IT APPLICATIONS IN COMMERCE

M.Com
First Semester
Paper IV
Study Material
2015 Admission onwards

UNIVERSITY OF CALICUT
SCHOOL OF DISTANCE EDUCATION
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Prepared by
   Prof. Biju John.M
   Department of Commerce,
   St.Thomas College, Thrissur

Scrutinised by
   Dr. Yakoob . C.
   Reader and Research Guide,
   SS College, Areacode.

Settings & Lay out:
   Computer Section, SDE

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Chapter 1
INFORMATION

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

DEFINITION OF INFORMATION

Gorden B. Davis and Margrethe H. Olson define information as “the data that has been processed into a form that is meaningful to the recipient and is of real and perceived value in current or prospective actions or decisions”.

In other words the data which has been converted into a useful and meaningful form is information.

Information Concepts

The word `information’ is used commonly in our day to day working. In MIS, information has a precise meaning and it is different from data. The information has a value in decision making while data does not have. Information brings clarity and creates an intelligent human response in the mind.

In MIS a clear distinction is made between data and information. Data is like raw materials while the information is equivalent to the finished goods produced after processing the raw material. Information has certain characteristics. These are:

- Information
- Improves representation of an entity
- Updates the level of knowledge
- Has a surprise value
- Reduces uncertainty
- Aids in decision making

The quality of information could be called good or bad depending on the mix of these characteristics.
Information can be defined as meaningfully interpreted data. If we give you a number 1-212-290-4700, it does not make any sense on its own. It is just a raw data. However if we say Tel: +1-212-290-4700, it starts making sense. It becomes a telephone number. If I gather some more data and record it meaningfully like:

Address: 350 Fifth Avenue, 34th floor
New York, NY 10118-3299 USA
Tel: +1-212-290-4700
Fax: +1-212-736-1300

It becomes very useful information - the address of New York office of Human Rights Watch, a non-profit, non-governmental human rights organization.

So, from a system analyst's point of view, information is a sequence of symbols that can be construed to a useful message.

An Information System is a system that gathers data and disseminates information with the sole purpose of providing information to its users.

The main object of an information system is to provide information to its users. Information systems vary according to the type of users who use the system.

A Management Information System is an information system that evaluates, analyzes, and processes an organization's data to produce meaningful and useful information based on which the management can take right decisions to ensure future growth of the organization.

Information Vs Data

Data can be described as unprocessed facts and figures. Plain collected data as raw facts cannot help in decision-making. However, data is the raw material that is organized, structured, and interpreted to create useful information systems.

Data is defined as 'groups of non-random symbols in the form of text, images, voice representing quantities, action and objects'.

Information is interpreted data; created from organized, structured, and processed data in a particular context.

According to Davis and Olson:
"Information is a data that has been processed into a form that is meaningful to recipient and is of real or perceived value in the current or the prospective action or decision of recipient."

Information, Knowledge and Business Intelligence

Professor Ray R. Larson of the School of Information at the University of California, Berkeley, provides an Information Hierarchy, which is:

- Data - The raw material of information.
- Information - Data organized and presented by someone.
- Knowledge - Information read, heard, or seen, and understood.
- Wisdom - Distilled and integrated knowledge and understanding.

Scott Andrews' explains Information Continuum as follows:

- Data - A Fact or a piece of information, or a series thereof.
- Information - Knowledge discerned from data.
- Business Intelligence - Information Management pertaining to an organization's policy or decision-making, particularly when tied to strategic or operational objectives.
CHARACTERISTICS OF INFORMATION

Good information is that which is used and which creates value. Experience and research shows that good information has numerous qualities. Good information is relevant for its purpose, sufficiently accurate for its purpose, complete enough for the problem, reliable and targeted to the right person. It is also communicated in time for its purpose, contains the right level of detail and is communicated by an appropriate channel, i.e. one that is understandable to the user. Further details of these characteristics related to organizational information for decision-making follows.

Availability/accessibility

Information should be easy to obtain or access. Information kept in a book of some kind is only available and easy to access if you have the book to hand. A good example of availability is a telephone directory, as every home has one for its local area. It is probably the first place you look for a local number. But nobody keeps the whole country’s telephone books so for numbers further afield you probably phone a directory enquiry number. For business premises, say for a hotel in London, you would probably use the Internet. Businesses used to keep customer details on a card-index system at the customer’s branch. If the customer visited a different branch a telephone call would be needed to check details. Now, with centralized computer systems, businesses like banks and building societies can access any customer’s data from any branch.

Accuracy

Information needs to be accurate enough for the use to which it is going to be put. To obtain information that is 100% accurate is usually unrealistic as it is likely to be too expensive to produce on time. The degree of accuracy depends upon the circumstances. At operational levels information may need to be accurate to the nearest penny – on a supermarket till receipt, for example. At tactical level department heads may see weekly summaries correct to the nearest £100, whereas at strategic level directors may look at comparing stores’ performances over several months to the nearest £100,000 per month.

Accuracy is important. As an example, if government statistics based on the last census wrongly show an increase in births within an area, plans may be made to build schools and construction companies may invest in new housing developments. In these cases any investment may not be recouped.

Reliability or objectivity

Reliability deals with the truth of information or the objectivity with which it is presented. You can only really use information confidently if you are sure of it’s reliability and objectivity. When researching for an essay in any subject, we might make straight for the library to find a suitable book. We are reasonably confident that the information found in a book, especially one that the library has purchased, is reliable and (in the case of factual information) objective. The book has been written and the author’s name is usually printed for all to see. The publisher should have employed an editor and an expert in the field to edit the book and question any factual doubts they may have. In short, much time and energy goes into publishing a book and for that reason we can be reasonably confident that the information is reliable and objective.
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Compare that to finding information on the Internet where anybody can write unedited and unverified material and ‘publish’ it on the web. Unless you know who the author is, or a reputable university or government agency backs up the research, then you cannot be sure that the information is reliable. Some Internet websites are like vanity publishing, where anyone can write a book and pay certain (vanity) publishers to publish it.

Relevance/appropriateness

Information should be relevant to the purpose for which it is required. It must be suitable. What is relevant for one manager may not be relevant for another. The user will become frustrated if information contains data irrelevant to the task in hand.

For example, a market research company may give information on users’ perceptions of the quality of a product. This is not relevant for the manager who wants to know opinions on relative prices of the product and its rivals. The information gained would not be relevant to the purpose.

Completeness

Information should contain all the details required by the user. Otherwise, it may not be useful as the basis for making a decision. For example, if an organization is supplied with information regarding the costs of supplying a fleet of cars for the sales force, and servicing and maintenance costs are not included, then a costing based on the information supplied will be considerably underestimated.

Ideally all the information needed for a particular decision should be available. However, this rarely happens; good information is often incomplete. To meet all the needs of the situation, you often have to collect it from a variety of sources.

Level of detail/conciseness

Information should be in a form that is short enough to allow for its examination and use. There should be no extraneous information. For example, it is very common practice to summarize financial data and present this information, both in the form of figures and by using a chart or graph. We would say that the graph is more concise than the tables of figures as there is little or no extraneous information in the graph or chart. Clearly there is a trade-off between level of detail and conciseness.

Presentation

The presentation of information is important to the user. Information can be more easily assimilated if it is aesthetically pleasing. For example, a marketing report that includes graphs of statistics will be more concise as well as more aesthetically pleasing to the users within the organization. Many organizations use presentation software and show summary information via a data projector. These presentations have usually been well thought out to be visually attractive and to convey the correct amount of detail.

Timing

Information must be on time for the purpose for which it is required. Information received too late will be irrelevant. For example, if you receive a brochure from a theatre and notice there was a concert by your favorite band yesterday, then the information is too late to be of use.
Value of information

The relative importance of information for decision-making can increase or decrease its value to an organization. For example, an organization requires information on a competitor’s performance that is critical to their own decision on whether to invest in new machinery for their factory. The value of this information would be high. Always keep in mind that information should be available on time, within cost constraints and be legally obtained.

Cost of information

Information should be available within set cost levels that may vary dependent on situation. If costs are too high to obtain information an organization may decide to seek slightly less comprehensive information elsewhere. For example, an organization wants to commission a market survey on a new product. The survey could cost more than the forecast initial profit from the product. In that situation, the organization would probably decide that a less costly source of information should be used, even if it may give inferior information.

The difference between value and cost

Many students in the past few years have confused the definitions of value and cost. Information gained or used by an organization may have a great deal of value even if it may not have cost a lot. An example would be bookshops, who have used technology for many years now, with microfiche giving way to computers in the mid to late 1990s. Microfiche was quite expensive and what the bookshops received was essentially a list of books in print. By searching their microfiche by publisher they could tell you if a particular book was in print. Eventually this information became available on CD-ROM. Obviously this information has value to the bookshops in that they can tell you whether or not you can get the book. The cost of subscribing to microfiche was fairly high; subscribing to the CD-ROM version only slightly less so.

Much more valuable is a stock system which can tell you instantly whether or not the book is in stock, linked to an on-line system which can tell you if the book exists, where it is available from, the cost and delivery time. This information has far more value than the other two systems, but probably actually costs quite a bit less. It is always up-to-date and stock levels are accurate.

We are so used to this system that we cannot envisage what frustrations and inconvenience the older systems gave. The new system is certainly value for money.

QUALITY OF INFORMATION

Information is a vital resource for the success of any organization. Future of an organization lies in using and disseminating information wisely. Good quality information placed in right context in right time tells us about opportunities and problems well in advance.

Good quality information: Quality is a value that would vary according to the users and uses of the information.

According to Wang and Strong, following are the dimensions or elements of Information Quality:

- **Intrinsic**: Accuracy, Objectivity, Believability, Reputation
Various authors propose various lists of metrics for assessing the quality of information. Let us generate a list of the most essential characteristic features for information quality:

- **Reliability**: It should be verifiable and dependable.
- **Timely**: It must be current and it must reach the users well in time, so that important decisions can be made in time.
- **Relevant**: It should be current and valid information and it should reduce uncertainties.
- **Accurate**: It should be free of errors and mistakes, true, and not deceptive.
- **Sufficient**: It should be adequate in quantity, so that decisions can be made on its basis.
- **Unambiguous**: It should be expressed in clear terms. In other words, in should be comprehensive.
- **Complete**: It should meet all the needs in the current context.
- **Unbiased**: It should be impartial, free from any bias. In other words, it should have integrity.
- **Explicit**: It should not need any further explanation.
- **Comparable**: It should be of uniform collection, analysis, content, and format.
- **Reproducible**: It could be used by documented methods on the same data set to achieve a consistent result.

**CLASSIFICATION OF INFORMATION**

Information can be classified in a number of ways and in this chapter, you will learn two of the most important ways to classify information.

**Classification by Characteristic**

Based on Anthony's classification of Management, information used in business for decision-making is generally categorized into three types:

- **Strategic Information**: Strategic information is concerned with long term policy decisions that defines the objectives of a business and checks how well these objectives are met. For example, acquiring a new plant, a new product, diversification of business etc., comes under strategic information.

- **Tactical Information**: Tactical information is concerned with the information needed for exercising control over business resources, like budgeting, quality control, service level, inventory level, productivity level etc.

- **Operational Information**: Operational information is concerned with plant/business level information and is used to ensure proper conduction of specific operational tasks as planned/intended. Various operator specific, machine specific and shift specific jobs for quality control checks comes under this category.
Classification by Application

In terms of applications, information can be categorized as:

- **Planning Information:** These are the information needed for establishing standard norms and specifications in an organization. This information is used in strategic, tactical, and operation planning of any activity. Examples of such information are time standards, design standards.

- **Control Information:** This information is needed for establishing control over all business activities through feedback mechanism. This information is used for controlling attainment, nature and utilization of important processes in a system. When such information reflects a deviation from the established standards, the system should induce a decision or an action leading to control.

- **Knowledge Information:** Knowledge is defined as "information about information". Knowledge information is acquired through experience and learning, and collected from archival data and research studies.

- **Organizational Information:** Organizational information deals with an organization's environment, culture in the light of its objectives. Karl Weick's Organizational Information Theory emphasizes that an organization reduces its equivocality or uncertainty by collecting, managing and using these information prudently. This information is used by everybody in the organization; examples of such information are employee and payroll information.

- **Functional/Operational Information:** This is operation specific information. For example, daily schedules in a manufacturing plant that refers to the detailed assignment of jobs to machines or machines to operators. In a service oriented business, it would be the duty roster of various personnel. This information is mostly internal to the organization.

- **Database Information:** Database information construes large quantities of information that has multiple usage and application. Such information is stored, retrieved and managed to create databases. For example, material specification or supplier information is stored for multiple users.

INFORMATION OVERLOAD

In the second half of the 20th Century, advances in computer and information technology led to the creation of the Internet.

In the modern information age, information overload is experienced as distracting and unmanageable information such as email spam, email notifications, instant messages, Tweets and Facebook updates in the context of the work environment. Social media has resulted in "social information overload," which can occur on sites like Facebook, and technology is changing to serve our social culture.

In today's society, day-to-day activities increasingly involve the technological world where information technology exacerabtes the number of interruptions that occur in the work environment. A study from 1997 that found 50% of management in Fortune 1000 companies were disrupted by emails more than six times an hour. Adding this decade's use of the Internet, management may be even more disrupted in their decision making, and may result in more poor decisions. Thus, the PIECES framework mentions information overload as a potential problem in existing information systems.
As the world moves into a new era of globalization, an increasing number of people are connecting to the Internet to conduct their own research and are given the ability to produce as well as consume the data accessed on an increasing number of websites. Users are now classified as active users because more people in society are participating in the Digital and Information Age. More and more people are considered to be active writers and viewers because of their participation. This flow has created a new life where we are now in danger of becoming dependent on this method of access to information. Therefore, we see an information overload from the access to so much information, almost instantaneously, without knowing the validity of the content and the risk of misinformation.

According to Sonora Jha of Seattle University, journalists use the Web to conduct research, get information regarding interviewing sources and press releases and update news online. Lawrence Lessig has described this as the "read-write" nature of the Internet.

"The resulting abundance of – and desire for more (and/or higher quality) – information has come to be perceived in some circles, paradoxically, as the source of as much productivity loss as gain." Information Overload can lead to "information anxiety," which is the gap between the information we understand and the information that we think that we must understand. As people consume increasing amounts of information in the form of news stories, e-mails, blog posts, Facebook statuses, Tweets, Tumblr posts and other new sources of information, they become their own editors, gatekeepers, and aggregators of information. One concern in this field is that massive amounts of information can be distracting and negatively impact productivity and decision-making. Another concern is the "contamination" of useful information with information that might not be entirely accurate (Information pollution). Research done is often done with the view that IO is a problem that can be understood in a rational way.

The general causes of information overload include:

- A rapidly increasing rate of new information being produced also known as journalism of assertion which is a continuous news culture where there is a premium put on how quickly news can be put out which leads to a competitive advantage in news reporting but this affects the quality of the news stories.
- The ease of duplication and transmission of data across the Internet
- An increase in the available channels of incoming information (e.g. telephone, e-mail, instant messaging, RSS)
- Ever-increasing amounts of historical information to dig through
- Contradictions and inaccuracies in available information
- A low signal-to-noise ratio
- A lack of a method for comparing and processing different kinds of information
- The pieces of information are unrelated or do not have any overall structure to reveal their relationships.

Information overload is not a monolithic problem. Instead, it is a kaleidoscope of intersecting smaller problems – information growth, information diversity, business process response times, human to information interactions, and information technology. It can be dealt with piece-meal, one process, one workflow, one application at a time. At this granular level, there are solutions. - Tackling Information Overload At the Source.
• create a "junk" email address. Use this email address for services you do not need to check regularly.
• On inboxes you check daily set up filters to remove unnecessary messages.
• Pay attention to the emails you send. Pay attention to who you cc and try to avoid generic "thanks" or "great" replies.
• Write clearly and try to stick to one theme in emails. Keep your subject line specific (i.e. don't just send a subject line stating "tomorrow").
• Read your message before you send it. This will help make your messages clear and hopefully avoid spelling errors.
• Respect your colleagues time as if it were your own. Allow time for you message to be answered.
• Use search techniques to control search results. Boolean logic (using AND or OR) and advanced options will narrow the field.
• Try to avoid online distractions when searching for specific content.
• Improve your search strategy to decrease results and noise.
• Develop a strategy for reviewing information

QUESTIONS
SHORT ANSWER TYPE
1. Define Information.
2. What is Business Intelligence?
3. Briefly describe Strategic Information.
4. What is accessibility of Information?

SHORT ESSAY TYPE
1. Explain Information Overload.
2. What are the characteristics of Information?
3. Explain in detail the classification of Information.

ESSAY QUESTIONS
1. Discuss the basic Concepts of Information. Explain the Quality, Characteristics and Classification of Information.
Simply put, a system is an array of components that work together to achieve a common goal, or multiple goals, by accepting input, processing it, and producing output in an organized manner. Consider the following examples:

- A sound system consists of many electronic and mechanical parts, such as a laser head, an amplifier, an equalizer, and so on. This system uses input in the form of electrical power and sound recorded on a medium such as a CD or DVD, and processes the input to reproduce music and other sounds. The components work together to achieve this goal.

- Consider the times you have heard the phrase “to beat the system.” Here, the term “system” refers to an organization of human beings—a government agency, a commercial company, or any other bureaucracy. Organizations, too, are systems; they consist of components—people organized into departments and divisions—that work together to achieve common goals.

**Systems and Subsystems**

Not every system has a single goal. Often, a system consists of several subsystems components of a larger system—with sub goals, all contributing to meeting the main goal. Subsystems can receive input from, and transfer output to, other systems or subsystems. Consider the different departments of a manufacturing business. The marketing department promotes sales of the organization’s products; the engineering department designs new products and improves existing ones; the finance department plans a budget and arranges for every unused penny to earn interest by the end of the day. Each department is a subsystem with its own goal, which is a sub-goal of a larger system (the company), whose goal is to maximize profit.

Now consider the goals of a manufacturing organization’s information system, which stores and processes operational data and produces information about all aspects of company operations. The purpose of its inventory control subsystem is to let managers know what quantities of which items are on hand and which may soon have to be reordered. The purpose of the production control subsystem is to track the status of manufactured parts. The assembly control subsystem presents the bill of material (a list of all parts that make up a product) and the status of assembled products. The entire system’s goal is to help deliver finished goods at the lowest possible cost within the shortest possible time.

An accounting system consists of several subsystems: accounts payable, records information about money that the organization owes to suppliers and service providers; accounts receivable, records sums owed to the organization and by whom; a general ledger, records current transactions; and a reporting mechanism, generates reports reflecting the company’s financial status. Each subsystem has a well-defined goal. Together, the subsystems make up the organization’s accounting system.

All professionals must understand systems, both organizational and physical. They need to understand their position in an organization so they can interact well with coworkers, employees of business partners, and customers. They need to understand information systems so that they can utilize them to support their work and interactions with other people.
Information Systems in Organizations

In an organization, an information system consists of data, hardware, software, telecommunications, people, and procedures. An information system has become synonymous with a computer-based information system, a system with one or more computers at its center, and which is how the term is used in this book. In a computer-based information system, computers collect, store, and process data into information according to instructions people provide via computer programs. Several trends have made the use of information systems (ISs) very important in business:

- The power of computers has grown tremendously while their prices have dropped.
- The capacity of data storage devices has grown while their prices have decreased.
- The variety and ingenuity of computer programs have increased.
- Quick and reliable communication lines and access to the Internet and the Web have become widely available and affordable.
- The fast growth of the Internet has opened opportunities and encouraged competition in Global markets.
- An increasing proportion of the global workforce is computer literate.

In this environment, organizations quickly lag behind if they do not use information systems and skills to meet their goals. Moreover, they must continuously upgrade the features of their information systems and the skills of their employees to stay competitive.

The Four Stages of Processing

All information systems 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:

- Entering data into the IS (input).
- Changing and manipulating the data in the IS (data processing).
- Getting information out of the IS (output).
- Storing data and information (storage).

A computer-based IS also uses a logical process to decide which data to capture and how to process it.

Input

The first step in producing information is collecting and introducing data, known as input, into the IS. Most data an organization uses as input to its ISs are generated and collected within the organization. These data elements result from transactions undertaken in the course of doing business. A transaction is a business event: a sale, a purchase, a payment, the hiring of a new employee, and the like. These transactions can be recorded on paper and later entered into a computer system; directly recorded through terminals of a transaction processing system (TPS), such as a point-of-sale (POS) machine; or captured online when someone transacts through the Web. A TPS is any system that records transactions. Often, the same system also processes the
transactions, summarizing and routing information to other systems; therefore, these systems are transaction processing systems, not just transaction recording systems.

Input devices (devices used to enter data into an IS) include the keyboard (currently the most widely used), infrared devices that sense bar codes, voice recognition systems, and touch screens. The trend has been to decrease the time and effort of input by using devices that allow scanning or auditory data entry.

Processing

The computer’s greatest contribution to ISs is efficient data processing. The computer’s speed and accuracy enable organizations to process millions of pieces of data in several seconds. For example, managers of a national retail chain can receive up-to-date information on inventory levels of every item the chain carries and then order accordingly; in the past, obtaining such information would take days. The huge gains in the speed and affordability of computing have made information the essential ingredient for an organization’s success.

Output

Output is the information an IS produces and displays in the format most useful to an organization. The most widely used output device is the video display, or video monitor, which displays output visually. Another common output device is the printer, used to print hard copies of information on paper. However, computers can communicate output through speakers in the form of music or speech and also can transmit it to another computer or electronic device in computer-coded form, for later interpretation.

Storage

One of the greatest benefits of using IT is the ability to store vast amounts of data and information. Technically, storing a library of millions of volumes on magnetic or optical storage media is feasible. Publishers, libraries, and governments have done that. For example, close to 8 million patents registered in the United States are stored on storage devices accessible through the Web.

TYPES OF SYSTEMS

Different kinds of system may be understood as Abstract and physical systems, Deterministic and probabilistic systems, Open and closed systems, and User-machines system.

Closed vs. Open Systems

Systems are closed or open, depending on the nature of the information flow in the system. A closed system stands alone, with no connection to another system: nothing flows in from another system; nothing flows out to another system. For example, a small check-producing system that prints and cuts checks when an employee enters data through a keyboard is a closed system. The system might be isolated for security purposes. An open system interfaces and interacts with other systems. For example, an accounting system that records accounts receivable, accounts payable, and cash flow is open if it receives its payroll figures from the payroll system. Subsystems, by definition, are always open, because as components of a bigger system, they must receive information from, and give information to, other subsystems. Increasingly, companies are implementing open—interfaced—information systems. Each system may then be referred to as a
module of a larger system, and the modules are interconnected and exchange data and information. For better cooperation, many organizations have interconnected their information systems to those of their business partners, mainly suppliers and clients.

An open system is one that interacts with its environment and thus exchanges information, material, or energy with the environment, including random and undefined inputs. Open systems are adaptive in nature, as they tend to react with the environment in such a way, so as to favor their continued existence. Such systems are ‘self organising’, in the sense that they change their organization in response to changing conditions.

A closed system is one, which does not interact with its environment. Such systems in business world are rare, but relatively closed systems are common. Thus, the systems that are relatively isolated from the environment but not completely closed, are termed closed system.

**Abstract and physical systems**

An abstract or conceptual system is an orderly arrangement of interdependent ideas or constructs, which may or may not have any counterpart in the real world.

On the other hand, physical systems are generally concrete operational systems made up of people, materials, machines, energy and other physical things; Physical systems are more than conceptual constructs.

**Deterministic and Probabilistic Systems**

A deterministic system is one in which the occurrence of all events is known with certainty. A probabilistic system is one in which the occurrence of events cannot be perfectly predicted. Though the behavior of such a system can be described in terms of probability, a certain degree of error is always attached to the prediction of the behavior of the system.

**User Machine Systems**

Most of the physical systems are user-machine (or human –machines) systems. It is difficult to think of a system composed only of people who do not utilize equipment of some kind to achieve their goals. In user-machine systems, both, i.e. human as well as machine perform some activities in the accomplishment of a goal (e.g. decision-making). The machine elements (may be computer hardware and software) are relatively closed and deterministic, whereas the human elements of the system are open and probabilistic.

**Natural and human-made systems**

There are natural and human-made (designed) systems. Natural systems may not have an apparent objective but their outputs can be interpreted as purposes. Human-made systems are made with purposes that are achieved by the delivery of outputs. Their parts must be related; they must be “designed to work as a coherent entity” – else they would be two or more distinct systems.

**CHARACTERISTICS OF SYSTEM**

A big system may be seen as a set of interacting smaller systems known as subsystems or functional units each of which have its defined tasks. All these work in coordination to achieve the overall objective of the system. System engineering requires development of a strong foundation in understanding how to characterize a system, product, or service in terms of its attributes, properties, and performance. Systems also exhibit certain features and characteristics, some of which are:
Objective

Every system has a predefined goal or objective towards which it works. A system cannot exist without a defined objective. For example an organization would have an objective of earning maximum possible revenues, for which each department and each individual has to work in coordination.

Standards

It is the acceptable level of performance for any system. Systems should be designed to meet standards. Standards can be business specific or organization specific. For example take a sorting problem. There are various sorting algorithms. But each has its own complexity. So, an algorithm should be the one that gives most optimum efficiency. So there should be a standard or rule to use a particular algorithm. It should be seen whether that algorithm is implemented in the system.

Environment

Every system whether it is natural or man made co-exists with an environment. It is very important for a system to adapt itself to its environment. Also, for a system to exist it should change according to the changing environment. For example, we humans live in a particular environment. As we move to other places, there are changes in the surroundings but our body gradually adapts to the new environment. If it were not the case, then it would have been very difficult for human to survive for so many thousand years.

Another example can be Y2K problem for computer systems. Those systems, which are not Y2K compliant, will not be able to work properly after year 2000. For computer a system to survive it is important these systems are made Y2K compliant or Y2K ready.

The environment is the ‘super system’ within which an organization operates. It excludes input, processes and outputs. It is the source of external elements that impinge on the system. For example, if the results calculated/the output generated by the ‘computer system’ are to be used for decision-making purposes in the factory, in a business concern, in an organization, in a school, in a college or in a government office then the system is same but its environment is different.

Feed Back

Feedback is an important element of systems. The output of a system needs to be observed and feedback from the output taken so as to improve the system and make it achieve the laid standards. A system takes input. It then transforms it into output. Also some feedback can come from customer (regarding quality) or it can be some intermediate data (the output of one process and input for the other) that is required to produce final output. Control in a dynamic system is achieved by feedback. Feedback measures output against a standard input in some form of cybernetic procedure that includes communication and control. The feedback may generally be of three types viz., positive, negative and informational. The positive feedback motivates the system. The negative indicates need of an action. The feedback is a reactive form of control. Outputs from the process of the system are fed back to the control mechanism. The control mechanism then adjusts the control signals to the process on the basis of the data it receives. Feed forward is a protective form of control. For example, in a ‘computer system’ when logical decisions are taken, the logic unit concludes by comparing the calculated results and the required results.
Boundaries

A system should be defined by its boundaries - the limits that identify its components, processes and interrelationships when it interfaces with another system. For example, in a 'computer system' there is a boundary for the number of bits, the memory size etc. that is responsible for different levels of accuracy on different machines (like 16-bit, 32-bit etc.).

Every system has defined boundaries within which it operates. Beyond these limits the system has to interact with the other systems. For instance, Personnel system in an organization has its work domain with defined procedures. If the financial details of an employee are required, the system has to interact with the Accounting system to get the required details.

Interface

Interfaces are another important element through which the system interacts with the outside world. System interacts with other systems through its interfaces. Users of the systems also interact with it through interfaces. Therefore, these should be customized to the user needs. These should be as user friendly as possible. The interface in a 'computer system' may be a CUI (Character User Interface) or a GUI (Graphical User Interface).

Control

The control element guides the system. It is the decision-making sub-system that controls the pattern of activities governing input, processing and output. It also keeps the system within the boundary set. For example, control in a 'computer system' is maintained by the control unit that controls and coordinates various units by means of passing different signals through wires.

Subsystem

A subsystem is a set of elements, which is a system itself, and a component of a larger system.

CONTROL IN SYSTEMS

Two final security management requirements that need to be mentioned are the development of information system controls and auditing business systems. Let’s take a brief look at these two security measures.

Information system controls are methods and devices that attempt to ensure the accuracy, validity, and propriety of information system activities. Information system (IS) controls must be developed to ensure proper data entry, processing techniques, storage methods, and information output. Thus, IS controls are designed to monitor and maintain the quality and security of the input, processing, output, and storage activities of any information system. For example, IS controls are needed to ensure the proper entry of data into a business system and thus avoid the garbage in, garbage out (GIGO) syndrome. Examples include passwords and other security codes, formatted data entry screens, and audible error signals. Computer software can include instructions to identify incorrect, invalid, or improper input data as it enters the computer system. For example, a data entry program can check for invalid codes, data fields, and transactions, and conduct “reasonableness checks” to determine if input data exceed specified limits or are out of sequence.
Auditing IT Security

IT security management should be periodically examined, or audited, by a company’s internal auditing staff or external auditors from professional accounting firms. Such audits review and evaluate whether proper and adequate security measures and management policies have been developed and implemented. This process typically involves verifying the accuracy and integrity of the software used, as well as the input of data and output produced by business applications. Some firms employ special computer security auditors for this assignment. They may use special test data to check processing accuracy and the control procedures built into the software. The auditors may develop special test programs or use audit software packages. Another important objective of business system audits is testing the integrity of an application’s audit trail. An audit trail can be defined as the presence of documentation that allows a transaction to be traced through all stages of its information processing. This journey may begin with a transaction’s appearance on a source document and end with its transformation into information in a final output document or report. The audit trail of manual information systems is quite visible and easy to trace. However, computer-based information systems have changed the form of the audit trail. Now auditors must know how to search electronically through disk and tape files of past activity to follow the audit trail of today’s networked computer systems.

Many times, this electronic audit trail takes the form of control logs that automatically record all computer network activity on magnetic disk or tape devices. This audit feature can be found on many online transaction processing systems, performance and security monitors, operating systems, and network control programs. Software that records all network activity is also widely used on the Internet, especially the World Wide Web, as well as on corporate intranets and extranets. Such an audit trail helps auditors check for errors or fraud, but also helps IS security specialists trace and evaluate the trail of hacker attacks on computer networks.

QUESTIONS
SHORT ANSWER TYPE
1. Define System.
2. What is User-Machine System?
4. What is Information System Control?
SHORT ESSAY TYPE
1. Elucidate the four stages in Processing.
2. What are the different types of System?
3. Explain the Characteristics of System.
ESSAY QUESTIONS
1. Explain the System Concepts. Give an elaborate account on different types of System, characteristics of System and Control in System.
Chapter 3

MANAGEMENT INFORMATION SYSTEM

Information systems have become as integrated into our daily business activities as accounting, finance, operations management, marketing, human resource management, or any other major business function. Information systems and technologies are vital components of successful businesses and organizations—some would say they are business imperatives. They thus constitute an essential field of study in business administration and management, which is why most business majors include a course in information systems. Since you probably intend to be a manager, entrepreneur, or business professional, it is just as important to have a basic understanding of information systems as it is to understand any other functional area in business.

Information technologies, including Internet-based information systems, are playing vital and expanding roles in business. Information technology can help all kinds of businesses improve the efficiency and effectiveness of their business processes, managerial decision making, and workgroup collaboration, which strengthens their competitive positions in rapidly changing marketplaces. This benefit occurs irrespective of whether the information technology is used to support product development teams, customer support processes, e-commerce transactions, or any other business activity. Information technologies and systems are, quite simply, an essential ingredient for business success in today’s dynamic global environment. Let’s take a moment to bring the real world into our discussion of the importance of information systems (IS) and information technology (IT).

If we are to understand information systems and their functions, we first need to be clear on the concept of a system. In its simplest form, a system is a set of interrelated components, with a clearly defined boundary, working together to achieve a common set of objectives. Using this definition, it becomes easy to see that virtually everything you can think of is a system, and one system can be made up of other systems or be part of a bigger system.

An information system (IS) can be any organized combination of people, hardware, software, communications networks, data resources, and policies and procedures that stores, retrieves, transforms, and disseminates information in an organization. People rely on modern information systems to communicate with one another using a variety of physical devices (hardware), information processing instructions and procedures (software), communications channels (networks), and stored data (data resources). Although today’s information systems are typically thought of as having something to do with computers, we have been using information systems since the dawn of civilization.

Even today we make regular use of information systems that have nothing to do with a computer. Consider some of the following examples of information systems: • Smoke signals for communication were used as early as recorded history and can account for the human discovery of fire. The pattern of smoke transmitted valuable information to others who were too far to see or hear the sender.

• Card catalogs in a library are designed to store data about the books in an organized manner that allows readers to locate a particular book by its title, author name, subject, or a variety of other approaches.
• Your book bag, day planner, notebooks, and file folders are all part of an information system designed to help you organize the inputs provided to you via handouts, lectures, presentations, and discussions. They also help you process these inputs into useful outputs: homework and good exam grades.

• The cash register at your favorite fast-food restaurant is part of a large information system that tracks the products sold, the time of a sale, inventory levels, and the amount of money in the cash drawer; it also contributes to the analysis of product sales in any combination of locations anywhere in the world.

• A paper-based accounting ledger as used before the advent of computer-based accounting systems is an iconic example of an information system. Businesses used this type of system for centuries to record the daily transactions and to keep a record of the balances in their various business and customer accounts.

DEFINITION

Kenneth Laudon and Jane P. Laudon defines management information system “A set of interrelated components that collect, process, store and distribute information to support decision making, coordination and control in an organization”.

Jerome Kanter defines management information system as “A system that aids management in making, carrying out and controlling decisions”.

CHARACTERISTICS OF MANAGEMENT INFORMATION SYSTEM

Following are the characteristics of an MIS:

• It should be based on a long-term planning.
• It should provide a holistic view of the dynamics and the structure of the organization.
• It should work as a complete and comprehensive system covering all interconnecting sub-systems within the organization.
• It should be planned in a top-down way, as the decision makers or the management should actively take part and provide clear direction at the development stage of the MIS. • It should be based on need of strategic, operational and tactical information of managers of an organization.
• It should also take care of exceptional situations by reporting such situations.
• It should be able to make forecasts and estimates, and generate advanced information, thus providing a competitive advantage. Decision makers can take actions on the basis of such predictions.
• It should create linkage between all sub-systems within the organization, so that the decision makers can take the right decision based on an integrated view. • It should allow easy flow of information through various sub-systems, thus avoiding redundancy and duplicity of data. It should simplify the operations with as much practicability as possible.
• Although the MIS is an integrated, complete system, it should be made in such a flexible way that it could be easily split into smaller sub-systems as and when required.
• A central database is the backbone of a well-built MIS
Characteristics of Computerized MIS

Following are the characteristics of a well-designed computerized MIS:

- It should be able to process data accurately and with high speed, using various techniques like operations research, simulation, heuristics, etc.
- It should be able to collect, organize, manipulate, and update large amount of raw data of both related and unrelated nature, coming from various internal and external sources at different periods of time.
- It should provide real time information on ongoing events without any delay.
- It should support various output formats and follow latest rules and regulations in practice.
- It should provide organized and relevant information for all levels of management: strategic, operational, and tactical.
- It should aim at extreme flexibility in data storage and retrieval.

WHAT IS AN INFORMATION SYSTEM?

An information system can be defined technically as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making and control in an organization. In addition to supporting decision making, coordination, and control, information systems may also help managers and workers analyze problems, visualize complex subjects, and create new products.

Information systems contain information about significant people, places, and things within the organization or in the environment surrounding it. By information we mean data that have been shaped into a form that is meaningful and useful to human beings. Data, in contrast, 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.

A brief example contrasting information and data may prove useful. Supermarket checkout counters scan millions of pieces of data from bar codes, which describe each product. Such pieces of data can be totaled and analyzed to provide meaningful information, such as the total number of bottles of dish detergent sold at a particular store, which brands of dish Three activities in an information system produce the information that organizations need to make decisions, control operations, analyze problems, and create new products or services.
Data and Information

*Raw data from a supermarket checkout counter can be processed and organized to produce meaningful information, such as the total unit sales of dish detergent or the total sales revenue from dish detergent for a specific store or sales territory.*

These activities are input, processing, and output. **Input** captures or collects raw data from within the organization or from its external environment. **Processing** converts this raw input into a meaningful form. **Output** transfers the processed information to the people who will use it or to the activities for which it will be used. Information systems also require **feedback**, which is output that is returned to appropriate members of the organization to help them evaluate or correct the input stage.

