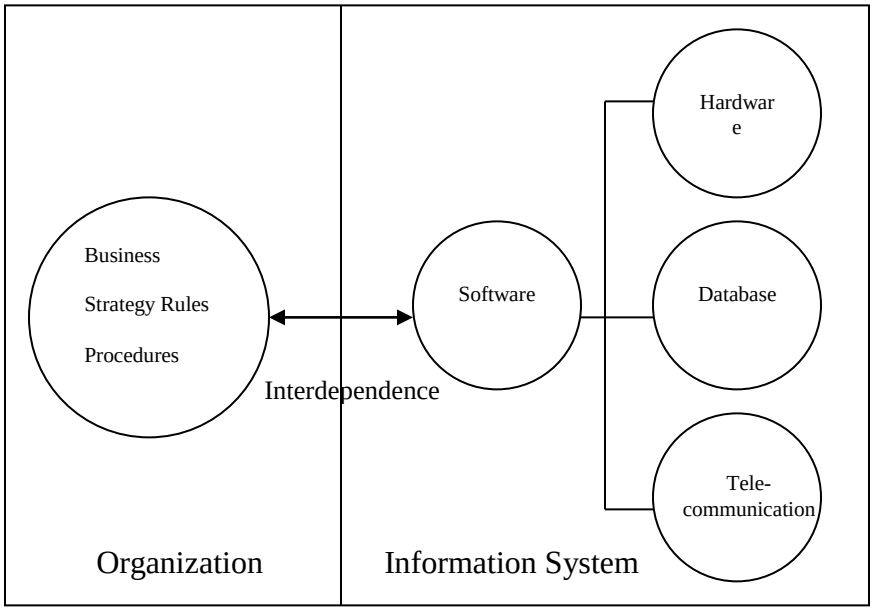


Figure 1-4

A second change in the relationship of IS and organizations results from the growing complexity and scope of system projects and applications. Over time, information systems have come to play a larger role in the life of the organization. Early information systems brought about largely technical changes that were relatively easy to achieve and accomplish and affects few people. Later systems affected managerial control and behavior (who has what information about whom, when and how often); ultimately systems influenced "core" institutional activities (what products and services are produced, under what conditions and by whom) concerning products, markets, suppliers and customers.

1.3.1 New Options for Organizational Design: The Networked Enterprise

The explosive growth in computing power and networks is turning organizations into networked enterprises, allowing information to be instantly distributed within and beyond the organization. This capability can be used to redesign and reshape organizations, transforming their structure, scope of operations, reporting and control mechanisms, work practices, work flows, products and services. The following describes the new ways of conducting business electronically.

Flattening organizations will results in fewer levels of management, with lower-level employees being given greater decision-making authority. Those employees are empowered to make more decisions than in the past are no longer work standard 8 hours and no longer necessary work in an office and they can be scattered geographically. Contemporary information technology makes more information available to line workers so they can make decisions that previously had been made by managers. Networked computers have made it possible for employees to work together as a team. Team members can collaborate closely even from distant locations. These changes mean that the management span of control has also been broadened, allowing high-level managers to manage and control more workers spread over greater distances.

Separating work from location is possible as organizing globally while working locally is made possible through technologies like e-mail, the Internet, video conferencing. Communication technology eliminates distance as a factor for many types of work in many situations. Collaborative teamwork across thousands of miles has become a reality designer's work on the design of a new product together even if they are located on different continents. Companies are not limited to physical locations or their own organizational boundaries for providing products and services. Virtual organization becomes reality where organization using network linking people, assets and ideas to create and distribute products and services without being limited by traditional organizational boundaries or physical location.

Reorganizing work flows as IS have been progressively replacing manual work procedures with automated work procedures, work flows and work processes. Improved work flow management enabled many organizations not only to cut cost significantly but also to improve customer service at the same time.

Increases flexibility of organization as companies uses communication technology to organize in more flexible way, increases their ability to respond to changes in the marketplace and to take advantage of new opportunities. Large organization can use information technology to achieve some of the agility and responsiveness of small organizations like mass customization, the use of software and computer networks to finely control production so that products can be easily customized with no added cost for small production runs. The result is a dynamically responsive environment in which products can be turned out in a greater variety.

Information technology is recasting the process of management, providing powerful new capabilities to help managers plan, organize, lead and control. For example the use of Enterprise Resource Planning (ERP) is a business management that integrates all facets of the business, including planning, manufacturing, sales and finance so that they can become closely coordinated by sharing information with each other.

Reducing organizational boundaries as networked information system enables transactions to be exchanged electronically among different companies, hence reducing the cost of obtaining products and services from outside the firm. An inter-organizational system is a system that automates the flow of information across organizational boundaries and links a company to its customers, distributors or suppliers.

CHAPTER TWO: THE STRATEGIC ROLE OF INFORMATION SYSTEMS

After completing this chapter, you will be able to:

- Analyze the role played by the six major types of information systems in organizations
- Describe the relationship between the various types of information systems
- Examine how the competitive forces and value chain models can be used to identify opportunities for strategic information systems
- Explain why strategic information systems are difficult to build and to sustain
- Describe how organizations can use information systems to enhance quality in their operations, products and services

2.1 Key System Applications in the Organization

Due to different interests, specialties and levels in an organization, there are different kinds of systems. No single system can provide all the information an organization needs. Organization and information systems can be divided into strategic, management, knowledge and operational level. All the above mentioned levels of an organization can be further divided into five functional areas: sales and marketing, manufacturing, accounting, finance and human resources. Figure 2.1 below shows the one way to depict the kinds of systems found in an organization.

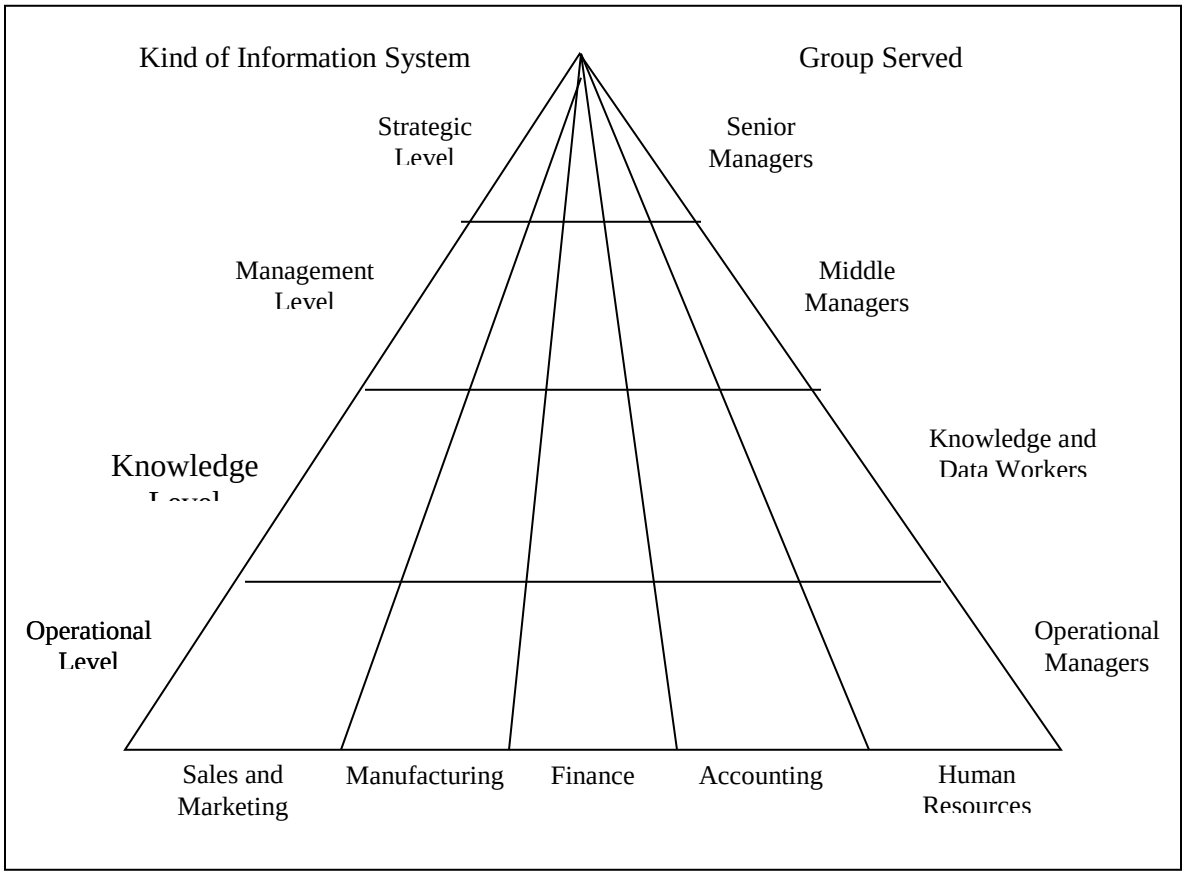


Figure 2-1

2.1.1 Different Kinds of Systems

Strategic level systems help senior manager with long-term planning. The principle concern at this level is matching changes in the external environment with existing organizational capabilities. It supports the long-range planning activities of senior management. It also helps the senior management to tackle and address strategic issues both in the firm and in the external environment.

Management level systems help middle managers monitor and control. It typically provides periodic reports rather than instant information on operations. It supports the monitoring, controlling, decision-making and administrative activities of middle managers. Some of the management level systems support non-routine decision making where they tend to focus on less-structured decisions for which information requirements are not always clear.

Knowledge level systems help knowledge and data workers design product, distribute information and cope with paperwork. The main purpose is to help integrate new knowledge into the business and to help the organization control the flow of paperwork. Knowledge level systems, especially in the form of workstations and office systems are the fastest-growing applications in business today.

Operational level systems help operational manager keep track of the firm's day-today activities. The principle purpose is of operational level system is to answer routine questions and to track the flow of transactions through the organization.

2.1.2 Six Major Types of Systems

Information systems are built to serve each of the four levels of an organization based on the five main functional area of business.

- *Transaction Processing Systems (TPS)* serve the operational level of an organization.
- *Knowledge Work Systems (KWS)* and *Office Automation Systems (OAS)* serve the knowledge level of an organization.
- *Decision-support Systems (DSS)* and *Management Information Systems (MIS)* serve the management level of an organization.
- *Executive Support Systems (ESS)* serves the strategic level of an organization.

2.2 The Strategic Role of Information Systems

2.2.1 What is a Strategic Information System?

Strategic Information Systems can be defined as computer systems at any level of the organization that change goals, operations, products, services or environmental relationships to help the organization gain a competitive advantage. The following describes the eight basic ways to gain competitive advantage.

INITIATIVE	BENEFIT
Reduce costs	A company can gain advantage if it can sell more units at a lower price while providing quality and maintaining or increasing its profit margin.
Raise barriers to market entrants	A company can gain advantage if it deters potentials entrants into the market, leaving less competition and more market potentials.
Establish high switching cost	A company can gain advantage if it creates high switching costs; making is economically infeasible for customers to buy from competitors.
Create new products or services	A company can gain advantage if it offers a unique product or service.
Differentiate products or services	A company can gain advantage if it can attract customers by convincing them its product differs from the competitors.
Enhance products or services	A company can gain advantage if its product or service is better than anyone else's.
Establish alliances	Companies from different industries can help each other gain advantage by offering combined packages of goods or services at special prices.
Lock in suppliers or buyers	A company can gain advantage if it can lock in either suppliers or buyers, making it economically impractical for suppliers or buyers to deal with competitors.

Strategic information systems should be distinguish from strategic level systems for senior managers that focus on long-term, decision making systems where strategic information systems can be used at all levels of an organization and are far-reaching and deep-rooted than the other kinds of systems. Strategic information systems

fundamentally change a firm's goals, products, services or internal and external relationships. In order to use the strategic information systems as competitive weapons, we must understand where strategic opportunities for businesses are like to be found based on two models of a firm and its environment: the Competitive Forces Models and the Value Chain Model

2.2.2 Countering Competitive Forces (Competitive Forces Model)

In the competitive forces model (a model used to describe the interaction of external influences, specially threats and opportunities, that effects an organization's strategy and ability to compete; illustrates in Figure 2.2), a firm faces a number of external threats and opportunities:

- The threat of new entrants into its market
- The pressure from substitute products or services
- The bargaining power of customers
- The bargaining power of suppliers
- The positioning of traditional industry competitors

Competitive advantage can be achieved by enhancing the firm's ability to deal with customers, suppliers, substitute products and services, and new entrants to its market, which in turn may change the balance of power between a firm and other competitors in the industry in the firm's favor.

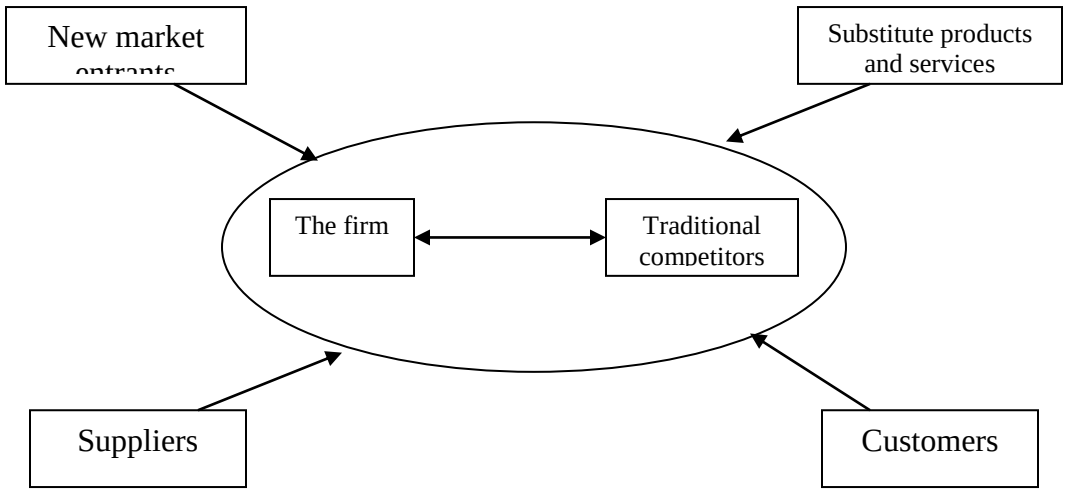


Figure 2-2

Organization can use four basic competitive strategies to deal with these competitive forces:

- Product differentiation

Firms can develop brand loyalty by product differentiation – creating unique new products and services that can be easily be distinguished from those of competitors, and that existing competitors or potential new competitors can't duplicate. Manufacturers are starting to use information systems to create products and services that are custom-tailored to fit the precise of individual customers.

