



Computer application I Theory notes

information technology (Vision Empowerment Training Institute)

COMPUTER APPLICATION

What is a computer?

A computer is an electronic machine for handling information. Thus when talking about computers, people refer to *information technology* (ways of handling information) and to *data processing*. Data is the input to a computer, such as a list of employees to be paid. Information is the product or end result.

Data processing is the use of automation (ie computers) to process raw data (input) to create meaningful information (output).

We can make the following initial points about computers.

The machines themselves, that is the physical components of a computer system, such as processor, screen, keyboard and printer, are referred to as the computer hardware.

A computer process data. The elements of data processing are input, processing, storage and output.

A computer's operations are performed under the control of a program. Programs are needed to make the computer's hardware process data. A program is a set of instructions which tells the computer what to do. General terms used to describe programs are software or applications.

Almost all business computers (and most scientific computers) are digital computers. This means that they operate by performing arithmetical operations on exact numbers, such as amounts of money. Albeit in a coded (binary) form. They do not measure continuously variable quantities, such as electrical voltages. Analogue computers, used primarily in scientific and industrial applications, measure rather than count.

The Processor

The processor, or 'brain' of the computer, is a collection of electronic circuitry and registers. Sometimes referred to as the central processing unit (CPU), the processor is divided into three areas : the control unit; the arithmetic and logic unit; and the memory. The set of operations that the processor performs is known as the instruction set, or repertoire, and this determines in part the speed at which processing can be performed. Processors for PCs are located on single chips (very small pieces of silicon or some other substance, containing complex electronic circuits).

Definition

A *processor* is the part of the computer that coordinates its actions.

Components of a CPU

The CPU is made up of 3 main parts :

- (a) The control unit
- (b) The arithmetic and logic unit (ALU)
- (c) The memory

The Control Unit

The control unit receives program instructions, one at a time, from the computer's memory. It supervises the execution of these instructions and sends out control signals to peripheral (input and output) devices, co-ordinated by a clock. The number of pulses (cycles) produced per second is an indication of processing speed, and is usually measured in

megahertz (MHz). One MHz is one million pulses (cycles) per second. A typical PC might have a specification of 133 MHz to 200 MHz.

The Arithmetic and Logic Unit (ALU)

This is the part of the processor where the arithmetical, logical and other operations are carried out. These include arithmetic (such as add, subtract, multiply and divide), comparison (such as 'does selling price exceed cost?'), branch operations (which change the order of program instructions) and the movement of data.

Memory

This is circuitry used to store data within the processor while the computer is operating. A personal computer has two types of memory.

1. Storage memory (or ROM – read only memory)

It is useful to think of the hard disk of a computer as a compact disc on which, instead of tunes, applications (or software) are recorded (or stored). When an application is called up we can play it (or use it). In addition, we can record our work onto the hard disk as individual files, and call up these files again when we need them.

We can also over-record (overwrite) files, for example when we have edited a previously created document and wish to keep only the latest version. Or we can over-write programs, for example when we are upgrading our software to a later version.

ROM is ' non-volatile' memory because its contents do not disappear when the computer's power source is switched off. A computer's start-up program is always held in a form of ROM, so that the computer can boot up (pull itself up by its bootstraps, ie start itself).

2. Working memory (or RAM – random access memory)

Working memory enables the computer to execute program instructions rapidly, by 'holding' the whole program in a work area rather than going back to the storage area to call up routines. This memory is 'volatile' in that its contents will disappear if the computer is switched off.

3. Data representation in memory

A computer's operations depend on simple circuits which can be switched on or off. These two states can be expressed as binary digits, ie, as the numbers 1 and 0 respectively. Any piece of data must be coded in these symbols before processing can commence. For example, in a commonly used code (ASCII), the capital letter A is coded as 1000001.

A single binary digit (1 or 0) is known as a bit. A group of 8 bits is a byte. Memory size is calculated in kilobytes, megabytes and gigabytes.

1 KB = 1 Kilobyte = 1,024 bytes

1 MB = 1 megabyte = 1,024 kilobytes

1 GM = 1 gigabyte = 1,024 megabytes

So a computer described as having a 1.2 GB hard disk (storage memory) would have a memory of : $1.2 \times 1,024 \times 1,024 \times 1,024 = 1,288,490,189$ bytes, and a computer described as having 32 MB RAM memory would have a memory of : $32 \times 1,024 \times 1,024 = 33,554,432$ bytes.

Many PCs offer the user the option of increasing the size of RAM, so that larger programs can be run. Memory can be increased in the following ways.

- (a) An expansion slot allows a chip providing extra RAM to be plugged into the PC, so as to become a part of the computer's main memory.

An extension card or board fulfils the same function, but fits inside the PC box itself. A PC may have space inside it to accept extra printed circuit boards, to enhance its memory or its processing capabilities.