In the Yankees’ system for selling tickets through its Web site, the raw input consists of order data for tickets, such as the purchaser’s name, address, credit card number, number of tickets ordered, and the date of the game for which the ticket is being purchased. Computers store these data and process them to calculate order totals, to track ticket purchases, and to send requests for payment to credit card companies. The output consists of tickets to print out, receipts for orders, and reports on online ticket orders. The system provides meaningful information, such as the number of tickets sold for a particular game, the total number of tickets sold each year, and frequent customers.

Although computer-based information systems use computer technology to process raw data into meaningful information, there is a sharp distinction between a computer and a computer program on the one hand, and an information system on the other. Electronic computers and related software programs are the technical foundation, the tools and materials, of modern information systems. Computers provide the equipment for storing and processing information. Computer programs, or software, are sets of operating instructions that direct and control computer processing. Knowing how computers and computer programs work is important in designing solutions to organizational problems, but computers are only part of an information system.

**FUNCTIONS OF AN INFORMATION SYSTEM**

Functions of an Information System: An information system contains information about an organization and its surrounding environment. Three basic activities—input, processing, and output—produce the information organizations need. Feedback is output returned to appropriate people or activities in the organization to evaluate and refine the input. Environmental factors, such as customers, suppliers, competitors, stockholders, and regulatory agencies, interact with the organization and its information systems.
The successful management of information systems and technologies presents major challenges to business managers and professionals. Thus, the information systems function represents:

- A major functional area of business equally as important to business success as the functions of accounting, finance, operations management, marketing, and human resource management.
- An important contributor to operational efficiency, employee productivity and morale, and customer service and satisfaction.
- A recognized source of value to the firm.
- A major source of information and support needed to promote effective decision making by managers and business professionals.
- A vital ingredient in developing competitive products and services that give an organization a strategic advantage in the global marketplace.
- A dynamic, rewarding, and challenging career opportunity for millions of men and women.
- A key component of the resources, infrastructure, and capabilities of today’s networked business enterprises.
- A strategic resource.

**DIMENSIONS OF INFORMATION SYSTEMS**

To fully understand information systems, you 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. We refer to this broader understanding of information systems, which encompasses an understanding of the management and organizational dimensions of systems as well as the technical dimensions of systems, as information systems literacy. Computer literacy, in contrast, focuses primarily on knowledge of information technology. The field of management information systems (MIS) tries to achieve this broader information systems literacy. MIS deals with behavioral issues as well as technical issues surrounding the development, use, and impact of information systems used by managers and employees in the firm. Let’s examine each of the dimensions of information systems—Organisations, Management, and Information Technology.
Figure 2 DIMENSIONS OF INFORMATION SYSTEMS

Information Systems Are More Than Computers Using information systems effectively requires an understanding of the organization, people, and information technology shaping the systems. An information system provides a solution to important business problems or challenges facing the firm.

Organizations

Information systems are an integral part of organizations. Indeed, for some companies, such as credit reporting firms, there would be no business without an information system. The key elements of an organization are its people, structure, business processes, politics, and culture.

Organizations have a structure that is composed of different levels and specialties. Their structures reveal a clear-cut division of labor. Authority and responsibility in a business firm are organized as a hierarchy, or a pyramid structure. The upper levels of the hierarchy consist of managerial, professional, and technical employees, whereas the lower levels consist of operational personnel.

Senior management makes long-range strategic decisions about products and services as well as ensures financial performance of the firm. Middle management carries out the programs and plans of senior management and operational management is responsible for monitoring the daily activities of the business. Knowledge workers, such as engineers, scientists, or architects, design products or services and create new knowledge for the firm, whereas data workers, such as secretaries or clerks, assist with scheduling and communications at all levels of the firm. Production or service workers actually produce the product and deliver the service. Experts are employed and trained for different business functions. The major business functions, or specialized tasks performed by business organizations, consist of sales and marketing, manufacturing and production, finance and accounting, and human resources.

An organization coordinates work through its hierarchy and through its business processes, which are logically related tasks and behaviors for accomplishing work. Developing a new product, fulfilling an order, and hiring a new employee are examples of business processes.

Most organizations’ business processes include formal rules that have been developed over a long time for accomplishing tasks. These rules guide employees in a variety of procedures, from writing
an invoice to responding to customer complaints. Some of these business processes have been written down, but others are informal work practices, such as a requirement to return telephone calls from co-workers or customers, that are not formally documented. Information systems automate many business processes. For instance, how a customer receives credit or how a customer is billed is often determined by an information system that incorporates a set of formal business processes.

Levels in a Firm

Business organizations are hierarchies consisting of three principal levels: senior management, middle management, and operational management. Information systems serve each of these levels. Scientists and knowledge workers often work with middle management.

Each organization has a unique culture, or fundamental set of assumptions, values, and ways of doing things, that has been accepted by most of its members. You can see organizational culture at work by looking around your university or college. Some bedrock assumptions of university life are that professors know more than students, the reasons students attend college is to learn, and that classes follow a regular schedule. Parts of an organization’s culture can always be found embedded in its information systems.

Different levels and specialties in an organization create different interests and points of view. These views often conflict over how the company should be run and how resources and rewards should be distributed. Conflict is the basis for organizational politics. Information systems come out of this cauldron of differing perspectives, conflicts, compromises, and agreements that are a natural part of all organizations.

Management

Management’s job is to make sense out of the many situations faced by organizations, make decisions, and formulate action plans to solve organizational problems. Managers perceive business challenges in the environment; they set the organizational strategy for responding to those challenges; and they allocate the human and financial resources to coordinate the work and achieve success. Throughout, they must exercise responsible leadership. The business information systems described in this book reflect the hopes, dreams, and realities of real-world managers.
But managers must do more than manage what already exists. They must also create new products and services and even re-create the organization from time to time. A substantial part of management responsibility is creative work driven by new knowledge and information. Information technology can play a powerful role in helping managers design and deliver new products and services and redirecting and redesigning their organizations.

Information Technology

Information technology is one of many tools managers use to cope with change. Computer hardware is the physical equipment used for input, processing, and output activities in an information system. It consists of the following: computers of various sizes and shapes (including mobile handheld devices); various input, output, and storage devices; and telecommunications devices that link computers together.

Computer software consists of the detailed, preprogrammed instructions that control and coordinate the computer hardware components in an information system.

Data management technology consists of the software governing the organization of data on physical storage media.

Networking and telecommunications technology, consisting of both physical devices and software, links the various pieces of hardware and transfers data from one physical location to another. Computers and communications equipment can be connected in networks for sharing voice, data, images, sound, and video. A network links two or more computers to share data or resources, such as a printer. The world’s largest and most widely used network is the Internet. The Internet is a global “network of networks” that uses universal standards to connect millions of different networks with more than 1.4 billion users in over 230 countries around the world. The Internet has created a new “universal” technology platform on which to build new products, services, strategies, and business models. This same technology platform has internal uses, providing the connectivity to link different systems and networks within the firm. Internal corporate networks based on Internet technology are called intranets. Private intranets extended to authorized users outside the organization are called extranets, and firms use such networks to coordinate their activities with other firms for making purchases, collaborating on design, and other inter-organizational work. For most business firms today, using Internet technology is both a business necessity and a competitive advantage.

The World Wide Web is a service provided by the Internet that uses universally accepted standards for storing, retrieving, formatting, and displaying information in a page format on the Internet. Web pages contain text, graphics, animations, sound, and video and are linked to other Web pages. By clicking on highlighted words or buttons on a Web page, you can link to related pages to find additional information and links to other locations on the Web. The Web can serve as the foundation for new kinds of information systems.

All of these technologies, along with the people required to run and manage them, represent resources that can be shared throughout the organization and constitute the firm’s information technology (IT) infrastructure. The IT infrastructure provides the foundation, or platform, on which the firm can build its specific information systems. Each organization must carefully design and manage its IT infrastructure so that it has the set of technology services it needs for the work it wants to accomplish with information Systems.
The Role of Information Systems in a Business

From the brief review of business functions, entities, and environments, you can see the critical role that information plays in the life of a business. Up until the mid-1950s, firms managed all this information and information flow with paper records. During the past 50 years, more and more business information and the flow of information among key business actors in the environment has been computerized. Businesses invest in information systems as a way to cope with and manage their internal production functions and to cope with the demands of key actors in their environments. Firms invest in information systems for the following business objectives:

- To achieve operational excellence (productivity, efficiency, ability)
- To develop new products and services
- To attain customer intimacy and service (continuous marketing, sales, and service; customization and personalization)
- To improve decision making (accuracy and speed)
- To achieve competitive advantage
- To ensure survival

Managers make decisions. Decision-making generally takes a four-fold path:

- Understanding the need for decision or the opportunity,
- Preparing alternative course of actions,
- Evaluating all alternative course of actions,
- Deciding the right path for implementation.

Need for MIS

MIS is an information system that provides information in the form of standardized reports and displays for the managers. MIS is a broad class of information systems designed to provide information needed for effective decision making. Data and information created from an accounting information system and the reports generated thereon are used to provide accurate, timely and relevant information needed for effective decision making by managers.

Management information systems provide information to support management decision making, with the following goals:

- Pre-specified and preplanned reporting to managers.
- Interactive and ad-hoc support for decision making.
- Critical information for top management.

MIS is of vital importance to any organization, because:

- It emphasizes on the management decision making, not only processing of data generated by business operations.
- It emphasizes on the systems framework that should be used for organizing information systems applications.
MIS AND OTHER ACADEMIC DISCIPLINES

The management information systems draw a lot of support from other academic disciplines too. The foundation of MIS is the management theory. It uses the principles and practices of management while designing the system, and gives due regard to the theory of organizational behavior.

It considers the human mind as a processor of information. While designing the report format and forming communication channels, MIS takes into account the behavior of the manager as an individual and in a group. It gives due regard to the personal factors such as bias, thinking with a fixed frame of reference, risk aversion, strengths and weaknesses.

Another area of academics is operational research. The operational research is used for developing the models of management problem and they are then incorporated in MIS as decision support systems. The inventory control, queuing theory, and resource programming are used in the MIS as decision support systems. The network theory is used for planning and controlling large projects.

In the area of accounting application, it uses the accounting principles to ensure that the data is correct and valid. It uses the accounting methodology for generating a trial balance, balance sheet and other books of accounts.

The MIS uses the communication theory in a significant manner. The principle of feedback is used while designing analysis and reporting systems. While designing the report format, attention is paid to avoid noise and distortions in the communication process.

The MIS is based on database and uses the database for generating information. The three types of data structures, viz., hierarchical, network and relational database have roots in the mathematics and the set theory.

The MIS becomes rich in content and more useful when it becomes more and more a decision-making or decision support system. This is possible when it builds decision making systems in MIS which in turn is possible if it draws tools, techniques, methods, rules and principles from pure science and application science, and uses them as an integral part of the system. The MIS uses knowledge from management, business management, mathematics, accounting, psychology, communication theory, operations research and probability theory for building processes, methods, and decision-support systems in designing business applications.

STRATEGIC ROLE OF MIS

What is a firm to do when it is faced with all these competitive forces? And how can the firm use information systems to counteract some of these forces? How do you prevent substitutes and inhibit new market entrants? There are four generic strategies, each of which often is enabled by using information technology and systems: low-cost leadership, product differentiation, focus on market niche, and strengthening customer and supplier intimacy.
Low-Cost Leadership

Use information systems to achieve the lowest operational costs and the lowest prices. The classic example is Walmart. By keeping prices low and shelves well stocked using a legendary inventory replenishment system, Walmart became the leading retail business in the United States. Walmart’s continuous replenishment system sends orders for new merchandise directly to suppliers as soon as consumers pay for their purchases at the cash register. Point-of-sale terminals record the bar code of each item passing the checkout counter and send a purchase transaction directly to a central computer at Walmart headquarters. The computer collects the orders from all Walmart stores and transmits them to suppliers. Suppliers can also access Walmart’s sales and inventory data using Web technology. Because the system replenishes inventory with lightning speed, Walmart does not need to spend much money on maintaining large inventories of goods in its own warehouses. The system also enables Walmart to adjust purchases of store items to meet customer demands. Competitors, such as Sears, have been spending 24.9 percent of sales on overhead. But by using systems to keep operating costs low, Walmart pays only 16.6 percent of sales revenue for overhead. (Operating costs average 20.7 percent of sales in the retail industry.) Walmart’s continuous replenishment system is also an example of an efficient customer response system. An efficient customer response system directly links consumer behavior to distribution and production and supply chains. Walmart’s continuous replenishment system provides such an efficient customer response.

Product Differentiation

Use information systems to enable new products and services, or greatly change the customer convenience in using your existing products and services. For instance, Google continuously introduces new and unique search services on its Web site, such as Google Maps. By purchasing PayPal, an electronic payment system, in 2003, eBay made it much easier for customers to pay sellers and expanded use of its auction marketplace. Apple created the iPod, a unique portable digital music player, plus a unique online Web music service where songs can be purchased for $.69 to $1.29 each. Apple has continued to innovate with its multimedia iPhone, iPad tablet computer, and iPod video player. Manufacturers and retailers are using information systems to create products and services that are customized and personalized to fit the precise specifications of individual customers. For example, Nike sells customized sneakers through its NIKEID program on its Web site. Customers are able to select the type of shoe, colors, material, outsoles, and even a logo of up to 8 characters. Nike transmits the orders via computers to specially-equipped plants in China and Korea. The sneakers cost only $10 extra and take about three weeks to reach the customer. This ability to offer individually tailored products or services using the same production resources as mass production is called mass customization.

Focus on Market Niche

Use information systems to enable a specific market focus, and serve this narrow target market better than competitors. Information systems support this strategy by producing and analyzing data for finely tuned sales and marketing techniques. Information systems enable companies to analyze customer buying patterns, tastes, and preferences closely so that they efficiently pitch advertising and marketing campaigns to smaller and smaller target markets.
The data come from a range of sources—credit card transactions, demographic data, purchase data from checkout counter scanners at supermarkets and retail stores, and data collected when people access and interact with Web sites. Sophisticated software tools find patterns in these large pools of data and infer rules from them to guide decision making. Analysis of such data drives one-to-one marketing that creates personal messages based on individualized preferences. For example, Hilton Hotels’ On Q system analyzes detailed data collected on active guests in all of its properties to determine the preferences of each guest and each guest’s profitability. Hilton uses this information to give its most profitable customers additional privileges, such as late check-outs. Contemporary customer relationship management (CRM) systems feature analytical capabilities for this type of intensive data analysis. The Interactive Session on Organizations describes how skillfully credit card companies are able to use this strategy to predict their most profitable cardholders. The companies gather vast quantities of data about consumer purchases and other behaviors and mine these data to construct detailed profiles that identify cardholders who might be good or bad credit risks. These practices have enhanced credit card companies’ profitability, but are they in consumers’ best interests?

**Strengthen Customer and Supplier Intimacy**

Use information systems to tighten linkages with suppliers and develop intimacy with customers. Chrysler Corporation uses information systems to facilitate direct access by suppliers to production schedules, and even permits suppliers to decide how and when to ship supplies to Chrysler factories. This allows suppliers more lead time in producing goods. On the customer side, Amazon.com keeps track of user preferences for book and CD purchases, and can recommend titles purchased by others to its customers. Strong linkages to customers and suppliers increase *switching costs* (the cost of switching from one product to a competing product), and loyalty to your firm. Some companies focus on one of these strategies, but you will often see companies pursuing several of them simultaneously. For example, Dell tries to emphasize low cost as well as the ability to customize its personal computers.

**LIMITATIONS OF MIS**

A Management Information System (MIS) is a valuable tool company management uses to gauge the effectiveness of their business operations. The MIS can provide detailed insight to certain portions of a company and also assist management with making critical business decisions. While the style and format of the MIS has changed over the years, its use in management decisions has increased greatly. A management information system is an approach a company uses when making various business decisions. Business owners and managers are responsible for operational, technical and strategic decisions. Using an information system helps these individuals gather pertinent documents that will help them make the best decision possible. While these systems were manual in previous decades, business technology allows companies to implement electronic systems. Some disadvantages can exist when using a management information system in a company.

**Expensive**

Installing a management information system can be expensive for a company. Information technology—while cheaper today than previous years—can represent a significant expense, especially for larger organizations. These systems may also require ongoing support or upgrade.
fees, which can represent future fixed cash outflows. Companies must create a budget to pay for these items to ensure the information system stays current with business technology. Attempting to integrate these systems with technology currently in use can also increase expenses.

**Maintenance**

Companies may need to hire maintenance individuals to help keep an electronic information system running smoothly. These individuals often need experience in computer science functions and other business topics. Not only does this increase labor costs, but it also requires additional training and ongoing education for these individuals. Business technology can change frequently, creating an environment where companies must have trained individuals who can properly maintain computers, websites, servers and other equipment in use by the management information system.

**Ineffective**

Management information systems have the potential to become ineffective in a company's operations. As with all computer systems, the management information system is only as good as the programmer. Gathering unimportant or non-essential information can delay business decisions because managers must request additional input. Spending too much time reprogramming or correcting issues can also increase the time spent in the decision-making process. Business owners and managers may also need extensive training on new systems, creating a learning curve that will hopefully diminish over time.

**The Facts**

An MIS is one method a company uses to obtain reliable information regarding its business operations. The MIS should not be concerned with whether the information can be retrieved, but rather how and what information should be retrieved so management can make effective decisions. Once information is provided through the MIS, decisions can be made regarding the effectiveness of business operations. Limitations do exist with an MIS, such as the expense to create and implement an MIS, training time for employees, lack of flexibility and capturing wrong or incomplete information.

**MIS Expense**

MIS implementation can be very expensive for companies looking to manage their operations more effectively. All divisions and processes must be reviewed when determining what information management wants extracted for decision purposes. The cost of this review followed by the installation costs can be extremely expensive for large companies. Additionally, new employee hiring or employee training related to the MIS can also add to the implementation costs.

**Employee Training**

Properly trained employees are a critical part of an MIS. Employees are at the front lines of business operations and create or manage the daily activities of the company. If an MIS finds a system flaw or management decides to change a process based on the MIS information, re-training employees will usually be required. The length and depth of the training may vary, making it difficult to estimate the cost of this training. Management will also have to account for the lost productivity during this training period.
MIS Flexibility

Once an MIS is created and installed in a company, it may prove to be an inflexible system. Making changes quickly to reflect fluctuating business operations may not be possible depending on the MIS style and functionality. While correcting policies such as internal controls or operating procedures may be easy, company-wide changes such as service changes, production enhancements or marketing strategy may not be simple. Major business changes will require major changes to the MIS, leading to increased costs and downtime of information reporting.

Information Flaws

The MIS is designed to provide information to management so sound decisions can be made regarding company operations. The biggest flaw an MIS can have is pulling incorrect or inadequate information for management. This problem results in wasted time and money for the company, leading to another review of the MIS to correct the information flaws.

QUESTIONS

SHORT ANSWER TYPE

1. Define Management Information System.
2. What is Information Technology?
3. State the levels in an Organization
4. What is IT Infrastructure?

SHORT ESSAY TYPE

1. Discuss the functions of Management Information System.
2. Elucidate the dimensions of Management Information System.
3. What are the functions of an Information System?

ESSAY QUESTIONS

1. Explain the dimensions and Functions of Management Information System.
2. Explain the Strategic role and need of Management Information System.
Chapter 4

SYSTEM DEVELOPMENT LIFE CYCLE

Building a new information system is one kind of planned organizational change. The introduction of a new information system involves much more than new hardware and software. It also includes changes in jobs, skills, management, and organization. When we design a new information system, we are redesigning the organization. System builders must understand how a system will affect specific business processes and the organization as a whole.

Information technology can promote various degrees of organizational change, ranging from incremental to far-reaching. Four kinds of structural organizational change that are enabled by information technology: (1) automation, (2) rationalization, (3) business process redesign, and (4) paradigm shifts. Each carries different risks and rewards. The most common form of IT-enabled organizational change is automation. The first applications of information technology involved assisting employees with performing their tasks more efficiently and effectively. Calculating paychecks and payroll registers, giving bank tellers instant access to customer deposit records, and developing a nationwide reservation network for airline ticket agents are all examples of early automation.

SYSTEM DEVELOPMENT LIFE CYCLE

New information systems are an outgrowth of a process of organizational problem solving. A new information system is built as a solution to some type of problem or set of problems the organization perceives it is facing. The problem may be one in which managers and employees realize that the organization is not performing as well as expected, or that the organization should take advantage of new opportunities to perform more successfully. The activities that go into producing an information system solution to an organizational problem or opportunity are called systems development. Systems development is a structured kind of problem solved with distinct activities. These activities consist of systems analysis, systems design, programming, testing, conversion, and production and maintenance.

The systems development activities usually take place in sequential order. But some of the activities may need to be repeated or some may take place simultaneously, depending on the approach to system building that is being employed.

![Figure 11-3: The Traditional Systems Development Lifecycle](image)

*The systems development lifecycle partitions systems development into formal stages, with each stage requiring completion before the next stage can begin.*
SYSTEMS ANALYSIS

Systems analysis is the analysis of a problem that a firm tries to solve with an information system. It consists of defining the problem, identifying its causes, specifying the solution, and identifying the information requirements that must be met by a system solution.

The systems analyst creates a road map of the existing organization and systems, identifying the primary owners and users of data along with existing hardware and software. The systems analyst then details the problems of existing systems. By examining documents, work papers, and procedures; observing system operations; and interviewing key users of the systems, the analyst can identify the problem areas and objectives a solution would achieve. Often the solution requires building a new information system or improving an existing one.

The systems analysis also includes a feasibility study to determine whether that solution is feasible, or achievable, from a financial, technical, and organizational standpoint. The feasibility study determines whether the proposed system is expected to be a good investment, whether the technology needed for the system is available and can be handled by the firm’s information systems specialists, and whether the organization can handle the changes introduced by the system.

Normally, the systems analysis process identifies several alternative solutions that the organization can pursue and assess the feasibility of each. A written systems proposal report describes the costs and benefits, and the advantages and disadvantages, of each alternative. It is up to management to determine which mix of costs, benefits, technical features, and organizational impacts represents the most desirable alternative.

Establishing Information Requirements

Perhaps the most challenging task of the systems analyst is to define the specific information requirements that must be met by the chosen system solution. At the most basic level, the information requirements of a new system involve identifying who needs what information, where, when, and how. Requirements analysis carefully defines the objectives of the new or modified system and develops a detailed description of the functions that the new system must perform. Faulty requirements analysis is a leading cause of systems failure and high systems development costs. A system designed around the wrong set of requirements will either have to be discarded because of poor performance or will need to undergo major modifications.

Some problems do not require an information system solution but instead need an adjustment in management, additional training, or refinement of existing organizational procedures. If the problem is information related, systems analysis still may be required to diagnose the problem and arrive at the proper solution.

SYSTEMS DESIGN

Systems analysis describes what a system should do to meet information requirements, and systems design shows how the system will fulfill this objective. The design of an information system is the overall plan or model for that system. Like the blueprint of a building or house, it consists of all the specifications that give the system its form and structure.

The systems designer details the system specifications that will deliver the functions identified during systems analysis. These specifications should address all of the managerial, organizational, and technological components of the system solution. Like houses or buildings, information systems may have many possible designs. Each design represents a unique blend of all technical and organizational components. What makes one design superior to others is the ease and efficiency with which it fulfills user requirements within a specific set of technical, organizational, financial, and time constraints.
The Role of End Users

User information requirements drive the entire system-building effort. Users must have sufficient control over the design process to ensure that the system reflects their business priorities and information needs, not the biases of the technical staff. Working on design increases users’ understanding and acceptance of the system. Insufficient user involvement in the design effort is a major cause of system failure. However, some systems require more user participation in design than others.

COMPLETING THE SYSTEMS DEVELOPMENT PROCESS

The remaining steps in the systems development process translate the solution specifications established during systems analysis and design into a fully operational information system. These concluding steps consist of programming, testing, conversion, production, and maintenance.

Programming

During the programming stage, system specifications that were prepared during the design stage are translated into software program code. Today, many organizations no longer do their own programming for new systems. Instead, they purchase the software that meets the requirements for a new system from external sources such as software packages from a commercial software vendor, software services from an application service provider, or outsourcing firms that develop custom application software for their clients.

Testing

Exhaustive and thorough testing must be conducted to ascertain whether the system produces the right results. Testing answers the question, “Will the system produce the desired results under known conditions?” Some companies are starting to use cloud computing services for this work.

The amount of time needed to answer this question has been traditionally underrated in systems project planning. Testing is time consuming: Test data must be carefully prepared, results reviewed, and corrections made in the system. In some instances, parts of the system may have to be redesigned. The risks resulting from glossing over this step are enormous.

Testing an information system can be broken down into three types of activities: unit testing, system testing, and acceptance testing. Unit testing, or program testing, consists of testing each program separately in the system. It is widely believed that the purpose of such testing is to guarantee that programs are error-free, but this goal is realistically impossible. Testing should be viewed instead as a means of locating errors in programs, focusing on finding all the ways to make a program fail. Once they are pinpointed, problems can be corrected.

System testing tests the functioning of the information system as a whole. It tries to determine whether discrete modules will function together as planned and whether discrepancies exist between the way the system actually works and the way it was conceived. Among the areas examined are performance time, capacity for file storage and handling peak loads, recovery and restart capabilities, and manual procedures.
Acceptance testing provides the final certification that the system is ready to be used in a production setting. Systems tests are evaluated by users and reviewed by management. When all parties are satisfied that the new system meets their standards, the system is formally accepted for installation.

The systems development team works with users to devise a systematic test plan. The test plan includes all of the preparations for the series of tests we have just described. The general condition being tested is a record change. The documentation consists of a series of test plan screens maintained on a database (perhaps a PC database) that is ideally suited to this kind of application.

Conversion is the process of changing from the old system to the new system. Four main conversion strategies can be employed: the parallel strategy, the direct cutover strategy, the pilot study strategy, and the phased approach strategy.

In a parallel strategy, both the old system and its potential replacement are run together for a time until everyone is assured that the new one functions correctly. This is the safest conversion approach because, in the event of errors or processing disruptions, the old system can still be used as a backup. However, this approach is very expensive, and additional staff or resources may be required to run the extra system.

The direct cutover strategy replaces the old system entirely with the new system on an appointed day. It is a very risky approach that can potentially be more costly than running two systems in parallel if serious problems with the new system are found. There is no other system to fall back on. Dislocations, disruptions, and the cost of corrections may be enormous.

The pilot study strategy introduces the new system to only a limited area of the organization, such as a single department or operating unit. When this pilot version is complete and working smoothly, it is installed throughout the rest of the organization, either simultaneously or in stages.

The phased approach strategy introduces the new system in stages, either by functions or by organizational units. If, for example, the system is introduced by function, a new payroll system might begin with hourly workers who are paid weekly, followed six months later by adding salaried employees (who are paid monthly) to the system. If the system is introduced by organizational unit, corporate headquarters might be converted first, followed by outlying operating units four months later.

Moving from an old system to a new one requires that end users be trained to use the new system. Detailed documentation showing how the system works from both a technical and end-user standpoint is finalized during conversion time for use in training and everyday operations. Lack of proper training and documentation contributes to system failure, so this portion of the systems development process is very important.

Production and Maintenance

After the new system is installed and conversion is complete, the system is said to be in production. During this stage, the system will be reviewed by both users and technical specialists to determine how well it has met its original objectives and to decide whether any revisions or modifications are in order. In some instances, a formal post implementation audit document is prepared. After the system has been fine-tuned, it must be maintained while it is in production to correct errors, meet requirements, or improve processing efficiency. Changes in hardware, software, documentation, or procedures to a production system to correct errors, meet new requirements, or improve processing efficiency are termed maintenance.
Approximately 20 percent of the time devoted to maintenance is used for debugging or correcting emergency production problems. Another 20 percent is concerned with changes in data, files, reports, hardware, or system software. But 60 percent of all maintenance work consists of making user enhancements, improving documentation, and recoding system components for greater processing efficiency. The amount of work in the third category of maintenance problems could be reduced significantly through better systems analysis and design practices.

QUESTIONS

SHORT ANSWER TYPE

1. State the process of System Development Life Cycle.
2. What is System Design?
3. What is System testing?
4. Briefly explain Phased Conversion?

SHORT ESSAY TYPE

1. Discuss System Design.
2. Elucidate the process of System Implementation.
3. What is System Analysis?

ESSAY QUESTIONS

1. Explain System Development Lifecycle.
TRADITIONAL SYSTEMS LIFE CYCLE

The **systems life cycle** is the oldest method for building information systems. The life cycle methodology is a phased approach to building a system, dividing systems development into formal stages. Systems development specialists have different opinions on how to partition the systems-building stages, but they roughly correspond to the stages of systems development that we have just described.

The systems life cycle methodology maintains a very formal division of labor between end users and information systems specialists. Technical specialists, such as system analysts and programmers, are responsible for much of the systems analysis, design, and implementation work; end users are limited to providing information requirements and reviewing the technical staff’s work.

The life cycle also emphasizes formal specifications and paperwork, so many documents are generated during the course of a systems project. The systems life cycle is still used for building large complex systems that require a rigorous and formal requirements analysis, predefined specifications, and tight controls over the system-building process. However, the systems life cycle approach can be costly, time-consuming, and inflexible. Although systems builders can go back and forth among stages in the life cycle, the systems life cycle is predominantly a “waterfall” approach in which tasks in one stage are completed before work for the next stage begins. Activities can be repeated, but volumes of new documents must be generated and steps retraced if requirements and specifications need to be revised. This encourages freezing of specifications relatively early in the development process. The life cycle approach is also not suitable for many small desktop systems, which tend to be less structured and more individualized.

PROTOTYPING

**Prototyping** consists of building an experimental system rapidly and inexpensively for end users to evaluate. By interacting with the prototype, users can get a better idea of their information requirements. The prototype endorsed by the users can be used as a template to create the final system.

The **prototype** is a working version of an information system or part of the system, but it is meant to be only a preliminary model. Once operational, the prototype will be further refined until it conforms precisely to users’ requirements. Once the design has been finalized, the prototype can be converted to a polished production system.

The process of building a preliminary design, trying it out, refining it, and trying again has been called an **iterative** process of systems development because the steps required to build a system can be repeated over and over again. Prototyping is more explicitly iterative than the conventional life cycle, and it actively promotes system design changes. It has been said that prototyping replaces unplanned rework with planned iteration, with each version more accurately reflecting users’ requirements.
Steps in Prototyping

Four-step model of the prototyping process, which consists of the following:

Step 1: Identify the user’s basic requirements. The system designer (usually an information systems specialist) works with the user only long enough to capture the user’s basic information needs.

Step 2: Develop an initial prototype. The system designer creates a working prototype quickly, using tools for rapidly generating software.

Step 3: Use the prototype. The user is encouraged to work with the system to determine how well the prototype meets his or her needs and to make suggestions for improving the prototype.

Step 4: Revise and enhance the prototype. The system builder notes all changes the user requests and refines the prototype accordingly. After the prototype has been revised, the cycle returns to Step 3. Steps 3 and 4 are repeated until the user is satisfied.

When no more iterations are required, the approved prototype then becomes an operational prototype that furnishes the final specifications for the application. Sometimes the prototype is adopted as the production version of the system.

Advantages and Disadvantages of Prototyping

Prototyping is most useful when there is some uncertainty about requirements or design solutions and often used for designing an information system’s end-user interface (the part of the system with which end users interact, such as online display and data entry screens, reports, or Web pages). Because prototyping encourages intense end-user involvement throughout the systems development life cycle, it is more likely to produce systems that fulfill user requirements. However, rapid prototyping can gloss over essential steps in systems development. If the completed prototype works reasonably well, management may not see the need for reprogramming, redesign, or full documentation and testing to build a polished production system. Some of these hastily constructed systems may not easily accommodate large quantities of data or a large number of users in a production environment.

The Prototyping Process

The process of developing a prototype consists of four steps. Because a prototype can be developed quickly and inexpensively, systems builders can go through several iterations, repeating steps 3 and 4, to refine and enhance the prototype before arriving at the final operational one.
RAPID APPLICATION DEVELOPMENT (RAD)

Object-oriented software tools, reusable software, prototyping, and fourth generation language tools are helping systems builders create working systems much more rapidly than they could using traditional systems-building methods and software tools. The term rapid application development (RAD) is used to describe this process of creating workable systems in a very short period of time. RAD can include the use of visual programming and other tools for building graphical user interfaces, iterative prototyping of key system elements, the automation of program code generation, and close teamwork among end users and information systems specialists. Simple systems often can be assembled from pre built components. The process does not have to be sequential, and key parts of development can occur simultaneously.

Sometimes a technique called joint application design (JAD) is used to accelerate the generation of information requirements and to develop the initial systems design. JAD brings end users and information systems specialists together in an interactive session to discuss the system’s design. Properly prepared and facilitated, JAD sessions can significantly speed up the design phase and involve users at an intense level. Agile development focuses on rapid delivery of working software by breaking a large project into a series of small subprojects that are completed in short periods of time using iteration and continuous feedback. Each mini-project is worked on by a team as if it were a complete project, including planning, requirements analysis, design, coding, testing, and documentation. Improvement or addition of new functionality takes place within the next iteration as developers clarify requirements. This helps to minimize the overall risk, and allows the project to adapt to changes more quickly. Agile methods emphasize face-to-face communication over written documents, encouraging people to collaborate and make decisions quickly and effectively.

END-USER DEVELOPMENT

Some types of information systems can be developed by end users with little or no formal assistance from technical specialists. This phenomenon is called end-user development. A series of software tools categorized as fourth-generation languages makes this possible. Fourth-generation languages are software tools that enable end users to create reports or develop software applications with minimal or no technical assistance. Some of these fourth generation tools also enhance professional programmers’ productivity. Fourth-generation languages tend to be nonprocedural, or less procedural, than conventional programming languages. Procedural languages require specification of the sequence of steps, or procedures, that tell the computer what to do and how to do it. Nonprocedural languages need only specify what has to be accomplished rather than provide details about how to carry out the task.

End users are most likely to work with PC software tools and query languages. Query languages are software tools that provide immediate online answers to requests for information that are not predefined, such as “Who are the highest-performing sales representatives?” Query languages are often tied to data management software and to database management systems .

On the whole, end-user-developed systems can be completed more rapidly than those developed through the conventional systems life cycle. Allowing users to specify their own business needs improves requirements gathering and often leads to a higher level of user involvement and satisfaction with the system. However, fourth-generation tools still cannot replace conventional
tools for some business applications because they cannot easily handle the processing of large numbers of transactions or applications with extensive procedural logic and updating requirements.

End-user computing also poses organizational risks because it occurs outside of traditional mechanisms for information systems management and control. When systems are created rapidly, without a formal development methodology, testing and documentation may be inadequate. Control over data can be lost in systems outside the traditional information systems department. To help organizations maximize the benefits of end-user applications development, management should control the development of end-user applications by requiring cost justification of end-user information system projects and by establishing hardware, software, and quality standards for user-developed applications.

SHORT ANSWER TYPE QUESTIONS
1. What are the alternative methods for System Development?.
2. Define Prototype.
3. What is Joint Application Design?
4. Describe Fourth Generation Languages ?

SHORT ESSAY TYPE
1. Discuss Prototyping.
2. Elucidate the process of End User Development.
3. Explain Rapid Application Development.

ESSAY QUESTIONS
1. What are the other approaches to System Development than SLDC. Elucidate
INTRODUCTION TO DIFFERENT SUB-SYSTEMS

Many companies today are using information technology to develop integrated cross functional enterprise systems that cross the boundaries of traditional business functions in order to reengineer and improve vital business processes all across the enterprise. These organizations view cross-functional enterprise systems as a strategic way to use IT to share information resources and improve the efficiency and effectiveness of business processes, and develop strategic relationships with customers, suppliers, and business partners. Companies first moved from functional mainframe-based legacy systems to integrated cross-functional client/server applications. This typically involved installing enterprise resource planning, supply chain management, or customer relationship management software from SAP America, PeopleSoft, Oracle, and others. Instead of focusing on the information processing requirements of business functions, such enterprise software focuses on supporting integrated clusters of business processes involved in the operations of a business.