- Focused differentiation

Businesses can create new market niche by focused differentiation – identifying a specific target for a product or service that it can serve in the superior manner. A firm can provide a specialized product or service that serves this narrow target market better than existing competitors and that discourages new competitors. An information system can give companies advantage by producing data to improve their sales and marketing techniques. Sophisticated data-mining software tools find patterns in large pools of data and infer rules from them that can be used to guide decision making. Data-mining is both a powerful and profitable tool, but it poses challenges to the protection of individual privacy. Data-mining technology combines information from many diverse sources to create a detailed "data image" about individuals, such as the income, hobbies, driving habit, and the question here is whether companies should be allowed to collect such detailed information about individuals.

- Developing tight linkages to customers and suppliers

Firms can create ties to customers and suppliers that "lick" customers into the firm's products and that tie suppliers into a delivery timetable and price structure shaped by the purchasing firm. This raises switching costs (the cost for customers to switch to competitors' product and services) and reduces customers' bargaining power and the bargaining power of suppliers. This is similar to the *just-in-time* delivery or inventory systems which reduce the cost of inventory, the space required for warehousing and construction time.

- Becoming the low-cost producer

To prevent new competitors from entering their markets, business can produce goods and services at a lower price than competitors. Strategically oriented information systems help firms significantly lower their internal costs, allowing them to deliver products and services at a lower price (and sometimes with higher quality) then what the competitors can provide. For example, organizations can use supply chain management to integrate supplier, distributor and customer's logistics requirements into one cohesive process. Information systems make supply chain management more efficient by integrating demand planning, forecasting, materials requisition, order processing, inventory allocation, order fulfillment, transportation services, receiving, invoicing and payment. Supply chain management can not only lower inventory costs but also can create efficient customer response systems that deliver the product or service more rapidly to the customer.

The following show how the above mentioned strategic can be use on the Internet.

Strategy	Internet Application
Product differentiation	Virtual banking which allows customers to view account statements, pay bills, check account balance and obtain 24-hour customer service through the World Wide Web
Focused differentiation	Hotel room reservation tracking system which provides electronic information on participating hotels. It can analyze these usage patterns to tailor hospitality-related products more closely to customer preferences
Links to customers and suppliers	Access through websites to track or check the status of any shipment
Low cost producer	Uses EDI (electronic data interchange) to quote any quotation or charge any bills.

2.2.3 Leveraging Technology in the Value Chain (Value Chain Model)

The value chain model highlights the primary or support activities that add a margin of value to a firm's products or services where information systems can best be applied to achieve a competitive advantage. The value chain model can supplement the competitive forces models by identifying specific, critical leverage points where a firm can use information technology most effectively to enhance its competitive position. This model views the firm as a series or chain or basic activities that add a margin of value to a firm's products or services. These activities can be categorized as either primary activities or support activities. Primary activities are most directly related to the production and distribution of the firm's product and services that create value for customer which includes inbound logistics, operations, outbound logistics, sales and marketing, and services. Support activities make the delivery of the primary activities possible and consist of organization infrastructure (administration and management), human resources (employee recruiting, hiring and training), technology (improving products and the production process) and procurement (purchasing input). Organizations have a competitive advantage when they can provide more value to the customers or when they provide the same value to customers at a lower price. Information systems could have strategic impacts if it helped the firm provide products or services at a lower cost than competitors or if it provides the products or services same cost as competitors but with greater value.

2.2.4 Difficulties in building and sustain strategic information system

- Not all strategic information systems make profit.
- They can be expensive and risky to build.
- Many strategic information systems are easily copied by other firms, so that strategic advantage is not always sustainable.
- Implementing strategic systems often requires extensive organizational change and a transition from one socio-technical level to another. Such changes are called strategic transitions and are often difficult and painful to achieve.

2.3 How Information Systems Promote Quality

2.3.1 What is Quality?

Quality can be defined from both producer and customer perspectives. From the perspective of producer, quality signifies conformance to specifications or absence of variation form those specification. From the perspective of customer, quality means:

- Concerned with the quality of physical product – its durability, safety, ease of use and installation.
- Concerned with the quality of service – the accuracy and truthfulness of advertising, responsiveness to warranties and ongoing product support.
- Concerned with psychological aspects – the company's knowledge of its product, the courtesy and sensitivity of sales and support staff, and the reputation of the product.

Total Quality Management (TQM) is a concept that makes quality control a responsibility to be shared by all people in an organization. TQM holds that the achievement of quality controls is an end in itself. Everyone is expected to contribute to the overall improvement of quality. TQM encompasses all of the functions within an organization.

2.3.2 How Information Systems Contribute to Total Quality Management

Information systems can help firms to achieve their goals by:

- Simplifying the product, the production process or both
- Benchmark
- Use customer demands as a guide to improving products and services
- Reduce cycle time
- Improve the quality and precision of the design
- Increase the precision of production

CHAPTER THREE: MAJOR TYPES OF INFORMATION SYSTEMS

After completing this chapter, you will be able to:

- Describe the specific categories of systems serving each organizational level
- Describe the value of different type of information systems to organization
- Describe the feature and characteristics of different information systems

3.1 Operational Level Information Systems

The information system that involved at operational level of an organization is Transaction Processing Systems. Transaction processing systems (TPS) are the basic business systems that serve the operational level of the system. A transaction processing system is a computerized system that performs and records the daily routine transactions necessary to the conduct of the business. A TPS is any system that records transaction (a business event: a sale, a purchase, the hiring of a new employee). TPS is the entry point where data are entered at its source at the time of transactions take place. TPSs are interfaced with applications that provide clerical workers and operational managers with up-to-date information.

At the operational level, tasks, resources and goals are predefined and highly structured. The decision to grant credit to customer, for instance, is made by a lower-level supervisor according to predefined criteria. All that must be determined is whether the customer meets the criteria.

The following table shows the specific types of application information systems that correspond to operation level:

Functional Area	Systems
Sales and Marketing	⇨ Order tracking ⇨ Order processing
Manufacturing	⇨ Machine control ⇨ Plant scheduling ⇨ Material movement control
Finance	⇨ Securities trading

	⇨ Cash management
Accounting	⇨ Payroll ⇨ Accounts payable ⇨ Accounts receivable
Human Resources	⇨ Compensation ⇨ Training and development ⇨ Employee record keeping

The following description and diagram shows a payroll TPS, which is a typical accounting transaction processing system found in most firms.

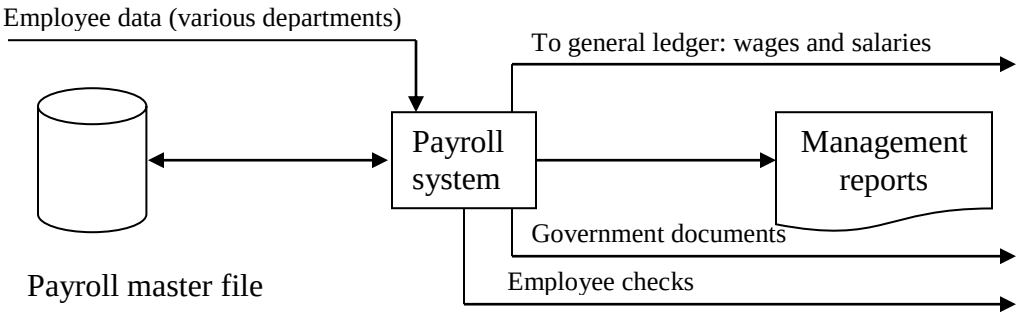


Figure 3-1

A payroll system keeps track of the money paid to employees. The master file is composed of discrete pieces of information (such as a name, address or employee number) called data elements. Data are keyed into the system, updating the data elements. The elements on the master file are combined in different ways to make up reports of interest to management and government agencies and paychecks sent to employees. These TPS can generate other report combinations of existing data elements.

Other typical TPS applications are identified in the following table:

Types of TPS	Major functions of system	Major application systems
Sales and Marketing systems	⇨ Sales management ⇨ Market research ⇨ Promotion ⇨ Pricing ⇨ New products	⇨ Sales Order Information System ⇨ Market Research System ⇨ Pricing System

Manufacturing/Production systems	⇨ Scheduling ⇨ Purchasing ⇨ Shipping/receiving ⇨ Engineering ⇨ Operations	⇨ Materials Resource Planning Systems ⇨ Purchase Order Control Systems ⇨ Quality Control Systems
Finance/Accounting systems	⇨ Budgeting ⇨ General ledger ⇨ Billing ⇨ Cost accounting	⇨ General Ledger ⇨ Accounts Receivable/Payable ⇨ Budgeting ⇨ Funds Management Systems
Human Resource systems	⇨ Personnel records ⇨ Benefits ⇨ Compensation ⇨ Labor relations ⇨ Training	⇨ Payroll ⇨ Employee Records ⇨ Benefit Systems ⇨ Career Path Systems
Other types	⇨ Admissions ⇨ Grade records ⇨ Course records ⇨ Alumni	⇨ Registration Systems ⇨ Student Transcript System ⇨ Curriculum Class Control Systems ⇨ Alumni Benefactor System

The table above shows that there are five functional categories of TPS: sales/marketing, manufacturing/production, finance/accounting, human resources and other types of TPS that are unique to a particular industry. All organizations have these five kinds of TPS (even if the system is manual). TPS are often so central to a business that TPS failure for a few hours can spell the demise of a firm and perhaps other firms linked to it. Manager needs TPS to monitor the status of internal operations and the firm's relations with the external environment. TPS are also major producers of

information for the other types of systems. For example, the payroll system illustrated before will supplies data to the company's general ledger system, which is responsible for maintaining records of the firm's income and expenses and for producing reports such as income statements and balance statements.

Information inputs for TPS are normally transactions and events. The processing process for TPS is to sort, list, merge or update the data based on the transactions or events. Information output from TPS is detailed reports, lists or summaries.

3.2 Knowledge Level Information Systems

Two types of information systems are categorized under the knowledge level of an organization, which are Knowledge Work Systems (KWS) and Office Automation Systems (OAS). These two types of systems serve the information needs at the knowledge level of the organization. KWS is a system that aid knowledge workers in the creation and integration of new knowledge in the organization. OAS can be computer systems such as word processing, e-mail systems and scheduling systems, which are designed to increase the productivity of data workers on the office. KWS aid knowledge workers whereas OAS primarily aid data workers (although they are also used extensively by knowledge workers).

In general, knowledge workers are people who hold formal universities degrees and who are often members of a recognized profession, like engineers, doctors, lawyers and scientists. The job for knowledge workers consists creating new information and knowledge, promote the creation of new knowledge and ensure that new knowledge and technical expertise are properly integrated into the business. Meanwhile, data workers typically have less formal, advanced educational degrees and tend to process rather than create information. The job for data workers are principally to use, manipulate and disseminate information, which consists primarily of secretaries, accountants or filing clerks. OAS is information technology applications designed to increase the productivity of data workers by supporting the coordinating and communicating activities of the typical office. OAS coordinates diverse information workers, geographic units and functional area. The system communicates with customers, suppliers and other

organization outside the firm and serves as a clearinghouse for information and knowledge flows.

The following table shows the specific types of application information systems that correspond to knowledge level:

Type of system	Applications
Knowledge Work Systems	⇨ Engineering Workstations ⇨ Graphics Workstations ⇨ Managerial Workstations
Office Automation Systems	⇨ Word Processing ⇨ Document Imaging ⇨ Electronic Calendars

Examples of KWS are like computer aided design (CAD) and robotics systems. CAD systems eliminate many manual steps in design and production by performing much of the design work on the computer. Examples of OAS are like word processing systems, desktop publishing systems and document imaging systems. Word processing systems are an office automation technology that facilitates the creation of documents through computerized text editing, formatting, storing and printing. Desktop publishing systems is a technology that produces professional quality documents combining output from word processors with design, graphics and special layouts features. Document imaging systems is the systems that convert documents and images into digital form so that they can be stored and accessed by the computer.

Information inputs for OAS are like documents and schedules mean while for KWS are like design specification and knowledge based. The processing process for OAS normally involves document management, scheduling and communication whereas for KWS, it involves modeling and simulations. Information output for OASs are normally documents, schedules and mails meanwhile for KWS are models and graphics.

The following figure 3.2 shows an example of an imaging system (a system that converts documents and images into digital form so that they can be stored and accessed by the computer). Document imaging systems are widely used knowledge applications. It converts documents and images into digital form so that they can be stored and

accessed by the computer. The system is made up of a network consisting image scanner, optical storage units, a mainframe computer and a local area network to link representatives' workstations and the scanner workstations located in the firm. Files and documents can be viewed on-line from desktop computers. This system is believed to reduce the amount of time it would take with a paper-based system, save paper and save cost and customer's services can be improved as the electronic documents can be assessed more rapidly.