4. Buses

Data is transferred within the processor or between the processor and peripherals by means of buses. A bus carries a number of bits (depending on its size) along a number of tracks. A bus with eight tracks therefore carries one byte at a time.

These parts are linked to each other and to the peripheral devices, such as input and output devices, through circuitry.

(a) The Memory

The third major component of the CPU is the memory. As its name suggests, this equipment is used for the temporary storage of information.

6.1 Introduction

The memory components of the CPU are quite expensive. Furthermore, they are volatile. For these reasons, it is not practical to use the main memory to store large amounts of data permanently for future usage. In practice, different devices are used for the storage of data over a long period of time.

The common storage devices are:

- a. Magnetic computer tapes
- b. Magnetic computer disks
- c. Optical disks

6.2 Magnetic Computer Tapes

In terms of storage devices, tape is quite a cheap medium. However, this medium also has its limitations. If the tape is used to store data which is not required quickly, as a security back-up for example, then it is a cheap means of doing so. If the data has to be easily accessible, irrespective of the order in which it is stored, then tapes will require too much time to find the require data to be efficient. The saving on the cost of the tape will be lose due to the increased cost of retrieving data held on the tape.

Magnetic tape has three important functions:

- (a) Protection against loss of valuable files

- (b) Archiving files
- (c) File portability

6.3 Magnetic Computer Disks

Introduction

Disks are more expensive than tapes but have significant advantages. In terms of the speed of retrieving data, disks are much faster than tapes. This is partly because it makes no difference where on the disk surface the required data is stored, since it can be accessed directly.

Each disk is divided into tracks and sectors.

The main types of disk are:

- a. The diskette
- b. The hard disk

The Diskette

Three types of interchangeable disk drives are commonly used in the PCs. They are the traditional floppy disk, the high capacity SuperDisk and Zip disk. The traditional 3.5 inch diskette, or floppy disk, is a thin mylar disk that is permanently enclosed in a rigid plastic jacket. It has 1.44 MB of storage space.

The Super Disk can store 120 MB of data. Both the floppy disk and Super disk are of the same size but have different disk density. Disk density is the number of bits of data that can be stored per unit area on the disk surface. The Super Disk drive reads from and writes to the traditional floppy disk but not vice versa. The Zip drive reads and writes to 100 MB Zip disks.

The diskettes are not attached to the computer. Instead, they are inserted into a device called a disk drive mounted on the computer. In this way, different disks can be used as and when required. This, of course, means that when a disk is full, another can be used so there is no restriction on the amount of data which can be stored.

Hard Disks

The two main objectives of the hard disk manufacturers are to put more data in less disk space and to enable a more rapid transfer of data to and from RAM. The two main types of hard disk are those that are permanently installed and those that are interchangeable.

Permanently installed or fixed hard disks are 1 to 5.25 inch permanent PC based hard disk has storage capacities of 4 GB to over 30 GB. Hard disks have data stored on both surfaces of the disk. The disk spin continuously in a sealed enclosure. The enclosure keeps the disk surface free from contaminants. This contaminant free environment allows hard disks to have greater density of data storage than the interchangeable diskettes.

The interchangeable hard disks are getting more popular. The 3.5 inch Iomega's Jaz drive can store 1 GB of data and is inserted and removed as easily as the 3.5 inch floppy.

Optical disks

The primary advantage of optical disks is that they are direct access forms of storage that can store vast amounts of data in a relatively small physical space. An optical disk device uses laser beams to store and retrieve data. It works just like a compact disk player for a stereo system. One laser beam writes to the recording surface by making pits in the disk and another reads the data from the light sensitive recording surface.

a. CD-ROM

One type of optical disk is the CD-ROM (compact disk read-only memory). Similar in concept to a ROM chip, these disks are read-only. Many PCs today have a CD-ROM drive installed. CD-ROMs offer a huge storage capacity (compared to floppy disks) at a relatively low cost. The capacity of a single CD-ROM is 680 MB.

The CD-ROM is manufactured by using special lasers to burn crevices in the disk. The spiral track on a CD-ROM is about 3 miles long with about 2 billion pits.

Once the master CD-ROM has been created, copies can be manufactured using techniques similar to those used to produce music CDs. Popular CD-ROM drives are classified simply as 24X, 32X and 40X. This means they spin at 24, 32, and 40 times the speed of the original CD standard.

b. Recordable CD (CD-R)

For users who want to record data, a compact disk writer is used. This is a device which uses a more powerful laser than a CD-ROM laser to record onto a CD-R. The recordable compact disk is different from the CD-ROM.

c. Magneto-Optical Disk

The Magneto-Optical Disk is presently known as DVD (digital video disk). The DVD can store up to 10 GB of data each. It is also backward compatible. This means that it can play all CD-ROMs and CDs. who want to record data, a compact disk writer is used. This is a device which uses a more powerful laser than a CD-ROM laser to record onto a CD-R. The recordable compact disk is different from the CD-ROM

Input

Introduction

Since computers are electronic devices which operate in a way not easily understood by humans, it is necessary for equipment to be used which will convert the signals used by computers into a form that can be used by humans and vice-versa. This is the role of input and output devices.