TRANSACTION PROCESSING SYSTEMS

Transaction processing systems (TPS) are cross-functional information systems that process data resulting from the occurrence of business transactions. Transactions are events that occur as part of doing business, such as sales, purchases, deposits, withdrawals, refunds, and payments. Think, for example, of the data generated whenever a business sells something to a customer on credit, whether in a retail store or at an e-commerce site on the Web. Data about the customer, product, salesperson, store, and so on, must be captured and processed. This need prompts additional transactions, such as credit checks, customer billing, inventory changes, and increases in accounts receivable balances, which generate even more data. Thus, transaction processing activities are needed to capture and process such data, or the operations of a business would grind to a halt. Therefore, transaction processing systems play a vital role in supporting the operations of most companies today. Online transaction processing systems play a strategic role in Web-enabled businesses. Many firms are using the Internet and other networks that tie them electronically to their customers or suppliers for online transaction processing (OLTP). Such real-time systems, which capture and process transactions immediately, can help firms provide superior service to customers and other trading partners. This capability adds value to their products and services, and thus gives them an important way to differentiate themselves from their competitors. Transaction processing systems capture and process data describing business transactions, update organizational databases, and produce a variety of information products. You should understand this as a transaction processing cycle of several basic activities,

1. Data Entry. The first step of the transaction processing cycle is the capture of business data. For example, transaction data may be collected by point-of-sale terminals using optical scanning of bar codes and credit card readers at a retail store or other business. Transaction data can also be captured at an e-commerce Web site on the Internet. The proper recording and editing of data so they are quickly and correctly captured for processing is one of the major design challenges of information systems.
2. **Transaction Processing.** Transaction processing systems process data in two basic ways: (1) batch processing, where transaction data are accumulated over a period of time and processed periodically, and (2) real-time processing (also called online processing), where data are processed immediately after a transaction occurs. All online transaction processing systems incorporate real-time processing capabilities. Many online systems also depend on the capabilities of fault tolerant computer systems that can continue to operate even if parts of the system fail.

3. **Database Maintenance.** An organization’s databases must be updated by its transaction processing systems so that they are always correct and up-to-date. Therefore, transaction processing systems serve to assist in maintaining the corporate databases of an organization to reflect changes resulting from day-to-day business transactions. For example, credit sales made to customers will cause customer account balances to be increased and the amount of inventory on hand to be decreased. Database maintenance ensures that these and other changes are reflected in the data records stored in the company’s databases.

4. **Document and Report Generation.** Transaction processing systems produce a variety of documents and reports. Examples of transaction documents include purchase orders, paychecks, sales receipts, invoices, and customer statements. Transaction reports might take the form of a transaction listing such as a payroll register, or edit reports that describe errors detected during processing.

5. **Inquiry Processing.** Many transaction processing systems allow you to use the Internet, intranets, extranets, and Web browsers or database management query languages to make inquiries and receive responses concerning the results of transaction processing activity. Typically, responses are displayed in a variety of pre-specified formats or screens. For example, you might check on the status of a sales order, the balance in an account, or the amount of stock in inventory and receive immediate responses at your PC.

### The Four Stages of Processing

All information systems 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:

- Entering data into the IS (input).
- Changing and manipulating the data in the IS (data processing).
- Getting information out of the IS (output).
- Storing data and information (storage).

A computer-based IS also uses a logical process to decide which data to capture and how to process it.

**Input**

The first step in producing information is collecting and introducing data, known as input, into the IS. Most data an organization uses as input to its ISs are generated and collected within the organization. These data elements result from transactions undertaken in the course of doing business. A transaction is a business event: a sale, a purchase, a payment, the hiring of a new employee, and the like. These transactions can be recorded on paper and later entered into a computer system; directly recorded through terminals of a transaction processing system (TPS), such as a point-of-sale (POS) machine; or captured online when someone transacts through the Web. A TPS is any system that records transactions. Often, the same system also processes the
transactions, summarizing and routing information to other systems; therefore, these systems are transaction processing systems, not just transaction recording systems. Input devices (devices used to enter data into an IS) include the keyboard (currently the most widely used), infrared devices that sense bar codes, voice recognition systems, and touch screens. The trend has been to decrease the time and effort of input by using devices that allow scanning or auditory data entry.

**Processing**

The computer’s greatest contribution to ISs is efficient data processing. The computer’s speed and accuracy enable organizations to process millions of pieces of data in several seconds. For example, managers of a national retail chain can receive up-to-date information on inventory levels of every item the chain carries and then order accordingly; in the past, obtaining such information would take days. The huge gains in the speed and affordability of computing have made information the essential ingredient for an organization’s success.

**Output**

Output is the information an IS produces and displays in the format most useful to an organization. The most widely used output device is the video display, or video monitor, which displays output visually. Another common output device is the printer, used to print hard copies of information on paper. However, computers can communicate output through speakers in the form of music or speech and also can transmit it to another computer or electronic device in computer-coded form, for later interpretation.

**Storage**

One of the greatest benefits of using IT is the ability to store vast amounts of data and information. Technically, storing a library of millions of volumes on magnetic or optical storage media is feasible. Publishers, libraries, and governments have done that. For example, close to 8 million patents registered in the United States are stored on storage devices accessible through the Web. Transaction processing systems (TPSs) are the most widely used information systems. The predominant function of TPSs is to record data collected at the boundaries of organizations, in other words, at the point where the organization transacts business with other parties. They also record many of the transactions that take place inside an organization. For example, they record the movement of parts from one phase of manufacturing to another, from raw materials to finished products. TPSs include POS machines, which record sales; automatic teller machines, which record cash withdrawals, deposits, and transfers; and purchase order systems, which record purchases. A typical example would be the purchase of gasoline at a pump, using a credit card. The purchase is recorded by the gasoline company and later at the credit card-processing bank. After these data elements are collected, the IS can automatically process the data immediately and store it for later access on demand. Transaction processing systems provide most of the data in organizations for further processing by other ISs.

**OFFICE AUTOMATION SYSTEMS**

Office automation systems (OAS) are configurations of networked computer hardware and software. A variety of office automation systems are now applied to business and communication functions that used to be performed manually or in multiple locations of a company, such as preparing written communications and strategic planning. In addition, functions that once required coordinating the expertise of outside specialists in typesetting, printing, or electronic recording can
now be integrated into the everyday work of an organization, saving both time and money. Types of functions integrated by office automation systems include (1) electronic publishing; (2) electronic communication; (3) electronic collaboration; (4) image processing; and (5) office management. At the heart of these systems is often a local area network (LAN). The LAN allows users to transmit data, voice, mail, and images across the network to any destination, whether that destination is in the local office on the LAN, or in another country or continent, through a connecting network. An OAS makes office work more efficient and increases productivity.

**Electronic Publishing**

Electronic publishing systems include word processing and desktop publishing. Word processing software, (e.g., Microsoft Word, Corel Word-Perfect) allows users to create, edit, revise, store, and print documents such as letters, memos, reports, and manuscripts. Desktop publishing software (e.g., Adobe PageMaker, Corel VENTURA, and Microsoft Publisher) enables users to integrate text, images, photographs, and graphics to produce high-quality printable output. Desktop publishing software is used on a microcomputer with a mouse, scanner, and printer to create professional-looking publications. These may be newsletters, brochures, magazines, or books.

**Electronic Communication**

Electronic communication systems include electronic mail (e-mail), voice mail, facsimile (fax), and desktop videoconferencing.

**Electronic Mail**

E-mail is software that allows users, via their computer keyboards, to create, send, and receive messages and files to or from anywhere in the world. Most e-mail systems let the user do other sophisticated tasks such as filter, prioritize, or file messages; forward copies of messages to other users; create and save drafts of messages; send "carbon copies"; and request automatic confirmation of the delivery of a message. E-mail is very popular because it is easy to use, offers fast delivery, and is inexpensive. Examples of e-mail software are Eudora, Lotus Notes, and Microsoft Outlook.

**Voice Mail**

Voice mail is a sophisticated telephone answering machine. It digitizes incoming voice messages and stores them on disk. When the recipient is ready to listen, the message is converted from its digitized version back to audio, or sound. Recipients may save messages for future use, delete them, or forward them to other people.

**Facsimile**

A facsimile or facsimile transmission machine (FAX) scans a document containing both text and graphics and sends it as electronic signals over ordinary telephone lines to a receiving fax machine. This receiving fax recreates the image on paper. A fax can also scan and send a document to a fax modem (circuit board) inside a remote computer. The fax can then be displayed on the computer screen and stored or printed out by the computer's printer.

**Desktop Videoconferencing**

Desktop videoconferencing is one of the fastest growing forms of videoconferencing. Desktop videoconferencing requires a network and a desktop computer with special application software (e.g., CUSeeMe) as well as a small camera installed on top of the monitor. Images of a computer user from the desktop computer are captured and sent across the network to the other computers and users that are participating in the conference. This type of videoconferencing simulates face-to-face meetings of individuals.
Electronic Collaboration

Electronic collaboration is made possible through electronic meeting and collaborative work systems and teleconferencing. Electronic meeting and collaborative work systems allow teams of coworkers to use networks of microcomputers to share information, update schedules and plans, and cooperate on projects regardless of geographic distance. Special software called groupware is needed to allow two or more people to edit or otherwise work on the same files simultaneously.

Teleconferencing is also known as videoconferencing. As was mentioned in the discussion of desktop videoconferencing earlier, this technology allows people in multiple locations to interact and work collaboratively using real-time sound and images. Full teleconferencing, as compared to the desktop version, requires special-purpose meeting rooms with cameras, video display monitors, and audio microphones and speakers.

Telecommuting and Collaborative Systems

Telecommuters perform some or all of their work at home instead of traveling to an office each day, usually with the aid of office automation systems, including those that allow collaborative work or meetings. A microcomputer, a modem, software that allows the sending and receiving of work, and an ordinary telephone line are the tools that make this possible.

Telecommuting is gaining in popularity in part due to the continuing increase in population, which creates traffic congestion, promotes high energy consumption, and causes more air pollution. Telecommuting can help reduce these problems. Telecommuting can also take advantage of the skills of homebound people with physical limitations.

Studies have found that telecommuting programs can boost employee morale and productivity among those who work from home. It is necessary to maintain a collaborative work environment, however, through the use of technology and general employee management practices, so that neither on-site employees nor telecommuters find their productivity is compromised by such arrangements. The technologies used in electronic communication and teleconferencing can be useful in maintaining a successful telecommuting program.

Image Processing

Image processing systems include electronic document management, presentation graphics, and multimedia systems. Imaging systems convert text, drawings, and photographs into digital form that can be stored in a computer system. This digital form can be manipulated, stored, printed, or sent via a modem to another computer. Imaging systems may use scanners, digital cameras, video capture cards, or advanced graphic computers. Companies use imaging systems for a variety of documents such as insurance forms, medical records, dental records, and mortgage applications.

Presentation graphics software uses graphics and data from other software tools to create and display presentations. The graphics include charts, bullet lists, text, sound, photos, animation, and video clips. Examples of such software are Microsoft Power Point, Lotus Freelance Graphics, and SPC Harvard Graphics. Multimedia systems are technologies that integrate two or more types of media such as text, graphic, sound, voice, full-motion video, or animation into a computer-based application. Multimedia is used for electronic books and newspapers, video conferencing, imaging, presentations, and web sites.
Office Management

Office management systems include electronic office accessories, electronic scheduling, and task management. These systems provide an electronic means of organizing people, projects, and data. Business dates, appointments, notes, and client contact information can be created, edited, stored, and retrieved. Additionally, automatic reminders about crucial dates and appointments can be programmed. Projects and tasks can be allocated, subdivided, and planned. All of these actions can either be done individually or for an entire group. Computerized systems that automate these office functions can dramatically increase productivity and improve communication within an organization.

DECISION SUPPORT SYSTEMS

Decision support systems are computer-based information systems that provide interactive information support to managers and business professionals during the decision making process. Decision support systems use (1) analytical models, (2) specialized databases, (3) a decision maker’s own insights and judgments, and (4) an interactive, computer-based modeling process to support semi structured business decisions.

An example might help at this point. Sales managers typically rely on management information systems to produce sales analysis reports. These reports contain sales performance figures by product line, salesperson, sales region, and so on. A decision support system (DSS), however, would also interactively show a sales manager the effects on sales performance of changes in a variety of factors (e.g., promotion expense and salesperson compensation). The DSS could then use several criteria (e.g., expected gross margin and market share) to evaluate and rank alternative combinations of sales performance factors.

Therefore, DSS are designed to be ad hoc, quick-response systems that are initiated and controlled by business decision makers. Decision support systems are thus able to support directly the specific types of decisions and the personal decision-making styles and needs of individual executives, managers, and business professionals.

A decision support system involves an interactive analytical modeling process. For example, using a DSS software package for decision support may result in a series of displays in response to alternative what-if changes entered by a manager. This differs from the demand responses of management information systems because decision makers are not demanding pre specified information; rather, they are exploring possible alternatives. Thus, they do not have to specify their information needs in advance. Instead, they use the DSS to find the information they need to help them make a decision. This is the essence of the decision support system concept. Four basic types of analytical modeling activities are involved in using a decision support system: (1) what-if analysis, (2) sensitivity analysis, (3) goal-seeking analysis, and (4) optimization analysis. Let’s briefly look at each type of analytical modeling that can be used for decision support.

What-If Analysis

In what-if analysis, a user makes changes to variables, or relationships among variables, and observes the resulting changes in the values of other variables. For example, if you were using a spreadsheet, you might change a revenue amount (a variable) or a tax rate formula (a relationship among variables) in a simple financial spreadsheet model. Then you could command the spreadsheet program to recalculate all affected variables in the spreadsheet instantly. A managerial user would be able to observe and evaluate any changes that occurred to the values in the spreadsheet, especially to a variable such as net profit after taxes. To many managers, net profit
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after taxes is an example of the **bottom line**, that is, a key factor in making many types of decisions. This type of analysis would be repeated until the manager was satisfied with what the results revealed about the effects of various possible decisions.

**Sensitivity Analysis**

Sensitivity analysis is a special case of what-if analysis. Typically, the value of only one variable is changed repeatedly, and the resulting changes on other variables are observed. As such, sensitivity analysis is really a case of what-if analysis that involves repeated changes to only one variable at a time. Some DSS packages automatically make repeated small changes to a variable when asked to perform sensitivity analysis. Typically, decision makers use sensitivity analysis when they are uncertain about the assumptions made in estimating the value of certain key variables. In our previous spreadsheet example, the value of revenue could be changed repeatedly in small increments, and the effects on other spreadsheet variables observed and evaluated. This process would help a manager understand the impact of various revenue levels on other factors involved in decisions being considered. A typical example might be determining at what point the interest rate on a loan makes a project no longer feasible. By varying the interest rate used in a net present value calculation, for example, a manager can determine the range of acceptable interest rates under which a project can move forward. Approaching the problem this way allows the manager to make decisions about a forthcoming project without knowing the actual cost of the money being borrowed.

**Goal-Seeking Analysis**

Goal-seeking analysis reverses the direction of the analysis done in what-if and sensitivity analyses. Instead of observing how changes in a variable affect other variables, goal-seeking analysis (also called **how-can** analysis) sets a target value (goal) for a variable and then repeatedly changes other variables until the target value is achieved. For example, you could specify a target value (goal) of $2 million in net profit after taxes for a business venture. Then you could repeatedly change the value of revenue or expenses in a spreadsheet model until you achieve a result of $2 million. Thus, you would discover the amount of revenue or level of expenses the business venture needs to reach the goal of $2 million in after-tax profits. Therefore, this form of analytical modeling would help answer the question, “How can we achieve $2 million in net profit after taxes?” instead of the question, “What happens if we change revenue or expenses?” So, goal-seeking analysis is another important method of decision support.

**Optimization Analysis**

Optimization analysis is a more complex extension of goal-seeking analysis. Instead of setting a specific target value for a variable, the goal is to find the optimum value for one or more target variables, given certain constraints. Then one or more other variables are changed repeatedly, subject to the specified constraints, until you discover the best values for the target variables. For example, you could try to determine the highest possible level of profits that could be achieved by varying the values for selected revenue sources and expense categories. Changes to such variables could be subject to constraints, such as the limited capacity of a production process or limits to available financing. Optimization typically is accomplished using software like the Solver tool in Microsoft Excel and other software packages for optimization techniques, such as linear programming.
Data Mining for Decision Support

Data mining’s main purpose is to provide decision support to managers and business professionals through a process referred to as knowledge discovery. Data mining software analyzes the vast stores of historical business data that have been prepared for analysis in corporate data warehouses and tries to discover patterns, trends, and correlations hidden in the data that can help a company improve its business performance. Data mining software may perform regression, decision tree, neural network, cluster detection, or market basket analysis for a business. The data mining process can highlight buying patterns, reveal customer tendencies, cut redundant costs, or uncover unseen profitable relationships and opportunities. For example, many companies use data mining to find more profitable ways to perform successful direct mailings, including e-mailings, or discover better ways to display products in a store, design a better e-commerce Web site, reach untapped profitable customers, or recognize customers or products that are unprofitable or marginal.

GROUP DECISION-SUPPORT SYSTEMS (GDSS)

The DSS we have just described focus primarily on individual decision making. However, so much work is accomplished in groups within firms that a special category of systems called group decision-support systems (GDSS) has been developed to support group and organizational decision making. A GDSS is an interactive computer-based system for facilitating the solution of unstructured problems by a set of decision makers working together as a group in the same location or in different locations. Collaboration systems and Web-based tools for videoconferencing and electronic meetings described earlier in this text support some group decision processes, but their focus is primarily on communication. GDSS, however, provide tools and technologies geared explicitly toward group decision making. GDSS-guided meetings take place in conference rooms with special hardware and software tools to facilitate group decision making. The hardware includes computer and networking equipment, overhead projectors, and display screens. Special electronic meeting software collects, documents, ranks, edits, and stores the ideas offered in a decision-making meeting. The more elaborate GDSS use a professional facilitator and support staff. The facilitator selects the software tools and helps organize and run the meeting. A sophisticated GDSS provides each attendee with a dedicated desktop computer under that person’s individual control. No one will be able to see what individuals do on their computers until those participants are ready to share information. Their input is transmitted over a network to a central server that stores information generated by the meeting and makes it available to all on the meeting network. Data can also be projected on a large screen in the meeting room. GDSS make it possible to increase meeting size while at the same time increasing productivity because individuals contribute simultaneously rather than one at a time. A GDSS promotes a collaborative atmosphere by guaranteeing contributors’ anonymity so that attendees focus on evaluating the ideas themselves without fear of personally being criticized or of having their ideas rejected based on the contributor. GDSS software tools follow structured methods for organizing and evaluating ideas and for preserving the results of meetings, enabling non attendees to locate needed information after the meeting. GDSS effectiveness depends on the nature of the problem and the group and on how well a meeting is planned and conducted.

When a team of people are to make decisions, a group decision support system (GDSS) can be useful. The systems are often named group intelligence systems, collaborative systems, or simply group systems. Their purpose is to facilitate the contribution of ideas, brainstorming, and choosing promising solutions. Often, one person serves as a facilitator of the entire process. Typically, a session starts by defining a problem to be resolved or a decision to be made; followed by
contribution of ideas, evaluation of the ideas (such as pros and cons of each idea), and some method of voting on the ideas. The voting determines the ranking of ideas to solve the problem or make a decision. The entire list of suggested decisions is then submitted to the final decision maker. If the group is authorized to make the decision, then the top-ranked offered decision is adopted. Think Tank 2, an application offered by Group Systems, and Facilitate Pro, offered by Facilitate.com, are typical examples of such systems.

The process not only helps in structuring the group decision-making process, it also creates an environment different from sitting around a table. GDSS allow participants to maintain anonymity during the entire session or parts of it. This removes the fear of putting forth ideas that might be dismissed or ridiculed. It also puts all the participants on equal footing regardless of rank or seniority. Anonymity helps elicit more creative ideas and a more open and thorough decision-making process. It also results in a consensus or at least a decision by a majority. Such decisions are less politically motivated and therefore garner more support when implemented.

**EXECUTIVE INFORMATION SYSTEM**

Executive information systems (EIS) are information systems that combine many of the features of management information systems and decision support systems. When they were first developed, their focus was on meeting the strategic information needs of top management. Thus, the first goal of executive information systems was to provide top executives with immediate and easy access to information about a firm’s critical success factors (CSFs), that is, key factors that are critical to accomplishing an organization’s strategic objectives. For example, the executives of a retail store chain would probably consider factors such as its e-commerce versus traditional sales results or its product line mix to be critical to its survival and success. Yet managers, analysts, and other knowledge workers use executive information systems so widely that they are sometimes humorously called “everyone’s information systems.” More popular alternative names are enterprise information systems (EIS) and executive support systems (ESS). These names also reflect the fact that more features, such as Web browsing, e-mail, groupware tools, and DSS and expert system capabilities, are being added to many systems to make them more useful to managers and business professionals.

In an EIS, information is presented in forms tailored to the preferences of the executives using the system. For example, most executive information systems emphasize the use of a graphical user interface, as well as graphics displays that can be customized to the information preferences of executives using the EIS. Other information presentation methods used by an EIS include exception reporting and trend analysis. The ability to drill down, which allows executives to retrieve displays of related information quickly at lower levels of detail, is another important capability. Executive information systems have spread into the ranks of middle management and business professionals as their feasibility and benefits have been recognized and as less expensive systems for client/server networks and corporate intranets became available. For example, one popular EIS software package reports that only 3 percent of its users are top executives.

**EXPERT SYSTEMS**

One of the most practical and widely implemented applications of artificial intelligence in business is the development of expert systems and other knowledge-based information systems. A
knowledge-based information system (KBIS) adds a knowledge base to the major components found in other types of computer-based information systems. An expert system (ES) is a knowledge-based information system that uses its knowledge about a specific, complex application area to act as an expert consultant to end users. Expert systems provide answers to questions in a very specific problem area by making humanlike inferences about knowledge contained in a specialized knowledge base. They must also be able to explain their reasoning process and conclusions to a user, so expert systems can provide decision support to end users in the form of advice from an expert consultant in a specific problem area.

The components of an expert system include a knowledge base and software modules that perform inferences on the knowledge in the knowledge base and communicate answers to a user’s questions. Figure 10.28 illustrates the interrelated components of an expert system. Note the following components:

**Knowledge Base.** The knowledge base of an expert system contains (1) facts about a specific subject area (e.g., *John is an analyst*) and (2) heuristics (rules of thumb) that express the reasoning procedures of an expert on the subject (e.g., *IF John is an analyst, THEN he needs a workstation*). There are many ways that such knowledge is represented in expert systems. Examples are rule-based, frame-based, object-based, and case-based methods of knowledge representation.

- **Software Resources.** An expert system software package contains an inference engine and other programs for refining knowledge and communicating with users. The inference engine program processes the knowledge (such as rules and facts) related to a specific problem. It then makes associations and inferences resulting in recommended courses of action for a user. User interface programs for communicating with end users are also needed, including an explanation program to explain the reasoning process to a user if requested. Knowledge acquisition programs are not part of an expert system but are software tools for knowledge base development, as are expert system shells, which are used for developing expert systems.

**Expert System Applications**

Using an expert system involves an interactive computer-based session in which the solution to a problem is explored, with the expert system acting as a consultant to an end user. The expert system asks questions of the user, searches its knowledge base for facts and rules or other knowledge, explains its reasoning process when asked, and gives expert advice to the user in the subject area being explored. Expert systems are being used for many different types of applications, and the variety of applications is expected to continue to increase. You should realize, however that expert systems typically accomplish one or more generic uses. Expert systems are being used in many different fields, including medicine, engineering, the physical sciences, and business. Expert systems now help diagnose illnesses, search for minerals, analyze compounds, recommend repairs, and do financial planning. So from a strategic business standpoint, expert systems can be and are being used to improve every step of the product cycle of a business, from finding customers to shipping products to providing customer service.

**Benefits of Expert Systems**

An expert system captures the expertise of an expert or group of experts in a computer-based information system. Thus, it can outperform a single human expert in many problem situations. That’s because an expert system is faster and more consistent, can have the knowledge of several experts, and does not get tired or distracted by overwork or stress. Expert systems also help preserve and reproduce the knowledge of experts. They allow a company to preserve the expertise
of an expert before she leaves the organization. This expertise can then be shared by reproducing the software and knowledge base of the expert system.

**Limitations of Expert Systems**

The major limitations of expert systems arise from their limited focus, inability to learn, maintenance problems, and developmental cost. Expert systems excel only in solving specific types of problems in a limited domain of knowledge. They fail miserably in solving problems requiring a broad knowledge base and subjective problem solving. They do well with specific types of operational or analytical tasks but falter at subjective managerial decision making. Expert systems may also be difficult and costly to develop and maintain. The costs of knowledge engineers, lost expert time, and hardware and software resources may be too high to offset the benefits expected from some applications. Also, expert systems can’t maintain themselves; that is, they can’t learn from experience but instead must be taught new knowledge and modified as new expertise is needed to match developments in their subject areas.

Although there are practical applications for expert systems, applications have been limited and specific because, as discussed, expert systems are narrow in their domain of knowledge. An amusing example of this is the user who used an expert system designed to diagnose skin diseases to conclude that his rusty old car had likely developed measles. In addition, once some of the novelty had worn off, most programmers and developers realized that common expert systems were just more elaborate versions of the same decision logic used in most computer programs. Today, many of the techniques used to develop expert systems can now be found in most complex programs without any fuss about them.

**Knowledge Engineering**

A knowledge engineer is a professional who works with experts to capture the knowledge (facts and rules of thumb) they possess. The knowledge engineer then builds the knowledge base (and the rest of the expert system if necessary), using an iterative, prototyping process until the expert system is acceptable. Thus, knowledge engineers perform a role similar to that of systems analysts in conventional information systems development.

**ARTIFICIAL INTELLIGENCE**

Artificial intelligence (AI) is a field of science and technology based on disciplines such as computer science, biology, psychology, linguistics, mathematics, and engineering. The goal of AI is to develop computers that can simulate the ability to think, as well as see, hear, walk, talk, and feel. A major thrust of artificial intelligence is the simulation of computer functions normally associated with human intelligence, such as reasoning, learning, and problem solving. Debate has raged about artificial intelligence since serious work in the field began in the 1950s. Technological, moral, and philosophical questions about the possibility of intelligent, thinking machines are numerous. For example, British AI pioneer Alan Turing in 1950 proposed a test to determine whether machines could think. According to the Turing test, a computer could demonstrate intelligence if a human interviewer, conversing with an unseen human and an unseen computer, could not tell which was which. Although much work has been done in many of the subgroups that fall under the AI umbrella, critics believe that no computer can truly pass the Turing test. They claim that it is just not possible to develop intelligence to impart true humanlike capabilities to computers, but progress continues. Only time will tell whether we will achieve the ambitious goals of artificial intelligence and equal the popular images found in science fiction. One derivative of the Turing test that is providing real value to the online community is a CAPTCHA. A CAPTCHA (Completely Automated Public Turing test to tell Computers and Humans Apart) is a type of challenge-response test used in a wide variety of computing applications to determine that the user is really a human and not a computer posing as one. A CAPTCHA is sometimes described as a reverse Turing test because it is administered by a machine and targeted to a human, in contrast to the standard Turing test that is typically administered by a human and targeted to a machine. The process involves one computer (such as a server for a retail Web site) asking a user to complete a simple test that the computer is able to generate and grade. Because other computers are unable to solve the CAPTCHA, any user entering a correct solution is presumed to be human. A common type of CAPTCHA requires that the user type the letters of a distorted image, sometimes with the addition of an
obscured sequence of letters or digits that appears on the screen. No doubt you have seen this when registering for a new account with a merchant or checking out from an online purchase.

Commercial Applications of Artificial Intelligence

Decision Support

- Intelligent work environment that will help you capture the *why* as well as the *what* of engineered design and decision making.
- Intelligent human-computer interface (HCI) systems that can understand spoken language and gestures, and facilitate problem solving by supporting organization wide collaborations to solve particular problems.
- Situation assessment and resource allocation software for uses that range from airlines and airports to logistics centers.

Information Retrieval

- AI-based intranet and Internet systems that distill tidal waves of information into simple presentations.
- Natural language technology to retrieve any sort of online information, from text to pictures, videos, maps, and audio clips, in response to English questions.
- Database mining for marketing trend analysis, financial forecasting, maintenance cost reduction, and more.

Virtual Reality

- X-ray–like vision enabled by enhanced-reality visualization that allows brain surgeons to “see through” intervening tissue to operate, monitor, and evaluate disease progression.
- Automated animation interfaces that allow users to interact with virtual objects via touch (e.g., medical students can “feel” what it’s like to suture severed aortas).

Robotics

- Machine-vision inspections systems for gauging, guiding, identifying, and inspecting products and providing competitive advantage in manufacturing.
- Cutting-edge robotics systems, from micro robots and hands and legs to cognitive robotic and trainable modular vision systems.

QUESTIONS

SHORT ANSWER TYPE

1. What is OLTP?
3. What is Artificial Intelligence?
4. What is GDSS?

SHORT ESSAY TYPE

1. Explain Executive Information System.
2. Elucidate the significance of Transaction processing System.

ESSAY QUESTIONS

1. Give a detailed account on TPS, EIS, OOS, DSS and GDSS.
2. Explain the concept of Expert systems and Artificial Intelligence.
Chapter 7
FUNCTIONAL INFORMATION SYSTEMS IN BUSINESS

Business managers are moving from a tradition where they could avoid, delegate, or ignore decisions about IT to one where they cannot create a marketing, product, international, organization, or financial plan that does not involve such decisions.

There are as many ways to use information technology in business as there are business activities to be performed, business problems to be solved, and business opportunities to be pursued. As a business professional, you should have a basic understanding and appreciation of the major ways information systems are used to support each of the functions of business that must be accomplished in any company that wants to succeed. Thus, in this section, we will discuss functional business systems, that is, a variety of types of information systems (transaction processing, management information, decision support, and so on) that support the business functions of accounting, finance, marketing, operations management, and human resource management.

As a business professional, it is also important that you have a specific understanding of how information systems affect a particular business function (e.g., marketing) or a particular industry (e.g., banking) that is directly related to your career objectives. For example, someone whose career objective is a marketing position in banking should have a basic understanding of how information systems are used in banking and how they support the marketing activities of banks and other firms.

MANUFACTURING/PRODUCTION INFORMATION SYSTEM

Manufacturing information systems support the production/operations function that includes all activities concerned with the planning and control of the processes producing goods or services. Thus, the production/operations function is concerned with the management of the operational processes and systems of all business firms. Information systems used for operations management and transaction processing support all firms that must plan, monitor, and control inventories, purchases, and the flow of goods and services. Therefore, firms such as transportation companies, wholesalers, retailers, financial institutions, and service companies must use production/operations information systems to plan and control their operations. In this section, we will concentrate on computer-based manufacturing applications to illustrate information systems that support the production/operations function.

Once upon a time, manufacturers operated on a simple build-to-stock model. They built 100 or 100,000 of an item and sold them via distribution networks. They kept track of the stock of inventory and made more of the item once inventory levels dipped below a threshold. Rush jobs were both rare and expensive, and configuration options were limited. Things have changed. Concepts like just-in-time inventory, build-to-order (BTO) manufacturing, end-to-end supply chain visibility, the explosion in contract manufacturing, and the development of Web-based e-business tools for collaborative manufacturing have revolutionized plant management.

A variety of manufacturing information systems, many of them Web-enabled, are used to support computer-integrated manufacturing (CIM). CIM is an overall concept that emphasizes that the objectives of computer-based systems in manufacturing must be to:
• **Simplify** (reengineer) production processes, product designs, and factory organization as a vital foundation to automation and integration.

• **Automate** production processes and the business functions that support them with computers, machines, and robots.

• **Integrate** all production and support processes using computer networks, cross functional business software, and other information technologies.

The overall goal of CIM and such manufacturing information systems is to create flexible, agile, manufacturing processes that efficiently produce products of the highest quality. Thus, CIM supports the concepts of **flexible manufacturing systems, agile manufacturing, and total quality management**. Implementing such manufacturing concepts enables a company to respond to and fulfill customer requirements quickly with high-quality products and services. Manufacturing information systems help companies simplify, automate, and integrate many of the activities needed to produce products of all kinds. For example, computers are used to help engineers design better products using both **computer-aided engineering (CAE)** and **computer-aided design (CAD)** systems, and better production processes with **computer-aided process planning**. They are also used to help plan the types of material needed in the production process, which is called **material requirements planning (MRP)**, and to integrate MRP with production scheduling and shop floor operations, which is known as **manufacturing resource planning**. Many of the processes within manufacturing resource planning systems are included in the manufacturing module of enterprise resource planning (ERP) software.

**Computer-aided manufacturing (CAM)** systems are those that automate the production process. For example, this could be accomplished by monitoring and controlling the production process in a factory (manufacturing execution systems) or by directly controlling a physical process (process control), a machine tool (machine control), or machines with some humanlike work capabilities (robots).

**Manufacturing execution systems (MES)** are performance-monitoring information systems for factory floor operations. They monitor, track, and control the five essential components involved in a production process: materials, equipment, personnel, instructions and specifications, and production facilities. MES includes shop floor scheduling and control, machine control, robotics control, and process control systems. These manufacturing systems monitor, report, and adjust the status and performance of production components to help a company achieve a flexible, high-quality manufacturing process.

**Process control** is the use of computers to control an ongoing physical process. Process control computers control physical processes in petroleum refineries, cement plants, steel mills, chemical plants, food product manufacturing plants, pulp and paper mills, electric power plants, and so on. A process control computer system requires the use of special sensing devices that measure physical phenomena such as temperature or pressure changes. These continuous physical measurements are converted to digital form by analog-to-digital converters and relayed to computers for processing.

**Machine control** is the use of computers to control the actions of machines. This is also popularly called **numerical control**. The computer-based control of machine tools to manufacture products of all kinds is a typical numerical control application used by many factories throughout the world.
MARKETING INFORMATION SYSTEM

The business function of marketing is concerned with the planning, promotion, and sale of existing products in existing markets, and the development of new products and new markets to better attract and serve present and potential customers. Thus, marketing performs an essential function in the operation of a business enterprise. Business firms have increasingly turned to information technology to help them perform vital marketing functions in the face of the rapid changes of today’s environment. For example, Internet/intranet Web sites and services make an interactive marketing process possible where customers can become partners in creating, marketing, purchasing, and improving products and services. Sales force automation systems use mobile computing and Internet technologies to automate many information processing activities for sales support and management. Other marketing information systems assist marketing managers in product planning, pricing, and other product management decisions; advertising, sales promotion, and targeted marketing strategies; and market research and forecasting. Finally, enterprise wide systems like customer relationship management link to the portfolio of marketing information systems to provide and obtain data essential to the marketing function. Let’s take a closer look at three of these marketing applications.

Interactive Marketing

The term interactive marketing has been coined to describe a customer-focused marketing process that is based on using the Internet, intranets, and extranets to establish two-way transactions between a business and its customers or potential customers.

The goal of interactive marketing is to enable a company to use those networks profitably to attract and keep customers who will become partners with the business in creating, purchasing, and improving products and services.

In interactive marketing, customers are not just passive participants who receive media advertising prior to purchase; they are actively engaged in network-enabled proactive and interactive processes. Interactive marketing encourages customers to become involved in product development, delivery, and service issues. This is enabled by various Internet technologies, including chat and discussion groups, Web forms and questionnaires, instant messaging, and e-mail correspondence. Finally, the expected outcomes of interactive marketing are a rich mixture of vital marketing data, new product ideas, volume sales, and strong customer relationships.

Targeted Marketing

Targeted marketing has become an important tool in developing advertising and promotion strategies to strengthen a company’s e-commerce initiatives, as well as its traditional business venues. Targeted marketing is an advertising and promotion management concept that includes five targeting components:

- **Community**. Companies can customize their Web advertising messages and promotion

Methods to appeal to people in specific communities. They can be communities of interest, such as virtual communities of online sporting enthusiasts, or arts and crafts hobbyists, or geographic communities formed by the Web sites of a city or other local organization.
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- **Content**. Advertising, such as electronic billboards or banners, can be placed on a variety of selected Web sites, in addition to a company’s Web site. The content of these messages is aimed at the targeted audience. An ad for a product campaign on the opening page of an Internet search engine is a typical example.

- **Context**. Advertising appears only in Web pages that are relevant to the content of a product or service. So, advertising is targeted only at people who are already looking for information about a subject matter (e.g., vacation travel) that is related to a company’s products (e.g., car rental services).

- **Demographic/Psychographic**. Web marketing efforts can be aimed only at specific types or classes of people: for example, unmarried, twenty-something, middle income, male college graduates.

- **Online Behaviour**. Advertising and promotion efforts can be tailored to each visit to a site by an individual. This strategy is based on a variety of tracking techniques, such as Web “cookie” files recorded on the visitor’s disk drive from previous visits. This enables a company to track a person’s online behavior at its Web site so marketing efforts (such as coupons redeemable at retail stores or e-commerce Web sites) can be targeted to that individual at each visit to its Web site.