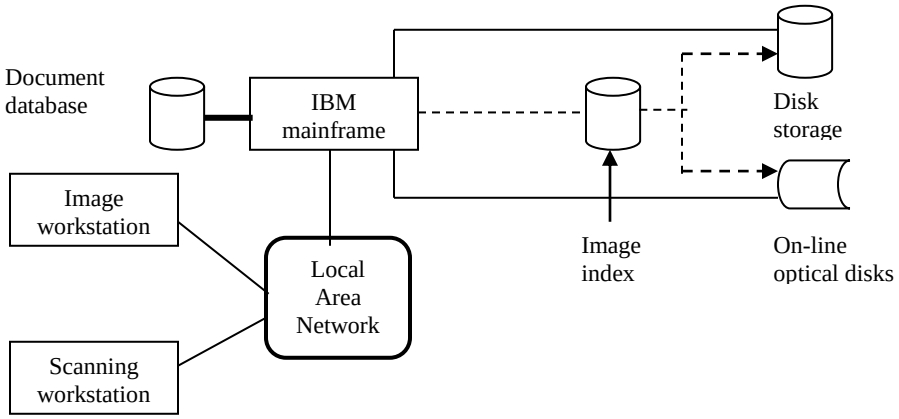


Figure 3-2

3.3 Management Level Information Systems

For management level of an organization, two types of information systems involved, which is Management Information System (MIS) and Decision Support System (DSS).

Management Information Systems (MIS, information system at the management level of an organization that serve the functions of planning, controlling and decision making by providing routine summary and exception reports) serves the management level of the organization, provides managers with reports and in some cases with on-line access to organization's current performance and historical records. Most of the systems oriented almost exclusively to internal, not environmental or external events. MIS primarily serve the functions of planning, controlling and decision making at the management level. Generally, they are dependant on underlying TPS for their data. MIS summarize and report on the basic operations of the company. The basic data from TPS

are compressed and are usually presented in long reports that are produced on a regular schedule. Figure 3.3 shows how a typical MIS transforms transactions level data from inventory, production and accounting into MIS files that are used to provide managers with reports.

MIS usually serve managers interested in weekly, monthly or yearly results – not day-today activities. MIS generally address structured questions that are known well in advance but the systems are not flexible and have little analytical capability. Most MIS uses simple routines such as summaries and comparisons as opposed to sophisticated mathematical models or statistical techniques.

Some of the characteristics of MIS are as follows:

- MIS support structured decisions at operational and management control levels. However, they are useful for planning purpose of senior management staff.
- MIS are generally reporting and control oriented. They are designed to report on existing operations and therefore to help provide day-to-day control of operations.
- MIS rely on existing corporate data and data flows.
- MIS have little analytical capability.
- MIS generally aid in decision making using past and present data.
- MIS are relatively inflexible.
- MIS have an internal rather than an external orientation.

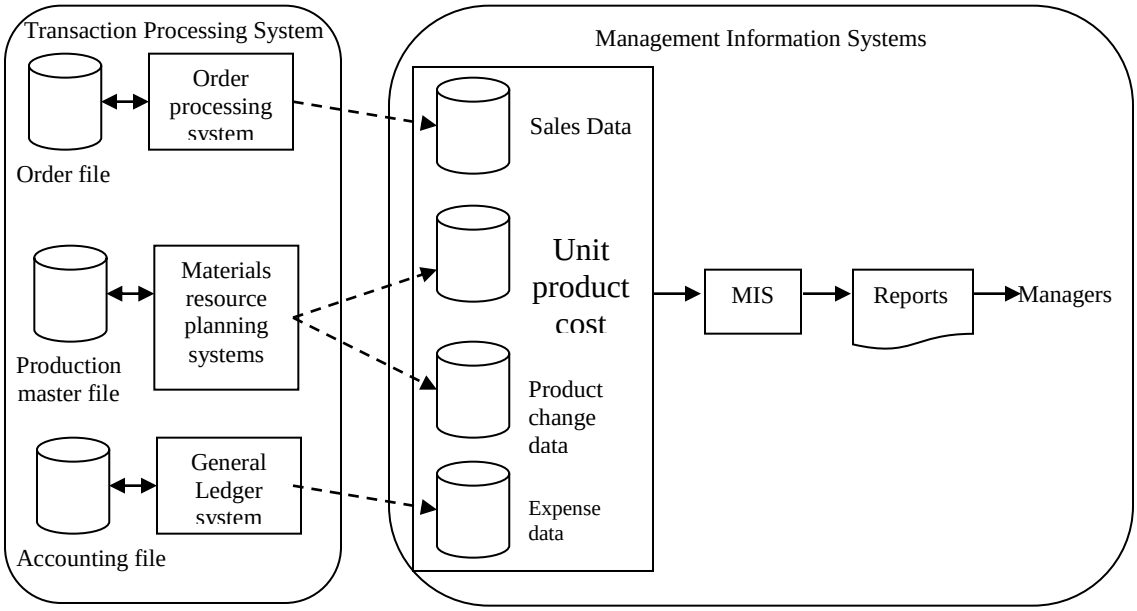


Figure 3-3

Decision Support Systems (DSS, information system at the management level of an organization that combine data and sophisticated analytical models or data analysis tools to support semi-structured and unstructured decision making) also serve the management level of the organization. DSS helps manager make decisions that are semi-structured, unique or rapidly changing and not easily specified in advance. Besides using internal information from TPS and MIS, they often bring in information from external sources like current stock prices or product prices of competitors. DSS have more analytical power than other systems. They built explicitly with a variety of models to analyze data, or they condense large amounts of data into a form where they can be analyzed by decision makers. DSS are normally designed in a way where the user can work with them directly, which means the system explicitly include user-friendly software. DSS are interactive where the user can change assumptions, ask new questions and include new data.

Some of the characteristics of DSS:

- DSS offers users flexibility, adaptability and quick response.
- DSS operate with little or no assistance from professional programmers.
- DSS provide support for decisions and problems whose solutions cannot be specified in advance.
- DSS use sophisticated data analysis and modeling tools.

The following figure 3.4 show an example of DSS that operates on a powerful PC and is used daily by managers who must develop bids on shipping contracts:

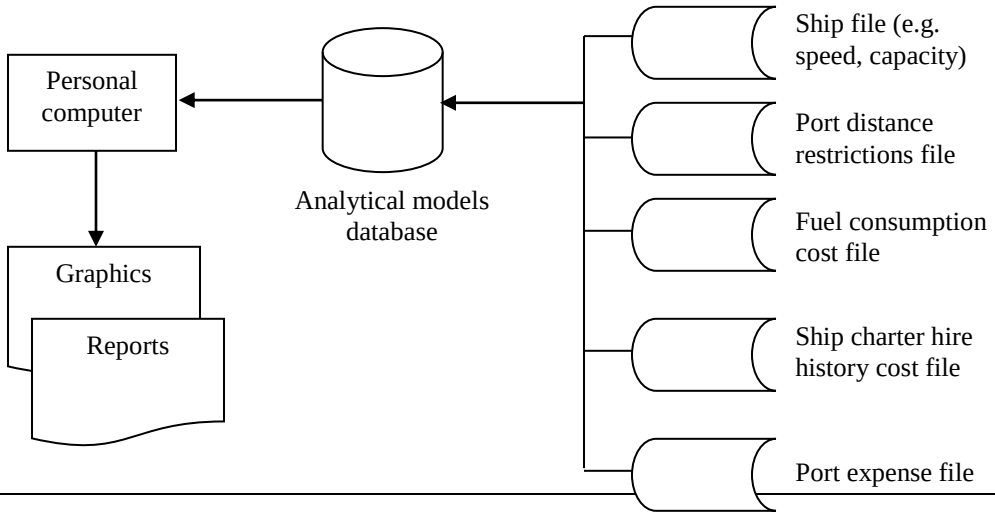


Figure 3.4

The following table shows the specific types of application information systems that correspond to management level:

Functional Area	MIS	DSS
Sales and Marketing	Sales Management	Sales Region Analysis
Manufacturing	Inventory Control	Production Scheduling
Finance	Annual Budgeting	Cost Analysis
Accounting	Capital Investment Analysis	Pricing/profitability Analysis
Human Resources	Relocation Analysis	Contract Cost Analysis

Information input for MIS are summary transaction data, high-volume data and simple models. For DSS, the information input are low-volume data or massive databases optimized for data analysis, analytic models and data analysis tools. Processing for MIS are routine reports, simple models and low-level analysis, meanwhile for DSS are interactive, simulations and analysis. Information outputs for MIS are summary and exception reports. For DSS, the information outputs are special reports, decision analysis or responses to queries.

3.4 Strategic Level Information Systems

Senior managers use Executive Support System (ESS) to make decisions. ESS serve the strategic level of an organization and address unstructured decisions and create a generalized computing and communications environment rather than providing any fixed application or specific capability. ESSs are designed to incorporate data about external events but they also draw summarized information from MIS and DSS. They filter, compress and track critical data, emphasizing the reduction of time and effort required to obtain information useful to executives. ESSs employ the most advanced graphics software and can deliver graphs and data from many sources immediately to a senior executive's office or to a boardroom. Unlike other types of information systems, ESSs are not designed primarily to solve specific problems. Instead, ESSs provide a

generalized computing and telecommunications capacity that can be applied to a changing array of problems. While many DSS are designed to be highly analytical, ESS comes with less analytical capabilities. Since ESSs are designed to be used by senior managers who often have little, is any, direct contact or experience with computer-based information systems, they incorporate easy-to-use graphic interfaces.

Figure 3.5 below shows an example of an ESS which consists of workstations with menus, interactive graphics and communication capabilities that can access historical and competitive data from internal corporate systems and external databases:

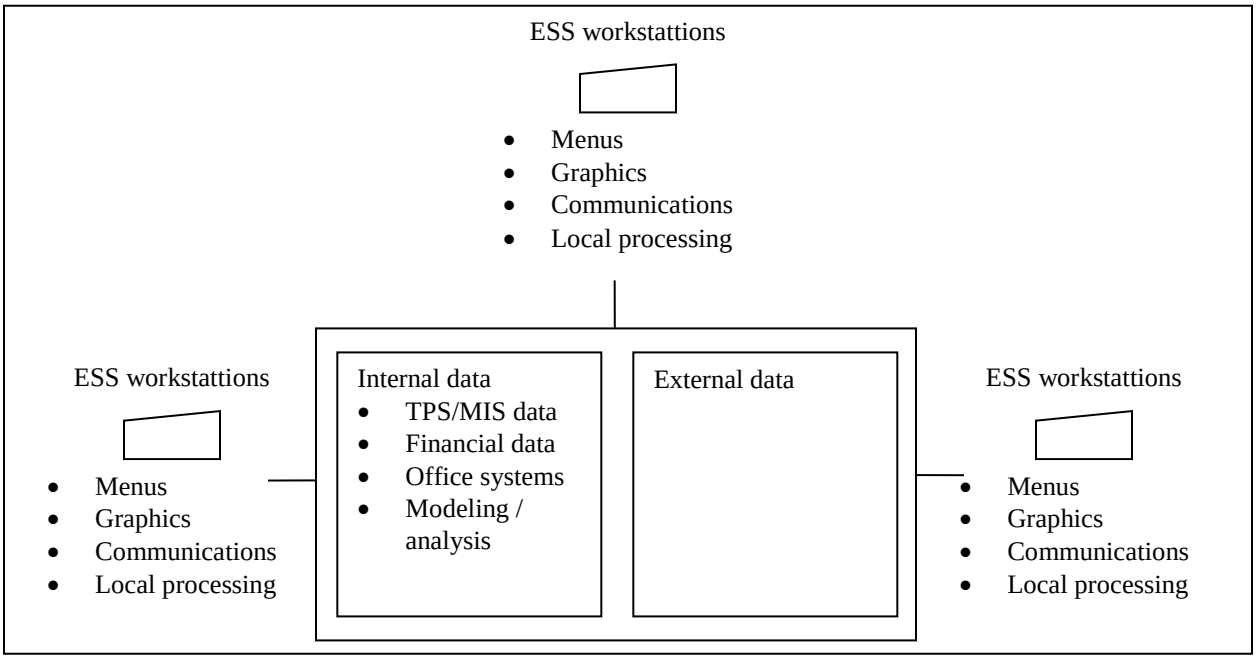


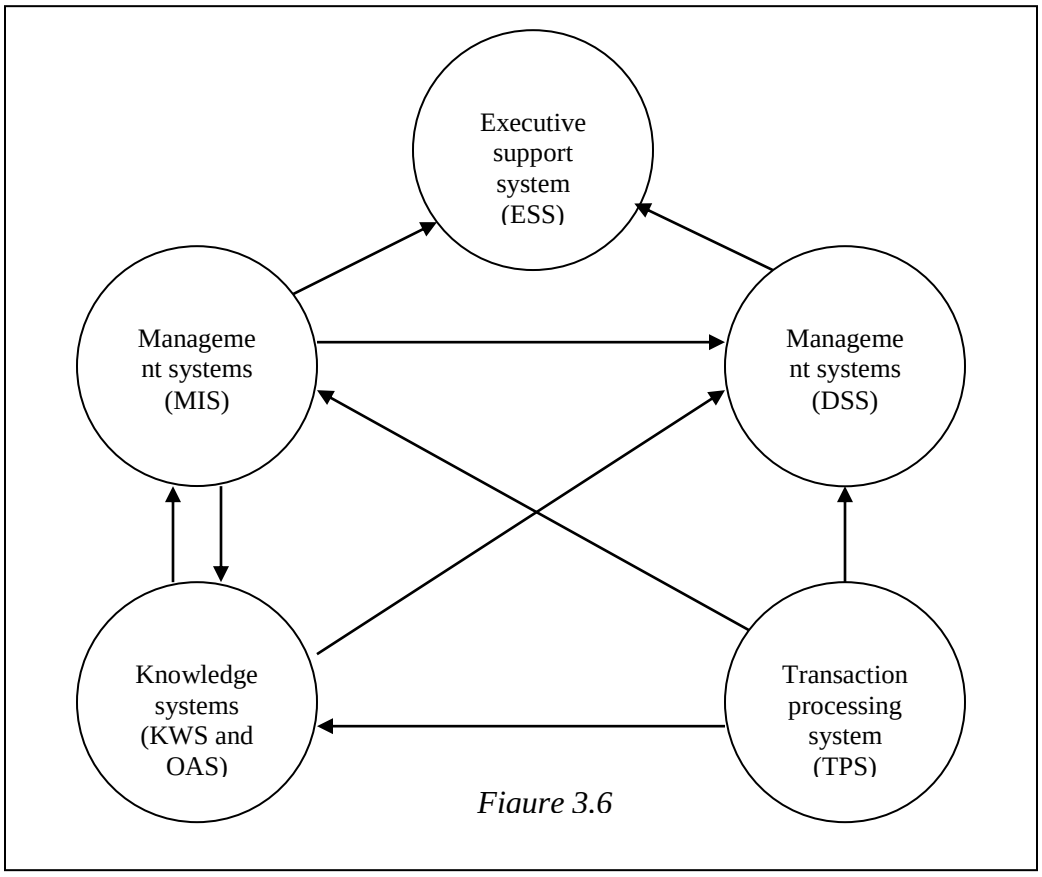
Figure 3.5

Information input for ESSs are aggregate data from external and internal sources. Processing for ESSs are graphics, simulations and interactive between user and the system. Information outputs for ESSs are projections, responses to queries.