As time progresses, the improvement in technology results in the development of input devices which make it easier for non-technical, untrained users to input data accurately and quickly.

Keyboard

Probably the most familiar of the input devices is the keyboard. Generally this resembles the QWERTY type keyboard common on most typewriters. Unlike the typewriter keyboard, however, the computer is extended to contain up to 102 keys, which include a number pad, a series of special function keys and some keys to control the cursor on the screen.

Mouse

The mouse is a small, plastic device which is connected to the computer by a small cable. It can be moved across a table top and the cursor will move across the screen in the same way. The cursor is a light square or line which appears on the screen to identify where the cursor is in the same position on the screen as the desired item, the item can be selected by pressing a button on the mouse. This saves the user having to type in the desired selection.

Touch Panel

The device which assists selection of items on a screen is the touch panel. This is a touch sensitive plastic sheet which is placed on the screen and again attached to the computer. The user can select items by touching the part of the touch pad at the location where the described item is on the screen. This will cause the touch pad to send an electrical signal to the computer and select the desired item.

Scanners

A scanner can be used to capture an image of a document or a picture and store this in the computer. In this way, both graphics and text can be stored and retrieved.

Stored images can be used for a number of purposes. Graphics can be incorporated into reports and newsletters. Scanned documents can be retrieved easily and reprinted, instead of having to search through the registry.

When the scanner is used in conjunction with an Optical Character Recognition (OCR), we will be able to not only capture an image of a text, but also to decipher and recognise the individual characters, numbers or symbols.

Bar Codes

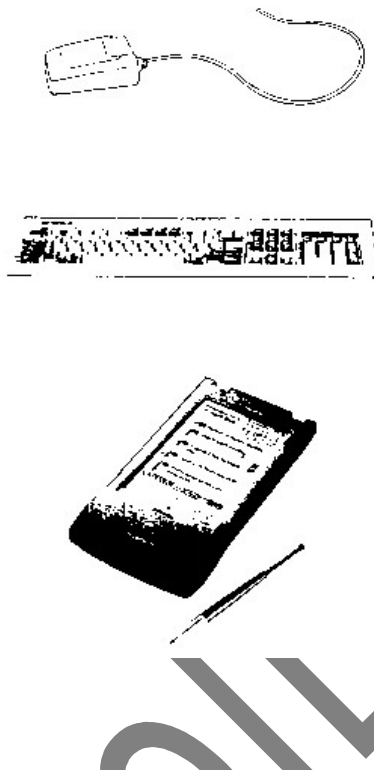
Another technique which is common today is bar coding. A bar code is a series of vertical stripes about one inch high. The stripes are of varying thickness and distances apart.

The combination of stripes (bar code) actually represents a numerical code. In this computer, this numerical code is the key field to a record containing data fields about the item.

Summary

- (a) The most familiar of the input devices is the computer keyboard which resembles the typewriter QWERTY type keyboard.
- (b) The mouse is a small, plastic device which is connected to the computer by a small cable. It can be moved across a table top and the cursor will move across the screen in the same way.
- (c) The touch panel is a touch sensitive plastic sheet which is placed on the screen and again attached to the computer.
- (d) A scanner can be used to capture an image of a document or a picture and store this in the computer. An Optical Character Recognition (OCR) software will decipher and recognise the individual characters, numbers or symbols.
- (e) A bar code is a series of vertical stripes about one inch high. A bar code reader is used to read the bar code and interpret the data.

Input Devices



Output

Introduction

Improvement in technology has resulted in the development of a variety of output devices which serve a variety of purposes. The quality of the output has improved at a continually reducing cost. In this chapter, we shall review various output methods and devices.

Terminals

Terminals are devices for translating and/or receiving data over a communication channel. They are connected to a computer, which controls the transmission of data over cables or over telephone lines.

The most well known of all output devices is the Visual Display Unit (VDU). The VDU is a general purpose terminal. Another name for the VDU is the monitor. When the terms “screen” or “display” are used, we refer to the part of the monitor where the output is shown.

Printers

1. Introduction

There are various types of printers available which give variety of different results. There are two main categories of printer :

- ◆ ***Impact printer***
 - *dot matrix printers*

- ◆ ***Non-impact printer***
 - *laser printer*
 - *Ink-jet printers*

In impact printers, the paper is actually struck by part of the printer, hence the term “impact”. Impact printers were the first type of printer to be developed. The way they work is similar to the typewriter in that an inked ribbon is pressed against the paper to make the mark.

2. **Dot matrix printers**

The cheapest of printers is the dot-matrix printer. This is an impact printer. Most impact printers used in the office today are dot-matrix printers.