An interesting and effective marriage between e-business and target marketing is the emergence of the digital billboard. It is estimated that about 450,000 billboard faces exist in the United States. While only a tiny fraction of them are digital, the new billboards are making a huge impact on markets all over the country. The concept behind the digital billboard is elegantly simple. A billboard is constructed using hundreds of thousands of small LEDs, which are controlled via a computer interface that can be accessed via the Web. Advertisers can change their messages quickly, including multiple times in one day. For example, a restaurant can feature breakfast specials in the morning and dinner specials in the evening. A realtor can feature individual houses for sale and change the creative content when the house sells. Print and broadcast news media alike use digital billboards to deliver headlines, weather updates, and programming information. WCPO-TV credits its meteoric rise in the ratings to the use of digital billboards to deliver breaking news and updates to the nightly newscast. The television station went from the bottom of the ratings in 2002 to the third largest ABC affiliate in the nation. When the I-35 bridge collapsed in Minneapolis in 2007, a dangerous situation for unsuspecting drivers existed. Within minutes, a digital billboard network in the area switched from showing advertising copy to informing drivers about the collapse. Later that evening, the digital billboards advised motorists to take alternate routes. Target marketing is in the digital arena, with a new way of doing something old.

**Sales Force Automation**

Increasingly, computers and the Internet are providing the basis for sales force automation. In many companies, the sales force is being outfitted with notebook computers, Web browsers, and sales contact management software that connect them to marketing Web sites on the Internet, extranets, and their company intranets. This not only increases the personal productivity of salespeople, but it dramatically speeds up the capture and analysis of sales data from the field to marketing managers at company headquarters. In return, it allows marketing and sales management to improve the delivery of information and the support they provide to their salespeople. Therefore, many companies are viewing sales force automation as a way to gain a strategic advantage in sales.
productivity and marketing responsiveness. For example, salespeople use their PCs to record sales data as they make their calls on customers and prospects during the day. Then each night, sales reps in the field can connect their computers by modem and telephone links to the Internet and extranets, which can access intranet or other network servers at their company. Then, they can upload information on sales orders, sales calls, and other sales statistics, as well as send e-mail messages and access Web site sales support information. In return, the network servers may download product availability data, prospect lists of information on good sales prospects, and e-mail messages.

Financial Management Systems

Computer-based financial management systems support business managers and professionals in decisions concerning (1) the financing of a business and (2) the allocation and control of financial resources within a business. Major financial management system categories include cash and investment management, capital budgeting, financial forecasting, and financial planning.

For example, the capital budgeting process involves evaluating the profitability and financial impact of proposed capital expenditures. Long-term expenditure proposals for facilities and equipment can be analyzed using a variety of return on investment (ROI) evaluation techniques. This application makes heavy use of spreadsheet models that incorporate present value analysis of expected cash flows and probability analysis of risk to determine the optimum mix of capital projects for a business. Financial analysts also typically use electronic spreadsheets and other financial planning software to evaluate the present and projected financial performance of a business. They also help determine the financing needs of a business and analyze alternative methods of financing. Financial analysts use financial forecasts concerning the economic situation, business operations, types of financing available, interest rates, and stock and bond prices to develop an optimal financing plan for the business. Electronic spreadsheet packages, DSS software, and Web-based groupware can be used to build and manipulate financial models. Answers to what-if and goal seeking questions can be explored as financial analysts and managers evaluate their financing and investment alternatives.

HUMAN RESOURCE INFORMATION SYSTEMS

The human resource management (HRM) function involves the recruitment, placement, evaluation, compensation, and development of the employees of an organization. The goal of human resource management is the effective and efficient use of the human resources of a company. Thus, human resource information systems (HRIS) are designed to support (1) planning to meet the personnel needs of the business, (2) development of employees to their full potential, and (3) control of all personnel policies and programs. Originally, businesses used computer-based information systems to (1) produce paychecks and payroll reports, (2) maintain personnel records, and (3) analyze the use of personnel in business operations. Many firms have gone beyond these traditional personnel management functions and have developed human resource information systems that also support (1) recruitment, selection, and hiring; (2) job placement; (3) performance appraisals; (4) employee benefits analysis; (5) training and development; and (6) health, safety, and security.

HRM and the Internet
The Internet has become a major force for change in human resource management. For example, online HRM systems may involve recruiting for employees through recruitment Sections of corporate Web sites. Companies are also using commercial recruiting services and databases on the World Wide Web, posting messages in selected Internet newsgroups, and communicating with job applicants via e-mail.

The Internet has a wealth of information and contacts for both employers and job hunters. Top Web sites for job hunters and employers on the World Wide Web include Monster.com, HotJobs.com, and CareerBuilder.com. These Web sites are full of reports, statistics, and other useful HRM information, such as job reports by industry, or listings of the top recruiting markets by industry and profession.

**HRM and Corporate Intranets**

Intranet technologies allow companies to process most common HRM applications over their corporate intranets. Intranets allow the HRM department to provide around-the-clock services to their customers: the employees. They can also disseminate valuable information faster than through previous company channels. Intranets can collect information online from employees for input to their HRM files, and they can enable managers and other employees to perform HRM tasks with little intervention by the HRM department.

For example, *employee self-service* (ESS) intranet applications allow employees to view benefits, enter travel and expense reports, verify employment and salary information, access and update their personal information, and enter time-sensitive data. Through this completely electronic process, employees can use their Web browsers to look up individual payroll and benefits information online, right from their desktop PCs, mobile computers, or intranet kiosks located around a work site. Another benefit of the intranet is that it can serve as a superior training tool. Employees can easily download instructions and processes to get the information or education they need. In addition, employees using new technology can view training videos over the intranet on demand. Thus, the intranet eliminates the need to loan out and track training videos. Employees can also use their corporate intranets to produce automated paysheets, the online alternative to time cards. These electronic forms have made viewing, entering, and adjusting payroll information easy for both employees and HRM professionals.

**QUESTIONS**

**SHORT ANSWER TYPE**

1. What is Manufacturing/Production Information System?
2. Elaborate CAE and CAD.
3. What is Marketing Information System?
4. What is GDSS?

**SHORT ESSAY TYPE**

1. Explain Marketing Information System.
2. Discuss on Manufacturing/Production Information System.
3. Explain Human Resource Information System.

**ESSAY QUESTIONS**

1. Explain the major Functional Information Systems.
Chapter 8

SPREAD SHEET - INTRODUCTION

Picture yourself having to make a difficult decision. Perhaps you want to buy a new car, or decide which college to attend, or which investment option will result in the biggest return. There are many criteria to consider—some positive and some negative—about each alternative. If only there was a way to compile the data in a way that makes the decision easier. There is...Excel!

Microsoft Excel is the most widely used spreadsheet program in the world. A spreadsheet is a software application that organizes data in rows and columns. Spreadsheets are most commonly used to manipulate numerical data like those used to establish your household budget, calculate profit/loss statements for your business, or determine your GPA.

As good as Excel is at handling numerical data, it can also be used to organize other types of data, including text and formulas. Use the rows and columns in Excel to enter data about your household inventory for your insurance needs, your address book to make sure that birthday cards are sent out on time, or even catalogue your CD collection. Once the data has been stored in Excel, you can sort and filter the data to suit your needs. Understanding how to create an effective spreadsheet can help you make better decisions. But first, let’s start with the basics. To open Excel, choose Start > All Programs > Microsoft Office > Microsoft Excel 2010. When you launch Excel, the application opens a blank document, called a workbook, as illustrated in Figure 1-1. With all of the visual stimuli found in the number of buttons, icons, rows, and columns, even a blank Excel document might appear overwhelming, but take a few minutes to familiarize yourself with all of these elements and you’ll be ready to begin entering your own data.

Figure 1-1
The Excel spreadsheet.

Identifying Screen Elements
A spreadsheet program is a software application that organizes your data into horizontal rows and vertical columns. That portion of Excel is called the worksheet area. Rows are numbered and columns are identified by letters. Above the worksheet area, the Ribbon is a collection of the commands you will use within Excel. Apart from the Ribbon, which will be discussed later in this chapter, you will need to be aware of several other elements.

**Title bar:** At the top of the application you see a title bar that shows the application name and the file name.

**Active cell:** The currently selected cell is called the active cell. The active cell has a thick border around it.

**Name box:** Shows the cell address, or name, of the active cell. You can use the range name feature to customize this name.

**Insert Function button:** Opens the Insert Function dialog box.

**Formula bar:** Displays the contents of the active cell.

**Scroll bars:** Excel worksheets have both horizontal and vertical scroll bars.

**Sheet tabs:** A new Excel Workbook opens with three worksheets. You can delete unneeded worksheets, or add extra worksheets to suit your needs.

**Status bar:** At the bottom of the Excel screen is the status bar that provides feedback to you of the current state of your worksheet. The status bar will indicate if the worksheet is ready for data entry, busy calculating, or has identified an error.

### Zeroing in on the Ribbon

First introduced in Microsoft Office 2007, the Ribbon is common to all Microsoft Office applications. It visually displays all of the most commonly used options needed to perform a particular task. The Ribbon groups these command buttons under functional tabs.

**Excel program icon:** Clicking on the program icon in the upper-left corner of Excel displays a menu with options for minimizing and closing the application.

**Quick Access Toolbar:** The Quick Access Toolbar provides access to basic file functions. By default, those functions are Save, Undo, and Redo. You can click the Customize Quick Access Toolbar arrow and choose More Commands from the drop-down menu to add the commands that you use most frequently.

Reduce the size of the Ribbon with the Minimize the Ribbon button.

**Minimize the Ribbon button:** Click the Minimize the Ribbon button to remove all but the Tabs from the Ribbon. When the Ribbon is minimized, this button changes to become the Expand the Ribbon button. You can temporarily expand the Ribbon by clicking any of the tabs.
Customize the Quick Access Toolbar to include the commands that you use most frequently.

**Tabs:** Excel command buttons are organized under eight tabs: File, Home, Insert, Page Layout, Formulas, Data, Review, and View. Other tabs appear only when needed. For instance, the Chart Tools tab appears only after you have selected a chart in Excel. Clicking different tabs changes the command options visible on the Ribbon.

**Groups:** Each of the tabs is divided into several collections of related tasks. These collections are called groups.

**Dialog Box Launcher:** Some of the groups on the Ribbon include a small arrow icon in the bottom-right corner of the group. This icon is called the Dialog Box Launcher, and clicking it opens a dialog box to refine how the command is applied to your file. Figure 1-6 shows the Insert Chart dialog box launched from the Charts group on the Insert tab.

The Dialog Box Launcher opens a dialog box with additional options related to the command group you selected.

**POPULAR SPREADSHEET BASED PROGRAMMES**

For a lot of people, working with spreadsheets is a necessary evil. Something they must endure to get their job done. Spreadsheets can be very useful and can make number-crunching much easier, but often people aren't fully trained on the software they are using, or aren't using the best software that they could be. In fact, many people will be hard-pressed to name a spreadsheet application beyond the ubiquitous Microsoft Excel.

Excel is a good spreadsheet tool and we'll discuss its features and functionality shortly. As part of Microsoft's Office productivity suite, however, it has benefited greatly from being bundled with Windows PCs for a long time. It is by far and away the dominant player in the spreadsheet...
software market. Where spreadsheet software is concerned, many people will have only used Excel. Despite this, there are other spreadsheet applications available that can do just as good a job as Excel. For people who already have Excel installed and are comfortable with it, it may be convenient to stick with what you know. For those who are less tied to Excel, however, or those who spend a lot of time using spreadsheets, it may be worth looking around at some potential alternatives (many of which are free).  

1. Microsoft Excel  

Price: **From £109.99 one-off, or £5.99 per month (both as part of Microsoft Office)**  

Microsoft Excel should need no introduction. It was made available as part of the Microsoft Office suite in 1990 and is the industry standard where spreadsheet software is concerned. Today, Excel is available both as an on-premise piece of software that can be bought and installed with a one-off payment as part of Office, or as a cloud-based offering that can be paid for on a monthly basis as part of Office 365. Excel provides a great deal of basic functionality that we now take for granted. It is, of course, possible to calculate formulas, extrapolate trends and work with sets of data. Charts can be produced to illustrate data sets and data can be filtered and sorted as required. The newest version of Excel, however, provides a host of more advanced features as well.

Excel is available across a variety of different platforms, including Windows, Mac, iOS, Android and Windows Phone. Users can create and edit spreadsheets on one device and continue working on them on another device, wherever they are. It's possible to share workbooks online and collaborate on them with others, helping to ensure that everyone is using the same version. It's also possible to share your screen and present Excel online via Lync when delivering data presentations.

Other tools are aimed at speeding up the process of working with Excel. Flash Fill detects what users are trying to do and offers a prediction of the final outcome, allowing them to fill a series of data quickly and with ease. Similarly, the Quick Analysis tool lets users convert data into a chart or table in two steps or less.

2. Apache Open Office Calc  

Price: **Free**  

Open Office was created as a free, open source alternative to Microsoft Office. It began life as Star Office in 1985 and was acquired by Sun Microsystems in 1999. According to the Open Office website, "Sun continued to sponsor development on OpenOffice.org for the next 10 years, a period during which not only did the project grow tremendously and became truly global, but the user base also saw an extraordinary increase, and as of the end of 2010 was estimated to be in excess of 100 million."

In 2011, the platform was donated to Apache, which continues to run it, and Apache says it has presided over 100 million downloads since the acquisition. Using Open Office can feel a lot like using an old version of Microsoft Excel, and its spreadsheet module, Calc, is no different. That isn't necessarily a bad thing. Users will find the interface and functionality familiar, albeit with fewer bells and whistles. Apache says it aims for new users to find the software intuitive and for more experienced users to find the data manipulation functionality comprehensive. Amongst Calc’s main features are Data Pilot, which allows users to import raw data in a variety of formats, Natural Language Formulas that allow users to type commands with normal words, and the Intelligent Sum Button that inserts a sum function or a subtotal automatically, depending on context. Calc also
School of Distance Education

offers a variety of Wizards to guide users through different processes and support for multiple users.

3. Libre Office

Price: Free

At this point, it’s worth mentioning Libre Office. Libre Office is based on the same source code as Apache Open Office, having been forked off from the product in 2011. Much of the look, feel and functionality are the same. Like Open Office, Libre Office is free and open source, and its spreadsheet function is also called Calc. It is suggested that Libre Office has been developed more quickly than Open Office, but there is little difference between the two and any decision likely comes down to user preference.

4. Google Sheets

Price: Free

Sheets are part of Google Docs, Google's productivity suite and its answer to Microsoft Office. While Sheets does not have the same amount of functionality as Excel, it does more than enough to be adequate for most purposes. In fact, its more stripped back approach could be seen as a benefit. There are fewer fancy features to get in the way, allowing the user to focus on the core functionality.

Sheets offers the functionality you would expect from a spreadsheet application, such as using standard formula elements, drag-to-fill for extrapolating trends and simple formatting tools. It is deeply integrated with Google Drive, meaning that all documents are saved to the cloud and can be downloaded in different formats if required. It's also possible to access Sheets via a browser, smartphone or tablet.

As with other Google Docs products, Sheets allows users to work on documents with others at the same time. Users can see how others are editing the sheet and a chat window allows for quick and easy communication. It's possible to share individual worksheets publicly or with specific people - and to set permissions for other users. Amongst the other features available in Sheets are an auto-save function that means users never have to remember to press save again and a version history, meaning that users can revert to an old version of a worksheet if needs be. It's also possible to work offline and to install add-ons that extend the application's functionality.

5. Zoho Sheet

Price: From free

Zoho's wide-ranging product portfolio extends to the office productivity market, and as with its other products, Zoho Docs (of which Sheet is a part) is available via a freemium model. Users can get an initial 5GB of storage along with basic functionality for free, while US$5 per month (around £3, AU$5.50) will get you 250GB of storage and some extra features. Users can upgrade, downgrade or cancel their plan at any point.

Zoho Sheet is much like Google's similarly named Sheets offering. It offers the straightforward functionality that users require without lots of flashy extra features. Users can collaborate in real-time and access their worksheets from any device at any time. The standard functions language is available and users can auto filter data to match specific conditions, apply conditional formatting, set up macros and use pivot tables.
As with Google Sheets, Zoho Sheet lets users create charts based on their data, and download worksheets in different formats. Spreadsheets can be published online, embedded in websites and shared with others. It's also possible to view the version history of a worksheet.

QUESTIONS

SHORT ANSWER TYPE

1. Define Active Cell.
2. What is a Dialogue Box Launcher.
3. Describe Quick Access Toolbar.

SHORT ESSAY TYPE

1. Explain the basic Screen Elements of Spread Sheet.
2. Discuss on Popular Spread Sheet based Programmes.

Chapter 9

MODELING AND FORMULATION

MODELING IN SPREADSHEET

A Data Model is a new approach for integrating data from multiple tables, effectively building a relational data source inside an Excel workbook. Within Excel, Data Models are used transparently, providing tabular data used in PivotTables, Pivot Charts, and Power View reports.

NOTE: This describes data models in Excel 2013. However, the same data modeling and Power Pivot features introduced in Excel 2013 also apply to Excel 2016. There's effectively little difference between these versions of Excel.

Most of the time, you’ll never even know the model is there. In Excel, a Data Model is visualized as a collection of tables in a Field List. To work with the model directly, you'll need to use the Microsoft Office Power Pivot in Microsoft Excel 2013 add-in.

When importing relational data, creating a model occurs automatically when you select multiple tables:

1. In Excel, use Data > Get External Data to import data from Access or another relational database that contains multiple related tables.
2. Excel prompts you to select a table. Check Enable selection of multiple tables.
3. Select two or more tables, click Next, and Finish.
4. In **Import Data**, choose the data visualization option you want, such as a PivotTable in a new sheet, and build your report. You now have a Data Model that contains all of the tables you imported. Because you selected the PivotTable report option, the model is represented in the Field List that you’ll use to build the PivotTable report.

What can you do with this model? You can use it to create PivotTables, Pivot Charts, and Power View reports in the same workbook. You can modify it by adding or removing tables, and if you use the Power Pivot add-in, you can extend the model by adding calculated columns, calculated fields, hierarchies, and KPIs.

When creating a Data Model, the visualization option is important. You want to choose PivotTable Report, PivotChart, or Power View Report for data visualization. These options allow you to work with all of the tables collectively. Had you chosen Table instead, each imported table would be placed into a separate sheet. In this arrangement, the tables can be used individually, but using all of the tables together requires a PivotTable, PivotChart, or Power View report.

**NOTES**

- Models are created implicitly when you import two or more tables simultaneously in Excel.
- Models are created explicitly when you use the Power Pivot add-in to import data. In the add-in, the model is represented in a tabbed layout, where each tab contains tabular data. See Get data using the Power Pivot add-in to learn the basics of data import using a SQL Server database.
- A model can contain a single table. To create a model based on just one table, select the table and click Add to Data Model in Power Pivot. You might do this if you want to use Power Pivot features, such as filtered datasets, calculated columns, calculated fields, KPIs, and hierarchies.
- Table relationships can be created automatically if you import related tables that have primary and foreign key relationships. Excel can usually use the imported relationship information as the basis for table relationships in the Data Model.
- For tips on how to reduce the size of a data model, see Create a memory-efficient Data Model using Excel 2013 and the Power Pivot add-in.

Use a Data Model in another PivotTable, PivotChart, or Power View report

An Excel workbook can contain only one Data Model, but that model can be used repeatedly throughout the workbook.

1. In Excel, click **Insert > PivotTable**.
2. In Create PivotTable, click **Use an external data source**, and then click **Choose Connection**.
3. In Existing Connection, click **Tables**.

4. Under This Workbook Data Model, **Tables in Workbook Data Model** is selected by default. Click **Open**, and then click **OK**. A PivotTable Fields list appears, showing all of the tables in the model.

Add existing, unrelated data to a Data Model

Suppose you’ve imported or copied lots of data that you want to use in a model, but did not check the **Add this data to the Data Model** box during import. Pushing new data into a model is easier than you think.

1. Start with the data that you want to add to the model. It can be any range of data, but using a named range works best.

2. Highlight the cells you want to add, or if the data is in a table or named range, place the cursor in a cell.

3. Use one of these approaches to add your data:

4. Click **Power Pivot > Add to Data Model**.

5. Click **Insert > PivotTable**, and then check **Add this data to the Data Model** in the Create PivotTable dialog box.

The range or table is now added to the model as a linked table. To learn more about working with linked tables in a model, see Add Data by Using Excel Linked Tables in Power Pivot.

Refine and extend the Data Model in the Power Pivot add-in

In Excel, Data Models exist to amplify and enrich the reporting experience, particularly when that experience includes PivotTables or other report formats that are intended for data exploration and analysis. While important, Data Models are purposely kept in the background so that you can focus on what you want to do with them.

But suppose working directly on the model is exactly what you want to do. Knowing that the Field List is based on a model, maybe you want to remove tables or fields because they aren’t useful in the list. Perhaps you want to view all of the underlying data that the model provides, or add KPIs, hierarchies and business logic. For all of these reasons and more, you’ll want to modify the Data Model directly. To modify or manage the Data Model, use the Power Pivot add-in. The add-in is part of the Office Professional Plus edition of Excel 2013, but not enabled by default. More about Start Power Pivot in Microsoft Excel add-in.

**Differences between a table in Power Pivot and a table in a sheet**

In Power Pivot, you cannot add a row to a table by directly typing in a new row like you can in an Excel worksheet. But you can add rows by using Paste commands and by refreshing data.

Data in an Excel worksheet is often variable and ragged: that is, one row might contain numeric data, and the next row might contain a graphic or string of text. In contrast, a table in Power Pivot is more like that in a relational database, in which each row has the same number of columns and most columns contain data.

Use the Data Model in Power View

A Data Model is used as the basis of a Power View report. Using the Power Pivot add-in, you can apply optimizations to the model that improve Power View reporting. Optimizations include: specify a default field list, choose representative fields or images to uniquely identify specific rows, or specify how rows with repeating values (such as employees or customers with the same name) are handled in a reporting application.

1. Create a Data Model by importing several related tables.

2. Click **Power Pivot > Manage** to open the Power Pivot window.
3. Select a table and apply optimizations:
   a. Click Advanced > Default Field Set. Choose the fields that should appear automatically on a Power View report when you click on the parent table. See Configure Default Field Set for Power View Reports for details.
   b. Click Advanced > Table Behavior. Optimize for report layouts that group data. Grouping is subject to default behaviors that sometimes produced unintended results, such as consolidating rows that should be listed separately. See Configure Table Behavior Properties for Power View Reports for details.
   c. Click Advanced > Data Category. Some report visualizations are specific to types of data. For example, if you have a time or date based table, you can assign a Date category that helps Power View with time-based visualizations.

4. Repeat for other tables.

5. In Excel, click Insert > Power View to start a new report. See Power View: Explore, visualize, and present your data for more information.

FORMULATION USING SPREADSHEET

Excel can help you do a lot of things with your data—sort it, organize it, and analyze it. These abilities are fun and useful, but I’m guessing that after putting all that data into an Excel worksheet, the first thing you will probably want to do is to perform mathematical calculations on it. For example, after entering the Northwest Region sales totals for April, May, and June (see Figure 2-1), you might want to add them all up so you can see how well they did in the second quarter. Excel calls such calculations formulas.

![Excel 2010 Sales Report](image)

**Figure 2-1** Excel formulas let you perform any number of calculations on your data

To create a formula, you type it into a cell. After you press Enter, the result of the calculation is displayed (rather than the formula itself). If you click the cell, the formula you typed appears in the Formula bar (see Figure 2-2). All formulas begin with an equals (=) sign, and typically include a reference to one or more cells. The values in the referenced cells are used when calculating the formula result. These cell values can be static (meaning they don’t change) or the result of another formula. For example, in cell E12, you might enter a formula that adds monthly sales for the Northwest Region to calculate the Second Quarter sales total.
In cell E16, you might enter a different formula that references the value in cell E12, adding it to the Second Quarter totals for the other regions. If you have to change the Northwest Region’s May sales amount later on, the total in cells E12 and E16 are automatically recalculated for you.

<table>
<thead>
<tr>
<th>Formula Bar</th>
<th>Actual Formula</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

While the result of a formula appears in the active cell, the formula itself appears in the Formula bar.

**Using Mathematical Operators**

As you learned earlier, all formulas begin with an equals (=) sign. Besides the equals sign, a formula typically includes one or more cell addresses that reference the values in those cells, and one or more mathematical operators, that tell Excel to add, subtract, multiply, divide, or to do something else with those values. Here are some common operators you should know:

- **Addition** +
- **Subtraction** –
- **Multiplication** *
- **Division** /
- **Exponentiation**

In addition to cell addresses and mathematical operators, formulas can also contain constants, which is just a fancy name for a number, such as 32, 2.75, or 5%. Yes, although you should not use dollar signs ($) or commas when entering a constant into a formula, if you prefer, you can use a % sign to enter a percentage such as 25% rather than using its decimal form (.25).

**Creating a Simple Formula**

Simple formulas include only one mathematical operator, such as subtraction (−). For example, suppose you own a gourmet food service that sells pre-packaged gourmet foods. Cell B12 contains the number of black bean taquitos you had in stock at the beginning of August, and cell C12 contains the number of black bean taquitos left at the end of August. In order to calculate how many taquitos you sold during August, you subtract the value in cell C12 from B12. Follow these steps:

1. Click the cell in which you want the result of the formula to appear.
2. Type an equals (=) sign.
3. Click the cell you want to reference in the formula, or type its address. For example, click cell B12. Excel places a colored box around cell B12; in the Formula bar, the cell address B12 appears in this same color (see Figure 2-3). You can type a value (such as .25) instead of a cell address if you like.
4. Type an operator to indicate the type of calculation you want Excel to perform. For example, type + (addition), − (subtraction), * (multiplication), or / (division).
5. Click the next cell you want to reference in the formula, or type its address. For example, click cell C12.
Excel places a differently colored box around this new cell, and uses that same color for the cell address shown in the Formula bar. You can type a value (such as 1.35) instead of referencing a cell if you want; for example, you might type =D25*.07 to calculate a 7% sales tax on an invoice total.

The color of the cell reference in the formula matches the border surrounding the actual cell.

Figure 2-3
Cells referenced in a formula are surrounded by a colored box that matches the cell address in the formula itself.

6. Press Enter to complete the formula. The result of the calculation appears in the cell you selected in Step 1.

QUESTIONS
SHORT ESSAY TYPE
1. Explain Modeling using Spreadsheet.
2. Discuss on Formulation through Spreadsheets.

Chapter 10
SPREAD SHEET FUNCTIONS

LOGICAL FUNCTIONS

Logical functions are used to display text or a value, or to perform some calculation, only if some condition is true. If the condition is not true, some alternate text or value is displayed, or some other calculation is performed. For example, you could tell Excel to compare the value in cell G10 with the value in H10, and if G10 is greater, to perform the calculation G10*.05. If G10 is not greater than H10, you could tell Excel to perform the calculation H10*.05 instead. The most common Logical function is the IF function, which has several variants.

IF

The syntax for the IF function is =IF(Condition,ActionIfTrue,ActionIfFalse). The first argument, Condition, is a logical test, which is essentially a comparison. If the comparison is true, the action listed as the second argument is taken. If the comparison is not true, the action listed as the third argument is taken.

To create a logical test or condition, you can use any of the following operators:

- = Equal
- <> Not equal
- > Greater than
- < Less than
- >= Greater than or equal to
For example, to test whether A2 is larger than B2, use the condition A2>B2. Now, suppose a teacher wants to use the IF function to determine whether a student has failed her class. Assuming the first student’s grade is in cell C4, she could type =IF(C4>64,“Pass”,“Fail”) in cell D4. If the first student’s grade is 65 or greater, then the word Pass will appear in cell D4. Otherwise, the word Fail appears. The teacher could then copy this formula down column D to display either Pass or Fail for each student.

Using the Financial Functions

The Financial functions are used by accountants and the like, to perform common tasks such as calculating the accrued interest on a security, depreciation on an asset, future value of an asset, or the monthly payment on a loan. Because most of the Financial functions are used by financial experts who understand them, I won’t dwell on too many. There are a few Financial functions, however, that just about anyone might use, and in this section, we explain more about them.

PMT

The PMT function can be used in three ways—to calculate the monthly payment on a loan, the interest rate you might earn on an investment, or the monthly deposit needed in order to reach some future total deposit amount. You feed the PMT function various information such as loan amount, interest rate, number of payments, and so on, depending on the result you’re looking for. Let’s take a closer look.

To use the PMT function to calculate a loan, use the following syntax: =PMT(Rate,NumberofPayments,LoanAmt) For example, suppose you are looking at buying a used car for somewhere between $10,000 and $12,000. You’ve found several loans and you want to compare them (see Figure 3-14). The first loan amounts have already been calculated, so you’ll enter the formula in cell C8 for the second loan, which is for six years at 7.25%.

Figure 3-14

Use the PMT function to calculate loan payments

Type =PMT(0.0725/12,6*12,–10000) and press Enter. It’s important that all the arguments are based on the same interval. The first argument is the interest rate, which needs to be converted to
its monthly equivalent. So you need to divide the yearly interest rate of 7.25% (which is .0725 in decimal form) by 12 to calculate the interest rate per month. The next argument is the number of monthly payments. Because the loan is for six years, you take 6 times 12 to calculate the number of months. The last argument is the present value of the loan, which for cell C8 is $10,000. Notice that the loan amount is entered as a negative. You don’t have to do that, but if you don’t, the PMT function returns a negative value because of the way the function performs its calculation. Although a negative payment amount might be pleasing to you, it probably won’t be acceptable to your bank. So be sure to enter the loan amount as a negative value.

Another reason you might use the PMT function is to calculate the interest you might earn on an investment, such as a CD (Certificate of Deposit). Use the following syntax: =PMT(Rate, Number of Payments,CurrentValue) For example, to calculate the annual interest you might earn on a CD with an interest of 3.75%, five-year term, and an investment of $5,000, you type =PMT(.0375,5,–5000). Because you are calculating the annual interest, you don’t have to divide the interest rate by 12. If the interest rate is calculated quarterly however, you’ll need to adjust the formula: =PMT(.0375/4,5*4,–5000). The final reason to use the PMT function is to calculate the amount you need to invest now, if you want to reach some future amount over time. Use the following syntax: =PMT(Rate,NumberOfPayments,FutureValue) For example, suppose you want to invest money annually in a CD that pays 6% in order to save $50,000 by the end of its term, which is 1 year. Type =PMT (.06,15,–50000).

**FV and PV**

Two other useful financial functions are FV and PV, which find the future or present value of an investment, given a specific interest rate and an amount to be invested each period. Use the following syntax:

=FV(Rate,NumberofPayments,PmtAmt,PresentValue, Type)
=PV(Rate,NumberofPayments,PmtAmt,FutureValue, Type)

Like the PMT function, all of these values need to be roughly equivalent, so if you are making quarterly payments, you need to divide the annual interest rate by four. In addition, like the PMT function, you need to enter the future or present value as a negative if you want to get a positive result.

The final argument for both functions, Type, tells Excel when the payment is made: use a 1 if you pay at the beginning of the month, and a 0 if you pay at the end (you can also omit this value and 0 is assumed).

So let’s determine how much you’ll have at the end of five years, if you invest $100 per month at 4%.

\Type this formula: =FV(.04/12,5*12,–100). Hmmm. It looks like at the end of five years, you’ll have $6,629.90. Not bad!

So what’s it worth to you in spending power, right now, to make those $100 payments each month? Try this formula: =PV(.04/12,5*12,–100). Well, looks like all that money is worth $5,429.91 right now. But keep in mind that you only have to part with $100 of it each month. That thought should keep the pain level down, along with the thought that after five years, you’ll have earned almost $1,200! Now that’s worth a little pain.

**STATISTICAL FUNCTIONS**
Average
To calculate the average of a range of cells, use the AVERAGE function.

\[
\text{AVERAGE(A1:O1)}
\]

Average if
To average cells based on one criteria, use the AVERAGEIF function. For example, to calculate the average excluding zeros.

\[
\text{AVERAGEIF(A1:O1, "<>0")}
\]

Note: <> means not equal to. The AVERAGEIF function is similar to the SUMIF function.

Median
To find the median (or middle number), use the MEDIAN function.

\[
\text{MEDIAN(A1:O1)}
\]

Check:

Mode
To find the most frequently occurring number, use the MODE function.

\[
\text{MODE(A1:O1)}
\]

Standard Deviation
To calculate the standard deviation, use the STEDV function.
To find the minimum value, use the MIN function.

<table>
<thead>
<tr>
<th>A</th>
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</table>

Max

To find the maximum value, use the MAX function.

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<th>A</th>
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<tbody>
<tr>
<td>1</td>
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<td>7</td>
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Large

To find the third largest number, use the following LARGE function.

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<tr>
<th>A</th>
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<th>N</th>
<th>O</th>
<th>P</th>
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</tr>
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<td>8</td>
<td>6</td>
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Check:

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<td>8</td>
<td>8</td>
<td>8</td>
<td>9</td>
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</tr>
</tbody>
</table>

Small

To find the second smallest number, use the following SMALL function.

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<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<tr>
<td>1</td>
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Check:
SPREADSHEET SECURITY

Workbooks are made to be shared, and thus, Excel provides lots of ways in which you can easily do that. For example, you can share a workbook and track the individual changes everyone makes to it. You can later review those changes and accept or reject them as you want. Another way that you can protect data is to simply lock it down, preventing anyone from changing it. You can lock down individual cells, a range of cells, or an entire worksheet in order to prevent anyone from changing its data. You can also protect a whole workbook, in order to prevent changes to its structure, such as adding worksheets or changing the workbook window’s size. Finally, when needed, you can prevent unauthorized users from even opening a workbook at all.

Locking and Unlocking Cells

If your goal is to allow others to view data but to prevent them from messing it up by changing it, you must start by designating the cells you want to protect. You designate cells for protection by locking them down. After locking down cells, you turn on protection, which tells Excel to protect the data in all the locked cells. You can protect individual cells, ranges, or an entire worksheet in this way. You can also tell Excel to hide formulas. The formula result will still be shown, but not the formula itself—in other words, if someone clicks the cell, the formula is not displayed in the Formula bar.

By default, all cells in a worksheet are locked, which means that if you just turn on protection, no one will be able to change anything in the protected area. So you actually work kind of backwards, unlocking the cells you do not want to protect, and then turning on protection. Before you turn on protection, you can also hide formulas. Follow these steps to unlock the cells in a worksheet that you want to allow users to change, and to hide formulas as desired:

1. Select the cell or range you want to unlock.
2. Click the Format button on the Home tab and select Lock Cell from the pop-up menu to turn that option off.
3. Repeat Steps 1 and 2 to unlock as many cells as you want.
4. To hide a formula, click its result cell, and then click the Format button on the Home tab.
5. Select Format Cells from the pop-up menu. The Format Cells dialog box appears.
6. Click the Protection tab.
7. Select the Hidden checkbox and click OK.
8. Repeat Steps 4–7 to hide additional formulas. After hiding formulas and unlocking cells, you are ready to protect the data you’ve kept locked. To protect the locked cells, you must now turn on worksheet protection.

After locking cells and protecting a worksheet, users can view the data in locked cells, but not change it. If a user tries to change the data in a locked cell, a message pops up, indicating that the cell data is protected.

(See Figure 13-6.) To avoid seeing a bunch of error messages, users can easily move from unlocked cell to unlocked cell by pressing Tab. By the way, a user can copy the data in locked
cells, but he/she can’t move it or delete it. In addition, data can’t be copied over the top of the data in locked cells. If you’ve hidden formulas, then they disappear after your protect the worksheet (but not the formula results).

Figure 13-6
If a user attempts to change data in a cell that’s locked, a warning message appears.

**Protecting a Worksheet**

After unlocking the cells or objects you do not need to protect from changes, and indicating which formulas you want to hide, it’s time to turn on worksheet protection so Excel can prevent data changes to the locked cells. Follow these steps:

1. Click the Format button on the Home tab and select Protect Sheet. You can also click the Protect Sheet button on the Review tab. The Protect Sheet dialog box appears, as shown in Figure 13-7.

Figure 13-7
Set options for the protected sheet.
2. To prevent unauthorized users from unprotected the sheet, type a password in the Password to Unprotect Sheet box. Passwords are case-sensitive.