3.5 Relationship of Systems to One Another: Integration

The various types of systems in the organization exchange data with one another. TPS are a major source of data for other systems, especially for MIS and DSS. ESS is primarily a recipient of data from lower-level systems. The other types of systems may

exchange data with each other as well. Data may also be exchanged among systems serving different functional areas. However, the different systems in an organization are only loosely integrated. The information needs of the various functional areas and organizational levels are too specialized to be served by a single system. Figure 3.6 below shows the relationship between the different systems:



Fiaure 3.6

CHAPTER FOUR: INFORMATION SYSTEMS, ORGANIZATIONS AND MANAGEMENT

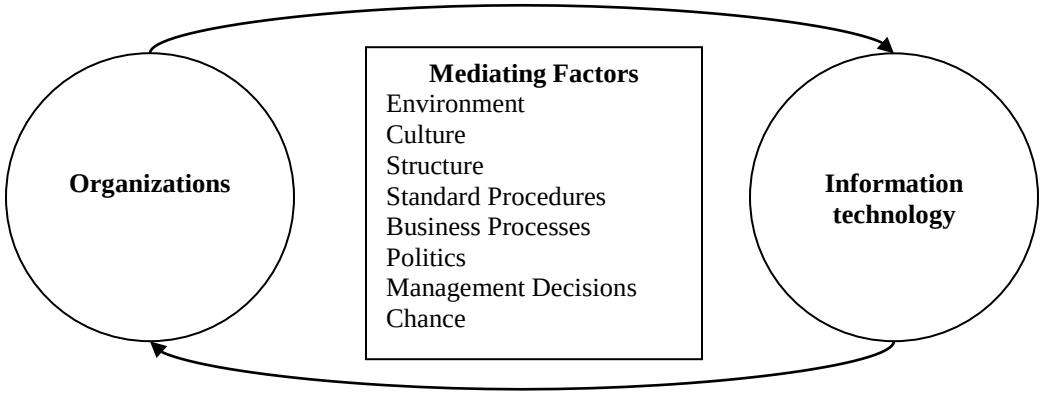
After completing this chapter, you will be able to:

- Identify the salient characteristics of organizations
- Analyze the relationship between information systems and organizations
- Contrasts the classical and contemporary models of managerial activities and roles
- Describe how managers make decisions in organizations
- Assess the implications of the relationship between information systems, organizations and management decision making for the design and implementation of information systems

4.1 Organization and Information Systems

Information systems and organizations have a mutual influence on each other. Information systems must be aligned with the organization to provide information needed by important groups within the organization. Meanwhile, organization must be aware of and open itself to the influences of information systems in order to benefit from new technologies. The interaction between information technology and organizations is very complex and is influenced by a great many mediating factors, including the organization's structure, standard operating procedures, politics, culture, surrounding environment and management decisions.

Figure 4.1 below illustrates the two-way relationship between organization and information technology.



Fiaure 4.1

4.1.1 What is an Organization

Organization is a stable, formal social structure that takes resources from the environment and processes them to produce outputs (technical definition). This technical definition focuses on three elements of an organization:

- Capital and labor are primarily production factors provided by the environment.
- The organization (the firm) transforms these inputs into products and services in a production function.
- The products and services are consumed by environments in return for supply inputs.

Figure 4.2 will shows the relation between these three elements. In the technical microeconomic definition of the organization, capitol and labor (the primary production factor provided by the environment) are transformed by the firm through the production process into products and services (output to the environment). The products and services are consumed by the environment, which supplies additional capital and labor as

inputs in the feedback loop.

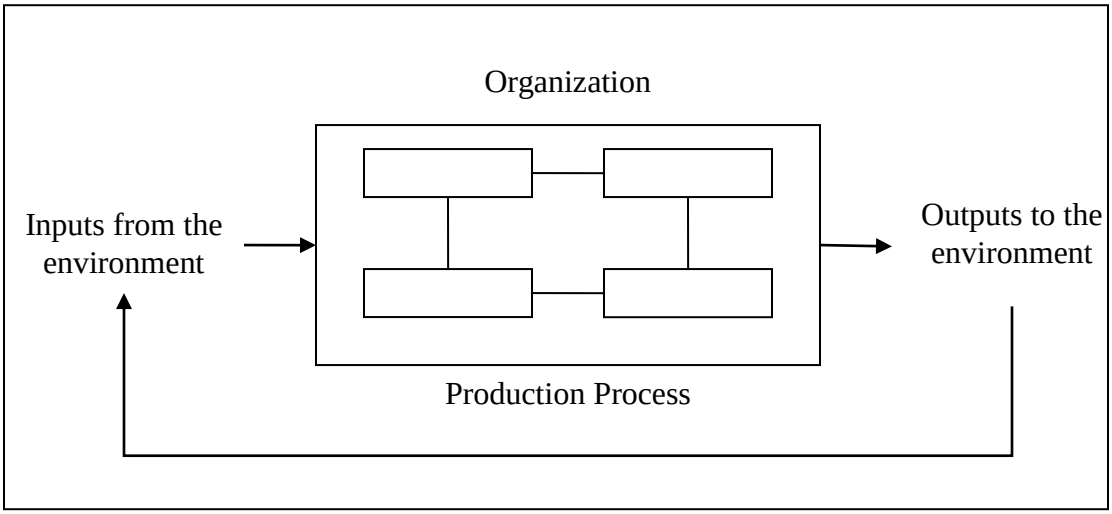
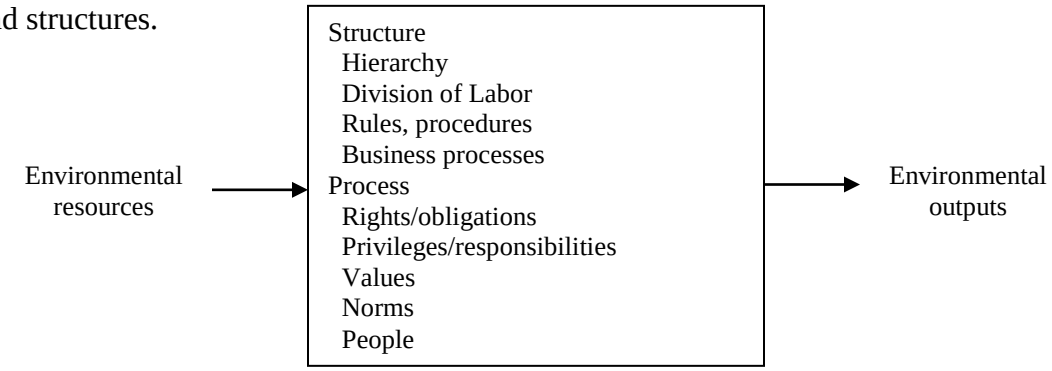


Figure 4.2

An organization is more stable than an informal group in terms of longevity and routine-ness. Organizations are formal legal entities, with internal rules and procedures, that must be abide by laws.

Organizations are also social structure because they are a collection of rights, privileges, obligations and responsibilities that are delicately balanced over a period of time through conflict and conflict resolution (behavioral definition).Figure 4.3 below shows the behavioral view of an organization that emphasizes group relationships, values and structures.



Fiaure 4.3

From the technical view of organization, it encourages organization to focus upon the way inputs are combined into outputs when technology changes are introduced into the company. The firm is seen as infinitely malleable, with capital and labor substituting for each other quite easily. Meanwhile, from the behavioral view of organization, it

suggests that building new information systems or rebuilding old ones involves much more than a technical rearrangement of machines or workers.

The technical and behavioral definitions of organizations are not contradictory but they complement each other. The technical definition tells us how many thousands of firms in competitive market combine capital, labor and information technology whereas the behavioral models takes us inside the individual firm to see how that technology affects the inner workings of the organization.

4.1.2 Why organizations are so much alike and why organizations are so different

According to Weber, all modern organizations (bureaucracies):

- Have a clear-cut *division of labor and specialization*;
- Arrange specialists in a *hierarchy* of authority;
- Limit authority and action by abstract *rules or procedures* (standard operating procedures, or SOPS);
- Create a system of *impartial and universalistic decision making*;
- Are devoted to the *principle of efficiency*: maximizing output using limited inputs.

Some supplements to Weber, identifies some additional features for organization as following:

- Have Standard Operating Procedures – a set of precise rules, procedures and practices developed by organization to cope with virtually all expected situations.
- Have Organizational Politics.
- Have Organizational Culture – the set fundamental assumptions about what products the organization produces, how and where it should produce them and for whom they should be produced.

Although all organizations do have common characteristics, no two organizations are identical. The differences of organizations are like:

- Structures.
- Goals.
- Constituencies.
- Leadership styles.
- Tasks

- Surrounding environments.
- Power.
- Function.
- Technology.
- Business processes.
- Levels

4.2 The Changing Role of Information Systems

The development of information architecture of organizations has change from:

- Electronic accounting machines (EAM) in 1950s with isolated "electronic accounting machines" with limited functions.
- Data processing departments in 1960s with large, centralized mainframe computers that served corporate headquarters and a few remote sites.
- Information systems in 1970s with midsized minicomputers located in individual departments or divisions of the organization that were networked to large, centralized computers.
- Information systems and services in 1980s with desktop PCs used dependently and linked to minicomputers and large computers.
- Enterprise-wide information utility from 1990 until recently with computers coordinated information flowing among desktops, between desktops, among minicomputers and mainframes and perhaps among hundreds of smaller local networks. These networks can be connected into a network linking the entire enterprise or linking to external networks, including Internet.

The position and role of information system specialists also have evolved over time. The formal organizational unit or function that has emerged is called information systems department. In the early years, the information systems group was composed mostly of programmers, highly trained technical specialists who wrote the software instructions for the computer. Today a growing proportion of staff members are system analysts, who constitute the principal liaison between the information systems group and the rest of the organization and the main job function of a system analyst is to translate business problem and requirements into information requirements and systems.

Information systems managers are leaders of teams of programmers and analysts, projects managers, physical facility managers, telecommunication managers and heads of office automation groups. They are also managers of computer operations and data entry staffs. End users are representatives of departments outside of the information systems group for whom applications are developed. In most organizations, the information systems department is headed by a chief information officer (CIO).

4.2.1 Why Organizations Build Information Systems

Some of the general benefits why organizations adopt information systems are as follow:

- More efficient.
- Save money.
- Reduce work force.
- Become vitally important simply to stay in business.
- A source of competitive advantage.
- More innovative than others.
- Satisfy the ambitious of various groups within an organization.

Figure 4.4 below shows the system development process that includes many considerations other than economic. The model divides the explanation for why organization adopts systems into two groups:

- *External environment factors* (constraints and opportunities) that influence the adoption and design of information systems. Examples of external constraints would be the rising costs of labor or other resources, the competitive actions of other organizations and changes in government regulations. Examples of external opportunities include new technologies, new sources of capital, the demise of a competitors or a new government program.
- *Institutional factors* are factors internal to the organization that influence the adoption and design of information systems. They may include values, norms and vital interests that govern matters of strategic importance to the organization.

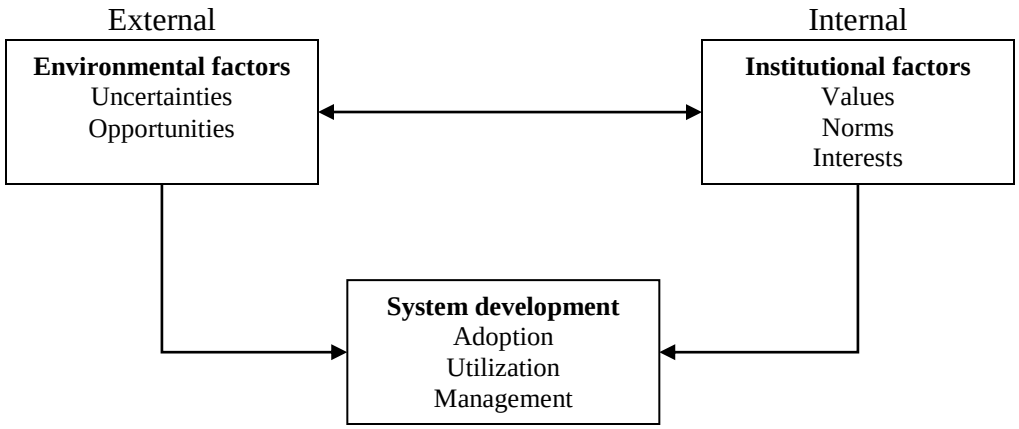


Figure 4.4

4.3 The Role of Managers in the Organization

Managerial roles are expectations of the activities that managers should perform in an organization. Their responsibilities range from making decisions to writing reports, to attend meetings. Behavioral model is used to describe the management based on behavioral scientists' observations of what managers actually do in their jobs. According to Mintzberg, these managerial roles fell into three categories:

- *Interpersonal roles*

Managers act as figureheads for the organization when they represent their companies to the outside world and perform symbolic duties. Managers act as leaders, attempting to motivate, counsel and support subordinates. Managers also act as a liaison between various levels of the organization; within each of these levels, they serve as a liaison among the members of the management team. Managers provide time and favors, which they expect to be returned.