Letters are formed by a matrix of pins which impact against the inked ribbon forcing it against the paper. The number of pins which form the matrix varies. Essentially, the pins are arranged in a rectangular fashion. A common size is seven pins high and nine pins across. By controlling which of these pins hit the ribbon at one time, any character from a blank space (i.e no pins impacting) to a small rectangle (i.e all pins hitting) can be achieved. The letter C, for example could be formed with 11 pins striking.

```
0****
*0000
*0000
*0000
0****
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The greater the density of pins, i.e the greater the number of pins in the matrix, the better the definition of the letter will be, resulting in a higher print quality. It follows that the more pins in the matrix, the more the printer will usually cost.

What are the advantages of dot matrix printers? Firstly, the dot-matrix are usually the cheapest of the impact printers. Secondly, the character set of the dot-matrix printer is infinitely variable since they are formed from very small elements (the dots) rather than being limited to those available on the pre-formed print element. This means that the dot-matrix printer can be used to produce graphs and other pictorial images as well as the more usual letters.

3. **Laser Printers**

The laser printer is the most common type of non-impact printer. These printers use a laser to “mark” the parts of the page where the text or image is to be formed. The paper is passed through a toner solution where the “marked” areas pick up the toner and the text becomes visible. Laser printers print on normal paper.

4. Ink-jet Printers

Ink-jet printers are also able to print on normal paper. They work by spraying ink directly onto the appropriate parts of the paper using small jets. The quality of ink-jet printers is generally high and use of different colour inks can be made for more complex prints. One major advantage is that ink-jet printers can print on a wide variety of surfaces, in addition to paper, which makes them quite versatile. Bubble-jet printers are ink-jet printers.

5. Microform

In addition to paper, it is sometimes desirable to produce a hard copy on different media. This is particularly useful in the financial functions where legal requirements enforce organisations to retain financial records for several years. Under these circumstances, it is useful to use a medium which takes less space than paper. This gives rise to Computer Output Microform (COM).

The word Microform means either Microfiche or Microfilm. In both of these media, printed details are photographically reduced in size and transferred onto film. The film can be magnified through a special reader in order to read the details. The difference between Microfilm and Microfiche is that the film is a long continuous strip several yards in length whereas the fiche is in the form of a sheet a few inches square.

Summary

- (b) Terminals are devices for translating and/or receiving data over a communication channel.
- (c) There are two main categories of printer :
 - ◆ Impact printer
 - ◆ Non-impact printer
- (d) An example of an impact printer is the dot matrix printer.
- (e) Examples of non-impact printers are laser printers and ink-jet printers.
- (f) In a dot-matrix printer, letters are formed by a matrix of pins which impact against the inked ribbon forcing it against the paper.
- (g) Laser printers use a laser to “ mark” the parts of the page where the text or image is to be formed.
- (h) Ink-jet printers work by spraying ink directly onto the appropriate parts of the paper using small jets.
- (i) Computer Output to Microform (COM) involves having printed details photographically reduced in size and transferred onto film.
- (j) The word Microform means either Microfiche or Microfilm.

Introduction

What is an Operating System?

An operating system is a program that acts as an interface between a user of a computer and the computer hardware. The purpose of an operating system is to provide an environment in which a user may execute program.

Objectives of Operating System

- (e) The primary goal is to make the computer system convenient to use.
 - a) Presents the user with a virtual machine that is easier to program.
- (f) The secondary goal is to use the computer hardware in an efficient manner.
 - b) Provides orderly and controlled allocation of processor, memory, input/output device among the various processes that are competing in a multi-user environment.

Concepts and Characteristics of Operating System

Operating System Concepts

- a) Processes
 - a. Refers to programs in execution.
 - b. Is controlled by operating system through Process Control Block (PCB).
- b) Files
 - a. Hides away the peculiarities of disk and input/output device.
 - b. Provides the programmers with an easy way to create, retrieve and modify files.
- c) The shell
 - a. High level command language which enables the users to interact with the system.

Operating System Structures

(a) Monolithic Systems

Description

Basic Structure Most common organization with no structure.

Operating system is designed as a collection of procedures, with each procedure being able to call any other procedure whenever it requires.

To construct an actual object program of the operating system, all individual procedures are compiled and binded into a single object file.

There is no information hiding as every procedure is visible to one another.

Basic Structure

- a) A main program invokes the requested service procedure.
- b) A set of service procedures that carry out the system calls.
- c) A set of utility procedures that help the service procedures.

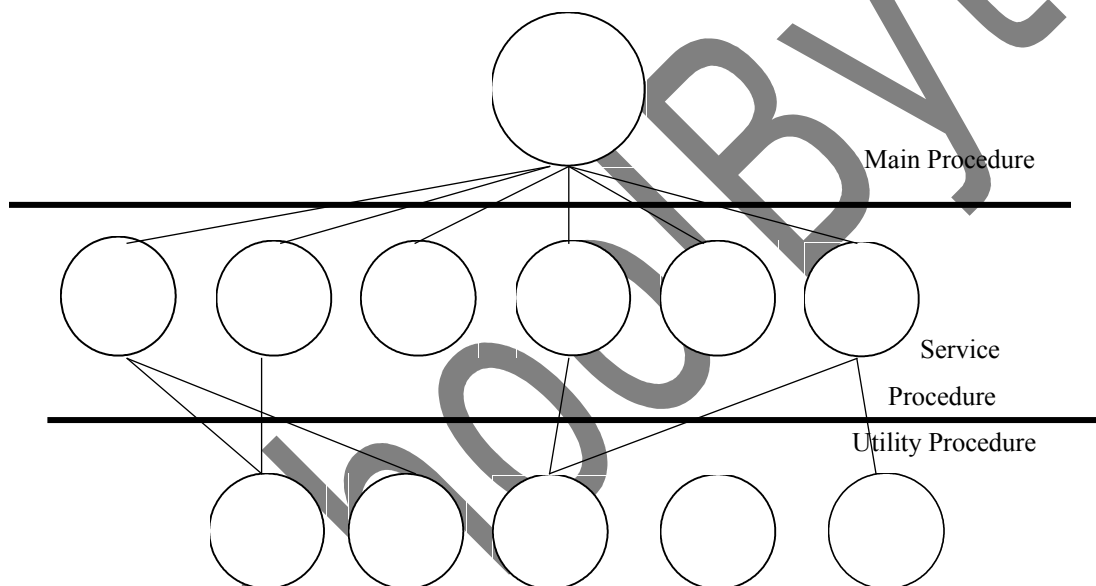


Figure 1-1: A simple structuring model for a monolithic system

(b) Client-Server Model

Description

The trend in client-server model is to implement most operating system function in user mode.

E.g. to read a file:- a user process (client process) sends a request to the file server- file server processes the request and sends back the result.