3. In the Allow All Users Of This Worksheet To section, select the options you want to allow:
   
   - **Select Locked Cells**: Allows users to click on a locked cell (they still can’t change its contents though).
   - **Select Unlocked Cells**: Allows users to click on unlocked cells, or to press Tab to move to one.
   - **Format Cells**: Allows users to apply formatting or conditional formats to cells.
   - **Format Columns**: Allows users to adjust column widths and hide columns.
   - **Format Rows**: Allows users to adjust row heights and hide rows.
   - **Insert Columns**: Allows users to insert new columns.
   - **Insert Rows**: Allows users to insert new rows.
   - **Insert Hyperlinks**: Allows users to add links.
   - **Delete Columns**: Allows users to remove columns.
   - **Delete Rows**: Allows users to remove rows.
   - **Sort**: Allows users to sort and filter unlocked cells.
   - **Use AutoFilter**: Allows users to change the settings on a filtered list.
   - **Use PivotTable Reports**: Allows users to manipulate PivotTable data and create new PivotTable reports.
   - **Edit Objects**: Allows users to make changes to charts, shapes, and other objects, and to add or edit comments. If this setting is turned off and a user changes data in an unlocked cell that affects a chart, the chart will change.
   - **Edit Scenarios**: Allows users to add and change scenarios.

4. Click OK.

5. If you entered a password in Step 2, the Confirm Password dialog box appears and you’re prompted to confirm the password by retying it. Do so and click OK. The worksheet is immediately protected. You can repeat this process with other sheets if you want.

After protecting a worksheet, you may find it difficult to make all the changes that you, its creator, need to make. To remove worksheet protection, click the Format button on the Home tab and select Unprotect Sheet. You can also click the Unprotect Sheet button on the Review tab. If you password-protected the sheet, type your password in the dialog box that appears and click OK. The worksheet is no longer protected.

**Protecting a Workbook**

In addition to protecting worksheets from unauthorized changes, you can protect entire workbooks as well. When you protect a workbook in this manner, you protect its structure—preventing users from adding, deleting, hiding, or un hiding worksheets. You can also prevent users from resizing the workbook window. Here’s how:

1. Click the Protect Workbook button on the Review tab. The Protect Structure
Windows dialog box appears, as seen in Figure 13-8.

![Figure 13-8](image)

Set options for the protected workbook

2. Select the changes you want to prevent:
   - **Structure**: Prevents users from adding, deleting, hiding, or unhiding worksheets.
   - **Windows**: Prevents users from resizing the workbook window, although they can still scroll.

3. To prevent unauthorized users from unprotecting the sheet, type a password in the Password box. Passwords are case-sensitive.

4. Click OK.

5. If you entered a password in Step 3, the Confirm Password dialog box appears and you're prompted to confirm the password by retyping it. Do so and click OK. The workbook is immediately protected. If you decide at some later date to remove the workbook protections (the workbook will no longer be shared, for example), just click the Protect Workbook button on the Review tab, enter the password if any, and click OK.

**Preventing a Workbook from Being Opened**

When the ultimate protection is needed, you can add a password to a workbook that prevents it from being opened by anyone who doesn’t know the password. Follow these steps:

1. Click the File tab to display Backstage.

2. Select Info from the list on the left to display the Information options on the right.

3. Click the Protect Workbook button and select Encrypt With Password from the pop-up menu. The Encrypt Document dialog box appears. (See Figure 13-9.)

![Figure 13-9](image)

Protect your workbook with a password
4. Type a password in the Password box. Passwords are case-sensitive.

5. Click OK.

6. The Confirm Password dialog box appears and you’re prompted to confirm the password by retying it. Type the same password you typed in Step 4 and click OK.

7. Save the workbook to save your changes.

The workbook remains open so you can continue to work on it. However, after you close it, when you open it again, you are prompted to enter your password, as shown in Figure 13-10. Do so and click OK. The workbook is opened and unless other protections are in place, you can make any changes you want.

![Password dialog box](Figure 13-10)

You must enter a password to view this workbook

DATABASE FUNCTION IN SPREADSHEET

The database functions operates on a range of cells that makes up the list or database. A database in this context is a list of related data in which rows are records and columns are fields. The first row of the list contains labels for each column.

The database (or list) is identified as the `data list` parameter in function syntax.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Syntax</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAVERAGE</td>
<td>Returns the average of selected database entries.</td>
<td>DAVERAGE(data list, field, criteria)</td>
</tr>
<tr>
<td>DCOUNT</td>
<td>Counts the cells that contain numbers in a database.</td>
<td>DCOUNT(data list, field, criteria)</td>
</tr>
<tr>
<td>DCOUNTA</td>
<td>Counts nonblank cells in a database.</td>
<td>DCOUNTA(data list, field, criteria)</td>
</tr>
<tr>
<td>DGET</td>
<td>Extracts from a database a single record that matches the specified criteria.</td>
<td>DGET(data list, field, criteria)</td>
</tr>
<tr>
<td>DMAX</td>
<td>Returns the maximum value from selected database entries.</td>
<td>DMAX(data list, field, criteria)</td>
</tr>
<tr>
<td>DMIN</td>
<td>Returns the minimum value from selected database entries.</td>
<td>DMIN(data list, field, criteria)</td>
</tr>
<tr>
<td>DPRODUCT</td>
<td>Multiplies the values in a particular field of records that match the criteria in a database.</td>
<td>DPRODUCT(data list, field, criteria)</td>
</tr>
<tr>
<td>DSTDEV</td>
<td>Estimates the standard deviation based on a sample of selected database entries.</td>
<td>DSTDEV(data list, field, criteria)</td>
</tr>
<tr>
<td>DSTDEVP</td>
<td>Calculates the standard deviation based on the entire population of selected database entries.</td>
<td>DSTDEVP(data list, field, criteria)</td>
</tr>
<tr>
<td>DSUM</td>
<td>Adds the numbers in the field column of records in the database that match the criteria.</td>
<td>DSUM(data list, field, criteria)</td>
</tr>
</tbody>
</table>
DVAR | Estimates variance based on a sample from selected database entries. | DVAR(datalist, field, criteria)
DVARP | Calculates variance based on the entire population of selected database entries. | DVARP(datalist, field, criteria)

LINKING DATA BETWEEN WORK SHEETS

To create a hyperlink to a place within a different workbook or to some other file such as a Word document, follow these steps:

1. Click the cell containing the text you want to use as the link, or click a graphic.

2. Click the Hyperlink button on the Insert tab. The Insert Hyperlink dialog box appears, as shown in Figure 6-19.

Select the Workbook

To Link to

![Insert Hyperlink dialog box](https://example.com/figure6-19.png)

Create a link to another workbook or other file.

3. Click the Existing File or Web Page button from the Link To list.

4. Enter the path to the file you want to link to in the Address text box, or select the drive and folder containing the file from the Look In list and then select the file.

5. To link to a specific place within a file such as another Excel workbook or a Word document, click the Bookmark button. To link to a cell on a specific worksheet, select that worksheet from the Cell Reference section of the Or Select A Place In This Document box. If you’ve created a range name or a bookmark in a Word file, select it from the Defined Names section in the Or Select A Place In This Document box. Click OK to return to the dialog box.

6. To enter a ScreenTip for the link, click the ScreenTip button, type the description to display in the ScreenTip, and click OK to return to the dialog box.

7. Click OK. The link is inserted into the worksheet. When you click the link, the file you linked to is opened and displayed.

QUESTIONS
SHORT ESSAY TYPE

1. Explain Logical Function in Excel.

2. Discuss on Financial Functions using Excel.

3. Give a brief account on Database Functions of Excel.


ESSAY QUESTIONS

1. Explain the major Functions performed in MS Excel.
LIQUIDITY ANALYSIS

As with most Excel financial ratios, liquidity ratio calculations require at least two data points from outside financial sources followed by a short Excel formula. There are several different liquidity ratios; each of them is used to demonstrate a company's ability to pay off short-term debt obligations. The two most common liquidity ratios are the current ratio and the quick ratio.

To calculate the current ratio, find the company's current assets and current liabilities by looking at its most recent balance sheet. Pick two consecutive cells within a column, such as A2 and A3, and title them "Assets" and "Liabilities" respectively. Immediately adjacent to those cells, in B2 and B3, enter the corresponding figures from the balance sheet. The calculation for the current ratio is performed in a separate cell using the following formula: \( \frac{B2}{B3} \).

A company's current ratio highlights how efficiently products can be turned into cash and is a critical figure when evaluating corporate governance. However, be wary of comparing current ratios across industries since operating cycles can vary dramatically.

The quick ratio is very similar to the current ratio and can be calculated by just adding one additional step to the current ratio. This time, import a third variable from the company's balance sheet: inventories. Using the same cell setup as before with the assets figure in B2 and the
liabilities figure in B3, add the figure for inventories in cell B4. Now, in the cell where the prior calculation for current ratio was performed, modify the formula to read: \( = (B2 - B4) / B3 \).

The quick ratio provides an even shorter-term perspective on solvency by only taking into account the most liquid assets. Since inventory can take some time to turn into cash assets, some believe this is a more realistic view.

**PROFITABILITY ANALYSIS**

Customer profitability is the profit that a company makes in serving a particular customer or client over a specific timeframe. This is the difference between the customer revenue and the costs of having business relationships with a specific customer.

Many companies do customer profitability analysis to determine which customer relationships are better or worth sustaining than others, as there are customer relationships that are unprofitable.

Prepare a Customer Profitability Analysis Report

This Customer Profitability Analysis Template is a free template that works best with Excel 2013 and has backward compatibility with earlier versions.
With this Excel template, you can easily determine how much you will earn and benefit by taking care of particular customer relationships. This template also tracks active customers, revenue from each customer within a given time period, and cost of sales per customer, among others. The main analysis category are Customer Activity, Profitability Analysis, Cost of Sales, Other Costs, and Summary Metrics.

Making investment decisions using Excel

Calculating Net Present Value (NPV) and Internal Rate of Return (IRR)

NPV and IRR are statistical tools for appraising projects and assisting in investment decision making. They measure cash flows over the period of a project and take account of the 'time value of money'. Money spent or received at different times cannot be directly compared. In general it is preferable to hold a sum of money now rather than in the future so that it can be put to some alternative use such as earning interest or being invested. The time value of money is specified as a discount rate (which is effectively the same as an interest rate) or the cost of capital.

Cash Outflows (expenditure)
- Initial investment to purchase assets
- Operating costs such as labor and materials
- Tax payments
- Project management expenses
- Any other outflow caused by accepting the project

Cash Inflows (income)
- Project revenues and grants
- Eventual scrap value of assets
- Any other inflow caused by accepting the project

Note that this technique uses cash flows, therefore depreciation is not a consideration and is excluded.

A decision is required about how anticipated future inflation is to be treated. If particular cash flows will be affected differently by inflation (e.g. labor costs rising at a faster rate than income) you may choose to build it into your calculations. If all values are likely to rise at a general rate, it can be completely disregarded and the answer will be unaffected.

If you use cash flow figures that are increased each period for inflation, you must multiply the discount rate by the general inflation rate. If the discount rate is 10% and inflation 15% the NPV calculation must use: (1+0.10) x (1+0.15) = 1.265. Thus the discount rate to be used would be 26.5%.

Before building your spreadsheet model another key consideration is whether the initial investment expense is immediate or at the end of the first period. Many textbook examples show the investment occurring immediately (i.e. period 0) while all other cash flows begin at the end of the first period. The Excel NPV function assumes that the initial outlay (or cash flow) is all at the end of the first period. Your formula will need to be adjusted if this is not the case.

Example

A firm is considering whether or not to invest in a new van and driver to replace its current use of a courier company. The main cash outflows and inflows are shown in the range L3:L12 (right) and a rate of 5% is used as a discount rate since otherwise the money could sit in the bank earning interest.

It is considered that a new van with advertising painted on the side will raise the profile of the company and therefore increase sales by 125 each year - each sale making a profit of £5. The
project is planned for a 6 year period, at the end of which the van will be sold for an estimated price of £2,300. The outlay on the new van will be immediate in terms of the cash flow.

<table>
<thead>
<tr>
<th></th>
<th>K</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Operation of new vehicle</td>
<td>Value</td>
</tr>
<tr>
<td>3</td>
<td>Cost of new van</td>
<td>14,500</td>
</tr>
<tr>
<td>4</td>
<td>Fuel</td>
<td>1,600</td>
</tr>
<tr>
<td>5</td>
<td>Maintenance variable</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Depreciation n/a</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Driver</td>
<td>16,200</td>
</tr>
<tr>
<td>8</td>
<td>New sales (deliveries)</td>
<td>125</td>
</tr>
<tr>
<td>9</td>
<td>Courier charge per delivery</td>
<td>16</td>
</tr>
<tr>
<td>10</td>
<td>Number of deliveries</td>
<td>1,250</td>
</tr>
<tr>
<td>11</td>
<td>Final sale of vehicle</td>
<td>2,300</td>
</tr>
<tr>
<td>12</td>
<td>Profit on each sale</td>
<td>5</td>
</tr>
<tr>
<td>13</td>
<td>Interest rate</td>
<td>5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Expense</td>
<td>Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Fixed</td>
<td>Maint</td>
<td>Total</td>
<td>Courier</td>
<td>New Sales</td>
<td>Sale of Van</td>
<td>Total</td>
<td>Cash Flow</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>year 0</td>
<td>14,500</td>
<td>14,500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-14,500</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>year 1</td>
<td>17,800</td>
<td>200</td>
<td>18,000</td>
<td>20,000</td>
<td>625</td>
<td>20,625</td>
<td>2,625</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>year 2</td>
<td>17,800</td>
<td>250</td>
<td>18,050</td>
<td>20,000</td>
<td>625</td>
<td>20,625</td>
<td>2,575</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>year 3</td>
<td>17,800</td>
<td>300</td>
<td>18,100</td>
<td>20,000</td>
<td>625</td>
<td>20,625</td>
<td>2,525</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>year 4</td>
<td>17,800</td>
<td>400</td>
<td>18,200</td>
<td>20,000</td>
<td>625</td>
<td>20,625</td>
<td>2,425</td>
<td></td>
</tr>
</tbody>
</table>
The straight forward cash flow shows that the project will generate additional income of £2,350. The net present value (cell C25) however adjusts this cash flow by the discount rate (5%) and shows that the return is in fact negative. In other words the business would be better off with its existing arrangements and not buying a van. Alternatively the money could be invested in a better alternative project.

The internal rate of return (cell E25) indicates the discount rate which is necessary for a NPV of 0 (i.e. breakeven). If the 5% value was replaced with a value of 4.18% the NPV would be very close to zero.

The two excel functions used above are as follows:

\[ [C25]=\text{NPV}(L13, I18:I23)+I17 \]
\[ =\text{NPV}(\text{discount rate, cash flow values}) \]

Note that the initial outlay in cell I17 is excluded from the NPV formula because it occurs immediately and should not be discounted. If it occurred at the end of the first year it would be included within the NPV formula (i.e. using the range I17:I23).
The guessed discount rate is an optional argument and not normally required.

If there are alternative projects of which only one can be selected, you should choose which ever has the largest positive NPV. It should be noted however that the longer the time span of a project, the greater the uncertainty and potential risk. Projects with shorter payback periods might be deemed preferable. If funds are unlimited, any project with an IRR greater than the discount rate is worthwhile.

**INVENTORY MANAGEMENT**

Microsoft Excel is one of the most versatile business tools available, and one that most of us already have, even if some of us typically avoid it like the plague. Therefore, utilizing it for inventory management is an easy way to cut costs, save time, and organize inventory, providing you’re willing to learn a few new tricks. While not a perfect fit for large businesses, or anyone with a few thousand different items in their inventory, Excel is excellent for tracking inventory, sales, data, ordering, and more than a dozen other functions. If you know how to utilize it correctly, you can generate a variety of highly valuable inventory formulas that will help you keep track of stock, sales, orders, and more. The following include five of the best practices for managing inventory in Excel.

1. **Organize Based on Sales Quantity**

   The easiest way to use Excel for tracking your stock is to organize your data based on sales quantity. This allows you to create a flexible inventory sheet that updates you when you need to order items because you can see sales right at the top. It also keeps your most sold items on the top for easier tracking, so you won’t be scrolling through pages of data to find what you need. There are a number of ways to do this, starting with manual organization on a daily or weekly basis, which can be a pain (no really, please don’t even think about this, your brain will hurt). The easiest way that won’t result in carpal tunnel from hours of manual data entry is the sort function built into Excel. However, you can also use the Rank function, which is slightly more sophisticated.

   The Sort Function only requires that all of your cells are the same size, that you select all of them, and that you can find the sort function on the top of the page. (This means no merging two cells in one column and three cells in another, design isn't that important). Don’t forget, you’ll have to re-sort each time you update your numbers. You typically want to use Descending order if you want to rank sales from highest to lowest. (As you may have guessed, the sales numbers represented in the image are purely fictional and do not represent hard data of any kind)

2. **Using Excel to Manage Outgoing Orders with a USB Barcode Scanner**

   The main problem with the above function is that you have to manually enter all of your incoming and outgoing products.

   When you have a great deal of products, several people entering values, or a busy day, things happen. Most of us don’t have robots to enter our Excel data, so human error is inevitable. For that reason, a barcode scanner is the next best thing (to robots). Most USB and wireless barcode
scanners are easy to program to integrate directly into Excel, and you can do so on separate lines or updating a single line. Programming for barcode scanners varies slightly by brand.

The standard function for a scanner is to press 'Enter' or 'Tab' after adding information to a cell. This means that it will add each new scanned item to the next row or the next column. You can program it differently, usually by finding a scan code for changing the function, but we'll go over a relatively easy way to program using the original multiple line code.

How it Works: Each time you scan a code with the USB barcode scanner, it automatically inputs the items SKU into your Excel document. For simplicities sake, we're using an extremely basic SKU, which you would not see in real life because the capacity for error is quite high when using a simple number. You can use anything you like, but you should avoid letter and number combinations that Excel will read as a string (i.e. as text instead of a number), unless you want to spend hours fixing code errors with “directs to empty cell” messages (fun, we know). If you have your scanner set to input the number of items scanned + the SKU number, you can easily generate running totals of ingoing and outgoing items, and all without selling your firstborn son for a magic solution.

In order to do this properly, we have to make two assumptions. The first is that unless we assign additional values to the barcode scanner, it won't put in other items such as value, product description, etc. You can most likely program this fairly easily using your barcode scanner codes, but this will differ depending on your software. However, using a barcode scanner is usually a good way to track incoming and outgoing inventory, rather than values, so you don’t necessarily need this information.

You can use the SUMIF function to calculate running totals for the same item on different lines. This uses a code that looks like =SUMIF (C5:C7,ES25,D5,D5:D7).

This may sound more complicated than your high school trigonometry test at first glance, but it is essentially =SUMIF (Cell Range (usually all the way down the page), SKU To Look For (in this case, ES25), Sales To Add Up). For product remaining, you use the same SUM function used to calculate sales in the previous model. Once you get the hang of it, it’s fairly simple.

3. Use Office 365 Excel in the Cloud

One of the main limitations of the traditional Microsoft Excel program is that there isn't really a feasible way for multiple people to add to the same document at once, unless you count backseat driving. While you can solve this with multiple Excel documents, today's technology presents another solution. The cloud. Microsoft has their own cloud solution with Office 365, but you can also go for Google Drive or a number of other free online solutions, but keep in mind that free isn’t always better. Office 365 allows for multiple users, real time updates, live backup, and of course, you can have several users editing the same document at once. An online version is especially useful if you have multiple people, multiple locations, or several computers for updating the inventory sheet. The most valuable function is, of course, the automatic updates. Plus, if you download a copy of Microsoft’s OneDrive to your computer, you can keep a backup copy directly on your computer to ensure that you can access it in case of an Internet outage.
4. Generating Inventory Reports

Inventory reports and analysis charts are relatively easy to generate, providing you have your inventory organized properly. You can choose to create reports on a daily, weekly, bi-weekly, or monthly basis, and create quarterly and yearly reports. The easiest way to do this is by setting up your basic parameters for your inventory and then dragging and dropping the sheet to a new Excel workbook. This automatically copies all of your work to the new one, which gives you a clean inventory page for each day, week, month, or however long you choose to keep records. You can also drag and drop all of your monthly records into one file to set up a yearly inventory, with individual sheets per month for easy organization. You can also generate charts using your data, but it’s up to you to decipher them at a later date.

5. Create Running Inventory Totals

Creating running inventory totals is a must if you want to easily keep track of your remaining stock. There are two ways to do it. For smaller businesses, or those with only a few large ticket items to keep track of, single inventory pages are the most convenient, because they allow you to allocate one page to each product. For larger businesses, or for those with more products, you can create a running inventory for sales, how much you've made, and how much product you have, unless going through over 1,000 sheets to see individual product reports sounds like fun.

QUESTIONS

SHORT ESSAY TYPE

1. How to perform Profitability Analysis using MS Excel?
2. Discuss on how to conduct Liquidity Analysis using MS Excel.
3. Elucidate on Inventory Management using MS Excel.
Chapter 12
DATABASE CONCEPTS

Just imagine how difficult it would be to get any information from an information system if data were stored in an unorganized way or if there were no systematic way to retrieve them. Therefore, in all information systems, data resources must be organized and structured in some logical manner so that they can be accessed easily, processed efficiently, retrieved quickly, and managed effectively. Data structures and access methods ranging from simple to complex have been devised to organize and access data stored by information systems efficiently. In this chapter, we will explore these concepts, as well as the managerial implications and value of data resource management.

It is important to appreciate from the beginning the value of understanding databases and database management. In today’s world, just about every piece of data you would ever want to access is organized and stored in some type of database. The question is not so much “Should I use a database?” but rather “What database should I use?” Although many of you will not choose a career in the design of databases, all of you will spend a large portion of your time—whatever job you choose—accessing data in a myriad of databases. Most database developers consider accessing the data to be the business end of the database world, and understanding how data are structured, stored, and accessed can help business professionals gain greater strategic value from their organization’s data resources.

DATA BASE CONCEPT

Before we go any further, let’s discuss some fundamental concepts about how data are organized in information systems. A conceptual framework of several levels of data has been devised that differentiates among different groupings, or elements, of data. Thus, data may be logically organized into characters, fields, records, files, and databases, just as writing can be organized into letters, words, sentences, paragraphs, and documents.

Character

The most basic logical data element is the character, which consists of a single alphabetic, numeric, or other symbol. You might argue that the bit or byte is a more elementary data element, but remember that those terms refer to the physical storage elements provided by the computer hardware. Using that understanding, one way to think of a character is that it is a byte used to represent a particular character. From a user’s point of view (i.e., from a logical as opposed to a physical or hardware view of data), a character is the most basic element of data that can be observed and manipulated.

Field

The next higher level of data is the field, or data item. A field consists of a grouping of related characters. For example, the grouping of alphabetic characters in a person’s name may form a name field (or typically, last name, first name, and middle initial fields), and the grouping of numbers in a sales amount forms a sales amount field. Specifically, a data field represents an attribute (a characteristic or quality) of some entity (object, person, place, or event). For example, an employee’s salary is an attribute that is a typical data field used to describe an entity who is an employee of a business. Generally speaking, fields are organized such that they represent some logical order, for example, last name, first name, address, city, state, and zip code.
Record

All of the fields used to describe the attributes of an entity are grouped to form a record. Thus, a record represents a collection of attributes that describe a single instance of an entity. An example is a person’s payroll record, which consists of data fields describing attributes such as the person’s name, Social Security number, and rate of pay. Fixed-length records contain a fixed number of fixed-length data fields. Variable length records contain a variable number of fields and field lengths. Another way of looking at a record is that it represents a single instance of an entity. Each record in an employee file describes one specific employee.

Normally, the first field in a record is used to store some type of unique identifier for the record. This unique identifier is called the primary key. The value of a primary key can be anything that will serve to uniquely identify one instance of an entity, and distinguish it from another. For example, if we wanted to uniquely identify a single student from a group of related students, we could use a student ID number as a primary key. As long as no one shared the same student ID number, we would always be able to identify the record of that student. If no specific data can be found to serve as a primary key for a record, the database designer can simply assign a record a unique sequential number so that no two records will ever have the same primary key.

File

A group of related records is a data file (sometimes referred to as a table or flat file). When it is independent of any other files related to it, a single table may be referred to as a flat file. As a point of accuracy, the term flat file may be defined either narrowly or more broadly. Strictly speaking, a flat file database should consist of nothing but data and delimiters. More broadly, the term refers to any database that exists in a single file in the form of rows and columns, with no relationships or links between records and fields except the table structure. Regardless of the name used, any grouping of related records in tabular (row-and-column form) is called a file. Thus, an employee file would contain the records of the employees of a firm. Files are frequently classified by the application for which they are primarily used, such as a payroll file or an inventory file, or the type of data they contain, such as a document file or a graphical image file. Files are also classified by their permanence, for example, a payroll master file versus a payroll weekly transaction file. A transaction file, therefore, would contain records of all transactions occurring during a period and might be used periodically to update the permanent records contained in a master file. A history file is an obsolete transaction or master file retained for backup purposes or for long-term historical storage, called archival storage.

Database

A database is an integrated collection of logically related data elements. A database consolidates records previously stored in separate files into a common pool of data elements that provides data for many applications. The data stored in a database are independent of the application programs using them and of the type of storage devices on which they are stored. Thus, databases contain data elements describing entities and relationships among entities. A database doesn’t need to look complex or technical to be a database; it just needs to provide a logical organization method and easy access to the data stored in it.

DATABASE TERMINOLOGY

The database concept is one of the most powerful, enduring technologies in the information systems environment. It encompasses a variety of technical and managerial issues and features that are at the heart of today’s information systems scene. In order to get started and begin to develop
the deep understanding of database that we seek, we will focus on five issues that establish a set of basic principles of the database concept:

1. The creation of a data-centric environment in which a company’s data can truly be thought of as a significant corporate resource. A key feature of this environment is the ability to share data among those inside and outside of the company who require access to it.

2. The ability to achieve data integration while at the same time storing data in a non-redundant fashion. This, alone, is the central, defining feature of the database approach.

3. The ability to store data representing entities involved in multiple relationships without introducing data redundancy or other structural problems.

4. The establishment of an environment that manages certain data control issues, such as data security, backup and recovery, and concurrency control.

5. The establishment of an environment that permits a high degree of data independence.

**DATABASE MANAGEMENT SYSTEM**

A database management system (DBMS) is a software system that enables the use of a database approach. The primary purpose of a DBMS is to provide a systematic method of creating, updating, storing, and retrieving the data stored in a database. It enables end users and application programmers to share data, and it enables data to be shared among multiple applications rather than propagated and stored in new files for every new application (Mullins, 2002). A DBMS also provides facilities for controlling data access, enforcing data integrity, managing concurrency control, and restoring a database.

**Advantages of the Database Approach**

The primary advantages of a database approach, enabled by DBMSs, are summarized as:

**PROGRAM-DATA INDEPENDENCE** The separation of data descriptions (metadata) from the application programs that use the data is called data independence. With the database approach, data descriptions are stored in a central location called the repository. This property of database systems allows an organization’s data to change and evolve (within limits) without changing the application programs that process the data.

**PLANNED DATA REDUNDANCY** Good database design attempts to integrate previously separate (and redundant) data files into a single, logical structure. Ideally, each primary fact is recorded in only one place in the database. For example, facts about a product, such as Pine Valley oak computer desk, its finish, price, and so forth are recorded together in one place in the Product table, which contains data about each of Pine Valley’s products. The database approach does not eliminate redundancy entirely, but it enables the designer to control the type and amount of redundancy.

**IMPROVED DATA CONSISTENCY** By eliminating or controlling data redundancy, we greatly reduce the opportunities for inconsistency. For example, if a customer’s address is stored only once, we cannot disagree about the customer’s address. When the customer’s address changes, recording the new address is greatly simplified because the address is stored in a single place. Finally, we avoid the wasted storage space that results from redundant data storage.

**IMPROVED DATA SHARING** A database is designed as a shared corporate resource. Authorized internal and external users are granted permission to use the database, and each user (or group of users) is provided one or more user views into the database to facilitate this use. A user view is a logical description of some portion of the database that is required by a user to perform some task. A user view is often developed by identifying a form or report that the user needs on a regular basis. For example, an employee working in human resources will need access to confidential employee data; a customer needs access to the product catalog available on Pine
Valley’s Web site. The views for the human resources employee and the customer are drawn from completely different areas of one unified database.

**INCREASED PRODUCTIVITY OF APPLICATION DEVELOPMENT** A major advantage of the database approach is that it greatly reduces the cost and time for developing new business applications. There are three important reasons that database applications can often be developed much more rapidly than conventional file applications:

1. Assuming that the database and the related data capture and maintenance applications have already been designed and implemented, the application developer can concentrate on the specific functions required for the new application, without having to worry about file design or low-level implementation details.

2. The database management system provides a number of high-level productivity tools, such as forms and report generators, and high-level languages that automate some of the activities of database design and implementation.

3. Significant improvement in application developer productivity, estimated to be as high as 60 percent (Long, 2005), is currently being realized through the use of Web services, based on the use of standard Internet protocols and a universally accepted data format (XML).

**ENFORCEMENT OF STANDARDS** When the database approach is implemented with full management support, the database administration function should be granted single point authority and responsibility for establishing and enforcing data standards. These standards will include naming conventions, data quality standards, and uniform procedures for accessing, updating, and protecting data. The data repository provides database administrators with a powerful set of tools for developing and enforcing these standards. Unfortunately, the failure to implement a strong database administration function is perhaps the most common source of database failures in organizations.

**IMPROVED DATA QUALITY** Concern with poor quality data is a common theme in strategic planning and database administration today. In fact, a recent report by The Data Warehousing Institute (TDWI) estimated that data quality problems currently cost U.S. businesses some $600 billion each year (www.tdwi.org/research/display.asp?ID=6589). The database approach provides a number of tools and processes to improve data quality. Two of the more important are the following:

1. Database designers can specify integrity constraints that are enforced by the DBMS. A constraint is a rule that cannot be violated by database users. If a customer places an order, the constraint that ensures that the customer and the order remain associated is called a “relational integrity constraint,” and it prevents an order from being entered without specifying who placed the order.

2. One of the objectives of a data warehouse environment is to clean up (or “scrub”) operational data before they are placed in the data warehouse (Jordan, 1996). Do you ever receive multiple copies of a catalog? The company that sends you three copies of each of its mailings could recognize significant postage and printing savings if its data were scrubbed, and its understanding of its customers would also be enhanced if it could determine a more accurate count of existing customers.

**IMPROVED DATA ACCESSIBILITY AND RESPONSIVENESS**

With a relational database, end users without programming experience can often retrieve and display data, even when it crosses traditional departmental boundaries. For example, an employee
can display information about computer desks at Pine Valley Furniture Company with the following query:

```sql
SELECT *
FROM Product T
WHERE Product Description = "Computer Desk";
```

The language used in this query is called Structured Query Language, or SQL. Although the queries constructed can be much more complex, the basic structure of the query is easy for even novice, nonprogrammers to grasp. If they understand the structure and names of the data that fit within their view of the database, they soon gain the ability to retrieve answers to new questions without having to rely on a professional application developer. This can be dangerous; queries should be thoroughly tested to be sure they are returning accurate data before relying on their results, and novices may not understand that challenge.

**REDUCED PROGRAM MAINTENANCE** Stored data must be changed frequently for a variety of reasons: new data item types are added, data formats are changed, and so on. A celebrated example of this problem was the well-known “year 2000” problem, in which common two-digit year fields were extended to four digits to accommodate the rollover from the year 1999 to the year 2000.

In a file processing environment, the data descriptions and the logic for accessing data are built into individual application programs (this is the program-data dependence issue described earlier). As a result, changes to data formats and access methods inevitably result in the need to modify application programs. In a database environment, data are more independent of the application programs that use them. Within limits, we can change either the data or the application programs that use the data without necessitating a change in the other factor. As a result, program maintenance can be significantly reduced in a modern database environment.

**IMPROVED DECISION SUPPORT** Some databases are designed expressly for decision support applications. For example, some databases are designed to support customer relationship management, whereas others are designed to support financial analysis or supply chain management.

**POPULAR DATABASE SOFTWARES**

Database is the backbone of today’s business. From public sectors to high tech industries, the infrastructure of enterprise is nothing but data, - the storage, transaction, and analytic of data. For IT professionals, Database is ever a big deal. No matter what you do in IT, certain levels of database knowledge and skills are definitely required. This page provides an updated list of the most powerful database systems which empower today’s enterprise businesses around the world:

1. **Oracle RDBMS**

   Oracle Enterprise Server, designed for grid computing, is the best RDBMS, running on multiple platforms, with the latest version 12c, in which the “c” is for cloud computing. In the IT industry, Oracle is "THE DATABASE." If you want to become a database administrator (DBA), make sure you are the Oracle DBA, and you are all set for your career. Oracle has the unshakeable market share in database field with big corporations, government agencies, and mission-critical data centers running on Oracle database in the Real Application Cluster (RAC) environment. Job opportunities with Oracle database are always there.

2. **IBM DB2**
DB2 is the database management system that delivers a flexible and cost-effective database platform to build robust on demand business applications. The DB2 Universal Database (UDB) Enterprise Server Edition (ESE) is one of the best RDBMS. IBM positions DB2 as the database of choice for robust, enterprise-wide solutions handling high-volume workloads, and optimized to deliver industry-leading performance while lowering costs. DB2 is used by many big insurance companies, for example, VSP, the leading vision insurance company, run its entire business on DB2. While DB2 is not likely to over perform Oracle in market share, it is definitely secured in the second position.

3. Microsoft SQL Server

Microsoft SQL Server is a comprehensive database software platform providing enterprise-class data management and integrated business intelligence (BI) tools. Even though as a late starter in database, Microsoft has made strategic investments to push its SQL Server to the frontline to compete with Oracle and DB2 head-to-head. As the foundation of Microsoft's comprehensive data platform, SQL Server delivers breakthrough performance for mission-critical applications, using in-memory technologies, faster insights from any data to any user in familiar tools like Excel, and a resilient platform for building, deploying, and managing solutions that span on-premises and cloud. Microsoft offers deep discounts to education sectors including public schools, universities, and public agencies in education, which helped SQL Server gain user base significantly.

4. SAP Sybase ASE

SAP Adaptive Server Enterprise (ASE), formerly Sybase, is a high-performance, mission-critical database management system that gives customers an operational advantage by lowering costs and risks. Sybase used to be one of the big 3 database giants (with Oracle and DB2) dominating the database field, but Sybase lost its momentum overtime, and eventually was sold out to SAP really cheap. Sybase database was widely used in banking industry, such as Wells Fargo Bank. It is unclear what would be the future outlook of SAP/Sybase database product since it depends on how SAP plan to position the ASE. Currently SAP Adaptive Server Enterprise (SAP Sybase ASE) is marketed as the affordable relational database management system (RDBMS) designed for high-performance transaction-based applications involving massive volumes of data – and thousands of concurrent users. In short, SAP/Sybase database is still a significant player, but its future is unclear.

5. Teradata

Teradata Database, with an interesting tagline, - "When the world gets smaller, the data gets bigger," is the most powerful Very Large Database (VLDB) system. Nowadays the concept of VLDB has shifted to Big Data which focuses on the value of data for business decision-making. Many large scale data warehousing and business intelligence systems are powered by Teradata. Teradata database is often used by big retailers and telecom enterprises. Teradata offers some unique features: the intelligent optimizer to process queries and filter data to efficiently respond to any request, applying that query power to dynamic data without adding columns to your table to accept new data.

6. ADABAS

Software AG is the maker of Adabas. Adabas once was the most powerful mainframe database, now runs in multiple platforms, and provides superior reliability and performance. Software AG says that Adabas is the comprehensive and scalable enterprise database management system optimized for big data and designed for reliability, high performance and low total cost of ownership. Available for mainframe, Linux®, UNIX® and Windows® (LUW) platforms. ADABAS is integrated with NATURAL, - Software AG's application development and deployment environment known for ease of-use, cross-platform portability and developer productivity.
7. MySQL
MySQL, an open source database, is the most popular database for web-based business applications, and is moving to enterprise level. MySQL is the most popular database for internet systems such as e-commerce and dynamic website. If you run your own blog with Wordpress, you are using MySQL. Many of the world's largest and fastest-growing organizations including Facebook, Google, Adobe, Alcatel Lucent and Zappos rely on MySQL to save time and money powering their high-volume Web sites, business-critical systems and packaged software. MySQL is now in Oracle’s hands but still maintains its independence.

8. FileMaker
FileMaker was the #1-selling easy-to-use database software for Windows and Mac OS. However, on the rise of Microsoft Access, FileMake has lost its competitive edge in the Windows environment, which forced FileMaker strategically build strength on the Mac platform. FileMaker, Inc., is now an Apple subsidiary, which may secure FileMaker's future supported by the strength of Apple products. FileMaker Server maximizes performance of shared databases while increasing security.