- *Informational roles*

Managers act as the nerve centers of their organization, receiving the most concrete, up-to-date information and redistributing it to those who need to be aware of it. Managers are therefore information disseminators and spokesperson for their organization.

- *Decision roles*

Managers act as entrepreneurs by initiating new kinds of activities. They handle disturbances arising in the organization. They allocate resources to staff members who

need them. They negotiate conflicts and mediate between conflicting groups in the organization.

4.4 Managers and Decision Making

4.4.1 The Process of Decision Making

Decision making remains one of the more challenging roles of a manager. Information systems have helped managers communicate and distribute information. However, they have provided only limited assistance for management decision making. Decision making can be classified by organization level, corresponding to the strategic, management, knowledge and operational levels of the organization. Strategic decision making determines the objectives, resources and policies of the organization. Management level decision making mainly controls how efficient or effective resources are utilized and how well operational units are performing. Knowledge level decision making mainly evaluates new ideas for products, services, ways to communicate new knowledge and ways to distribute information throughout the organization. Operational level decision making will decide how to carry out specific tasks specified by upper and middle management and establish criteria for completion and allocate resources.

Within each of these levels of decision making, decisions can be classified as *unstructured decisions* and *structured decisions.* Unstructured decisions are non-routine decisions in which the decision maker must provide judgment, evaluation and insights into the problem definition and there is no agreed-upon procedure for making such decisions. Structured decisions are decisions that are repetitive, routine and have a definite procedure for handling them.

Combining these two views of decision making produces the grid shown in Figure 4.5 which shows the different kinds of information systems at the various organizational level support different types of decisions.

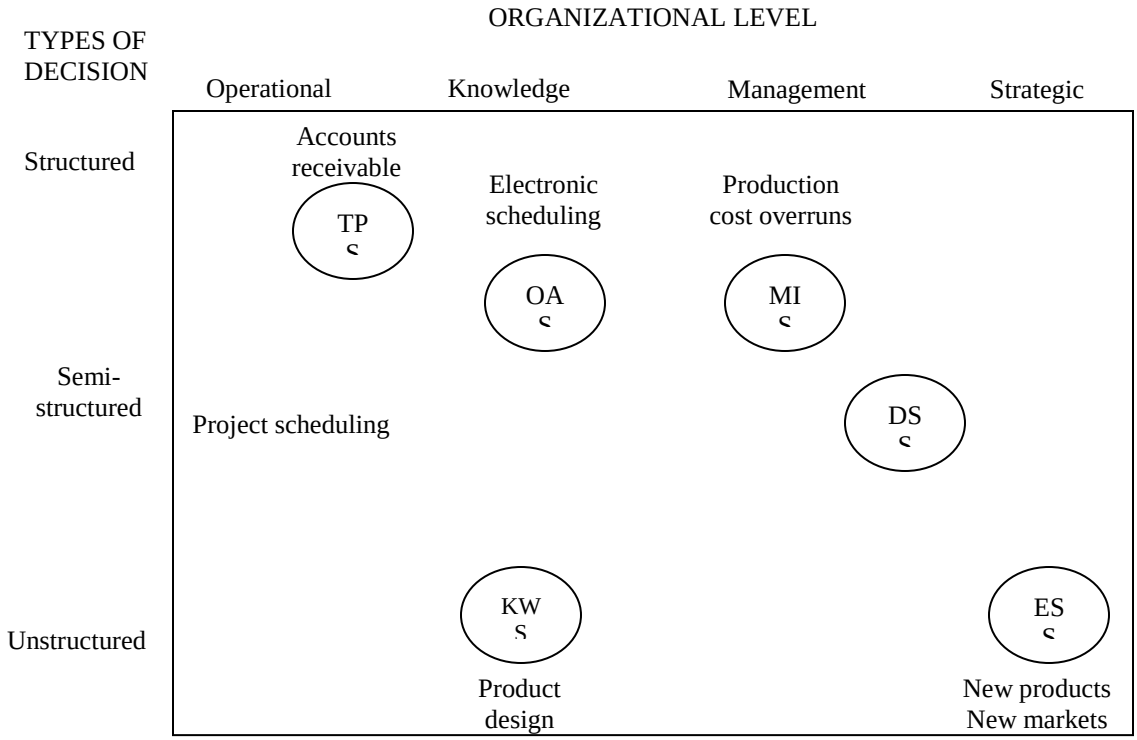


Figure 4.5

4.4.2 Stages of Decision Making

Making decisions consist several activities. Simon (1960) described four different stages in decision making: *intelligence, design, choice and implementation.*

- Intelligence. The first of Simon's four stages of decision making. Individual collect information to identify and understand problems occurring in the organization.
- Design. Simon's second stage of decision making. Individual conceives of possible alternative solutions.
- Choice. Simon's third stage of decision making. Individual selects among the various solution alternatives.
- Implementation. Simon's final stage of decision making. Individual puts the decision into effect and reports on the progress of the solution.

In general, the stages of decision making do not necessarily follow a liner path. At any point in the decision making process, a loop back can be done to go back to a previous stage.

CHAPTER FIVE: TECHNICAL FOUNDATIONS OF INFORMATION SYSTEMS

After completing this chapter, you will be able to:

- Describe computers and information processing
- Describe information systems software
- Understands the concept of managing data resources
- Describe the technology of communication, networks

5.1 What is a computer system?

Regardless of size, age, function or capability, all computers have the same basic components and operate according to the same basic principles. A computer must handle fours basic operations: accept data, store data and instructions, process data and lastly output data. In recent years, almost every computer has also been expected to support data communications. Computers conduct these operations with the same basic equipment. In general, every computer has these components:

- *Central processing unit (CPU)* is the most important part of any computer. It manipulates raw data into a more useful form and controls the other parts of the computer systems. Two main unit of CPU is *arithmetic logic unit (ALU)* that performs the principles logic and arithmetic operations of the computer and *control unit* that controls and coordinates the other parts of the computer system.
- *Primary storage that s*tores all or part of the program that is being executed, stores the operating system programs that manage the operation of the computer and holds data that are being used by the program. Internal primary storage of a computer is often called RAM (Random Access Memory) and can directly access any randomly chosen location in the same amount of time. Besides RAM, ROM (Read Only Memory) is also used to store important or frequently used programs and it comes with manufacturer when a computer is purchased. ROM can be further divided into two subclasses:
  - Programmable read-only memory (PROM) which is used in control devices because it can be reprogrammed once.

- Erasable programmable read-only memory (EPROM) that can be erased and reprogrammed many times.

- *Secondary storage is a r*elatively long-term, nonvolatile storage of data outside the CPU and primary storage. It can be divided into three different categories:
  - *Magnetic disk* which can be divided further into two main type, floppy disks and hard disks. Floppy disk is a removable magnetic disks storage primarily used with PCs. Hard disk is a magnetic tape resembling a thin steel platter with an iron oxide coating and is used in large computer systems and in many PCs.
  - *Optical disk* is also called compact disks or laser optical disks. It stores data at densities many times greater than those of magnetic disks. Compact disks read-only memory (CD-ROM) is a read-only optical disks storage used for imaging, reference a database applications with massive amounts of unchanging data and for multimedia. Write once/read many (WROM) or Compact disk-recordable (CD-R) is an optical disk system that allows users to record data only once and data cannot be erased but can be read indefinitely. *Magnetic Tape* in an inexpensive, older secondary storage medium in which large volumes of information are stores sequentially by means of magnetized and non-magnetized spots on tape.

- *Input and output devices/peripheral devices. Input devices* converts data and instructions into electronic from for input into the computer. Examples of input devices are like keyboard, computer mouse, touch screens and etc. *Output devices* convert electronic data produces by the computer system and display them in a form that people can understand. Examples of output devices are like printer, video display and etc.

5.2 Information Systems Software

Software is a detailed instruction that control the operation of a computer system. Without software, computer hardware could not perform the tasks we associate with computers. The main functions of software are managing the computer resources of the organization, provide tools for human beings to take advantage of these resources and act as an intermediary between organizations and stored information. *Software program* is a

series of statements or instructions to the computer. A stored program concept means that a program must be stored in the computer's primary storage along with the required data in order to execute, or have its instructions performed by the computer. Software can be divided into two major types:

- *System software* is a generalized program that manages the resources of the computer. O*perating system* is the system software that manages and controls computer's activities. An operating system performs three main functions: allocation and assignment, scheduling and the last one is monitoring.
- *Application software* is programs written for a specific application to perform functions specific by end users. Application software works through system software, which access to computer hardware.

5.3 Managing data resources

5.3.1 Problems with traditional file environment

Traditional file environment (flat file organization/data file organization) is a way of collecting and maintaining data in an organization that leads to each functional area or division creating and maintaining its own data files and programs. Traditional file environment will results the following problems:

- Data redundancy and confusion.
- Program-data independence.
- Lack of flexibility.
- Poor security.
- Lack of data sharing and availability.

The above mentioned problems can be solved by using a database.

5.3.2 Database environment

Database is a collection of data organized to service many application at the same time by storing and managing data so that they appear to be in one location. A database management system (DBMS) is special software to create and maintain a database and enable individual business applications to extract the data they need without having to

create separate files or data definitions in their computer programs. A DBMS has three components:

- A data definition language.
- A data manipulation language.
- A data dictionary.

5.3.3 Three major types of database models

The earliest DBMS were *hierarchical* which organizes data in a treelike structure. A record is subdivided into segments that are connected to each other in one-to-many parent-child relationship. The most common hierarchical DBMS is IBM's IMS (Information Management System). The *network data model* is a variation of the hierarchical data model. This model is useful for depicting many-to-many relationships. *Relational data model* is a type of logical database model that treats data if they were stored in two-dimensional tables. It can relate data stored in one table to data in another as long as the two tables share a common data element. *Object relational data model* is a model used mostly for Internet databases. The following table shows the comparison of database alternatives.

Types of database	Processing efficiency	Flexibility	End-user friendliness	Programming complexity
Hierarchical	High	Low	Low	High
Network	Medium-high	Low-medium	Low-moderate	High
Relational	Lower but improving	High	High	Low

5.4 Telecommunications and Networks

5.4.1 Components and functions of a telecommunication system

A telecommunication is a collection of compatible hardware and software arranged to communicate information from one location to another. The following are essential components of telecommunication systems:

- Computers to process information.
- Terminals or any input/output devices that send or receive data.

- Communication channels, the links by which data or voice are transmitted between sending and receiving devices in a network. Communication channels use various communication media, such as telephone lines, fiber-optics cables, coaxial cables and wireless transmission.
- Communication processors, such as modems, multiplexers, controllers and front-end processors, which provide support functions for data transmission and reception.
- Communication software, which controls input and output activities and manages other functions of the communication network.

Functions of telecommunication system:

- Establishes the interface between the sender and the receiver.
- Routes messages along the most efficient paths.
- Performs elementary processing of the information to ensure that the right message gets to the right receiver.
- Performs editorial tasks on the data.
- Converts messages from one speed into the speed of a communications line or from one format to another format.
- Controls the flow of information.

5.4.2 Communication Networks

Networks can be classified by their shape (topology) or by their geographic scope and type of services provided. Networks classified by their topology:

- *Star network* is a network in which all computers and other devices are connected to a central host computer. All communications between networks devices must pass through the host computer.
- *Bus network* is a topology that links a number of computers by a single circuit with all messages broadcast to the entire network.
- *Ring network* is a network in which all computers are linked by a closed loop in a manner that passes data in one direction from one computer to another.

Networks classified by their geographic scope:

- *Private branch exchanges (PBX)* is a central switching system that handles a firm's voice and digital communication.

- *Local area networks (LAN)* is a telecommunication network that requires its own dedicated channels and that encompasses a limited distance, usually one building or several buildings in close proximity.
- *Wide area networks (WAN)* is a network that spans a large geographical distance. May consist of a variety of cables, satellite and microwave technology.
- *Value-added network (VAN)* is a private, multi-path, data-only, third-party managed network that is used by multiple organizations on a subscription basis.

CHAPTER SIX: REDESIGNING THE ORGANIZATION WITH INFORMATION SYSTEMS

After completing this chapter, you will be able to:

- Demonstrate how building new systems can produce organizational change.
- Explain how the organization can develop information systems that fit its businesses plan.
- Identify the core activities in the systems development process.
- Analyze the organizational change requirements for building successful systems.
- Describe models for determining the business value of information systems.
- Describe the different approaches to systems-building.

6.1 Systems as Planned Organizational Change

The introduction of new information system involves much more than new hardware and software. It also includes changes in jobs, skills, management and organization. In the concept of socio-technical, one cannot install new technology without considering the people who must work with it. When we design a new information system, we are redesigning the organization.

One of the most important things to know about building a new information system is that this process is one kind of planned organizational change. Systems builders must understand how a system will affect the organization as whole, focusing particularly on organizational conflict and changes in the locus of decision making. Builders must also consider how the nature of work groups will change under the impact of the new system.

Systems can be technical successes but organizational failures because of a failure in the social and political process of building the systems. Analysts and designers are responsible for ensuring that key members of the organization participate in the design process and are permitted to influence the ultimate shape of the system.

6.1.1 Establishing Organizational Information Requirements

In order to develop an effective information systems plan, the organization must have a clear understanding of both its long- and short-term information requirements. Two principal methodologies for establishing the essentials information requirements of the organization as a whole are enterprise analysis and critical success factors.