The operating system functions are moved up to higher level leaving the kernel to handle the communication between the clients and servers.

Since all operating system functions are moved to user mode, any bugs in the process will only affect the particular server and not the entire machine.

Other features are that:

Operating system is split into smaller and manageable parts

is suitable in a distributed system.

c) Structure consists of

File service

Process

Terminal service

Memory service

Introduction

Definition

Application software is a collection of related programs designed to perform a specific task, to solve a particular problem for the user.

Software Acquisition

Software packages can be acquired by

Custom Built Software

Big organizations may have their own in-house Information Systems personnel who develop application software tailored to the needs of the organization.

Customized Software

Software houses/external agencies develop packages in modular design. This facilitates them to easily construct software packages tailored to customer needs based on the 'building-brick' principle.

Off the shelf packages

This software serves general needs and customer can select the software according to their needs. Such software is available in many computer retail outlets.

Custom-Built Software

Advantages

Usually suitable

Software is built based on requirements specification.

Efficient

Codes are optimized; only codes relevant to the functions are developed.

Easy modifications

Alterations can be made easily as source code and other related resources are available within the organization.

Disadvantages

Expensive

Time is incurred in analyzing, designing, developing testing and implementing the software.

Budget is required for additional resources related to development, installation and training cost.

Slow acquisition

Time is spent, in the development of the software from analysis to implementation stage.

Limited feedback from other users

Normally it is tailored to the major users within the organization and feedback is received from these users within the organization.

Software Packages

Advantages:

Implementation

Packages are equipped with instructions on implementation procedures. Implementation is quicker and therefore cheaper.

System design, programming and system testing

It is cost effective as there is reduced effort in system analysis, design and programming.

EDP expertise

Small organizations with no Information Systems Department can enjoy high quality software without the expertise in the organization.

System Documentation

Packages are normally well documented.

Portability

Package may be portable from existing computer system to other computers.

Efficiency

In terms of speed, storage requirements and accuracy, the efficiency of a package that a user can expect depends and varies on the way the package are used and also on the requirements of the user.

Disadvantages

Suitability

A package may be suitable for specific user requirements.

Ease of Maintenance

It may be difficult or impossible to modify or tailor a package to suit specific user requirements. Enhancements may not be easily incorporated.

Inefficiency

A package may not be efficient as it may include irrelevant features.

Factors Affecting the Choice of Software Packages

a) Definition of Requirements

The user company cannot abandon the study of company objectives, systems investigation and consequent definition of data processing requirements. In these respects the approach is the same as when designing a system in-house.

b) Study of Range

A range of packages should be examined in depth before a choice is made, and existing users of the packages should be consulted for their practical experience and opinions. It should be remembered that the more commonly used packages result in pressure on the suppliers to keep them up-to-date.

Interfacing

How easily does a package interface with the user's own routines, both existing and future?

c) Amendments

At least one member of the user company staff must be completely conversant with the detailed operations and capabilities of the package adopted. This facilitates in-house tuning and making subsequent amendments. Moreover, it is important that a package's output be meaningful to the end-users.

Suppliers must be able to support on-going amendments, especially those required through legislation such as for taxation and payment.

d) Performance

How efficient is the package in terms of its average and maximum run times on the computer? What resources does it demand such as peripherals and amount of main and backing storage? What is the running time?

e) Contract Terms

The terms of the contract should embrace factors such as the terms of payment, supplier's assistance with implementation, extent of documentation, future maintenance and cost of packages. A highly suitable package may sometimes be rejected because of its high cost. The user should therefore be realistic when scouting for a suitable package. Often, an expensive package may include many 'fancy' features that are not really needed.

f) Hardware Configuration

Sometimes, to fully exploit the power of a package one may require suitable hardware. Thus, there may be hidden cost in the purchase of hardware necessary to use the package. The hardware configuration, therefore, must be carefully studied.

g) Ease of Use

A package should not be too difficult to use or require the users to master technical knowledge before he could fully utilize the package. However, initial training must be anticipated.

h) Accompanying Documentation

A well documented package will facilitate training of new staff, problem determination and solving. Thus the provision of good documentation is a single very important factor in the selection of package.

i) Reputation of Vendors

A well proven package that has been installed in many installations is most likely to be well accepted and functional. However, these packages may tend to be a little more expensive.