9. Microsoft Access
Microsoft Access is the most used desktop database application in Windows. Coming with the Microsoft Office suite, Access is cheap and accessible from most Windows laptops and workstations. Although mainly considered as a desktop database, Access becomes ever popular database for internet systems, - many e-commerce and content management systems is powered by Access database running on the Microsoft's IIS web server platform. Skills of Microsoft Access are always in demand, although the pay may not be great.

10. Informix
Informix, now under IBM, once was the most promising object-oriented database. It had been speculated that the object-oriented database would one day replace the traditional RDBMS (relational database management system), which means Infomix could have taken over Oracle in the IT world, but it had never happened. Thus as a falling star, Infomix was acquired by IBM. The latest version of Infomix has built with some new features, such as NoSQL capability, which unleashes the way to combine unstructured and structured data in a smart way, bringing NoSQL to the SQL database.

QUESTIONS

SHORT ANSWER TYPE
1. Define Database.
2. What is a Record?
3. Briefly describe Primary Key?
4. What is a flat file?

SHORT ESSAY TYPE
1. Explain basic principles of Database Concept.
2. What are advantages of Database Approach?
3. Explain in basic Database Concepts.

ESSAY QUESTIONS
1. Discuss on the most widely used Database Packages.
2. Elucidate the Significance and Principles of Database Concepts.

**Chapter 13**

**DBMS – COMPONENTS AND STRUCTURE**

**COMPONENTS OF DBMS**

Let us examine the major components of a typical database environment and their relationships. Following is a brief description of the nine components:

1. **Computer-aided software engineering (CASE) tools** CASE tools are automated tools used to design databases and application programs. These tools help with creation of data models and in some cases can also help automatically generate the “code” needed to create the database. We reference the use of automated tools for database design and development throughout the text.

2. **Repository** A repository is a centralized knowledge base for all data definitions, data relationships, screen and report formats, and other system components. A repository contains an extended set of metadata important for managing databases as well as other components of an information system.

3. **DBMS** A DBMS is a software system that is used to create, maintain, and provide controlled access to user databases.

4. **Database** A database is an organized collection of logically related data, usually designed to meet the information needs of multiple users in an organization. It is important to distinguish between the database and the repository. The repository contains definitions of data, whereas the database contains occurrences of data.

5. **Application programs** Computer-based application programs are used to create and maintain the database and provide information to users.

6. **User interface** The user interface includes languages, menus, and other facilities by which users interact with various system components, such as CASE tools, application programs, the DBMS, and the repository.

7. **Data and database administrators** Data administrators are persons who are responsible for the overall management of data resources in an organization. Database administrators are responsible for physical database design and for managing technical issues in the database environment.

8. **System developers** System developers are persons such as systems analysts and programmers who design new application programs. System developers often use CASE tools for system requirements analysis and program design.

9. **End users** End users are persons throughout the organization who add, delete, and modify data in the database and who request or receive information from it. All user interactions with the database must be routed through the DBMS.
In summary, the database operational environment is an integrated system of hardware, software, and people, designed to facilitate the storage, retrieval, and control of the information resource and to improve the productivity of the organization.

DATABASE STRUCTURE

The relationships among the many individual data elements stored in databases are based on one of several logical data structures, or models. Database management system (DBMS) packages are designed to use a specific data structure to provide end users with quick, easy access to information stored in databases. Five fundamental database structures are the hierarchical, network, relational, object-oriented, and multidimensional models.

Hierarchical Structure

Early mainframe DBMS packages used the hierarchical structure, in which the relationships between records form a hierarchy or treelike structure. In the traditional hierarchical model, all records are dependent and arranged in multilevel structures, consisting of one root record and any number of subordinate levels. Thus, all of the relationships among records are one-to-many because each data element is related to only one element above it. The data element or record at the highest level of the hierarchy (the department data element in this illustration) is called the root element. Any data element can be accessed by moving progressively downward from a root and along the branches of the tree until the desired record (e.g., the employee data element) is located.

Network Structure

The network structure can represent more complex logical relationships and is still used by some mainframe DBMS packages. It allows many-to-many relationships among records; that is, the network model can access a data element by following one of several paths because any data element or record can be related to any number of other data elements. For example, departmental records can be related to more than one employee record, and employee records can be related to more than one project record. Thus, you could locate all employee records for a particular department or all project records related to a particular employee. It should be noted that neither the hierarchical nor the network data structures are commonly found in the modern organization. The next data structure we discuss, the relational data structure, is the most common of all and serves as the foundation for most modern databases in organizations.

Relational Structure

The relational model is the most widely used of the three database structures. It is used by most microcomputer DBMS packages, as well as by most midrange and mainframe systems. In the relational model, all data elements within the database are viewed as being stored in the form of simple two-dimensional tables, sometimes referred to as relations. The tables in a relational database are flat files that have rows and columns. Each row represents a single record in the file, and each column represents a field. The major difference between a flat file and a database is that a flat file can only have data attributes specified for one file. In contrast, a database can specify data attributes for multiple files simultaneously and can relate the various data elements in one file to those in one or more other files.

Database management system packages based on the relational model can link data elements from various tables to provide information to users. For example, a manager might want to retrieve and display an employee’s name and salary from the employee table, as well as the name of the employee’s department from the department table, by using their common department number field (Dept no) to link or join the two tables. The relational model can relate data in any one file with data in another file if both files share a common data element or field. Because of this, information
can be created by retrieving data from multiple files even if they are not all stored in the same physical location.

**Relational Operations**

Three basic operations can be performed on a relational database to create useful sets of data. The *select* operation is used to create a subset of records that meet a stated criterion. For example, a select operation might be used on an employee database to create a subset of records that contain all employees who make more than $30,000 per year and who have been with the company more than three years. Another way to think of the select operation is that it temporarily creates a table whose rows have records that meet the selection criteria. The *join* operation can be used to combine two or more tables temporarily so that a user can see relevant data in a form that looks like it is all in one big table. Using this operation, a user can ask for data to be retrieved from multiple files or databases without having to go to each one separately.

Finally, the *project* operation is used to create a subset of the columns contained in the temporary tables created by the select and join operations. Just as the select operation creates a subset of records that meet stated criteria, the project operation creates a subset of the columns, or fields, that the user wants to see. Using a project operation, the user can decide not to view all of the columns in the table but instead view only those that have the data necessary to answer a particular question or construct a specific report. Because of the widespread use of relational models, an abundance of commercial products exist to create and manage them. Leading mainframe relational database applications include Oracle 10g from Oracle Corp. and DB2 from IBM. A very popular Mid range database application is SQL Server from Microsoft. The most commonly used database application for the PC is Microsoft Access.

**Multidimensional Structure**

The multidimensional model is a variation of the relational model that uses multidimensional structures to organize data and express the relationships between data. You can visualize multidimensional structures as cubes of data and cubes within cubes of data. Each side of the cube is considered a dimension of the data. Each cell within a multidimensional structure contains aggregated data related to elements along each of its dimensions. For example, a single cell may contain the total sales for a product in a region for a specific sales channel in a single month. A major benefit of multidimensional databases is that they provide a compact and easy-to-understand way to visualize and manipulate data elements that have many interrelationships. So multidimensional databases have become the most popular database structure for the analytical databases that support *online analytical processing* (OLAP) applications, in which fast answers to complex business queries are expected.

**Object-Oriented Structure**

The object-oriented model is considered one of the key technologies of a new generation of multimedia Web-based applications. This *encapsulation* capability allows the object-oriented model to handle complex types of data (graphics, pictures, voice, and text) more easily than other database structures. The object-oriented model also supports *inheritance*; that is, new objects can be automatically created by replicating some or all of the characteristics of one or more *parent* objects. Such capabilities have made *object-oriented database management systems* (OODBMS) popular in computer-aided design (CAD) and a growing number of applications. For example, object technology allows designers to develop product designs, store them as objects in an object-oriented database, and replicate and modify them to create new product designs. In addition, multimedia Web-based applications for the Internet and corporate intranets and extranets have become a major application area for object technology.

**SHORT ESSAY TYPE**

1. Explain the major components of a Database Management System
2. Give an elaborate account on the Structure of DBMS.
Chapter 14

RELATIONAL DATABASE MANAGEMENT SYSTEM

In 1970, Dr. Edgar F. (Ted) Codd of IBM published in Communications of the ACM a paper entitled “A Relational Model of Data for Large Shared Data Banks.” This paper marked the beginning of the field of relational databases. During the 1970s, the relational approach to databases progressed from being a technical curiosity to a subject of serious interest in the information systems community. But it was not until the early 1980s that commercially viable relational database management systems became available. There were two basic reasons for this. One was that, while the relational database was very tempting in concept, its application in a real-world environment was elusive for performance-related reasons. The second reason was that at exactly the time that Codd’s paper was published, the earlier hierarchical and network database management systems were just coming onto the commercial scene and were the focus of intense marketing efforts by the software and hardware vendors of the day. Eventually, both of these obstacles were overcome and the relational model became and remains the database model of choice.

Several factors converged in the early 1980s to begin turning the tide toward relational database. One was that the performance issues that held back its adoption in the 1970s began to be resolved. Another was that, after a decade of use of hierarchical and network database management systems, information systems professionals were interested in an alternative that would move toward simplifying the database design process and produce database structures that were easier to use and understand at all levels. Also, at this time there was increasing interest in a DBMS environment that would allow easier, more intuitive access to the data by an increasingly broad range of personnel. Finally, the early 1980s saw the advent of the personal computer. As software developers began trying to create all manner of applications and supporting software utilities for the PC, it quickly became clear that the existing hierarchical and network database approaches would not work in the PC environment, for two reasons. One was that these DBMSs were simply too large to store and use on the early PCs. The other was that they were too complex to be used by the very broad array of non-information-systems professionals at whom the PCs were targeted.

Today, the relational approach to database management is by far the primary database management approach used in all levels of information systems and for most application purposes, from accounting to banking to manufacturing to sales on the World Wide Web. Relational database management is represented today by such products as Microsoft Access and SQL Server, Oracle, Sybase, and IBM’s DB2 and Informix. While these and other relational database systems differ in their features and implementations, they all share a common data structure philosophy and a common data access tool: Structured Query Language (SQL) (often pronounced “sequel”). This chapter will focus on the basic concepts of how data is stored and retrieved in a relational database by a relational DBMS.

THE RELATIONAL DATABASE CONCEPT

Relational Terminology
In spite of the apparent conflict between non-redundant, linear file data storage and data integration, the relative simplicity of simple, linear files or structures that resemble them in a true database environment is very desirable. After all, the linear file arrangement is the most basic and commonly used data structure there is. This is precisely one of the advantages of relational database management

To begin with, consider the data structure used in relational databases. In a relational database, the data appears to be stored in what we have been referring to as simple, linear files. Following the conventions of the area of mathematics on which relational database is based, we will begin calling those simple linear files relations, although in common practice they are also referred to as ‘‘tables.’’ In the terminology of files, each row is called a ‘‘record,’’ while in a relation, each row is called a tuple. In files, each column is called a ‘‘field,’’ while in a relation each column is called an attribute. In practice, in speaking about relational database, people commonly use the terms relation, table, and file synonymously. Similarly, tuple, row, and record are often used synonymously, as are attribute, column, and field.

It is important to note that there are technical differences between the concept of a file and the concept of a relation (which is why we say that in a relational database the data only appears to be stored in structures that look like files). The differences include:

The columns of a relation can be arranged in any order without affecting the meaning of the data. This is not true of a file.

Similarly, the rows of a relation can be arranged in any order, which is not true of a file.

Every row/column position, sometimes referred to as a ‘‘cell,’’ can have only a single value, which is not necessarily true in a file.

No two rows of a relation are identical, which is not necessarily true in a file. A relational database is simply a collection of relations that, as a group, contain the data describing a particular business environment.

**Primary and Candidate Keys**

A relation always has a unique primary key. A primary key (sometimes shortened in practice to just ‘‘the key’’) is an attribute or group of attributes whose values are unique throughout all rows of the relation. In fact, the primary key represents the characteristic of a collection of entities that uniquely identifies each one. The primary key might then be the combination of the First, Middle, and Last Name attributes (assuming this would always produce a unique combination of values. If it did not, then a fourth attribute could be added to the relation and to the primary key as a sequence field to produce. Some attribute or combination of attributes of a relation has to be unique and this can serve as the unique primary key, since, by definition, no two rows can be identical. In the worst case, all of the relation’s attributes combined could serve as the primary key if necessary (but this situation is uncommon in practice).

**Candidate Keys** If a relation has more than one attribute or minimum group of attributes that represents a way of uniquely identifying the entities, then they are each called a candidate key. (Actually, if there is only one unique attribute or minimum group of attributes it can also be called a candidate key.) For example, in a personnel relation, an employee number attribute and a Social Security Number attribute (each of which is obviously unique) would each be a candidate key of that relation. When there is more than one candidate key, one of them must be chosen to be the
primary key of the relation. That is where the term ‘candidate key’ comes from, since each one is a candidate for selection as the primary key. The decision of which candidate key to pick to be the primary key is typically based on which one will be the best for the purposes of the applications that will use the relation and the database. Sometimes the term alternate key is used to describe a candidate key that was not chosen to be the primary key of the relation.

Foreign Keys

Foreign Keys If, in a collection of relations that make up a relational database, an attribute or group of attributes serves as the primary key of one relation and also appears in another relation, then it is called a foreign key in that other relation. The concept of the foreign key is crucial in relational databases, as the foreign key is the mechanism that ties relations together to represent unary, binary, and ternary relationships.

Extracting Data from a Relation

Thus far, the discussion has concentrated on how a relational database is structured. But building relations and loading them with data is only half of the story. The other half is the effort to retrieve the data in a way that is helpful and beneficial to the business organization that built the database. If the database management system did not provide any particular help in this effort, then the problem would revert to simply writing a program in some programming language to retrieve data from the relations, treating them as if they were simple, linear files. But the crucial point is that a major, defining feature of a relational DBMS is the ability to accept high-level data retrieval commands, process them against the database’s relations, and return the desired data. The data retrieval mechanism is a built-in part of the DBMS and does not have to be written from scratch by every program that uses the database. As we shall soon see, this is true even to the extent of matching related records in different relations (integrating data), as in the earlier example of finding the name of the salesperson on a particular customer account. We shall address what relational retrieval might look like, first in terms of single relations and then across multiple relations.

Since a relation can be viewed as a tabular or rectangular arrangement of data values, it would seem to make sense to want to approach data retrieval horizontally, vertically, or in a combination of the two. Taking a horizontal slice of a relation implies retrieving one or more rows of the relation. In effect, that’s an expression for retrieving one or more records or retrieving the data about one or more entities. Taking a vertical slice of a relation means retrieving one or more entire columns of the relation (down through all of its rows). Taken in combination, we can retrieve one or more columns of one or more rows, the minimum of which is a single column of a single row, or a single attribute value of a single record. That’s as fine a sense of retrieval as we would ever want.

Using terminology from a database formalism called relational algebra and an informal, hypothetical command style for now, there are two commands called Select and Project that are capable of the kinds of horizontal and vertical manipulations just suggested.

DATABASE ADMINISTRATION

The “people side” of database management has two parts: data administration and database administration. Data administration is a planning and analysis function that is responsible for setting data policy and standards, for promoting the company’s data as a competitive resource, for
accounting for the use of data, and for providing liaison support to systems analysts during application development. The database administration function is more operationally oriented and is responsible for the day-to-day monitoring and management of the company's various active databases, as well as for providing liaison support to program designers during application development. Database administration typically carries out many of the policies set by data administration.

THE ADVANTAGES OF DATA AND DATABASE ADMINISTRATION

The initial question is, why do companies need these data and database administration departments? What value do they add? Are they just additional “cost centers” that don’t produce revenue? Indeed, at one time or another, most companies have struggled with these questions. But in today’s heavily data-intensive, information-dependent business environment, these functions are recognized as being more important than ever.

Data as a Shared Corporate Resource

Data is a corporate resource that has taken its rightful place alongside money, plant and equipment, personnel, and other corporate resources. Virtually all aspects of business have become dependent on their information systems and the data flowing through them. Today’s organizations could not function without their vast stores of personnel data, customer data, product data, supplier data, and so forth. Indeed, data may well be the most important corporate resource because, by its very nature, it describes all of the others. Furthermore, the effective use of its data can give a company a significant competitive advantage. Whether it is used for supply chain management, customer service, or advanced marketing applications, a company’s data can have a real impact on its share of the marketplace and on its bottom-line profitability.

Efficiency in Job Specialization

Many of the functions involved in the management of data are highly specialized and require specific expertise. They can range from long-range data planning to working with the idiosyncrasies of a particular database management system. This argues for a full-time staff of specialists who do nothing but manage a company’s data and databases.

Operational Management of Data

It is clear that at the operational level, for the day-to-day management of the company’s production databases, an independent department must be responsible. The reasons for this have already been set forth above. Since the data is likely to be shared among several or many corporate functions and users, it makes sense for the data to be managed by an independent group whose loyalty is to the overall company and not to any individual function. There is also the specific example that in the shared data environment there will always be some applications or users that depend on other applications or users to collect data and/or update the tables on a regular or irregular basis. Clearly it is prudent to have an independent data administration group keep track of who is responsible for updating which tables, and monitor whether they have kept to the expected schedule, for the benefit of everyone else who uses these tables.

Managing Externally Acquired Databases

In today’s information systems environment, some databases are not designed by a company’s own personnel but are acquired as part of purchased software packages. A prominent example of this is Enterprise Resource Planning (ERP) software like the multifunction integrated software sold
by companies such as SAP and People soft. These packages consist of application modules that manage a variety of corporate functions (personnel, accounting, etc.). They typically include a central database that all the application modules share. When a company decides to go the ERP route, they are making an important commitment to a shared data resource. Once again, the only arrangement that makes sense for managing this shared resource is to have an independent group that is tasked with managing it for the overall good of the company.

Managing Data in the Decentralized Environment

With the advent in the 1980s of personal computers, local-area networks, and new, user-friendly software, many companies ‘‘decentralized’’ at least some of their information systems work. These technologies permitted user departments all over the company to handle some or all of their information systems needs on their own, without having to rely on the central information systems organization. There are a variety of advantages and disadvantages to this arrangement (but a book on database management is not the place to go into them). While such developments as ERP software with its centralized database concept have swung the pendulum back towards the centralized IS environment to some extent, decentralization is a fact of life to a greater or lesser degree in virtually all companies. The question is then, in terms of the advantages of data and database administration: do we need these functions more or less in the decentralized environment than we do in the centralized environment? Some people might say that we don’t need them. In fact, when the move towards decentralization began, one of the stated reasons was to reduce the ‘‘overhead’’ of the central IS department and that included database administration. Furthermore, many people are quite content to develop their own databases on their PCs using MS Access and other such PC-based DBMSs. But a very strong argument says that data and database administration are even more important in a decentralized environment than in a centralized one.

DATA MINING

With the enormous amount of data stored in files, databases, and other repositories, it is increasingly important, if not necessary, to develop powerful means for analysis and perhaps interpretation of such data and for the extraction of interesting knowledge that could help in decision-making.

Data Mining, also popularly known as Knowledge Discovery in Databases (KDD), refers to the nontrivial extraction of implicit, previously unknown and potentially useful information from data in databases. While data mining and knowledge discovery in databases (or KDD) are frequently treated as synonyms, data mining is actually part of the knowledge discovery process.

The Knowledge Discovery in Databases process comprises of a few steps leading from raw data collections to some form of new knowledge. The iterative process consists of the following steps:

- **Data cleaning**: also known as data cleansing, it is a phase in which noise data and irrelevant data are removed from the collection.

- **Data integration**: at this stage, multiple data sources, often heterogeneous, may be combined in a common source.

- **Data selection**: at this step, the data relevant to the analysis is decided on and retrieved from the data collection.

- **Data transformation**: also known as data consolidation, it is a phase in which the selected data is transformed into forms appropriate for the mining procedure.
· **Data mining**: it is the crucial step in which clever techniques are applied to extract patterns potentially useful.

· **Pattern evaluation**: in this step, strictly interesting patterns representing knowledge are identified based on given measures.

· **Knowledge representation**: is the final phase in which the discovered knowledge is visually represented to the user. This essential step uses visualization techniques to help users understand and interpret the data mining results.

It is common to combine some of these steps together. For instance, *data cleaning* and *data integration* can be performed together as a pre-processing phase to generate a data warehouse. *Data selection* and *data transformation* can also be combined where the consolidation of the data is the result of the selection, or, as for the case of data warehouses, the selection is done on transformed data.

The KDD is an iterative process. Once the discovered knowledge is presented to the user, the evaluation measures can be enhanced, the mining can be further refined, new data can be selected or further transformed, or new data sources can be integrated, in order to get different, more appropriate results.

Data mining derives its name from the similarities between searching for valuable information in a large database and mining rocks for a vein of valuable ore. Both imply either sifting through a large amount of material or ingeniously probing the material to exactly pinpoint where the values reside. It is, however, a misnomer, since mining for gold in rocks is usually called “gold mining” and not “rock mining”, thus by analogy, data mining should have been called “knowledge mining” instead. Nevertheless, data mining became the accepted customary term, and very rapidly a trend that even overshadowed more general terms such as knowledge discovery in databases (KDD) that describe a more complete process. Other similar terms referring to data mining are: data dredging, knowledge extraction and pattern discovery.

Data mining allows the discovery of knowledge potentially useful and unknown. Whether the knowledge discovered is new, useful or interesting, is very subjective and depends upon the application and the user. It is certain that data mining can generate, or discover, a very large number of patterns or rules. In some cases the number of rules can reach the millions. One can even think of a meta-mining phase to mine the oversized data mining results. To reduce the number of patterns or rules discovered that have a high probability to be non-interesting, one has to put a measurement on the patterns. However, this raises the problem of completeness. The user would want to discover all rules or patterns, but only those that are interesting. The measurement of how interesting a discovery is, often called **interestin** **gness**, can be based on quantifiable objective elements such as *validity* of the patterns when tested on new data with some degree of *certainty*, or on some subjective depictions such as *understandability* of the patterns, *novelty* of the patterns, or *usefulness*.

Discovered patterns can also be found interesting if they confirm or validate a hypothesis sought to be confirmed or unexpectedly contradict a common belief. This brings the issue of describing what is interesting to discover, such as meta-rule guided discovery that describes forms of rules before the discovery process, and interestingness refinement languages that interactively query the results for interesting patterns after the discovery phase. Typically, measurements for
interestingness are based on thresholds set by the user. These thresholds define the completeness of the patterns discovered. Identifying and measuring the interestingness of patterns and rules discovered, or to be discovered, is essential for the evaluation of the mined knowledge and the KDD process as a whole. While some concrete measurements exist, assessing the interestingness of discovered knowledge is still an important research issue.

How do we categorize data mining systems?

There are many data mining systems available or being developed. Some are specialized systems dedicated to a given data source or are confined to limited data mining functionalities, other are more versatile and comprehensive. Data mining systems can be categorized according to various criteria among other classification are the following:

- Classification according to the type of data source mined: this classification categorizes data mining systems according to the type of data handled such as spatial data, multimedia data, time-series data, text data, World Wide Web, etc.

- Classification according to the data model drawn on: this classification categorizes data mining systems based on the data model involved such as relational database, object-oriented database, data warehouse, transactional, etc.

- Classification according to the kind of knowledge discovered: this classification categorizes data mining systems based on the kind of knowledge discovered or data mining functionalities, such as characterization, discrimination, association, classification, clustering, etc. Some systems tend to be comprehensive systems offering several data mining functionalities together.

- Classification according to mining techniques used: Data mining systems employ and provide different techniques. This classification categorizes data mining systems according to the data analysis approach used such as machine learning, neural networks, genetic algorithms, statistics, visualization, database oriented or data warehouse-oriented, etc. The classification can also take into account the degree of user interaction involved in the data mining process such as query-driven systems, interactive exploratory systems, or autonomous systems. A comprehensive system would provide a wide variety of data mining techniques to fit different situations and options, and offer different degrees of user interaction.

DATA WAREHOUSING

Data warehousing is the process of constructing and using a data warehouse. A data warehouse is constructed by integrating data from multiple heterogeneous sources that support analytical reporting, structured and/or ad hoc queries, and decision making. Data warehousing involves data cleaning, data integration, and data consolidations.

Using Data Warehouse Information

There are decision support technologies that help utilize the data available in a data warehouse. These technologies help executives to use the warehouse quickly and effectively. They can gather data, analyze it, and take decisions based on the information present in the warehouse. The information gathered in a warehouse can be used in any of the following domains:

- Tuning Production Strategies - The product strategies can be well tuned by repositioning the products and managing the product portfolios by comparing the sales quarterly or yearly.
Customer Analysis - Customer analysis is done by analyzing the customer's buying preferences, buying time, budget cycles, etc.

Operations Analysis - Data warehousing also helps in customer relationship management, and making environmental corrections. The information also allows us to analyze business operations.

Integrating Heterogeneous Databases

To integrate heterogeneous databases, we have two approaches:

• Query-driven Approach
• Update-driven Approach

Query-Driven Approach

This is the traditional approach to integrate heterogeneous databases. This approach was used to build wrappers and integrators on top of multiple heterogeneous databases. These integrators are also known as mediators.

Process of Query-Driven Approach

1. When a query is issued to a client side, a metadata dictionary translates the query into an appropriate form for individual heterogeneous sites involved.
2. Now these queries are mapped and sent to the local query processor.
3. The results from heterogeneous sites are integrated into a global answer set.

Disadvantages

• Query-driven approach needs complex integration and filtering processes.
• This approach is very inefficient.
• It is very expensive for frequent queries.
• This approach is also very expensive for queries that require aggregations.

Update-Driven Approach

This is an alternative to the traditional approach. Today’s data warehouse systems follow update-driven approach rather than the traditional approach discussed earlier. In update-driven approach, the information from multiple heterogeneous sources are integrated in advance and are stored in a warehouse. This information is available for direct querying and analysis.

Advantages

This approach has the following advantages:

• This approach provides high performance.
• The data is copied, processed, integrated, annotated, summarized and restructured in semantic data store in advance.
• Query processing does not require an interface to process data at local sources.

Functions of Data Warehouse Tools and Utilities

The following are the functions of data warehouse tools and utilities:

• Data Extraction - Involves gathering data from multiple heterogeneous sources.
• Data Cleaning - Involves finding and correcting the errors in data.
• Data Transformation - Involves converting the data from legacy format to warehouse format.
• Data Loading - Involves sorting, summarizing, consolidating, checking integrity, and building indices and partitions.
• Refreshing - Involves updating from data sources to warehouse.

Note: Data cleaning and data transformation are important steps in improving the quality of data and data mining results.
Data Warehouse Features

The key features of a data warehouse are discussed below:

- **Subject Oriented** - A data warehouse is subject oriented because it provides information around a subject rather than the organization's ongoing operations. These subjects can be product, customers, suppliers, sales, revenue, etc. A data warehouse does not focus on the ongoing operations, rather it focuses on modelling and analysis of data for decision making.

- **Integrated** – A data warehouse is constructed by integrating data from heterogeneous sources such as relational databases, flat files, etc. This integration enhances the effective analysis of data.

- **Time Variant** - The data collected in a data warehouse is identified with a particular time period. The data in a data warehouse provides information from the historical point of view.

- **Non-volatile** - Non-volatile means the previous data is not erased when new data is added to it. A data warehouse is kept separate from the operational database and therefore frequent changes in operational database are not reflected in the data warehouse.

**Note:** A data warehouse does not require transaction processing, recovery, and concurrency controls, because it is physically stored and separate from the operational database.

Data Warehouse Applications

As discussed before, a data warehouse helps business executives to organize, analyze, and use their data for decision making. A data warehouse serves as a sole part of a plan-execute-assess "closed-loop" feedback system for the enterprise management. Data warehouses are widely used in the following fields:

- Financial services
- Banking services
- Consumer goods
- Retail sectors
- Controlled manufacturing

Types of Data Warehouse

Information processing, analytical processing, and data mining are the three types of data warehouse applications that are discussed below:

- **Information Processing** – A data warehouse allows to process the data stored in it. The data can be processed by means of querying, basic statistical analysis, reporting using cross tabs, tables, charts, or graphs.

- **Analytical Processing** – A data warehouse supports analytical processing of the information stored in it. The data can be analyzed by means of basic OLAP operations, including slice-and-dice, drill down, drill up, and pivoting.

- **Data Mining** - Data mining supports knowledge discovery by finding hidden patterns and associations, constructing analytical models, performing classification and prediction. These mining results can be presented using visualization tools.

QUESTIONS

SHORT ANSWER TYPE

1. Define RDBMS.
2. What is a Foreign Key?
3. Briefly explain the Relational Terminology.
4. What is Database Administration?

SHORT ESSAY TYPE

1. Explain Data Mining.
2. What is Data Warehousing? Explain
3. What are the Advantages of Database Administration?

ESSAY QUESTIONS
1. Discuss on Database Administration and its benefits.
2. Elucidate on Data Mining and Data Warehousing.

Chapter 15

INTRODUCTION TO DATABASE SOFTWARE

MS ACCESS 2016

Microsoft has made many strides with the Access program since its invention. Over the years it has risen has one of the most dominant database programs with user-friendly features. Access 2013 is a part of the Office 2012 and so have similar commands and features as that of Microsoft Word and Microsoft Excel. Information can easily be shared between Access and all other Microsoft programs. This guide provides a detailed look along with detailed steps on how to work in Access 2016 and the features that are commonly utilized.

OPERATING IN THE ACCESS 2016 INTERFACE

Microsoft Access 2016 can be installed as self-supporting program or from a DVD as a part of the Office suite programs. Nevertheless, whether you used any of the installation options, the program works the same with the same functionality. The most commonly used method of starting Access is from the Start Menu (for Windows 7) or the Start Screen (for Windows 8) presented whenever you select the left end of the Windows taskbar.

Whenever you start Access without opening a database, you will see the starting screen for the program appear. It is from this screen you can now open existing databases or open new databases. All the tools necessary for you to enter and manipulate data and create database items are contained in the program window that is displaying the database. The way persons generally operate with a database is the closely reflected in the design of Access 2016. However, if you are unfamiliar with the interface, listed below are details of the program window components.

Recognizing the Program Window Components

The Title Bar

This bar is located across the top of the display of the program window shows names of the active databases and the pathway to the folder where it is kept. Also, it provides tools necessary for managing both the program window and the program. The tools on title bar can be used to redo or undo changes, size and move the window, get help with the program and save the database. There is a program icon located at the left end of the title bar that you can click on to show commands to maximize, restore, size, close the window, move and minimize. The Quick Access toolbar is located at the right of the Access icon whereby it displays the redo, save and undo buttons. The Quick Access toolbar can also be customized to display the commands you want. Additionally, you can find four other buttons at the right end of the title bar; the restore/maximize button, the minimize button, the close buttons and the Help button which opens the Access Help Window that you may use regular techniques to locate information.

The Navigation Pane
The navigation pane shows a list of database items on the left side of the program window. The Navigation Pane displays all the items within the database by the type of object. You can sort the list by selecting the title bar on the pane and then selecting the group or category of the items you wish to display. The groups can also be expanded and collapsed in the list by selecting the chevrons in the section bars. The Navigation Pane consists of buttons in its upper right corner, such as the Shutter Bar Open/close button that allows you to maximize it. In order for you to redisplay the navigation pane, click on the Shutter Bar Open/CeClose button again. Also, you can pull the right border of the pane to the right or left to make it narrower or wider.

The Status Bar

The status bar is located at the program window, across the bottom. The purpose of this bar is to show information about the present database and to also provide accessibility to specific program functions. The View Shortcuts toolbar, located at the right end of the bar, provides useful buttons for changing the view of the active database object.

The Ribbon

Below the Title bar is the Ribbon which consist of buttons which represents all the commands needed for working efficiently with an Access database. Also, a set of tabs are located across the ribbon which displays a set of commands whenever you click on it. These commands can be divided into three categories:

Commands related to managing Access and its databases. These commands are all located together in the Backstage view which will appear if you click on the colored File tab located at the left end of the ribbon. Also, by clicking on the Page tab located at the Colored left pane, you can view the commands that are organized on pages.

Commands related to working with the database content. These commands are the buttons on the remaining tabs of the ribbon. Whenever you select an object in a database, you will see one or more tool tabs appear at the right end of the ribbon.

Related Commands. These commands are not represented by buttons in a group like that of the other commands. Instead, they can be found in a pane or dialog box, which you can show by clicking on the dialog box launcher found in the lower right corner of the group.

To the right of the ribbon is the Collapse the Ribbon button which by clicking on it, hides the groups of commands but still has the tab names visible. If you want to temporarily show the commands, you can click on any of the tab names. Whenever all of the ribbon is temporarily visible, you can click on the Pin the Ribbon button which is located to the right of the group names, to make the ribbon display permanent.

Operating with the Ribbon

The Microsoft Access Ribbon can be described as dynamic, meaning that the buttons adapt to any available space as the width changes. Because of this, the buttons may or may not have a label, be small or large and they may even be entries of a list. The width of the ribbon is dependent on three elements:

The Program window width. This provides the ribbon with more space.
The Screen resolution. This is the size of the screen display conveyed as pixel high times pixels wide (P x P). The larger the screen resolution, the more information that will hold on the screen. Screen resolution options depend on the monitor and graphics adapter. In order to change your screen resolution you:

Right click on the Windows desktop from which you then click on Screen Resolution
Open the Screen Resolution Panel item.
Click on the Resolution arrow located on the Screen Resolution page, which you pull to select the screen resolution of your choice.
You then click on Apply or OK.

The magnification of your screen display. User and text interface features are bigger and are therefore more readable but fewer features fit on the screen whenever you change the magnification settings in windows. The magnification can be set from as low as 100 percent to as high as 500 percent. You can adjust the magnification from the Display control panel item by:

Right click on the windows desktop and then click on Personalize.
Then click on Display which is located on the bottom left corner of the Personalization page.
If you want a screen magnification of 150 percent, click on that option on the Display page.
To choose another magnification, click on the Custom Sizing options
In the Custom Sizing dialog box, click on the magnification that suits you in the drop down list.
Then click on OK

After that, the custom magnification is displayed on the Display page along with any warnings about potential issues with choosing that specific magnification.

You then click on Apply located on the Display page to apply the chosen magnification.

UNDERSTANDING THE DATABASE MODELS

For simple databases, information is stored only in one table. These simple databases are usually called Flat File databases. Complex databases such as Access, which store information in multiple tables, are referred to as Relational databases. If you organize the information properly in a relational database then you can treat these tables as a single area of storage and can pull information electronically from other different tables in whatever order you wish.

The types of database items that one will operate with in Microsoft Access are Forms, queries, tables, modules and macros. However, of all these item types, tables are the only ones used as storage for information. The other items are used to manipulate, enter, manage, retrieve, display or analyse information which are stored in tables.

Therefore, a database, in its most simple form, can be described as the electronic correspondent of an ordered list of information. Each list or table is arranged in rows and columns. Because a database stores information in an electronical format, it is possible for you to control the information in many ways to prolong its usefulness. The main purpose and importance of a database is to quickly retrieve the information you want as long as that information is stored.

Facilitating Macros and Other Dynamic Contents
Nearly all databases comprise off macros and other dynamic contents that can run codes on a computer. The code, in majority of the cases, is present to perform database related task but can also be used to create and spread viruses by hackers. Whenever you open a database that is not kept in a trusted location then Access shows a security warning below the ribbon. Three ways in which you can facilitate macros and other dynamic contents are:

By making the database location a trusted location or by transferring the database to a trusted location. Automatically, Access facilitates macros content in any database saved within that specified location.

By allowing the macros for the use in the present session of the database.

By adding the database publisher to a list of trusted database publishers. However, this option is only available if the digital signature of the publisher is attached to the database. In order to add the publisher of a digitally signed database in the trusted Publishers list you:

Click on Some active content has not been disabled, located in the security warning bar.

On the Info page located in the backstage view, click on the Enable Content button.

Then click on Advanced Options.

In the Microsoft Office Security Options dialog box click on Trust all Documents from this publisher.

Then click on OK.

How to Add the Location of a Database to the Trusted Locations List

In order to add the location of a database to the trusted locations list you:

Show the backstage view

Then you click on Options

Click on Trust Center, located in the left pane of the Access Options dialog box.

Then click on Trust Center Settings.

You then click on Trusted Locations located in the left pane of the Trust Center.

Click on Add new location which is found on the Trusted Location page.

Then in the Microsoft Office Trusted Location you click on Browse.

In the Browse dialog box, go to the folder containing the present database and then click on OK.