Enterprise Analysis (Business Systems Planning) is an analysis of organization-wide information requirements by looking at the entire organization in terms of organizational units, functions, processes and data elements. It helps to identify the key entities in the organization's data. This method starts with the notion that the information requirements of a firm or a division can be specified only with a thorough understanding of the entire organization. The central method used in the enterprise analysis approach is to take a large sample of managers and ask them how they use information, where they get the information, what environments are like, what their objectives are, how they make decisions and what their data needs are. The results of this large survey of managers are aggregated into subunits, functions, processes and data metrics. Data elements are organized into logical application groups and these results will be display out in the form of chart for easier interpretation and decision making based on the survey. The weakness for this method is that is produces an enormous amount of data that is expensive to collect and difficult to analyze. Most of the interviews are conducted with senior or middle managers with little effort to collect information from clerical workers and supervisory managers. Moreover, the questions frequently focus not on the critical objectives of management and where information is needed, but rather on what existing information is used. The following table shows the topics that should be included in an information system plan.

Stages	Activities
1. Purpose of the Plan	• Overview of plan contents • Changes in firm's current situation • Firm's strategic plan • Current business organization • Key business processes • Management strategy

2. Strategic Business Plan	• Current situation • Current business organization • Changing environments • Major goals of business plan

3. Current Systems	• Major systems supporting business functions and processes
	• Major current capabilities
	  ▪ Hardware
	  ▪ Software
	  ▪ Database
	  ▪ Telecommunications
	• Difficulties meeting business requirements
	• Anticipated future demands

4. New development	• New system projects
	  ▪ Project descriptions
	  ▪ Business rationale
	• New capabilities required
	  ▪ Hardware
	  ▪ Software
	  ▪ Database
	  ▪ Telecommunication and Internet

5. Management Strategy	• Acquisition plans • Milestones and timing • Organizational realignment • Internal reorganization • Management controls • Major training initiatives • Personnel strategy
6. Implementation plan	• Detailed implementation plan • Anticipated difficulties in implementation

	• Progress reports
7. Budget requirements	• Requirements • Potential savings • Financing • Acquisition cycle

Strategic Analysis or Critical Success Factor (CSF) approach argue that the information requirements of an organization are determined by a small number of easily identified operational goals shaped by the industry, the firm, the manager and the broader environment that are believed to assure the success of an organization. An important premise of the strategic analysis approach is that there are a small number of objectives that managers can easily identify and information systems can focus on. The principal method used in CFS analysis is personal interviews- three to four –with a number of top managers to identify their goals and the resulting CSFs. The strength of CSF method is that it produces a smaller data set to analyze than does enterprise analysis and will produce systems that are more custom-tailored to an organization. Another strength of CSF method is that it takes into account the changing environment with which organizations and managers must deal. Unlike enterprise analysis, the CSF method focuses organizational attention on how information should be handled. The primary weakness of this method is that the aggregation process and the analysis of the data are art forms where there is no particular rigorous way in which individual CSFs can be aggregated into a clear company pattern. Another weakness of this method is that this method is clearly biased toward top managers as their will be the ones being interviewed. Lastly, this method does not necessarily overcome the impact of a changing environment or changed in managers.

6.1.2 Systems Development and Organizational Change

New information systems can promote various degree of organizational change, enabling organizations to redesign their structure, scope, power relations, workflows, products and services. The following table describes how information technology is being used to transform organizations.

Information Technology	Organizational Change
Global networks	International division of labor: • The operations of a firm are no longer determined by location • The global reach of firms is extended • Costs of global coordination decline • Transaction costs decline
Enterprise networks	Collaborative work and teamwork: • The organization of work can now be coordinated across divisional boundaries • A customer and product orientation emerges • Widely dispersed task forces become dominant work group • The costs of management (agency costs) declined • Business processes are changed
Distributed networks	Empowerment: • Individuals and work groups now have the information and knowledge to act • Business processes are redesigned, streamlined • Management costs decline • Hierarchical and centralization decline
Portable networks	Virtual organization: • Work is no longer tied to geographic location • Knowledge and information can be delivered anywhere they are needed, anytime • Work becomes portable • Organizational costs decline as real estate is less essential for business
Graphical user interfaces	Accessibility: • Everyone on the organization – even senior executives

	– can access information and knowledge • Work-flows can be automated, contributed to by all from remote locations • Organizational costs decline as work-flows move from paper to digital image, documents and voice

6.1.3 The Spectrum of Organizational Change

Information technology can promote various degrees of organizational change, ranging from incremental to far-reaching. There are four kinds of structural organizational change that are enabled by information technology:

- Automation involves assisting employees to perform their tasks more efficiently and effectively or in another word, using the computer to speed up the performance of existing tasks.
- Rationalization of procedures is a deeper form of organizational change that streamlines the standard operation procedures, eliminating obvious bottlenecks, so that automation makes operating procedures more efficient.
- Business process reengineering (BPR) is the radical redesign of business processes, combining steps to cut waste and eliminating repetitive, paper-intensive tasks in order to improve cost, quality and service, and to maximize the benefits of information technology. The process of streamlining business procedures so that documents can be moved easily and efficiently is called work-flow management.
- Paradigm shift is a radical re-conceptualization of the nature of the business and the nature of the organization.

The most common forms of organizational change are automation and rationalization. These relatively slow-moving and slow-changing strategies present modest return but little risk. Faster and more comprehensive change like reengineering and paradigm shift carry high rewards but offers a substantial chance of failure. BPR and paradigm shift often fail because extensive organizational change is so difficult to orchestrate.

6.2 System Development Process

System development refers to all the activities that go into producing an information systems solution to an organizational problem or opportunity. System development is a structured kind of problem solving with distinct activities. The core activities in system development will be described briefly in the following table.

Process	Activities
Systems analysis	• Is the analysis of the program that the organization will try to solve with an information system • Consists of defining the problem, identifying its causes, specifying the solution and identifying the information requirements that must be met by a system solution • Produces feasibility report which addresses three major area – technical, economic and operational
Systems design	• Is the details how a systems will meet the information requirements as determined by the systems analysis • Can be broken into logical and physical design • Logical design lays out the components of the information system and their relationship to each other as they would appear to us • Physical design is the process of translating the abstract logical model into the specific technical design for the new system
Programming	• Is the process of translating the system specifications prepared during the design stage into program code
Testing	• Is the exhaustive and thorough process that determines whether the system produces the desired results under known conditions • Can be broken into unit (program), system and acceptance testing • Unit testing (program testing) is the process of testing each program separately in the system • System testing tests the functioning of the information

	systems as a whole in order to determine if discrete modules will function together as planned • Acceptance testing provides the final certification that the system is ready to be used in a production setting
Conversion	• Is the process of changing from the old system and the new system • Four main conversions involved – parallel, direct, phased and pilot • Detailed documentation will be produced
Production	• Is the stage after the new system is installed and the conversion is completed • During this time, the system is reviewed by users and technical specialists to determine how well it has met its original goal
Maintenance	• Are the changes in hardware, software, documentation or procedures to a production system to correct errors, meet new requirements or improve processing efficiency

Each of the core system development activities entails interaction with the organization.

6.3 Building successful systems

From an organizational and behavior point of view, the major causes of information systems failure are:

- Insufficient or improper user participation in the systems development process.
- Lack of management support.
- Poor management of the implementation process.
- High level of complexity and risk in the systems development projects.

Implementation is the entire process of organizational change surrounding the new information system. Different patterns of the implementation should be analyzed in order to understand system's success or failure. Relationship between participants (system designers and end users) is practically important in the whole process of

implementation. Besides that, the support and control from management of the implementation process are an essential part as it acts as the mechanisms for dealing with the level of risks (determined by project size, structure and experience with technology) in each new system.

The business value of information systems can be determined using the following models:

- Capital budgeting like cost/benefit ratio, net present value and return on investments (ROI).
- Portfolio analysis and scoring analysis includes non-financial considerations and can be used to evaluate alternative information systems projects. Figure 6.2 below shows a system portfolio where companies should examine their portfolio of projects in terms of potential benefits and likely risks. Certain kinds of projects should be avoided altogether and others developed rapidly. There is no ideal mix and companies in different industries have different profiles.

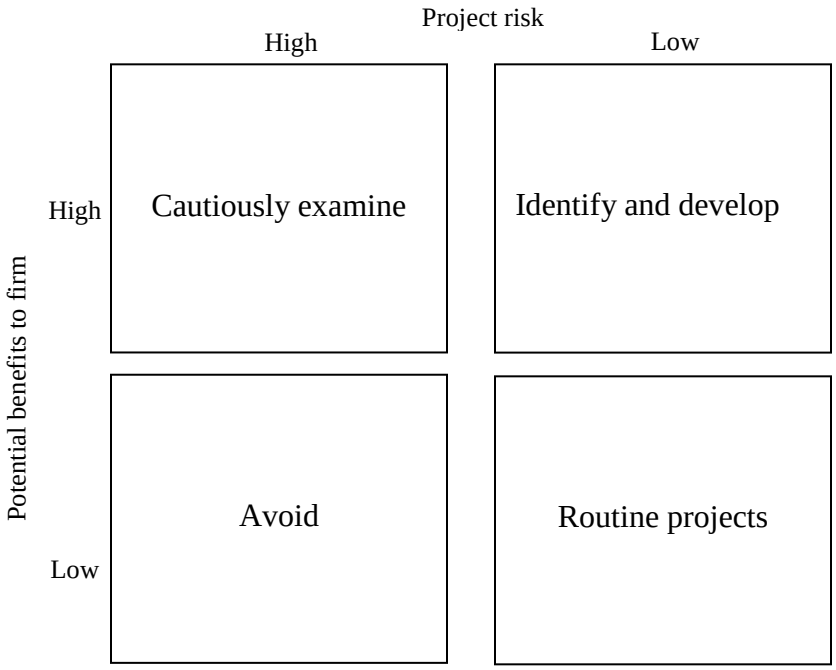


Figure 6.2

6.4 Approaches to Systems-Building

Different approaches are being used in building a system. The advantages and disadvantages of these approached will be as follow:

Approach	Advantages	Disadvantages
Traditional systems lifecycle • Project definition • System study • Design • Programming • Installation • Post-implementation	• Useful for large projects that need formal specifications and tight management control over each stage of systems-building	• Rigid and costly • Not-well suited for unstructured, decision oriented applications
Prototyping • Builds an experimental system rapidly and inexpensive for end users to interact with and evaluate	• Encourages end-user involvement in system development and iteration of system until specifications are captured accurately	• Rapid creation of prototype can results in systems that have not been completely tested or documented
Application software	• Eliminates the need for writing software programs • Cuts down on the amount of design, testing, installation and maintenance work	• To meet organization requirements, packages may require extensive modifications that can raise development costs • Cannot provide customized solution • Cannot adopt to changes easily
End-user development	• Improved requirements determination • Reduced application backlog • Increased end-user participation and control	• Propagates information systems and data sources that do not necessarily meet quality assurance standard and not easily

	of systems development process	controlled
Outsourcing	• Save application development costs • Allow firm to develop applications without an internal information systems staff	• Firms lose control over their information systems • Too dependent on external vendors

CHAPTER SEVEN: MANAGING KNOWLEDGE

After completing this chapter, you will be able to:

- Explain the importance of knowledge management
- Describes the applications useful for distributing, creating and sharing knowledge
- Evaluate the role of artificial intelligence in knowledge management
- Describe how organizations can used expert systems and case-based reasoning to capture knowledge
- Describe how organizations can use neural networks and other intelligent techniques to improve their knowledge base

7.1 Knowledge Management in the Organization

Knowledge has becomes a central productive and strategic asset, the success of the organization increasingly depends on its ability to gather, produce, maintain and disseminate knowledge. Hence, the process of developing procedures and routines to optimize the creation, flow, learning and sharing knowledge and information in the firm becomes a central management responsibility which brings to a term known as knowledge management. Knowledge management is the process of systematically and actively managing and leveraging the stores of knowledge in an organization. Knowledge management is the combination of activities involved in gathering, organizing, sharing, analyzing and disseminating knowledge to improve an organization's performance. Knowledge is usually perceived as "know-how", which is usually accumulated through experience combined with knowing certain information or, at least knowing where information can be found. Knowledge management is the attempt by organizations to put procedures and technologies in place that do the following:

- Transfer individual knowledge into databases.
- Filter and separate the most relevant knowledge.
- Organize that knowledge in databases that either:
    - Allow other employees to easily access the knowledge.
    - "Push" specific knowledge to employees based on their pre-specified needs.

All the major types of information systems mentioned before facilitate the flow of information and have organizational knowledge embed in them. However, office automation system (OAS), knowledge work systems (KWS), group collaboration and artificial intelligence applications are especially useful for knowledge management. OAS, KWS, artificial intelligence applications and group collaboration focuses on supporting information and knowledge work and on defining and capturing the organization's knowledge base. The knowledge base may include:

- Structured internal knowledge
- External knowledge
- Informal knowledge (tacit knowledge)

Figure 7.1 below shows the array of information systems specifically designed to support knowledge management.