Software Categories

a) Spreadsheet Packages

A spreadsheet, also known as a worksheet, is used for planning, modelling and forecasting purposes, e.g. budgeting, sales analysis and break-even analysis.

The principal of a spreadsheet is that it simulates a large matrix of cells within which a data item or formula can be held. Once in a cell, the data item or formula can be replicated, moved, sorted, filed, printed and so on, at will. These facilities provide the means of easily and rapidly processing the data without the user having to write a program. The spreadsheet is controlled by a set of user commands in conjunction with a small menu that appears at the top of the screen.

An almost limitless range of work can be performed to give a wide variety of results. Some examples of spreadsheet programs are Symphony, Lotus 1-2-3 and Excel.

b) Word Processing Packages

WP in its simplest form is an enhanced typewriter which stores the text on a disk. It enables users to type:

One-off texts such as individualized letters and memo.

Replicated text such as standard letters to customers with some degree of individuality.

Updateable text such as reports which needs to be amended at regular intervals.

WP offers facilities such as line wrap around, title and page number generation, text merging, spell check, glossary, text editing, arithmetic capability. Some examples of WP are WordPerfect, MS-Words, WordStar.

c) Database Management System (DBMS)

DBMS is a system that organizes the storage of data so as to facilitate the retrieval of data for different applications. It may be required to handle a number of different systems concurrently, e.g. batch processing, online enquiries and transaction processing. DBMS offers facilities such as screen formatting to enable easy data entry, parameter-controlled report generating. It also provides Structured Query Language to enable users to query and extract information. Other facilities include dynamic creation and maintenance of data dictionary, validation of data enabling users written programs to enhance and change contents in database, sorting records, logging of transactions, audit trail creation, control of user password record and file locking in multi-user systems. Some examples of DBase IV, Access, FoxPro, IDMS, IMS.

d) Desktop Publishing (DTP)

DTP packages create pages of mixed text and illustrations. Newsletters, notices, advertisements, catalogue books are prepared with this package. Frames are represented on the screen where text and illustrations are inserted. The text can have several font types and sizes within a single document and with the help of mouse-controlled pointer graphics are created. These information can be stored on disk and retrieved at a later period and amended. DTP packages offer facilities such as wide range of font and print sizes, columns which can be organized automatically, auto spacing of characters and lines to fit the text, scaling and cropping of illustrations so as to fit the available space, page numbers insertion. Example of DTP are CorelDraw, Aldus Freehand, Framemaker.

e) Integrated Packages

Integrated packages have combined functions of word processing, spreadsheet, DBMS, Graphics, E-Mail, Programming. Instead of purchasing different individual packages, a single package is bought. Such packages have hotlink data (update on one document automatically updates all related documents). Examples of integrated packages are Framework, Microsoft Office.

Application Software

Types of Software

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(f) Efficiency

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2. Disadvantages

1. Suitability

A package may be suitable for specific user requirements.

2. Ease of Maintenance

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3. Inefficiency

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How easily does a package interface with the user's own routines, both existing and future?

4. Amendments

At least one member of the user company staff must be completely conversant with the detailed operations and capabilities of the package adopted. This facilitates in-house tuning and making subsequent amendments. Moreover, it is important that a package's output be meaningful to the end-users.

Suppliers must be able to support on-going amendments, especially those required through legislation such as for taxation and payment.

5. Performance

How efficient is the package in terms of its average and maximum run times on the computer? What resources does it demand such as peripherals and amount of main and backing storage? What are the running time?

6. Contract Terms

The terms of the contract should embrace factors such as the terms of payment, supplier's assistance with implementation, extent of documentation, future maintenance and cost of packages. A highly suitable package may sometimes be rejected because of its high cost. The user should therefore be realistic when scouting for a suitable package. Often, an expensive package may include many 'fancy' features that are not really needed.

7. Hardware Configuration

Sometimes, to fully exploit the power of a package one may require suitable hardware. Thus, there may be hidden cost in the purchase of hardware necessary to use the package. The hardware configuration, therefore, must be carefully studied.

8. Ease of Use

A package should not be too difficult to use or require the users to master technical knowledge before he could fully utilize the package. However, initial training must be anticipated.

9. Accompanying Documentation

A well documented package will facilitate training of new staff, problem determination and solving. Thus the provision of good documentation is a single very important factor in the selection of package.

10. Reputation of Vendors

A well proven package that has been installed in many installations is most likely to be well accepted and functional. However, these packages may tend to be a little more expensive.

Software Categories

(a) Spreadsheet Packages