In the Microsoft Office Trusted Location dialog box, click on Subfolders of this location are also trusted check box if needed.

Click on OK in each of the open dialog boxes.

How to Change the Way Access Controls Macros in Databases

If you want to, you can change the way Access handles macros in your databases by:

Showing the Trust Center first,

Then in you click on Macro Settings located in the left pane.

You then select the option that matches the way you want access to handle the macros.
These options are ‘Disable all macros without notification’, ‘Disable all macros with notification’, ‘disable all macros except digitally signed macros’ and ‘enable all macros’.

Click on OK in order to close the Trust center.

You then click on Ok to close the Access Options dialog box

EXPLORING THE TABLES OF ACCESS

The main database objects are tables and their sole purpose is to store information. Other database objects purpose is to interrelate in some way with one or more tables. An Access database can hold more than thousands of tables and the number of records confined in each table are restricted more by the storage space.

All objects of Access have two or more views. The two most used views for Tables are Datasheet view and Design view. Datasheet view enables you to show and alter the table’s data while Design view enables you to show and alter the table’s structure. In order to open a table in the Datasheet view, you can either:

Double click its name in the Navigation pane or Right click its name and then click on Open.

In order to open a table in the Design view you can simply:

right click on its name and Then click on Design View.

Whenever a table is open in the Datasheet view, by clicking on the View button located in the Views group on the Home tab, it changes to Design View. Whenever it is open in Design View, by clicking on the Button, it changes to Datasheet view. If you want, it is possible for you to switch the view by just clicking on one of the buttons located on the Views Shortcuts toolbar in the button right corner of the program window.

The Datasheet view shows the table’s data in rows which are the records and columns which are the fields. The first row of the database is consists of headings which are the field names. In a lot of cases, you find that two tables may have one or more field names in common and it is because of this why it is now possible to insert the datasheet from one table to the next. Such a datasheet is referred to as a Sub datasheet which enables you to show information in more than one table simultaneously.

How to Open Existing Databases and Explore the Table Structure

In the Navigation pane, click on the document twice in order to open the table in Datasheet view.

Click on the Shutter Bar Close button located at the right end of the Navigation pane title bar to show of the table’s fields

To alter the width of some columns to accommodate their lengthiest entries you:

In the row that has the field names at the top of the table, point the cursor to the right border of the First column. The pointer will then change to a double headed arrow by which you double click on the border.

You then double click on right border of any other column whose field’s width needs adjusting.

To Open a Second table you:

Click on the Shutter Bar Open button located in the Navigation pane.
You then double click on the document in order to open the table you want in Datasheet view (the previous table is still open in case you need it).

In the second table, at the left of the record for the fifth category, click on the Expand button in order to show the Sub datasheet which has all the records from the first table that are assigned to the selected category.

To the left of the selected category, click on the Collapse button to hide the Sub datasheet.

To close the second table, click on the Close button at the right end of the page tab bar.

You then close the First table. Access will then ask you if you want to save changes to the table, clock on Yes.

You then click on the Third table located in the Navigation pane.

Click on the Next Record button several times, which is located on the Records Navigation bar, in order to move the selection down the selected field.

To view the structures of the Currently Open table you:

Click on the Design view button located on the View Shortcuts toolbar, to show the Third table structure in design view.

**TABLE CREATION**

A simple database, such as a contact list, might use only a single table. Many databases, however, use several tables. When you create a new database, you create a new file on your computer that acts as a container for all of the objects in your database, including your tables.

You can create a table by creating a new database, by inserting a table into an existing database, or by importing or linking to a table from another data source — such as a Microsoft Office Excel workbook, a Microsoft Office Word document, a text file, or another database. When you create a new, blank database, a new, empty table is automatically inserted for you. You can then enter data in the table to start defining your fields.

**Create a new table in a new database**

1. Click the **Microsoft Office Button**, and then click **New**.
2. In the **File Name** box, type a file name for the new database.
3. To browse to a different location to save the database, click the folder icon.
4. Click **Create**.

The new database opens, and a new table named Table1 is created and opens in Datasheet view.

**Create a new table in an existing database**

1. Click the **Microsoft Office Button**, and then click **Open**.
2. In the **Open** dialog box, select the database that you want to open, and then click **Open**.
3. On the **Create** tab, in the **Tables** group, click **Table**.
Use a table template to create a table

In earlier versions of Access, you used the Table Wizard to quickly create a table from sample tables and fields. In Office Access 2007, you use table templates and field templates instead.

A table template is an empty table that you can start using as-is, or modify to suit your needs. Office Access 2007 comes with the following table templates, designed to be compatible with the Windows SharePoint Services 3.0 lists of the same name:

- **Contacts** A table for managing business contact information, which includes e-mail addresses, Web page URLs, and attachments, such as a service contract and a photo.
- **Tasks** A table for tracking tasks, which includes a field for attachments.
- **Issues** A table for tracking issues, which includes a field for attachments and an append-only Memo field that keeps a history of old field values.
- **Events** A table for managing events, which includes a rich text Memo field and a field for attachments.
- **Assets** A table for managing business assets, which includes two currency fields so that you can track asset depreciation.

After you create a table by using a table template, you may want to add fields by using field templates. A field template is a predefined field that you can add to any table in Datasheet view. For more information about using a field template, see the section Add a field by using a field template, later in this article.

Create a new table by using a table template

1. Click the **Microsoft Office Button**, and then click **Open**.
2. In the **Open** dialog box, select and open the database in which you wish to create a table.
3. On the **Create** tab, in the **Tables** group, click **Table Templates** and then select one of the available templates from the list.

A new table is inserted, based on the table template that you chose.

Import or link to create a table

You can create a table by importing or linking to data that is stored elsewhere. You can import or link to data in an Excel worksheet, a Windows SharePoint Services list, an XML file, another Access database, a Microsoft Office Outlook folder, and more.
When you import data, you create a copy of the data in a new table in the current database. Subsequent changes to the source data will have no effect on the imported data, and changes to the imported data do not affect the source data. After you connect to a data source and import its data, you can then use the imported data without connecting to the source. You can change the design of an imported table.

When you link to data, you create a linked table in the current database that represents a live link to the existing information that is stored elsewhere. When you change data in a linked table, you are changing it in the source. Whenever data changes in the source, that change is shown in the linked table. You must be able to connect to the data source whenever you use a linked table. You cannot change the design of a linked table.

NOTE You cannot edit data in an Excel worksheet by using a linked table. As a workaround, import the source data into an Access database, and then link to the database from Excel. For more information about linking to Access from Excel, search Excel Help, or see the links in the See Also section.

Create a new table by importing or linking to external data

1. Click the Microsoft Office Button , and then click Open.
2. In the Open dialog box, select and open the database in which you wish to create a new table.
3. On the External Data tab, in the Import group, click one of the available data sources.

1. Follow the instructions in the dialog boxes that appear at each step.
Access creates the new table and displays it in the Navigation Pane.
TIP You can also import or link to a SharePoint list by using a command on the Create tab

Use a SharePoint site to create a table

You can create a table in your database that imports from or links to a SharePoint list. You can also create a new SharePoint list by using a predefined template. The predefined templates in Office Access 2007 include Contacts, Tasks, Issues, and Events.

1. Click the Microsoft Office Button , and then click Open.
2. In the Open dialog box, select the database in which you want to create the new table, and then click Open.
3. On the Create tab, in the Tables group, click SharePoint Lists.

4. Do one of the following:
Create a SharePoint list that is based on a template

- Click either Contacts, Tasks, Issues, or Events.
- In the Create New List dialog box, type the URL for the SharePoint site where you want to create the list.
- Enter a name for the new list and its description in the Specify a name for the new list and Description boxes.
- To open the linked table after it is created, select the Open the list when finished check box (selected by default).

Create a new custom list

- Click Custom.
- In the Create New List dialog box, type the URL for the SharePoint site where you want to create the list.
- Enter a name for the new list and its description in the Specify a name for the new list and Description boxes.
- To open the linked table after it is created, select the Open the list when finished check box (selected by default).

Import the data from an existing list

- Click Existing SharePoint List.
- In the Get External Data dialog box, type the URL for the SharePoint site that contains the data that you want to import.
- Click Import the source data into a new table in the current database, and then click Next.
- Select the check box next to each SharePoint list that you want to import.
- Link to an existing list

- Click Existing SharePoint List.
- In the Get External Data - SharePoint Site dialog box, type the URL for the SharePoint site that contains the list to which you want to link.
- Click Link to the data source by creating a linked table, and then click Next.
- Select the check box next to each SharePoint list to which you want to link.

Creating Queries

Two basic types of queries can be created to aid in locating specific items of information when using Microsoft Access. They are:

Select – this finds the records in the database that matches the criteria you specified. It then displays those records in a datasheet, form, or report. This query option can be used to display specific fields from specific records from one table or multiple tables.

Action – this finds the records in the database that matches the criteria you specified and then does something with those records. An action query is used to guarantee the ongoing accuracy of a database.

Both types of queries can be saved and run at any time to generate updated results of any data changes.
USING A WIZARD TO CREATE QUERIES

Previously, you learned how to get information from a database table by filtering it. Even though the filtering techniques are effective, they are limited by the fact that the filters are only saved temporarily or not saved at all. Also, the filters are only applied to the table or form that is opened at the moment. Filters can be made permanently available, or you can filter multiple tables or tables that are not open. This can be done by using queries. The type of query that is most common is the select query. To set up a select query you would use a query wizard. There are four types of wizards available:

Simple – a query is set up by this wizard to get data from one table or multiple tables. The results are then displayed in a datasheet.

Find Duplicates – a query is set up by this wizard to find specified records that contain the same information in one field or more than one field.

Find Unmatched – a query is set up by this wizard to find records in a single table that don’t have related records in another table.

Crosstab – a query is set up by this wizard to calculate and restructure data to make it easier to be analysed. This type of query can be used for calculation of averages, sums, and counts. It can also be used for other types of totals such as data that is grouped by two types of information, one down the left side of the datasheet and another across the top.

Microsoft Access must understand the relationship between fields in multiple tables in order for a query to work effectively.

Whether you are creating a query manually or by using a wizard, what you are essentially doing is creating a statement that describes the conditions that have to be met for records to be matched in one table or multiple tables. When the query is run, the records that match will appear in a new datasheet.

CREATING MANUAL QUERIES

Less common queries can be created manually by using Query Designer. The features of Query Designer are listed below:

The top pane consists of field lists for the table which can be included in the query.

There are lines connecting the field lists to show that tables are related by common fields.

A key icon indicates the primary key field in a table.

The Field row of the design grid has the names of the names of the fields that are actually included in the query.

The Table row indicates which table each field belongs to.

The Sort row shows which field or fields, if any, that the query results will be sorted on.
In the Show row if the check box is selected, then this means that results datasheet will display the field. If the box is cleared, it means that the field can be used to determine the query results, however, it will not be displayed.

The Criteria row can contain criteria that determine the records to be displayed. Finally, the Or row sets up alternative criteria.

When you manually create a query, you add field lists to the top pane of Query Designer for the tables to be used. You do so by double clicking or dragging fields from the list to consecutive columns of the design grid. You then specify on which field to sort the records that match and which field value to display in the results datasheet. Similar to filters, queries are most powerful when the criteria are set up in Criteria and Or rows because this is where you specify exactly which information is to be extracted.

An existing query can be modified and rerun to show variations of the same basic criteria.

This can be done in Design view. However, doing this repeatedly can become a tedious task. A parameter query can be set up to avoid the wearisome task. Parameter queries display a dialog box to prompt for the information that will be used in the query. A parameter query can be set up if you know that you will run variations of the same query. This query type is very helpful when used as the basis for a report that you will occasionally run.

**USING QUERIES TO SUMMARIZE DATA**

A query is normally used to locate all records that meet particular criteria. However, there are times when you are more interested in the summary of the query results than the details of the records.

Summary information can be extracted easily by creating a query that groups the necessary fields and also does the math. The mathematical calculations are done by utilizing an aggregate function. They are listed below:

- **Sum** – the total of the values in a field is calculated
- **Avg** – the average of the values in a field is calculated
- **Min** – the lowest value in a field is extracted.
- **Max** – the highest value in the field is extracted.
- **Count** – the number of values in a field are counted. Null (blank) is not included in the count.
- **St Dev** – the standard deviation of the values in a field are calculated.
- **Var** – the variance of the values in a field are calculated.

You are given the option of creating a summary query by the Simple Query wizard when a query you created by using that wizard is based on a table with fields that contain numeric data. On the wizard’s second page, you can select Summary and then click on Summary Options. A dialog box is displayed for you to specify which aggregate function you want to use.

When manually creating a query or making changes to one that was already created, a Total row can be added to the grid. Just go to the Design tool tab and click on the Show/Hide group and then select the Totals button. From a list, you can then choose the aggregate function that you want.
This list allows you to do several things. You can group fields, enter an expression select the first or last record that meets the specified criteria, or make additional criteria refinements.

All the data in a table can be summarized without creating a query. To do so you firstly open the table in Datasheet view. To add a Total row at the bottom of the table, go to the Home tab in Records group and click on the Totals button. The row can be removed from the table by clicking the Totals button again. From a list you can select the type of summary data that you want to be displayed in the total row of each field. The types of summary available for each field are dependent on its data type.

**USING QUERIES TO DO CALCULATIONS**

You previously learned that queries have built-in aggregate functions that can be used to summarize data. Queries can also be used to perform calculations and also create new fields in which to save them.

A basic principle of good database design is to never store information that can be calculated from data that already exists. To avoid increasing the size of the database by creating new fields and populating it with unnecessary information, you can use an expression in a query to calculate the required information from data that already exists, whenever that information is needed.

The results from one query can be used as a field in another query.

**USING QUERIES TO UPDATE RECORDS**

Updating Records

As the size of a database grows through usage, the possibility exists that errors will manifest themselves or some information will become out-dated. It is a tedious task to scroll through records to identify those that need changing. Microsoft Access 2016 provides tools and techniques to help you to efficiently complete such a task.

The Find & Replace command which is found on the Home Tab under the Find group will help you to find or replace multiple occurrences of the same word or phrase. These commands work similarly to those found in Word and Excel.

An action query is the tool needed to manipulate information that was stored in a database.

An action query searches records and finds the ones that match the selection criteria and performs an action on them. Certain kinds of data manipulation are easy to be done with an action query. Using a query saves times and helps to avoid errors.

There are four kinds of action queries:

Append – this action adds records from one table or multiple tables to the end of one table or multiple tables.

Delete – this action deletes records from one table or multiple tables.

Make-table – this action creates a new table from part or all of the data in one or more tables.

Update – this action makes changes to records in one table or multiple tables. You should always make a backup copy a table before running an update query as permanent changes will be made to the underlying table. To create a copy of a table:
Go to the Navigation pane
Click on the Tables list
Click the table you want to copy
Press Ctrl+C to copy
Press Ctrl+V to paste the copy
Enter a name for the new table in the Paste Table As dialog box
Click OK
The backup copy of the table will become a part of the database. When you are sure that the update query produced the desired results, you can delete the backup table.

An action query cannot be created directly. Firstly, you have to create a select query and then convert it. You would then open the existing select query in Query Designer and click on the Design tool tab and choose the appropriate button in the Query Type group. Or, right-click the query in Query Designer, click Query Type, and choose the query type that you want.

**USING QUERIES TO DELETE RECORDS**

Deleting Records

The information that is stored in a database might become out-dated and need to be discarded in order to maintain an efficient database. Discarding obsolete records needs to be done periodically. Once more, the task can be a tedious and time consuming one if you choose to scroll through every table manually and delete records. A delete query is used to get rid of records that match a particular pattern.

Please take into consideration, the fact that deleted records cannot be recovered and a delete query can have far-reaching effects that you never expected.

There is an option called Cascade Delete Related Records which will not only delete records from the table you selected but also records from another table that are related to the first table. If this is the option you want, then select it. If not, please ensure this option is deselected before you run the delete query.

To guarantee that you will not accidentally delete any relevant and needed information, go to the Database tools tab, click the Relationships button and display the Relationships page. You will see if you are deleting any data from a table that has a relationship with another table. If such a relationship exists, right-click the relationship line, click Edit Relationship and if the Enforce Referential Integrity check box was selected, ensure that the Cascade Delete Records check box is not selected.

You might want to take further precautions to safeguard your database against potential problems before attempting any record deletions. You can create a new table to store the records you want to delete and review them one more before permanently deleting them.

**CREATING FORMS**
There are three basic sections in every form: the Form Header, Detail, and Form Footer. When you use the Form tool or wizard to create a form, a logo placeholder and a title is added to the Form Header section. Each field in the underlying table has a set of text box and label controls that are added to the Detail section. The Form Footer section is left blank. Any form can be customized by adding controls to its sections. These controls can be rearranged to make the form easier to work with.

When designing a form, the main thing to take into consideration is the ease with which data can be entered. When data entry is made easier, people are less likely to make mistakes. One way to eliminate mistakes is to have Access automatically enter data based on entries that were already made. A second way to eliminate mistakes is to make it possible for data to be entered simultaneously in more than one table by using sub forms.

**HOW TO MODIFY FORMS THAT WERE CREATED BY A WIZARD**

A form that is intended as the primary means of entering new records will usually include all fields from the underlying table. Using the Form tool is the fastest way to create a form that includes all the fields from a single table. Using a wizard is another way, and this method provides more control over the creation of the form. With either method, the form can be easily customized after it has been created.

You can gauge the effects of moving and sizing controls and labels because the data in the underlying table is displayed in Layout view. You can adjust properties on the Property Sheet pane to modify form elements and make the most of the adjustments that you will likely want in the custom form.

Working in Design view will allow you more control over the layout of a form as you can modify the structure of the form on a design grid. However, the data from the underlying table(s) will not be seen.

The form design grid has three sections:

- **Form Header** – this section contains the information that will be shown at the top of the form, for example is a title.
- **Detail** – this section contains a text box control and an associated label control for each field that was chosen to be included in the form.
- **Form Footer** – this section can contain information that is to be displayed at the bottom of the form. This section is closed by default.

Design view will allow you to work with the form by doing the following:

- Adjusting the size of sections.
- Applying a theme.
- Changing the size of controls.
- Arranging controls logically to facilitate the entry of data.
- Adjusting the properties of form elements in the Property Sheet pane.
- Adding fields from the Field List pane.
Adding controls to limit data entry choices and functionality to the form.

Different Form Types

Majority of forms will allow you to enter data and add or edit records in one table or multiple tables. There are some forms that will allow you to do more than that as they are more specialized. From the Create tab of the Forms group the following types of forms can be created:

Form Design – you can design a form from scratch from the blank design grid in that is displayed in Design view.

Blank form – a blank canvas is displayed in Layout view and the Field List pane is opened so you can drag fields from the database tables onto the form.

Navigation – this type displays a gallery of predefined navigation form layouts.

Additional types of forms can be accessed by clicking the More Forms button:

Multiple items – more than one record is displayed on a single form page. This is also sometimes referred to as a Continuous form.

Datasheet – this forms looks like a datasheet (table) and also acts like one.

Split – two co-ordinated views of the same data is provided, one in form and one in datasheet. This makes the process of finding and editing records much simpler and easier.

Modal dialog – this form looks like a dialog box and behaves like one. It has OK and Cancel default buttons. Nothing else can be done while this form is still active. It has to be closed first.

How to Add Controls

Text box and label controls are the most common controls found in forms; however, there are many other types of controls that you can use to enhance your forms. Enhancements include adding list boxes, combo boxes, and check boxes. This gives people choices instead of them having to make entries in text boxes.

When a form is displayed in Design view or Layout view, the available controls in that view can be found on the Design tool tab in the Controls gallery. Each control is one of these types:

Bound – this is a control that is linked to a field in a table or the datasheet that was created by a query and include the following:

Text boxes and labels
Combo boxes, check boxes, list boxes, and option groups and buttons
Charts
Sub-forms or sub-reports

Unbound – this is a control that is not bound to any underlying data and includes the following:

Buttons and toggle buttons
Tabs and page breaks
Hyperlinks, web browser controls, and navigation controls
Attachments
Frames
Lines and images

HOW TO DISPLAY SUB-FORMS
If there is a one-to-many relationship between two tables, the information from the “one” side and the “many” side can be displayed by using a main form and a sub-form. For example, there is a table with Customers names and another table with customer Orders.

These tables are related. The main form might display information about the customer (the “one” side) while the sub-form would list all orders that were made by this customer (the “many” side). So, “one” customer has “many” orders.

To create a main form to include all the fields of one table with a sub-form that includes all the fields of another table, this can be done quickly by using the Form tool to create the form and its sub-form. This can be done as long as only a single one-to-many relationship between tables was already defined on the Relationships page. Just click the primary table in the Navigation pane, then go to the Forms group and from the Create tab, click the Form button. The Form tool will create and display both a main form and a sub-form, with each one containing all the fields of its source table.

How to create fields for main forms & Sub-forms

The Form wizard can be used to create a main and sub-form to include only some fields in their underlying tables. The following steps guide you on how to use the Form wizard:
Firstly, you have to ensure that a relationship exists between the tables before using the wizard:
Go to the Forms group
Then to the Create tab
Click Form Wizard
Go to the Tables/Queries list on the wizard’s first page and click the table on which you want the form to be based.
In Available Fields list, double-click the fields you want included in the sub-form.
Click Next
Select the primary table and Form with sub-form(s) on the wizard’s second page.
From the third page of the wizard, choose the layout that you want
Click Next
On the wizard’s final page, enter the titles for your forms and select Open the form to view or enter information
Click Finish

REPORT GENERATION
An Access report can be divided into two general categories:
1) Information derived from records in one or more tables and:
2) Everything else. This category consist of the page headers and footers, explanatory and introductory text, the title and any logos and other graphics.
Just as you can use a form tool to make a form that includes all the fields in a table, you can make a report that includes all the fields by using a Report tool. The Report tool is located in the Report groups on the Create tab. However, you are more likely to use a Wizard to create a report especially if the report is based on only some of the fields in the table.
Using a Wizard to Create a Report

The report Wizard leads you through a series of questions and then based on your answers, it creates a report. You must then know what information to include in the report and after you provide that information, the wizard makes a report layout and adds a text box control and a label control for each of your specified fields. In order to create a simple report using a Wizard you:

In the Navigation pane of the Tables group, ensure that the All Access Objects are being displayed. You then click on the table you want to use.

Click on the Report button, located on the Create tab in the Reports group, to make a report based on all the fields in the selected table and show it in Layout view.

Because this not the report you want, close that report and click on NO when prompted to save it.

You then click on the Report Wizard located on the Create tab in the Report group, to start the wizard.

ALTERING THE DESIGN OF A REPORT

If you want, you can use the Report wizard to get a fast start on a report however this will require you to frequently want to alter the report to obtain the results you want. Just like a form, a report comprises of text box controls that are bound to the matching fields in the original table and their related tables. If you want, you may add images, labels, text boxes and other controls and you can also format them by either setting their properties in the Property Sheet pane or using commands on the ribbon.

You can also change the content and layout of reports in both Design view and Layout view. If you are doing a simple adjustment, it is easier to do in Layout view because you can see the layout with the actual data making the process more spontaneous.

PRINTING AND PREVIEWING A REPORT

Just like other Microsoft Office 2016 programs, the Print preview can be used to preview reports in Access. Previewing your reports before you print them ensures that no mistakes made are printed in the final version.

It is very important that you pay keen attention to how the page breaks when you are previewing your report. With a group report, you are in control of whether group headings are permitted to appear at the bottom of a page with no information and whether groups are permitted to break crossway pages. You can adjust the setup of your pages from the Page setup tool tab located in the Layout View or from the tab shown when you change to Print preview. Clicking on the Page Setup button allows you to see the Page Setup dialog box, in which you can adjust all these settings in one place other than making other alterations.

Whenever you are ready to print you just simply click on the Print button located on the Print preview tab which will show the Print dialog box. Also, it is possible for you to show the Print page of the Backstage view and then print one duplicate of the report with the default print settings by just clicking on the Quick Print button.
BUSINESS APPLICATION OF DATABASE SOFTWARE

Most companies are familiar with what can be done in Microsoft Word and Excel, but understanding what Microsoft Access can do is a bit harder to grasp. The idea of creating databases and trying to maintain them seems like an unnecessary use of resources. However, for businesses this program can provide several distinct advantages, particularly when it comes to managing growth and organization.

Microsoft Access provides a much more robust way for companies to track data and projects than Excel or Word. Access may take more time to learn than the more commonly used Microsoft apps, but it also has the most value added for tracking projects, budgets, and growth. All of the data necessary to run a business for comparison and analyses is maintained in a single program, making it easier to run reports and charts than any other program.

Microsoft offers a number of templates to simplify the learning process and users can customize the templates as they go. Understanding the fundamentals of Microsoft Access can help businesses see its full value in their daily operations.

If you're already using a spreadsheet, it is easy to convert your Excel spreadsheet to an Access database.

Maintaining Customer Information

The database allows businesses to track all necessary information for each client or customer, including addresses, order information, invoices, and payments. As long as the database is stored on a network where all employees can access it, users can make sure information stays current. Because client information is critical to every small business, the database can be secured.

Adding forms to the database helps small businesses that data is consistently entered by all employees.

As users become familiar with the program, more elaborate components can be added, such as mapping to client addresses. This lets employees verify addresses for new customers or plan routes for deliveries.

It also allows businesses to create invoices and be able to send emails or regular mail and be able to track when and how invoices were paid. Updating and storing customer data in Access is more reliable than a spreadsheet or Word document, and streamlines managing that information.

Tracking Financial Data

Many businesses purchase software specifically for tracking finances, but for a small business that is not only unnecessary, it tends to create extra work. In addition to being able to create and track invoices, all business expenses and transactions can be recorded through the same program.

For companies that have the full Microsoft Office Suite, including Outlook and Access, payment reminders in Outlook can be linked to the database. When the reminder pops up, users can make the necessary payments, enter the data in Access, then close out the reminder.

It may be necessary to purchase more sophisticated software as the business grows, and those businesses have an advantage if all of their financial data is stored in Access. Many other programs can accommodate data exported from Access, making it easier to migrate information when the time comes.
Managing Marketing and Sales

One of the most little used but powerful ways of using Access is to monitor marketing and sales information. With existing client information already stored in the database, it is easy to send emails, flyers, coupons, and regular post to those who might be interested in sales or special offers. Small businesses can then track how many of their existing clients responded following a marketing campaign.

For new customers, entire campaigns can be created and monitored from a single location. This makes it easier for employees to see what has already been completed and what remains to be done or what follow ups are necessary.

Tracking Production and Inventory

Similar to client tracking, being able to track data on inventory, resources, and stock is critical for any business. Access makes it easy to enter data on shipments to warehouses and to know when it is time to order more of a particular product. This is especially critical for manufacturers that require a number of different resources to complete a product, such as airplane parts or active pharmaceutical ingredients.

Even service industries have to keep inventory, and having all of that information in one place makes it easier to see which computer is assigned to which employee or determine when office equipment needs to be upgraded. Whether tracking vehicles, mobile devices, serial numbers, registration information, user logs, or hardware life spans, small businesses will be able to track their hardware more easily.

Beyond hardware, businesses need to be able to track software. From registration and the number of computers allowed to use the software to version information and user, it is vital for businesses to be able to quickly and accurately pull information on their current configurations. The recent ending of support for Windows XP serves as a stark reminder of why it is important to know what software and operating systems are on business computers and devices.

Running Reports and Analyses

Perhaps the most powerful aspect of Access is the user’s ability to generate reports and charts from all of the data. Being able to compile everything stored in the different databases is what makes Microsoft Access a powerhouse for small businesses. A user can quickly generate a report that compares costs of resources against current pricing, create a chart that illustrates how much is in stock for an upcoming marketing campaign, or run an analysis identifying which clients are behind on payments. With a little extra knowledge about queries, small businesses can take control of how they view data.

Even more important, Microsoft Access can be tied into other Microsoft products. Small businesses can review a report, look up client data, and generate invoices in Word. A mail merge can create regular post letters while the user simultaneously generates an email in Outlook. Data can be exported to Excel for a more in-depth look at details, and from there be sent to PowerPoint for a presentation. Integration with all of the other Microsoft products is perhaps the best reason to use Access to centralize all of a business’s information.

SHORT ANSWER TYPE QUESTIONS

2. How to facilitate Macros in MS Access?

SHORT ESSAY TYPE

1. Explain Table Creation.
2. What is a Query. How is it Created?
3. How are reports generated in MS Access?
4. Discuss on Form Creation.

ESSAY QUESTIONS
1. Explain how to create Tables, Queries, Forms and Report Generation using MS Access.

Chapter 16

ENTERPRISE RESOURCE PLANNING

INTRODUCTION

The business environment has changed more in the last five years than it did over the previous five decades. The pace of change continues to accelerate and corporations around the world seek to revitalize, reinvent and resize in an effort to position themselves for success in the 21st century. The ability to respond to a new customer needs and seize market opportunities as they arise is crucial. Successful companies today recognize that a high level of interaction and coordination along the supply chain will be a key ingredient of their continued success. Enterprises are continuously striving to improve themselves in the areas of quality, time to market, customer satisfaction, performance and profitability. Tomorrow’s winners will be those businesses that can most effectively gather, and quickly act upon crucial information. Making informed business decisions in this manner would enable organizations to accomplish their business growth and at the same time enable them to utilize the information to competitive advantage.

To make it possible for the companies to execute this vision, there is a need for an infrastructure that will provide information across all functions and locations within the organization. The Enterprise Resource Planning (ERP) software fulfills this need. Companies, public or private, whether in the manufacturing or the service sector, have always been searching for the “total solution”. MRP II, the closed-loop manufacturing resources planning which used to be the panacea for all enterprise resource planning problems not as long ago, has now become only a subset of this overall objective. Today, the entire enterprise must be managed within a more global, tightly integrated, closed-loop solution. This expanded functionality can be called Enterprise Resource Planning (ERP).

What do Microsoft, Coca-Cola, Cisco, Eli Lilly, Alcoa, and Nokia have in common? Unlike most businesses, which operate on 25-year-old back-office systems, these market leaders reengineered their businesses to run at breakneck speed by implementing a transactional backbone called enterprise resource planning (ERP). These companies credit their ERP systems with having helped them reduce inventories, shorten cycle times, lower costs, and improve overall operations.

Businesses of all kinds have now implemented enterprise resource planning (ERP) systems.

ERP serves as a cross-functional enterprise backbone that integrates and automates many internal business processes and information systems within the manufacturing, logistics, distribution, accounting, finance, and human resource functions of a company. Large companies throughout the world began to install ERP systems in the 1990s as a conceptual framework and catalyst for
reengineering their business processes. ERP also served as the vital software engine needed to integrate and accomplish the cross functional processes that resulted. Now, ERP is recognized as a necessary ingredient that many companies need in order to gain the efficiency, agility, and responsiveness required to succeed in today’s dynamic business environment.

*ERP is the technological backbone of e-business, an enterprise wide transaction framework with links into sales order processing, inventory management and control, production and distribution planning, and finance.*

Enterprise resource planning is a cross-functional enterprise system driven by an integrated suite of software modules that supports the basic internal business processes of a company. For example, ERP software for a manufacturing company will typically process the data from and track the status of sales, inventory, shipping, and invoicing, as well as forecast raw material and human resource requirements. ERP gives a company an integrated real-time view of its core business processes, such as production, order processing, and inventory management, tied together by the ERP application software and a common database maintained by a database management system. ERP systems track business resources (such as cash, raw materials, and production capacity), and the status of commitments made by the business (such as customer orders, purchase orders, and employee payroll), no matter which department (manufacturing, purchasing, sales, accounting, and so on) has entered the data into the system. ERP software suites typically consist of integrated modules of manufacturing, distribution, sales, accounting, and human resource applications. Examples of manufacturing processes supported are material requirements planning, production planning, and capacity planning. Some of the sales and marketing processes supported by ERP are sales analysis, sales planning, and pricing analysis, while typical distribution applications include order management, purchasing, and logistics planning. ERP systems support many vital human resource processes, from personnel requirements planning to salary and benefits administration, and accomplish most required financial recordkeeping and managerial accounting applications.

**The Ideal ERP System**

An ideal ERP system is when a single database is utilized and contains all data for various software modules. These software modules can include:

1. **Manufacturing:** Some of the functions include; engineering, capacity, workflow management, quality control, bills of material, manufacturing process, etc.
2. **Financials:** Accounts payable, accounts receivable, fixed assets, general ledger and cash management, etc.
3. **Human Resources:** Benefits, training, payroll, time and attendance, etc
4. **Supply Chain Management:** Inventory, supply chain planning, supplier scheduling, claim processing, order entry, purchasing, etc.
5. **Projects:** Costing, billing, activity management, time and expense, etc.
6. **Customer Relationship Management:** Sales and marketing, service, commissions, customer contact, calls center support, etc.
7. **Data Warehouse:** Usually this is a module that can be accessed by an organizations customers, suppliers and employees.

**Benefits of ERP**

The ERP packages promise the seamless integration of all information flowing through an organization; they are becoming the fastest growing softwares in the world. The ERP vendors like SAP, Oracle, Baan, QAD, J.D.Edwards, Peoplesoft are in demand for their packages. The main task of the ERP system is to
deliver products to the companies to manage their internal and external functions efficiently. There are several other advantages of adopting the ERP system, few of them are as follows:

1. **Improved efficiency:** This is achieved by reduction of cycle time, inventory reduction, order fulfillment, improving support to supply chain, management, etc.

2. **Business integration:** ERP packages are integrated, i.e. Exchange of data among related business components is possible. In the large companies timing of system constructions, directive differs for each product and department function.

3. **Better decision making:** The decision making procedure become easier because of highly structured programmed process. These processes governs days to day operations and produces reports in structured form, which are further used by top management of organization to meet with its basic goals and objectives and to monitor the whole organization.

4. **Quick response time to customers:** The system is easy to operate so, that not much computer skills are required to handle the operations. Because of its comprehensive nature the system avoids unnecessary duplication and redundancy in data gathering and storage. Thus the response time to customer is reduced.

5. **Business integration:** ERP creates the common database across the organization which is used by various departments within the organization. The ERP supports the flow of information within department automatically. This business integration capabilities makes it easy to group business details in real time and carry out various types of management decision in time. The support systems like DSS can use this common database. Thus information and the data are on the fingertip of top level management.

6. **Analysis and planning capabilities:** Though different types of decisions support systems and simulation function, ERP makes the analysis of data easier. The DSS also supports the middle and top management for tactical and strategic planning.

7. **Technology support:** Utilization of latest development in Information technology is quickly adapted by the ERP packages. Distributed system, open system, client server technology, internet, intranet, E–commerce, CALS (Computer aided Acquisition and Logistic Support) are some examples of flexible environment adopted by ERP. The ERP packages itself design in a way that they can incorporate with latest technology even during the customization, maintenance and expansion phases.

**Features of ERP**

Characteristics generally attributed to ERP systems in the literature are presented in Table 1. In doing so, an attempt has been made to include all characteristics, notwithstanding the different terminologies used by different authors in describing them.

**Table 1**: Recapitulation of the main characteristics of ERP systems

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Explanatory elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration</td>
<td>Interconnections between functions and hierarchical levels</td>
</tr>
<tr>
<td></td>
<td>Interaction between the various processes</td>
</tr>
<tr>
<td>Completeness (generic function)</td>
<td>Wide range of functions</td>
</tr>
<tr>
<td></td>
<td>Applicable to various types of firms</td>
</tr>
<tr>
<td></td>
<td>Connectivity with the outside</td>
</tr>
<tr>
<td>Homogenisation</td>
<td>Unique data referential</td>
</tr>
<tr>
<td></td>
<td>Uniformity of human-machine interfaces</td>
</tr>
<tr>
<td>Real-time</td>
<td>Real-time update and consultation</td>
</tr>
<tr>
<td>Adaptability (flexibility)</td>
<td>Capability to follow rule and organisation changes (made possible by parametering)</td>
</tr>
</tbody>
</table>
Integrated Management Information

In any information system there is a logical flow of information that is, in any information system, data supplied to the system (input), are manipulated (processed) and transformed into information (output). The simple IPO (Input – processed – output) model has been used. Input Processed Output Through the processing technology of information system data has been transformed into useable information.

Management Information System (MIS) is an integrated information system, which is one of the popular subsystem or technology used in ERP. It is defined as the management information system (MIS) a system, which provides information supports for the decision – making in the organization. The MIS may be depicted by IPO model. i.e. people follow procedures to manipulate data and produce information.

The MIS elements are TP (transaction process), RS (reporting system), DSS (Decision supports system).
1. **TP** is a collection, storage and processing of data and day – to day operational system
2. **RS** is providing report based on business rules and procedures
3. **DSS** is a system for providing information to help the management with new

Unstructured decision – making.