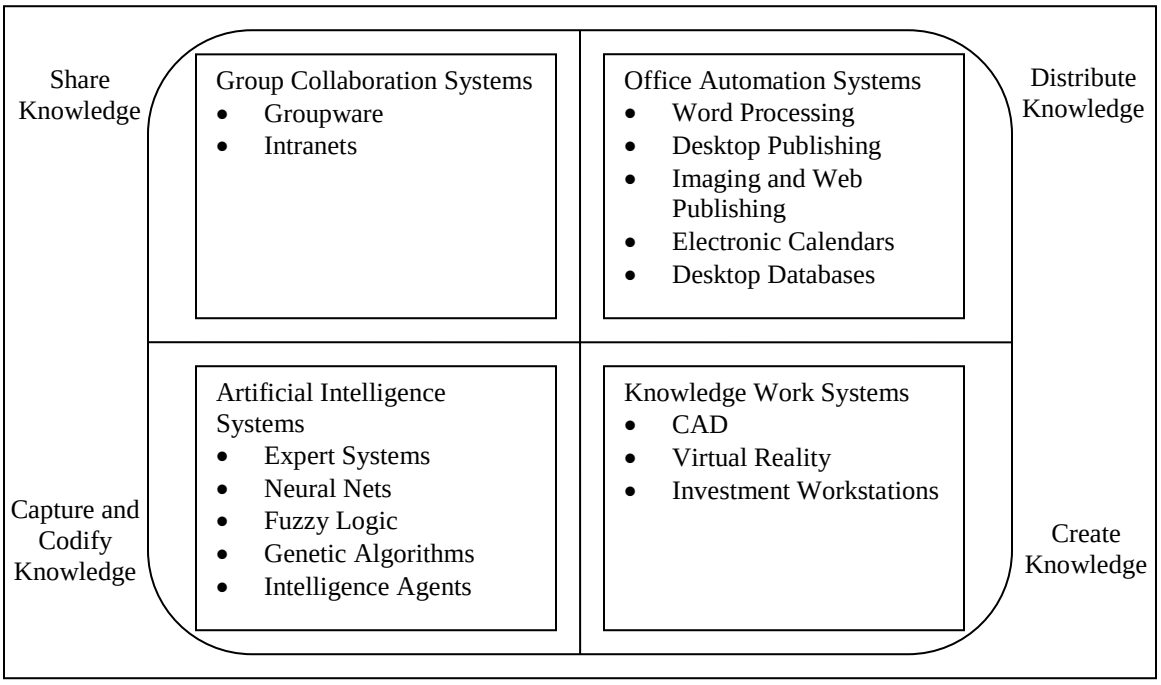


Figure 7.1

OAS helps disseminate and coordinate the flow of information in the organization. KWS supports the activities of highly skilled knowledge workers and professionals, as they create new knowledge and try to integrate it into the organization. Group collaboration and support systems support the creation and sharing of knowledge

among people working in groups. Artificial intelligence systems provide organizations and managers with codified knowledge that can be reused by others in the organization.

7.2 Information and Knowledge Work Systems

Information work is work that consists primarily of creating or processing information. It is carried out normally by:

- *Data workers* who primarily process and disseminate the organization's information and paperwork such as secretaries or bookkeepers.
- *Knowledge workers* who design products or services or create knowledge for the organization such as engineers, scientist or architects.

Main function is to generate information based on their knowledge.

7.2.1 Distributing Knowledge: Office and Document Management Systems

Most data work and a great deal of knowledge work take place in offices, so the office plays a major role in coordinating the flow of information throughout the entire organization. The office has three basic functions, which is managing and coordinating the work of data and knowledge workers, connecting the work of the local information workers with all levels and functions of the organization and connecting the organization to the external world. The major activities carried out by the workers:

- Managing documents.
- Scheduling for individuals and groups.
- Managing data.

These activities can be supported by OAS, which can be defined as any application of information technology that intends to increase productivity of information workers in the office. OAS can be a word processing system, desktop publishing system and document imaging system. Although word processing and desktop publishing address the creation and presentation of documents, they only exacerbate the existing paper avalanche problem. Locating and updating information in that format is a great source of organizational inefficiency. One way to reduce problems stemming from paper work-flow is to employ document imaging system. The diagram of typical components

of a document imaging system can be found in chapter 3. Document imaging system is a:

- System that converts documents and images into digital form so that they can be stored and accessed by the computer.
- The systems store, retrieve and manipulate a digitized image of a document, allowing the document itself to be discarded.
- The system must contain a scanner that converts the document image into a bit-mapped image, storing that image as a graphic.
- If the document is not in active use, it usually is stored on an optical disk system.
- The optical disk kept on-line in a jukebox (a device for storing and retrieving many optical disks), require a certain amount of time to retrieve the document automatically.
- The system also requires an index server to contain the indexes that will allow users to identify and retrieve document when needed.
- Index data are entered so that a document can be retrieved in a variety of ways, depending upon application.

7.2.2 Creating Knowledge: Knowledge Work Systems

Knowledge workers perform three key roles that are critical to the organization and to managers who work within the organization. The first key role is keeping the organization up-to-date in knowledge as it develops in the external world – in technology, science, social thought and the arts. Secondly, knowledge workers also serve as internal consultants regarding the areas of their knowledge, the changes taking places and the opportunities. Lastly, this group of workers also acts as change agents evaluating, initiating and promoting change projects. Some basic requirements of KWS:

- Requires great computing power in order to handle rapidly sophisticated graphics or complex calculations.
- Quick and easy access to external databases.
- User-friendly interfaces to save time by allowing user to perform needed tasks and get to required information without having to spend a lot of time learning how to use the computer.

Examples of KWS:

- CAD/CAM, which stands for computer-aided design and computer-aided manufacturing, provides engineers, designers and factory managers with precise control over industrial design and manufacturing.
- Virtual reality systems, which provides drug designers, architects, engineers and medical workers with precise photo-realistic simulations of objects.
- Investment workstations, which consists of high-end PCs used in financial sector to analyze trading situations instantaneously and facilitate portfolio management.

7.2.3 Sharing Knowledge: Group Collaboration Systems and Intranet Knowledge Environments

In group coordination and collaboration, they key technologies involved are like e-mail, teleconferencing, data-conferencing, videoconferencing, groupware and intranets. Out of so many different technologies, groupware and intranets are the most valuable in sharing knowledge. Groupware is software that recognizes the significance of groups in offices by providing functions and services that support collaborative activities of work groups, was the primary tool for creating collaborative work environments. It is built around three key principles – communication, collaboration and coordination (the 3 C's). Groupware is capable to perform the following tasks:

- Publishing – posting documents as well as simultaneous work on the same document by multiple users along with a mechanism to track changes to these documents.
- Replication – maintaining and updating identical data on multiple PCs and servers.
- Discussion tracking – organizing discussions by many users on different topics.
- Document management – storing information from various types of software in a database.
- Work-flow management – moving and tracking documents created by groups.
- Portability – availability of software for mobile use to access the corporate network from the road.
- Security – preventing unauthorized access to data.

- Application development – developing custom software applications with the software.

7.3 Artificial Intelligence

7.3.1 What is Artificial Intelligence?

A narrow definition of the term "intelligence" is the "ability to learn". The better equipped a person is with mental tools to learn and apply new ideas, the higher his or her intelligence. But intelligence actually includes many things; making associations between a previous experience and a new situation, drawing conclusion in a systematic manner, quickly adopting new ways to solve problems, being able to separate what is important from what is not important in solving a problem and determining what tools can or cannot help in handling complex situations. In short, intelligence is the ability to learn and also to think. Artificial intelligence (AI) can be defined as the effort to develop computer-based systems that can behave like human, with the ability to learn languages, accomplish physical tasks, use perceptual apparatus and emulate human expertise and decision making. The family of AI includes:

- Natural language processing

Natural language processors (NLPs) are programs that are designed to take human language as input and translate it into standard set of statements that a computer can execute. The purpose of these sophisticated programs is to alow human beings to use their own natural language when interacting with programs such as databases management systems (DBMSs) or decision making systems (DSSs). The goal of natural language processors is eventually eliminate the need for people to learn programming languages or customized commands for computers to understand them. Their great advantage is in the way they can be used in combination with voice-recognition devices to allow the user to command computers to perform tasks, without touching a keyboard or any other input device. One of the greatest challenges in natural language processing is the fact that the same combination of words may take on completely different meanings depending upon the context in which it is used. The challenge is to teach the machine to interpret the words correctly, according to their context.

- Robotics

Robotics engineer build machines designed to perform useful work. Many are designed to do what human beings have long done, only more efficiently and effectively. Besides that, robots are also extremely useful in environments where people can be easily and seriously injured such as defusing a bomb. In general, robots need to sense their position and their surroundings, execute the functions they are programmed to perform and provide feedback as needed. With the advancement of voice recognition, some robots are programmed to recognize and execute vocal commands.

- Expert systems

Expert systems (ESs) are the efforts that were directed toward the design of programs to solve problems in specific areas by utilizing experts' knowledge and reasoning. The purpose of ESs it to replicate the unstructured and undocumented knowledge of the few (the experts) and put it at the disposal of others. Because f the way ESs are formulated (based on experience of experts) ESs cannot help users deal with events that are not taken into consideration by the experts during development. To build an ES, a specialist called a knowledge engineer questions expert and translates their knowledge into code. In most systems, the knowledge is represented in one of several forms. The most popular form is IF-THEN rules. Two other methods used to represent knowledge in a computer program are semantic frames, which are tables of list entities and their attributes and semantic networks, which are maps of entities and their related attributes. ES shells – programs designed to facilitate development of ESs with minimal programming – have facilitated the building of ESs.

Although the cost of developing some systems can reach seven figures or more, the benefits can outweigh the expenses. The benefits or reasons for using expert system are as follows:

- Contributes to productivity by conducting tasks that free employees to focus on work only human beings can do.
- To enhance product/service quality.
- To enforce consistent reasoning.
- To gain more insight into decision-making process.
- To better control complex systems.
- To distribute scarce expertise.
- To preserve expertise.

- To train less-experienced employees.
- To reduce costs.
- To monitor vast amount of information.

While the use of ESs can save resources, the systems have their limitations. Time and research efforts will be needed to overcome the limitations that ESs still have, including the following:

- ESs can handle only narrow domains.
- ESs do not posses common sense.
- Ess have limited ability to learn.
- Require large, lengthy and expensive development efforts.
- High cost involved in hiring or training expertise in this field.
- Knowledge base of expert system is fragile and brittle.
- Can only represent limited forms of knowledge.

- Intelligent machine/agents

Intelligence agents is the latest development in AI, where computer programs that automatically wade through massive amounts of data and select and deliver the most suitable information for the user, according to contextual or specific requirements. The major application of intelligent agents is on the Web. The main purpose of intelligent agents is to carry out their assignments significantly faster, more frequently and more effectively than human beings.

- Artificial vision

Artificial vision is the ability of a machine to "see" its environment, to make choices about its actions based on what it sees and to recognize visual input according to general patterns.

- Neural networks

Neural networks are design to mimic the way the human brain operates – the way it links facts, draws conclusion and uses experience to learn and to understand how new facts relate to each other. Neural networks enable machine learning, the ability of a system to update its knowledge dynamically from its own experiences and apply them to future sessions.

- Fuzzy Logic

Fuzzy logic is based on rules that do not have discrete boundaries, but lie along a continuum, enabling a system to better deal with ambiguity. Fuzzy logic allows computer applications to solve in a manner that is more human like.

- Genetic algorithms

Genetic algorithms are mathematical functions that use Darwinian principles to improve an application. The functions are designed to simulate in the software environment, in minutes or seconds, what happens in natural environments over millions of years. The process starts with a large collection of functions, relatively small and well-defined computer program designed to solve part of an overall problem. The programs are run, and the results are tested to determine which programs give the best results in solving a problem. The best programs are kept, the others are mutated and the new generation of programs is tested. The process is repeated until a clear best program emerges.

7.3.2 Why Business is interested in AI?

Although AI applications are much more limited than human intelligence, they are of great interest to business for the following reasons:

- To preserve expertise that might be lost through the retirement, resignation or death of an acknowledged expert.
- To store information in an active form – to create knowledge base.
- To create a mechanism that is not subject to human feelings.
- To eliminate routine and unsatisfying jobs held by people.
- To enhance the organization's knowledge base by suggesting solutions to specific problems that are too massive and complex to be analyzed by human being in a short period of time.

CHAPTER EIGHT: ENHANCING MANAGEMENT DECISION MAKING

After completing this chapter, you will be able to:

- Differentiate and describe a decision-support system and a group decision-support system
- Describe how decision-support systems and group decision-support system can enhance decision making
- Describe the capabilities of executive support system
- Assess the benefits of executive support system.

8.1 Decision Support System

Decision Support System (DSS) is a computer system at the management level of an organization that combines data, analytical tools and models to support semi-structured and unstructured decision making. A DSS provides users with a flexible set of tools and capabilities for analyzing important blocks of data.

8.1.1 DSS vs. MIS

DSS are more targeted than MIS systems. An MIS provides managers with reports based on routine flows of data and assists in the general control of the organization. Meanwhile, DSS is tightly focused on a specific decision or classes of decisions such as routing, queuing, evaluating and so forth. A DSS promises end-user control of data, tools and sessions. An MIS focused on structured information flows whereas DSS emphasizes on change, flexibility and a quick response. With a DSS there is less of an effort to link users to structured information flows and a correspondingly greater emphasis on models, assumptions, ad hoc queries and display graphics. Both the DSS and MIS rely on professional analysis and design. However, MIS usually follows a traditional system development methodology where information requirements are frozen before design and throughout the life cycle but DSS is consciously iterative and never frozen.

8.1.2 Types of Decision-Support Systems

There are two basic types of decision-support systems, model-driven and data driven. Model-driven DSS were primarily stand-alone system that uses some type of model to perform "what-if" and other kinds of analyses. Such systems were often developed by end-user divisions or groups not under central IS control. Their analysis capabilities were based on a strong theory or model combined with a good user interface that made the model easy to use.

The second type is a data-driven DSS. These systems support decision making by allowing users to extract and analyze useful information that was previously buried in large database. Data from TPS are collected in data warehouse for this purpose. On-line analytical processing (OLAP) and data-mining (technology used to find hidden patterns and relationships in large databases and inferring rules from them to predict future behavior) can then be used to analyze data. The types of information can be yield from data-mining includes associations, sequences, classifications, clusters and forecasts.

8.1.3 Components of DSS

Figure 8.1 below illustrates the components of a typical DSS. They include:

- DSS database – a collection of current or historical data from a number of applications or groups. Can be a small PC database or a massive data warehouse.
- DSS software system – collection of software tools that are used for data analysis, such as OLAP or data-mining tools, or a collection of mathematical and analytical models.
- User interface – permits easy interaction between users of the system and the DSS software tools.