A spreadsheet, also known as a worksheet, is used for planning, modelling and forecasting purposes, e.g. budgeting, sales analysis and break-even analysis.

The principal of a spreadsheet is that it simulates a large matrix of cells within which a data item or formula can be held. Once in a cell, the data item or formula can be replicated, moved, sorted, filed, printed and so on, at will. These facilities provide the means of easily and rapidly processing the data without the user having to write a program. The spreadsheet is controlled by a set of user commands in conjunction with a small menu that appears at the top of the screen.

An almost limitless range of work can be performed to give a wide variety of results. Some examples of spreadsheet programs are Symphony, Lotus 1-2-3 and Excel.

(b) Word Processing Packages

WP in its simplest form is an enhanced typewriter which stores the text on a disk. It enables users to type:

1. One-off texts such as individualized letters and memo.
 2. replicated text such as standard letters to customers with some degree of individuality.
 3. updateable text such as reports which needs to be amended at regular intervals.
- (a) WP offers facilities such as line wrap around, title and page number generation, text merging, spell check, glossary, text editing, arithmetic capability. Some examples of WP are WordPerfect, MS-Words, WordStar.
4. Database Management System (DBMS)

DBMS is a system that organizes the storage of data so as to facilitate the retrieval of data for different applications. It may be required to handle a number of different systems concurrently, e.g. batch processing, online enquiries and transaction processing. DBMS offers facilities such as screen formatting to enable easy data entry, parameter-controlled report generating. It also provides Structured Query Language to enable users to query and extract information. Other facilities include dynamic creation and maintenance of data dictionary, validation of data enabling users written programs to enhance and change contents in database, sorting records, logging of transactions, audit trail creation, control of user password record and file locking in multi-user systems. Some examples of DBase IV, Access, FoxPro, IDMS, IMS.

5. Desktop Publishing (DTP)

DTP packages create pages of mixed text and illustrations. Newsletters, notices, advertisements, catalogue books are prepared with this package. Frames are represented on the screen where text and illustrations are inserted. The text can have several font types and sizes within a single document and with the help of mouse-controlled pointer graphics are created. This information can be stored on disk and retrieved at a later period and amended. DTP packages offer facilities such as wide range of font and print sizes, columns which can be organized automatically, auto spacing of characters and lines to fit the text, scaling and cropping of illustrations so as to fit the available space, page numbers insertion. Examples of DTP are CorelDraw, Aldus Freehand, Framemaker.

6. Integrated Packages

Integrated packages have combined functions of word processing, spreadsheet, DBMS, Graphics, E-Mail, Programming. Instead of purchasing different individual packages, a single package is bought. Such packages have hotlink data (update on one document automatically updates all related documents). Examples of integrated packages are Framework, Microsoft Office.

Software falls into two categories. These are :

- (a) Application software

(b) Systems software

(a) Application Software

This is the set of instructions or programs which make the computer performs a particular task which will satisfy a processing requirement of the user. An example is the inventory system.

(b) Systems Software

This is the set of instructions or programs which create a computer environment within which the applications software can work.

Therefore, application software determines what processing is done by the computer. Systems software determines how that processing will be done by the computer.

Word Processing

Introduction

The name of this software is virtually self-explanatory. A word processor is an application software which allows the user to manipulate text so as to produce documents accurately and efficiently.

The software will provide the user with a blank screen page onto which text can be entered. Once the text is on the page, it can be altered with the greatest of ease, thereby allowing the correction of errors and perhaps more importantly, allowing the author of the document to change his mind. When a document is finally complete, and as the author wants it, then it can be printed and saved.

The software will allow multiple copies of the same document to be printed at the touch of a button. If a word still turns out to be incorrectly spelt, the document can called up again, the correction made without retyping the whole document and the page printed.

Features

(a) Page Formatting

Some processors will allow the user to select different print fonts, set a variety of tab stops, indent margins on the left or both sides and select single, double or treble spacing.

(b) Word Wrap

One of the most importantly features of word processor is that of word-wrap. With most typewriters, when the end of line is reached, the bell rings to alert the user to the need to press the carriage return to start a new line. With the word-wrap facility, the user merely continues to type and the word processor will continue onto a new line when required, without splitting words in the middle of them. Similarly , when the end of a page is reached, the software will simply scroll the old page up the screen and a new page will appear automatically at the bottom.

(c) Block Functions

Most word processors allow the user to identify blocks of text which can be manipulated together. Blocks can be moved, copied or deleted. This facility is often used to allow transfer of blocks of text from one document (or file) to another, thereby allowing the repeated use of standard paragraphs in several documents.