This provides needs of managers at operational level of organization and working environment is isolated. They operate at the department level and only provides predefined information. This system provides different reports, which are based on specified business rules. As it provides the information only in the form of reports, it has several limitations.

After successful implementation of ERP in any organization it reduces cycle time and also reduces cost.

ERP are cross-functional and enterprise wide. All functional departments that are involved in operations or production are integrated in one system. In addition to manufacturing, warehousing, logistics, and information technology, this would include accounting, human resources, marketing, and strategic management. Prior to the concept ERP systems, departments within an organization (for example, the human resources (HR) department, the payroll department, and the financials department) would have their own computer systems. The HR computer system (often called HRMS or HRIS) would typically contain information on the department, reporting structure, and personal details of employees. The payroll department would typically calculate and store paycheck information. The financial department would typically store financial transactions for the
organization. Each system would have to rely on a set of common data to communicate with each other. For the HRIS to send salary information to the payroll system, an employee number would need to be assigned and remain static between the two systems to accurately identify an employee. The financial system was not interested in the employee-level data, but only in the payouts made by the payroll systems, such as the tax payments to various authorities, payments for employee benefits to providers, and so on. This provided complications. For instance, a person could not be paid in the payroll system without an employee number.

ERP software, among other things, combined the data of formerly separate applications. This made the worry of keeping numbers in synchronization across multiple systems disappears. It standardised and reduced the number of software specialties required within larger organizations.

Best practices were also a benefit of implementing an ERP system. When implementing an ERP system, organizations essentially had to choose between customizing the software or modifying their business processes to the “Best Practice” function delivered in the vanilla version of the software. Typically, the delivery of best practice applies more usefully to large organizations and especially where there is a compliance requirement such as IFRS, Sarbanes-Oxley or Basel II, or where the process is a commodity such as electronic funds transfer. This is because the procedure of capturing and reporting legislative or commodity content can be readily codified within the ERP software, and then replicated with confidence across multiple businesses who have the same business requirement.

Where such a compliance or commodity requirement does not underpin the business process, it can be argued that determining and applying a Best Practice actually erodes competitive advantage by homogenizing the business as compared to everyone else in the industry sector.

QUESTIONS
SHORT ESSAY TYPE

1. Explain the Features of Enterprise Resource Planning.

2. What are the benefits of ERP?

3. What are the requirements of an Ideal ERP System?
Chapter 17

ENTERPRISE RESOURCE PLANNING AND BUSINESS PROCESS RE-ENGINEERING

ERP and BPR

Business Process Re-engineering (BPR) is the fundamental rethinking and radical redesign of business processes of an organization to achieve dramatic improvement in critical contemporary measures of performance such as cost, quality, service and speed. In simple terms, the process of examining current processes and redesigning those processes to increase the efficiency and effectiveness of an organization is called BPR. More precisely, BPR means the rapid and radical redesign of strategic, value-added business processes and systems, policies and organizational structure that support them to optimize workflow and productivity in an organization. BPR concurrently pursues breakthrough improvements in quality, speed, service and cost by leveraging the potential of information technology while addressing the issues of organizational strategies and vision for change. Breakthrough improvement means quantum gains of 5 to 10 times compared to incremental improvements of 20-30 percent. These improvements are generally characterized in terms of improvement of product and service quality at low cost and less time lag between product designs to marketing.

Innovation and major improvements in the performance of business processes are difficult to achieve without leveraging the potential of ERP. Most of the business processes were developed before modern computers and communication technologies existed. ERP and BPR go hand in hand. Therefore, it is recommended that ERP should be used to innovate the business processes and not just automate. ERP can be used not only to automate transactional and laborious business processes but also to redesign the work management systems in an organization. ERP improves coordination and information access across organizational units, thereby allowing for more effective management of task interdependence.

ER Modules

Today, more and more organizations are using the ERP system in order to improve their business transactions. A company can have various kinds of data that is scattered; ERP integrates this information and store on a single central database. To achieve the high performance ERP packages contain many modules. Each ERP package has its own features and benefits. The modules like
finance module, plant maintenance, quality management, material management etc. are some common modules available with all ERP packages.

An ERP system consists of a variety of functions that are linked together. The various modules of an ERP system include financial system include financial accounting, controlling, asset accounting, materials management, production planning for discrete as well as for process manufacturing, quality management, plant maintenance, sales and distribution, human resource management, project management. Although ERP features vary from application, the typical ERP functionality covers the following core enterprise functions and the associated sample modules.

**Functional Modules of ERP Software**

ERP software is made up of many software modules. Each ERP software module mimics a major functional area of an organization. Common ERP modules include modules for product planning, parts and material purchasing, inventory control, product distribution, order tracking, finance, accounting, marketing, and HR. Organizations often selectively implement the ERP modules that are both economically and technically feasible.

**Manufacturing and Logistics Modules**

It consists of a group of applications for planning production, taking orders and delivering products to the customer.

*Production Planning:* Performs capacity planning and creates a daily production schedule for a company’s manufacturing plant.

*Materials Management:* Controls purchasing of raw materials needed to manufacture products.

The main sub-system of material management modules are:

1. Pre purchasing activities
2. Purchasing
3. Vendor evaluation
4. Inventory management
5. Invoice verification and material inspection

1. **Pre Purchasing Activities:** It specially includes items with services and items with materials. For this data and manual entry efforts are reduced to minimum. The entering service specification may be planned and unplanned.

   *Planned service* specification means that services whose precise nature and intended scope are already known at beginning of procurement project.

   *Unplanned service* specifications are service, which are not defined initially. A procurement project may include number of individual services, which can not or do not wish specify in detail is having unplanned service specification.

2. **Purchasing:** The system performs the functions like procurement of materials and services, determination of possible sources of supply for requirement identified by the materials planning and control systems or arising directly within a user dept monitoring of deliveries and payments of vendors etc.
3. **Vendor Evaluation:** This system also offers the users a point based evaluation system. This evaluation is based on certain selection criteria the performance of vendor is measured eg: price, quality, delivery, support, replacement of returns, lead times etc. The scores are computed automatically with the help of predefined criteria.

4. **Inventory Management:** Inventory management is not only related to the stock but also handles goods movement and maintaining information pertaining to this like

   (a) Stock value for inventory management
   (b) Account assignment for cost accounting
   (c) Corresponding G/L accounts for financial accounting via automatic account assignment

5. **Invoice Verification and Material Inspection:**

   (a) Starts with purchase requisition, continues with purchasing and goods receipt and ends with invoice receipt.
   (b) It allows invoices that do not originate in materials procurement to be processed e.g. on line buying
   (c) It permitted credit memos to be processed, either as invoice cancellation and discounts

**Sales and distribution:** Tracks activities from the receipt of a request for qualification to billing and shipping the products.

**Order entry and processing:** Automates the data entry process of customer orders and keep track of the status of orders.

**Warehouse management:** Maintains records of warehoused goods and process movement of products through warehouse.

**Transportation management:** Arranges, schedules and monitors delivery of products to customers by trucks, trains and other vehicles.

**Project management:** Monitors costs and works schedules on a project by project basis.

**Plant maintenance:** Sets plans and oversees the upkeep of internal facilities.

**Customer service management:** Administers installed base service agreements and checks contracts and warranties when customers call for help.

**Finance Module**

The accounting and finance module is divided into four main parts.

1. General Ledger
2. Accounts Receivable
3. Accounts Payable
4. Asset Accounting

General Ledger

The central task of G/L accounting is to provide a comprehensive picture of external
Accounting and accounts. Recording all business transactions (primary postings as well as settlements from internal accounting) in a software system that is fully integrated with all the other operational areas of a company ensures that the accounting data is always complete and accurate.

The ERP FI General Ledger has the following features:

1. Free choice of level: corporate group or company
2. Automatic and simultaneous posting of all sub-ledger items in the appropriate general ledger accounts (reconciliation accounts)
3. Simultaneous updating of general ledger and cost accounting areas
4. Real-time evaluation of and reporting on current accounting data, in the form of account displays, financial statements with different balance sheet versions and additional analyses.

Essentially, the general ledger serves as a complete record of all business transactions. It is the centralized, up-to-date reference for the rendering of accounts. Actual individual transactions can be checked at any time in real-time processing by displaying the original documents, line items and monthly debits and credits at various levels such as:

1. Account
2. Journals
3. Summary of monthly debits and credits (balances)
4. Balance sheet/profit and loss evaluations

**Accounts Payable**

Records and administers accounting data for all vendors. It is also an integral part of purchasing, where deliveries and invoices are recorded based on each vendor. The system automatically makes postings to the FI component in response to these transactions. In the same way, the system supplies the Cash Management application component with figures from invoices in order to optimize liquidity planning.

Outstanding payables are settled by the payment program, which supports all standard payment methods (checks, transfers, and so on), in printed form as well as in electronic form (data medium exchange on diskette and electronic data interchange). Payment methods specific to different countries are also covered by this program. If necessary, you can create dunning notices for outstanding receivables (for example, to receive payment for credit memos). This function is supported by the dunning program.

Postings made in Accounts Payable are simultaneously recorded in the General Ledger where different G/L accounts are updated based on the transaction involved (payables, down payments and so on). To help you keep track of open items, there are due date forecasts and other standard reports that you can carry out.

**Accounts Receivable**

Records and administers the accounting data of customers. It is also an integral part of sales management.
All postings in Accounts Receivable are also recorded directly in the General Ledger. Different G/L accounts are posted depending on the transaction involved (for example, receivables, down payments, bills of exchange and so on). The system contains a range of tools that you can use to monitor open items; for example, account analyses, alarm reports, due date lists and a flexible dunning program. The printed material linked to these tools can be individually formulated to suit your requirements. This is also the case for payment notices, balance confirmations, account statements and interest calculations. Incoming payments can be allocated to due receivables using user-friendly screen functions or by electronic means such as EDI and data communication. The payment program can automatically carry out direct debiting and down payments.

There are a range of tools available for documenting the transactions which occur in accounts receivable, including balance lists, journals, balance audit trails and other standard reports. When drawing up financial statements, the items in foreign currency are revalued, customers who are also vendors are listed, and the balances on the accounts are sorted by remaining life.

Not only is accounts receivable one of the branches of accounting that forms the basis of adequate and orderly accounting, it also provides (thanks to its close integration with the Sales and Distribution component) the data required for effective credit management, as well as (through its link to Cash Management) information important for the optimization of liquidity planning.

**Asset Accounting**

The Asset Accounting (FI-AA) component is used for managing and supervising fixed assets with ERP System. In ERP Financial Accounting, it serves as a subsidiary ledger to the FI General Ledger, providing detailed information on transactions involving fixed assets.

As a result of the integration in the ERP System, FI-AA transfers data directly to and from other systems. For example, it is possible to post from the Materials Management (MM) component directly to FI-AA. When an asset is purchased or produced in-house, you can directly post the invoice receipt or goods receipt, or the withdrawal from the warehouse, to assets in FI-AA. At the same time, you can pass on depreciation and interest directly to Financial Accounting (FI) and Cost Accounting (CO). From the Plant Maintenance (PM) component, you can settle maintenance activities that require capitalization to assets.

The FI-AA component consists of the following parts:

1. Traditional asset accounting
2. Leased assets
3. Preparation for consolidation
4. Information system

Traditional asset accounting encompasses the entire lifetime of the asset from purchase order or the initial acquisition (possibly managed as an asset under construction) through its retirement. The system calculates, to a large extent automatically, the values for depreciation, interest, insurance and other purposes between these two points in time, and places this information at your disposal in a varied form using the Information System. There is a report for depreciation forecasting and simulation of the development of asset values.

The system also offers special functions for leased assets, and assets under construction. The system enables you to manage values in parallel currencies using different types of valuation.
These features simplify the process of preparing for the consolidation of multinational group concerns.

**Controlling Module**

This module consists of:

1. Overhead cost controlling
2. Product cost controlling

**Overhead Cost Controlling**

Overhead costs are indirect costs that cannot be directly assigned to cost objects. Overhead Cost Controlling component enables you to plan, allocate, control, and monitor overhead costs.

Planning in the overhead area lets you specify standards which enable you to control costs and evaluate internal activities.

All overhead costs are assigned to the cost centers where they were incurred, or to the jobs which led to their being incurred. The ERP system provides you with many methods for the further allocation of overhead. Using these methods you can allocate the overhead costs true to their origins. Some of the overheads can be assigned to cost objects with minimum effort and converted to direct costs.

At the end of a posting period, when all allocations have been made, the plan (target) costs are compared with the corresponding actual costs on the basis of the operating rate. You can analyze the resulting target/actual variances by cause and use the analyses for further managerial accounting measures within controlling.

**Product Cost Controlling**

Product Cost Planning is an area within Product Cost Controlling in which you can plan thenon-order related costs of, and determine the prices for, materials and other cost accounting objects. Product Cost Planning comprises the following:

1. Cost Estimate with Quantity Structure
2. Cost Estimate without Quantity Structure
3. Reference and Simulation Costing
4. Price Update

**Enterprise Controlling**

The ERP System’s EC (Enterprise Controlling) application has been designed with four subcomponents to account for these various aspects and organizational options.

**Profit Center Accounting**

Profit center accounting creates a company organization which is distinct from all other organizational concepts. Profit centers are master data from a management perspective. To avoid additional entries, the corresponding allocations can be effected in the operational systems (for example, material, project, cost center). Profits and losses are determined for these profit centers (valuation with transfer prices) as well as the key figures for responsibility accounting (ROI, cash
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flow, and so forth). For the latter, some balance sheet items must be available for each profit center.

**Consolidation**

This subcomponent consists of general consolidation functions. These functions are for external as well as for internal reporting. Integrated application areas are not only consolidated financial statements on the group level as required by law but also business area consolidation, profit center consolidation or consolidation based on group-wide profitability analysis by product line. The advantages lie in a rule-based reconciliation between external and internal consolidation values.

**Executive Information System**

ERP-EIS makes it possible to define company-specific data structures which are oriented toward multidimensional evaluation views. Data acquisition programs are available for most of the ERP components and for many R/2 components. Data can also be transferred from non-ERP applications. Many functions are available to process this data into a consistent, uniform whole. A graphical interface is available for presentations, particularly for management. Hierarchical processing and elimination functions make simple consolidation functions possible.

**Plant Maintenance Module**

The achievement of world-class performance demands delivery of quality products expeditiously and economically. Organizations simply cannot achieve excellence with unreliable equipment. The attitude towards maintenance management has changed as a result of quick response manufacturing, “just-in-time” reduction of work-in-progress inventory, and the elimination of wasteful manufacturing practices. Machine breakdown and idle time for repair was once an accepted practice. Times have changed. Today when a machine breaks down, it can shut down the production line and the customer’s entire plant.

The plant maintenance module provides an integrated solution for supporting the operational needs of an enterprise-wide system. The module includes an entire family of products covering all aspects of plant/equipment maintenance and becomes integral to the achievement of process improvement.

Plant maintenance supports various options for structuring technical systems with its object, type and function-related views, and enables flexible navigation. Data concerning the planning, processing and history of maintenance tasks is documented in the system and complies with business verification requirements. You can use the catalog feature of the plant maintenance system to define causes, activities and maintenance tasks. All maintenance tasks such as inspection, servicing and repair activities are saved in a historical database. In addition to standard indicators, diverse analysis options are also available in many systems for evaluating this data.

Plant maintenance provides you with technical and business reports and various presentation options according to the criteria used. For example, organizational unit, location, execution period for the tasks, or system manufacturer. This information helps you to reduce the duration and costs of plant down as a result of damage and to recognize possible weak points within your technical system in good time. It also forms the basis for defining an optimum maintenance strategy in the
The major subsystem of a plant maintenance module are:

1. Preventive maintenance control
2. Equipment tracking
3. Component tracking
4. Plant maintenance calibration tracking
5. Plant maintenance warranty claims tracking

Quality Management Module
The Quality management area facilitates the establishment and execution of business quality. In today’s global marketplace, quality management and quality assurance ideals are now the requirements of doing business rather than elective efforts left to the choice of a business. In ERP, quality management is based on the driving standards first set forth by the ISO 9000 series of quality measures and business certification.

ERP’s Quality Management module has been built to automate ISO compliance. By ISO Standards, Quality management must be applied to all areas of a business – not just production but internal company management and business processes as well. Therefore elements of quality management can be found throughout the different modules. QM module exists as a central control point to establish, track, and maintain quality measurements and analyses throughout the ERP business architecture.

In ERP, the QM module manages the following key aspects of business quality management:

**Material Management:** Vendor evaluation, goods receipt evaluations, material inspection result management, provision of inspection data to the procurement team.

**Production:** Inspection planning and work scheduling, inspection activities within production activities, production quality monitoring, surfacing of problems in production areas.

**Sales & Distribution:** Inspection upon creation of delivery orders, proof of quality for approved deliveries, surfacing of problems in order fulfillment.

**Accounting:** Surfacing of costs associated with quality management actions.

In relation to the activities directly related to the act of monitoring quality management, ERP also provides the following functions:

**Quality Planning:** Creation of plans to manage various quality inspection procedures.

**Quality Inspection:** Scheduling of quality inspection activities, generate documents resulting from inspections, collect and analyze quality data, suggest corrective or follow up measures.

**Quality Controls:** Establish benchmark quality standards and sample groups of information, generate statistical tools to monitor and evaluate quality compliance, development of corrective task plans.

**Production Planning and Material Management Module**
This function is used for entering planning data related to the entire organization. Model-supported simulations can be carried out based on this planning data as well as on actual data. The resulting
Integration of the operational ERP applications permits group-wide investment controlling with investment programs and budgeting, investment monitoring of ongoing measures, and depreciation simulation.

**Materials Management**

**Purchasing**

Purchasing is a component of Materials Management (MM). The MM module is fully integrated with other modules in the ERP System. It supports all phases of materials management: materials planning and control, purchasing, goods receiving, inventory management, and invoice verification.

The Purchasing component has the following tasks:

1. External procurement of materials and services
2. Determination of possible sources of supply for a requirement identified by the materials planning and control system or arising directly within a user department
3. Monitoring of deliveries and payments to vendors

Good communication between all participants in the procurement process is necessary for Purchasing to function smoothly. Purchasing communicates with other modules in the ERP System to ensure a constant flow of information. For example, it works side by side with the following modules:

**Controlling (CO)**

The interface to the cost accounting system (Controlling) can be seen above all in the case of purchase orders for materials intended for direct consumption and for services, since these can be directly assigned to a cost center or a production order.

**Financial Accounting (FI)**

Purchasing maintains data on the vendors that are defined in the system jointly with Financial Accounting. Information on each vendor is stored in a vendor master record, which contains both accounting and procurement information. The vendor master record represents the creditor account in financial accounting.

Through PO account assignment, Purchasing can also specify which G/L accounts are to be charged in the financial accounting system.

**Sales and Distribution (SD)**

Within the framework of materials planning and control, a requirement that has arisen in the Sales area can be passed on to Purchasing. In addition, when a requisition is created, it can be directly assigned to a sales order.

**Inventory Management**

ERP’s Inventory Management system allows you to:

1. Manage your stocks on a quantity and value basis
2. Planning, Entry, and Proof of Goods Movements
3. Carrying Out the Physical Inventory
1. **Managing Stocks by Quantity:** In the Inventory Management system, the physical stocks reflect all transactions resulting in a change in stock and thus in updated inventory levels. The user can easily obtain an overview of the current stocks of any given material. For each material, not only the stocks in the warehouse are shown, but also the stocks ordered but not yet delivered, reserved for production or for a customer, and the stocks in quality inspection can be monitored. For example, if a further subdivision by lots is required for a material, one batch per lot is possible. These batches are then managed individually in the stock. Special stocks from the vendor or from the customer (for example, consignment stocks) are managed separately from your company’s own stock. This guide discusses the various stock types used in the ERP System and how the corresponding stocks vary due to goods movements.

2. **Managing Stocks by Value:** The stocks are managed not only on a quantity basis but also by value - a prerequisite for cost accounting. With every goods movement, the following values are updated:
   
   (a) The stock value for inventory management
   (b) The account assignment for cost accounting
   (c) The corresponding G/L accounts for financial accounting via automatic account

   Both the quantity and the value are updated automatically when entering a goods movement.
   
   This mainly deals with monitoring inventories by quantity.

3. **Planning, Entry, and Proof of Goods Movements:** Goods movements include both “external” movements (goods receipts from external procurement, goods issues for sales orders) and “internal” movements (goods receipts from production, withdrawals of material for internal purposes, stock transfers, and transfer postings).

   For each goods movement a document is created which is used by the system to update quantities and values and serves as proof of goods movements. Goods receipt/issue slips are printed to facilitate physical movements and the monitoring of the individual stocks in the warehouse.

   This focuses on planning and entering all types of goods movements.

**Physical Inventory**

The adjustment between the physical stocks and the book inventories can be carried out independently of the physical inventory method selected.

The ERP System supports the following physical inventory methods:

1. Periodic Inventory
2. Inventory Sampling
3. Cycle-Counting

**Inventory Management and Warehouse Management**

The Inventory Management system can be extended by the Warehouse Management system (WM) which manages storage bins in complex warehouse structures.

While Inventory Management manages the stocks by quantity and value, the Warehouse Management component does even more by reflecting the special structure of a warehouse,
monitoring the allocation of the storage bins and any transfer transactions in the warehouse via completion confirmation procedures.

**Invoice Verification**

The Invoice Verification component is part of the Materials Management (MM) system. It provides the link between the Materials Management component and the Financial Accounting, Controlling, and Asset Accounting components.

Invoice Verification in Materials Management serves the following purposes:

1. It completes the materials procurement process - which starts with the purchase requisition, continues with purchasing and goods receipt and ends with the invoice receipt. It allows invoices that do not originate in materials procurement (for example, services, expenses, course costs, etc.) to be processed.

2. It allows credit memos to be processed, either as invoice cancellations or discounts. Invoice Verification does not handle the payment or the analysis of invoices. The information required for these processes are passed on to other departments.

Invoice Verification Tasks include:

- Entering invoices and credit memos that have been received. Checking the accuracy of invoices with respect to contents, prices, and arithmetic. Executing the account postings resulting from an invoice. Updating certain data in the ERP system, for example, open items and material prices. Checking invoices that were blocked because they varied too greatly from the purchase order. The high degree of integration in the ERP system allows these tasks to be carried out smoothly and efficiently.

**Production Planning**

This area is used to manage the planning activities that enable a factory to project and execute plans that reflect product and service deliveries. The production functionality allows for the control and manipulation of factory resources in regard to materials capacity, shop floor capacity and personnel capacity – all elements essential to producing materials and services.

Following are the definitions of the key elements you will find in the production.

**Master Data:** Master data plays an important role in each functional area and contributes to effective integration. Master data in the production area centers on information that further defines the material master as well as provides critical master data that specifies bills of material, production work centers, process routing methods and engineering change management. A planning team is typically responsible for the activities in this area.

**Master Planning:** Here you will find additional materials forecasting, demand management, long-term planning and master Production Schedule development. This sort of activity is to be managed by a factory planning team.

**MRP (Materials Requirement Planning):** From an overall factory planning perspective, this is where all demand, supply and resources are pooled and a total factory plan is developed to drive the different areas responsible for supporting a company’s product or service delivery throughput. This area is typically driven by a planning team, but procurement teams can sometimes provide analysis and input into the results of this business area’s activity.
Repetitive Manufacturing: The production submenu provides for the control and maintenance of production. Other methods are available, which help factories work with the production methods that best meet their needs.

QUESTIONS

SHORT ANSWER TYPE

1. Define BPR.
2. What is Quality Management Module?

SHORT ESSAY TYPE

1. Explain Data Mining.
2. Elucidate on the various Modules of ERP.

Chapter 18

ERP IMPLEMENTATION METHODOLOGY

ERP Implementation Methodology

Broadly, the steps involved in a total ERP implementation can be listed as follows:

1. Identification of the needs for implementing an ERP package
2. Evaluating the “as-is” situation of your business
3. Deciding upon the desired would-be situation for your business
4. Reengineering of the business processes to achieve the desired results
5. Evaluation of the various ERP packages
6. Finalizing of the ERP package
7. Installing the requisite hardware and networks
8. Finalizing the implementation consultants
9. Implementation of the ERP package

We now briefly discuss these steps:

Identification of the needs for Implementing an ERP Package

The first step for implementing an ERP package is to identify the reasons for going in for an ERP solution for your business. This step prepares you for some basic questions like:

1. Why should I implement an ERP package?
2. Will it significantly improve my profitability?
3. Will it lead to reduced delivery times for my products?
4. Will it enhance my customer’s satisfaction level in terms of cost, delivery time, service and quality?
5. Will it help reduce the costs of my products?
6. Will it enable me to achieve the same business volume with reduced manpower?
7. Will it enable me to re-engineer my business processes?
The above questions, although very obvious, should form the basis of the decision to adopt an ERP implementation and should at all times be the final goal. The other factors that should be taken into consideration are:

1. Need for quick flow of information between business partners
2. Effective management information system for quick decision-making
3. Elimination of manual preparation of various statutory statements
4. Need for a high level of integration between the various business functions

Evaluating the “as – is” Situation of your Business

In this step, one needs to thoroughly understand what existing business processes the organization is following to transact its business. The various business functions should first be enumerated.

*Example:* Procurement, production, sales, etc.

Now the processes used to achieve the business transactions should be listed in detail. The technique of process mapping can be used here. The process map should give you the following details for any business process:

1. The total time the business process takes to complete
2. The total number of decision points involved
3. The number of departments / geographical locations that the business process involves
4. The flow of information
5. The number of reporting points

Deciding upon the desired would – be Situation for your Business

In this step, we decide on what we want our business processes to finally look like. Here we use the techniques of benchmarking to ensure that the targets set are comparable to the best in the industry. Benchmarking can be done on various aspects of the business like cost, quality, lead time, service, etc.

Re-engineering of the Business Processes to Achieve the desired Results

To achieve the new business processes we re-engineer the existing processes in such a manner that

1. The business process cycle time is reduced significantly
2. The number of decision points are reduced to the bare minimum
3. The flow of information is streamlined, i.e. there is no unnecessary to – and - fro flow of information between departments.

Evaluation of the various ERP Packages

In this step various ERP packages available in the market are evaluated with respect to the following aspects:

*Global presence:* Check the performance and acceptability of the package globally.

*Local presence:* Check how the package is performing in the local market – this gives an idea as to how well a package is taking care of the country specific business needs.

*Investment in R & D:* Evaluate the package from the point of view of investments the ERP vendor is making in R & D to continuously upgrade their product. A good investment in R & D is a healthy indication of the longevity of the package.

*Target market:* See which segment of the industry the package is basically aiming at. Some packages, for example, are specific to process industry type of applications whereas others cater
specifically to discrete manufacturing. Choose a package that has a strong hold in your type of industry.

**Price:** This is of course the main criterion that decides what package you will finally go in for

**Modularity:** This aspect needs to be considered when you want to implement only some particular functions in the ERP package. The availability of the package as independent modules is a must in this case.

**Obsolescence:** While considering a package it is essential to see what would be the active life of the product before it become obsolete. As mentioned above the investments in R & D directly contribute to upgrade a package from time to time thus increasing its useful life.

**Ease of implementation:** This factor needs to looked into in detail because a quick, smooth and hassle-free implementation is the key to successful transition from the legacy system. This in turn ensures that your business is not adversely affected in the transition period.

**Cost of implementation:** With large-scale integration of ERP packages and the consequent complexity built into them, it has become essential to consider the cost of implementation which in some cases can be phenomenal.

**Post-implementation support:** Before deciding on an ERP package, it is advisable to check the quality and range of the post-implementation support that the vendor provides for his package.

**Finalizing the ERP Package**

After a thorough evaluation of all the ERP packages vis-a-vis the key factors of your business, the package best suited to your business needs is selected. The process of finalizing can be simplified by making a matrix of the key factors. You can then rate all the packages under these heads.

**Installing the requisite Hardware and Networks**

In this step one has to install the hardware and networks required for the chosen ERP package. The installation of the hardware has to be well planned because generally the hardware arrives in time and lies idle due to the delays in implementation. Also, the induction of the hardware should be in a phased manner to avoid blocking of capital.

**Finalizing the Implementation Consultants**

The factors which go into the selection of the consultant are:

1. Skill – set available with the consultant (application area)
2. Installation base of the consultant
3. Industry – specific experience (knowledge of the various industry – specific business processes)
4. Finances involved in hiring the particular consultant

**Implementation of the ERP Package**

The broad steps involved in the implementation of the ERP package are:

1. Formation of implementation team
2. Preparation of implementation plan
3. Mapping of business processes on to the package
4. Gap analysis
5. Customization
6. Development of user – specific reports and transactions
Formation of Implementation Team

It is of the greatest importance to form an implementation team consisting of knowledgeable users from all functions along with IT personnel and personnel from the implementation consultant. From the people chosen, the project manager, project leaders and the module leaders should be identified and also a steering committee should be formed. The functions of the steering committee are:

1. To monitor the progress of the implementation
2. To see to it that the schedule of the implementation is adhered to
3. Resolve any problems that come up in the due course of the implementation
4. Allocation of resources for implementation

Preparation of Implementation Plan

An important task is the preparation of a detailed implementation plan that covers the total implementation process. Here various project management techniques like PERT charts can be used. The implementation plan should have clear components and should include the schedule for the following:

1. Training of the project team
2. Mapping of business processes onto the software
3. Function-wise implementation
4. Customization
5. Uploading of data
6. Test runs
7. Parallel run
8. Crossover

Mapping of Business Processes on to the Package

This is a crucial step where the re-engineered business processes are mapped on to the software. In mapping, the implementation team tries to fulfill the user requirements by making use of the standard functionality available in the software. However, if the requirements cannot be covered fully by the standard system, then the next step of implementation, i.e. gap analysis comes into the picture.

Gap Analysis

As mentioned above, the user requirements that cannot be directly mapped on to the standard system form the basis of gap analysis. Here, all such uncovered requirements are compiled into a gap analysis report. The ‘gaps’ are then classified into the following three heads:
1. Gaps which can be taken care of with a little programming effort
2. Gaps which involve an extensive programming effort and hence require extra resources
3. Gaps which cannot be taken care of in the system.

For the first category, the project team directly takes action and resolves the issue. For the second and third category of gaps, however, the steering committee comes into the picture and decides on the extra resource allocation / process change.

**Customization**

Once the process mapping and gap analysis have been done, the actual customizing starts. In this step, first the customizing needs are chalked out and then the actual job is handed over to the respective functional teams.

**Development of User – Specific Reports and Transactions**

As mentioned under gap analysis, any user requirements not covered by the standard system need to be provided by extra programming effort. In this step, the required reports and transactions are created.

**Uploading of Data from Existing Systems**

With customizing in place, the system is now ready to receive the master and transaction data from the existing system. In this step, programmed transfer of data takes place from the existing system to the new system. To avoid wrong tabulation of master data, the transfer process needs to be thoroughly checked in the trial runs. At times it too involves a lot of programming effort.

**Test Runs**

In this step, the test runs on the system are started. Sample transactions are tried to see whether the customizing and master data uploading has been error – free. The result of the sample transactions is evaluated and any changes required in settings to get the desired results are incorporated.

**User Training**

The training of users can be started alongside the test runs. Users belonging to different functionalities are trained in their respective function. Normally user training includes:

1. Logging in and logging out
2. Getting to know the system
3. Navigating through the various menu paths
4. Trying sample transactions in respective functions

**Parallel Run**

With the successful test runs and user training in place, the parallel run of the system can be now started. In parallel run, the business transactions are carried out both through the existing system as well as through the new system. The implementation team then takes care of any lacunae which come to light during the parallel run.

**Concurrence from user on Satisfactory Working of the System**

If the parallel run is satisfactory and error – free, or errors that may have come up have been resolved, the users may be asked for their final approval.

**Migration to the New System**

When the parallel run has been successfully tried for a reasonable length of time and when the users and the implementation team feel absolutely confident, it is time to go ‘live’.
User Documentation

User documentation includes the details on how to carry out the various transactions. It is different from the regular ERP package documentation in the sense that it is more specific in nature than general documentation. It only covers alternatives that are being used in the particular business so as to make it easy for the user to understand and use them.

Post-implementation Support

Post – implementation support generally involves queries from the user, minor changes in the report formats, as well as small changes in layouts of various printed formats like purchase orders etc.

System Monitoring and Fine Tuning

In this phase, the IT people monitor the system closely to see the performance aspects and fine tune the database and other administrative aspects of the system so that the user can derive the best performance from it.

Popular ERP Packages

Like every other segment of the IT industry, the ERP industry is evolving rapidly. The industry has clearly differentiated between very large enterprises and the small and medium business sectors. It is the second segment that is seeing rapid growth and the emergence of new players in the ERP business.

SAP – Founded in 1972 by five former IBM engineers, SAP is the undisputed market leader in the ERP space and is the third largest software company in the world. Its current version has more than 30,000 relational database tables that allow it to handle extremely complex business situations. While it is an undisputed number one in the Tier I ERP space, SAP has been criticized at times for being too complex and difficult to handle. If you are a small or medium company, this solution is probably more than what your company needs or could potentially handle.

Oracle – While Oracle was formerly best known for its relational database, it was for many years the database of choice for SAP ERP applications. This cooperative situation had existed since the late 70's. However, sometime around 2004, Oracle began to look at building its own ERP solutions and at the same time SAP began to offer its ERP solutions on the Microsoft SQL Server database platform as well. The first Oracle ERP product was Oracle Financials which was released into the market as early as in 1989. However, post 2004, Oracle began to become a serious player in the ERP market and is now a well-established number 2 in the Tier I market.

Microsoft – Microsoft Dynamics is mostly focused on Tier II clients in the ERP space. It provides solutions in a number of different business domains including in the Customer Relationship Management domain. A great advantage of Microsoft products is its great ease of use. This holds for its ERP products as well.

Infor – Infor Global Solutions is a privately held company that has grown rapidly in the Tier II vendor space since 2002. The company has taken an aggressive acquisition route to growth and continues to follow this path even now with its acquisition of ENXSUITE in 2011. Infor has a global presence to match the footprint of the top 3 and has clients in 194 countries. Infor has solutions in as many as in 14 different domains and it has a very good presence in each of the four specific domains.
Epicor – Started in 1984 and working initially with DOS, Epicor later converted its products to Windows and followed a merger and acquisition path to acquire companies selling ERP products and then to offer their solutions as a comprehensive package. Epicor has a presence in over 150 countries and has more than 20,000 Tier II / III customers. Epicor likes to call its ERP “the key to possibilities not yet imagined”.

Lawson – Acquired by Infor a couple of years ago, Lawson still maintains a separate identity although it does display the Infor logo on its web site. Specifically mentioning that it is tailored for the small to midsized business, Lawson has a presence in 68 countries and has more than 4,500 installations. Lawson caters to a large number of verticals and uses this as its USP. Simplicity of the solution is another key focus area in a market best known for its complexity.

QAD – The QAD website shows a chain with the logo of the cloud forming one of the links so we have an idea what is on the company’s mind. The QAD Enterprise Application is designed to make it easy for first time ERP users to begin using an ERP in their company with the least amount of migration problems. The company supports and engages with its customers to ensure that the return on investment is obtained rapidly.

Sage – is a UK based company and had its beginnings in a 1981 summer job when the first version of a type of accounting software was written. This grew into larger versions until eventually, in 1984, Sage Software was launched as a company and achieved a fair amount of success. Like many other companies in the ERP space, Sage has grown by a number of acquisitions and says that ‘acquisitions are part of its DNA’. The cross pollination of DNA appears to have been very successful given the rate of growth Sage has been seeing.

IFS – Founded in 1983, IFS focuses on building agile ERP solutions that use SOA architecture. This implies easy modification and adaptation to user needs. IFS is most useful for core strategic processes - service & asset management, manufacturing, supply chain and project management. It has a user base in excess of 2,000 installations and customers in 50 countries. One key reason for its success is its sharp focus on specific verticals.

Consona Corp – Deriving its name from ‘consonance with the customer’, Consona is active in ERP, CRM, knowledge management and other related fields. The company is privately held and has grown by acquiring a number of specialist ERP companies. If you are doing business in a niche area where Consona has a focus, you may just be lucky. No one else we know is offering an ERP solution tailored to printed circuit board manufacturers or to metal wire and cable manufacturers. A solution as focused as this is bound to be better than a generic ERP when put to use in one of those industries.

QUESTIONS

ESSAY QUESTIONS

1. Discuss in detail about ERP Implementation Methodology.
2. Explain about the popular ERP Packages.