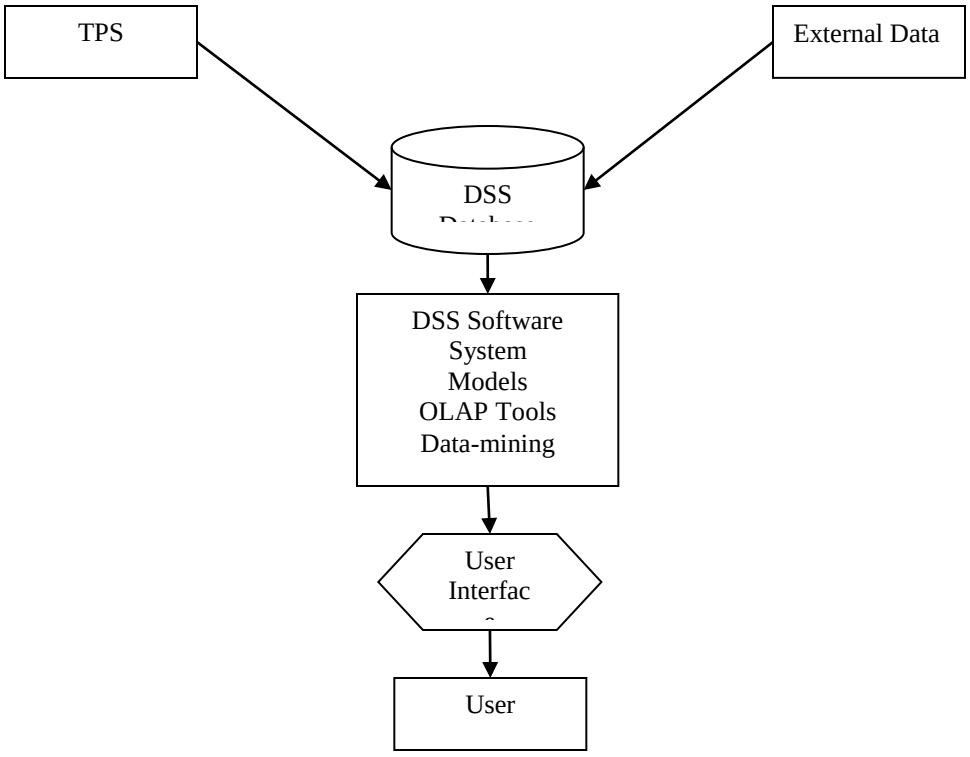


Figure 8.1

8.1.4 Web-based DSS

DSS based on the web and the Internet are being developed to:

- Support decision-making
- Providing on-line access to various databases and information pools along with data analysis software.

Customer decision-support system (CDSS) is a system to support the decision-making process of an existing or potential customer.

8.2 Group Decision-Support System

Early DSS focused largely on supporting individual decision making. However because so much work is accomplished in groups within organization, system developers and scholars began to focus on how computers can support group and organizational

decision making. And result from this, a new category of systems developed, known as group decision-support systems (GDSS).

8.2.1 What is Group Decision-Support System (GDSS)?

GDSS is an interactive computer-based system to facilitate the solution for unstructured problems by a set of decision makers working together as a group. GDSS was developed in response to a growing concern over the quality and effectiveness of meetings. The purposes of having GDSS are as follows:

- Improve preplanning to make meetings more effective and efficient.
- Create open, collaborative meeting atmosphere.
- Increase participation.
- Enables attendees to contribute criticism-free idea.
- Enables ideas being evaluated on its merits rather than on the basis of the source of the idea.
- Idea organization and evaluation.
- Sets priorities and making decisions.
- Access to external information.
- Preservation of "organizational memory".

One response to the problems of group decision making has been the adoption of new methods of organizing and running meetings. Techniques such as facilitated meetings, brainstorming and criticism-free idea generation have become popular and are now accepted as standard. Another response has been the application of technology to the problems resulting in the emergence of group decision-support systems.

8.2.2 Characteristics of GDSS

Three basic elements of a GDSS had been identified:

- Hardware – physical hardware and also electronic hardware.
- Software tools – like e-questionnaires, e-brainstorming and so forth.
- People – refers not only to the participants but also to a trained facilitator and often to a staff that supports the hardware and software.

An electronic meeting system (EMS) is a type of collaborative GDSS that uses information technology to make group meetings more productive by facilitating communication as well as decision making. It supports meetings at the same place and time or different places and times. The workstations are networked and are connected to the facilitator's console, which serves as both the facilitator's workstation and control panel and the meeting's file server. All data that the attendees forward from their workstations to the group are collected and saved on the file server. The facilitator is able to project computer images onto projection screen at the front center of the room. The facilitator controls the use of tools during the meeting, often selecting from a large tool box that is part of the organization's GDSS. Attendees have full control over their own desktop computers and able to view the agenda, use desktop PC ordinary tools, tap into production data that have been made available or work on the screen associated with the current meeting step and tool. However, no one can view anyone else's screens so participant's work is confidential until they release it to the file server for integration with the work of others.

8.3 Executive Support Systems (ESS)

ESS is an information system at the strategic level of an organization designed to address unstructured decision making through advanced graphics and communications. ESS combines data from internal and external sources and creates generalized computing and communications environment that can be focused and applied to a changing array of problems. ESS helps senior executives monitor organizational performance, track activities of competitors, spot problems, identify opportunities and forecast trends. ESS has the ability to drill down, moving down from a piece of summary data to lower and lower levels of detail. Benefits of using an ESS are as follows:

- Flexible.
- Ability to analyze, compare and highlight trends.
- Monitor performance more successfully in their areas of responsibility.
- Decentralization of decision making.

CHAPTER NINE: INFORMATION SYSTEMS SECURITY AND CONTROL

After completing this chapter, you will be able to:

- Describe why information systems are so vulnerable to destruction, error, abuse and system quality problems
- Compare general controls and application controls for information systems
- Select the factors that must be considered when developing the controls of information systems
- Describe the most important software quality-assurance techniques
- Describe the importance of auditing information systems and safeguarding data quality

9.1 System Vulnerability and Abuse

The development, implementation and maintenance of information systems constitute a large and growing part of the cost of doing business, protecting these resources is a primarily concern. The increasing reliance on information systems, combined with their connection to the "outside world" in the form of the Internet, makes security corporate information systems increasingly challenging. The role of computer controls and security is to protect systems against these and many other mishaps, as well as to help organizations ensure that their information systems operations complies with the law and with expectation of employees and customers for privacy. The major goals of information security are:

- To reduce the risk of systems and organizations ceasing operations.
- To maintain information confidentiality.
- To ensure the integrity and reliability of data resources.
- To ensure the availability of data resources.
- To ensure compliance with national security laws and privacy policies and laws.

9.1.1 Why Systems are vulnerable?

The threats to computerized information system can stem from technology, organizational and environmental factors. The threats can be view from two main aspect, risk to hardware and risk to application and data.

Risk to hardware involves physical damage to computers, peripheral equipment and communication media. The major causes of such damage are natural disasters, blackouts and brownout and vandalism.

Natural disasters that pose a risk to information systems (ISs) include fire, floods, earthquakes, tornadoes and lightning, which can destroy hardware, software or both, causing total or partial paralysis of systems or communication lines. Flood water short-circuits and burns delicate components such as microchips. Lightning and voltage surges cause tiny wires to melt and destroy circuitry. Obviously, all data and programs stored in memory chips in a computer are lost when this happens. Water from floods and the heat created when circuits are shorted may also ruin the surface of storage media such as magnetic tapes or disks, thereby destroying data. In addition, wildlife and human error occasionally destroy communication lines. The easiest way to protect against loss of data caused by natural disasters is to automatically duplicate all data periodically and store duplicate copy in a site many miles away from the office.

Blackouts and brownouts happened when power is disrupted from the computer which results in computers and its peripheral devices cannot functions. The change in power supply can have very damaging effects on computer processes and storage. Blackouts are incidents of a total loss of electrical power, meanwhile in brownouts, the voltage of the power decreases or there are very short interruptions in the flow of power. Power failure may not only disrupt operations but also cause irreparable damage to hardware. Occasional surges in voltage are equally harmful because their impact on equipment is similar to that of lightning. The popular way of handling brownouts is to connect a voltage regulator between computers and the electric network. A voltage regulator boosts or decreases voltage to smooth out drops or surges and guarantees maintenance of voltage within an acceptable tolerance. To ensure against interruptions in power supply, organization use uninterruptible power supply (UPS) systems which provide an alternative power supply for a short time, as soon as a power net fails.

Vandalism occurs when human beings deliberately destroy computer systems. It is difficult to defend computers against vandalism. In the work place, the best measure

against vandalism is to allow access only to those who have real need for the system. Sensitive equipment, such as servers, should be locked in a special room.

Risk to application s and data are theft of information, data alteration and destruction, computer viruses, programs that support unauthorized access and non-malicious mishaps.

9.1.2 Concerns for System Builders and Users

The heightened vulnerability of automated data has created special concerns for the builders and users of information systems. These concerns include:

- Disaster. Fault-tolerant computer systems contains extra hardware, software and power supply components that can back a system up and keep it running to prevent system failure. Fault-tolerant technology is used by firms for critical applications with heavy on-line transaction processing requirements. In on-line transaction processing, transactions entered on-line are immediately processes by the computer. Multitudinous changes to databases, reporting or requests for information occurs each instant. Most of the firms will contract their backup facilities with disaster recovery firms.
- Security. Refer to the policies, procedures and technical measures used to prevent unauthorized access, alteration, theft or physical damage to information systems.
- Errors. Computers can also serve as instruments of error, severely disrupting or destroying an organization's record keeping and operations.

In addition to disasters, viruses and security breaches, defective software and data pose a constant threat to information systems, causing untold losses in productivity. Bugs and defects hides within the codes of software are the major problems faced by most of the firms. Bugs are the segment of program codes, which causes defects or errors. The main source of bugs is the complexity of decision-making code. Zero defects cannot be achieved in large programs because complete testing is not possible. Another reason that systems are unreliable is that computer software traditionally difficult to be maintained. Maintenance is the most expensive phase of the systems development process due to organizational changes, which affects information requirements. Besides that, the complexity of the program code and faulty system analysis and design also contributes to

the difficulties in maintenance. Another common source to information systems failure is poor data quality (data that are inaccurate, untimely or inconsistent with other sources). Bad data can lead to bad decisions, product recalls and even financial losses.

9.2 Creating a Control Environment

To minimize all the happening of information systems failure, special policies and procedures must be incorporated into the design and implementation of information systems. The combination of manual and automated measures the safeguard information systems and ensure that they perform according to management standards is termed control. Controls are constraints and other measures imposed on a user or a system and can be used to secure systems against the risks or to reduce damage caused to systems, applications and data. Control consists of all the methods, policies and procedures that ensure protection of the organization's assets, accuracy and reliability of its records and operational adherence to management standards. Computer systems are controlled by a combination of general controls and application controls.

9.2.1 General controls:

General controls are those that control the design, security and use of the computer programs and the security of data files in general throughout the organization. It is a combination of system software and manual procedures and applies to all applications area. General controls include the following:

- Controls over the system *implementation* process, which audit the systems development process at various points to make sure that it is properly controlled and managed.
- *Software control*, which controls to ensure the security and reliability of software and also prevents unauthorized access of software programs.
- *Physical hardware controls*, which controls to ensure the physical security and correct performance of computer hardware.
- *Computer operations controls*, which are the procedures to ensure that programmed procedures, are consistently and correctly applied to data storage and processing.

- *Data security controls,* which controls to ensure that data files on either disk or tape are not subject to unauthorized access, change or destruction.
- *Administrative disciplines, standards and procedures,* which is a formalized standards, rules, procedures and disciplines to ensure that the organization's controls are properly executed and enforced. The most important administrative controls are s*egregation of functions* where the principle of internal control to divide responsibilities and assign tasks among people so their job functions do not overlap, to minimize the risk of errors and fraudulent manipulation of the organization's assets. *Written policies and procedures* will establish formal standards for controlling information systems operation. *Supervision* of personnel involved in control procedures that ensures that the controls for an information system are performing as intended.

Weakness in each of these general controls can have a widespread effect on programmed procedures and data throughout the organization. The following table summarizes the effect of weakness in general controls:

Weakness	Impact
Implementation controls	⇨ New systems or systems that have been modified will have error of fail to function as required.
Software control (program security)	⇨ Unauthorized changes can be made in processing. ⇨ The organization may not be sure of which programs or systems have been changed.
Software control (system software)	⇨ These controls may not have a direct effect on individual applications. ⇨ Other general controls depend heavily on system software, so a weakness in this area impairs the other general controls.
Hardware control	⇨ Hardware may have serious malfunctions or may break down altogether, introducing numerous errors or destroying computerized

	records.
Computer operation control	⇨ Random errors may occur in a system. ⇨ Most processing will be correct, but occasionally it may not be.
Data file security control	⇨ Unauthorized changes can be made in data stored in computer systems or unauthorized individuals can access sensitive information.
Administrative control	⇨ All of the other control may not be properly executed or enforced.

9.2.2 Application Controls

Application controls are specific controls within each separate computer application. They include automated and manual procedures that ensure that only authorized data are completely and accurately processed by that application. The controls of each application should encompass the whole sequence of processing. Application controls can be classified as:

- *Input controls*. The procedures to check data for accuracy and completeness when they enter the system. There are specific input controls for input authorization, data conversion, data editing and error handling. Control total is a type of input control that requires counting transactions or quantity fields prior to processing for comparison and reconciliation after processing. Edit checks includes routines performed to verify input data and correct errors prior to processing. Some important edit techniques are like reasonableness check, format check, existence check and dependency check.
- *Processing controls.* The routines for establishing that data are complete and accurate during updating. The major processing controls are run control totals, computer matching and programmed edit checks. Run control totals are the procedures for controlling completeness of computer updating by generating control totals that reconcile total before and after processing. Computer matching is the processing control that matches input data to information held on master files.

- *Output controls.* Measures that ensure the results of computer processing are accurate, complete and properly distributed. Typical output controls includes the following:
    - Balancing output totals with input and processing totals.
    - Reviews of the computer processing logs to determine that all of the correct computer jobs executed properly for processing
    - Formal procedures and documentation specifying authorized recipients of output reports, checks or other critical documents.