(d) Mail Merge

The more sophisticated word processors also allow a function known as mail merge. This is where a standard letter or other document can be produced, leaving gaps for details of the recipient's name and address. These details, for a number of recipients, can be entered onto another file and the two merged together at the time of printing. This process would result in a copy of the document, complete with name and address, for each of the recipients held on the second file. Such a facility is nowadays often used in mailshots and circulars.

(e) Spell Checker

Another feature which is of great use to users is that of the spelling checker. This facility allows the user to check the spelling of any, or all, the words in a document prior to printing. This software checks the spelling against an internal dictionary and a personal one which would contain entries such as people's names. One slight disadvantage is that much of this software is produced in America and results in the spelling checker questioning words which are spelt differently in Britain or America. There are, however, spelling checkers available which use the British spellings.

(f) Thesaurus

Finally, and as an extension to the spelling checker, there are now word processors which have the facility to a thesaurus to provide alternative words for the user. This again is quite useful tool and avoids having to use a manual method.

Spreadsheets

Introduction

A spreadsheet is essentially a grid made up of columns and rows. Numbers can be input into cells and formulas defined to perform numerical computation. Spreadsheets are used to perform repetitive financial computations. There are several different spreadsheet packages on the market.

How a Spreadsheet Works

Despite the variation in the features and purchase price of each, they are all based on the same basic concept. The software, when loaded, fills the screen with a grid formed of columns and rows. This resembles an "electronic sheet of squared paper". Each of the squares is known as a cell and each cell can contain either numbers, characters or formulae which are entered and manipulated by the user. Each sheet of cells is known as a worksheet.

Just as squares on a map can be identified by their grid reference, so the cell on a worksheet can be uniquely identified by a combination of letters and numbers by which the rows and columns are named. This is called the cell address.

If a cell contains a number, the number can be used in calculations elsewhere in the worksheet by the use of a formula. A formula uses the numbers from other cells by referring to the address of the

cell which contains the number. The package will use the number in the cell referred to, regardless of its value. This means that if you change the number in the cell, the new value will be used in the calculation without having to rewrite the formula. It is this ability to establish relationships between cells, independently from the actual content of the cells, which makes the spreadsheet such a valuable financial tool.

Spreadsheets come with a variety of commands which allow the user to manipulate and copy data, set display formats and, often, produce graphical output. In the less sophisticated spreadsheets, these commands have to be remembered by the user whereas in the more sophisticated packages, there is a menu system which acts as prompt from which the user can select.

The presentation of numerical data can be greatly enhanced with the use of graphs. In the more sophisticated spreadsheets, a variety of different types of graph can be produced from the data on the worksheet. In broad terms, the more you pay, the more you get. This relates not only to the number of different types of graph, but also how easy it is to define and produce the graphs.

Application of Spreadsheets

As mentioned above, the most common use of spreadsheet packages is in the financial field. The ability to define the relationships between cells using formulae enables the user to perform "what-if..." analyses.

An example of this would be a cash flow forecast for business which would entail an estimate of potential profits based on estimates of sales income minus the related costs of the sales and overheads. Once the formulae are set up, the values of the differences on the cash flow. Thus a number of scenarios can be examined with little effort.

Databases

A database is a collection of related data items that are stored together for use in many application systems. In a company, we can find many application systems (e.g. personal system), each of which has one or more users. These applications may store all their data in a single database. Thus, many users will read or access data in that single database.

Users will usually access the database indirectly, by using the application system (e.g. personal system). The application systems themselves do not access the database directly, but will use another software called the Database Management System (DBMS).

Desk Top Publishing (DTP)

An office technology that is currently enjoying considerable popularity is desktop publishing. Desktop publishing involves the use of desktop microcomputer systems that are equipped with special hardware and/or software features, to produce documents that look as though they were done by a professional print shop. In using these systems, users can combine word-processed text with such elements as artwork, photos, and a variety of magazine style fonts. The overall effect can be stunningly attractive.

DTP systems allow users to combine a variety of graphical fonts onto a page, use pre-stored art images (called clip art) on pages, and draw lines and boxes to highlight text or art. Fonts and clip art can also be purchased as add-ons from third-party vendors to extend the library of options offered for sale by the original-package vendor.

In some DTP systems, more sophisticated options are available. For instance, one can digitize complex art images such as photos, which are composed of a variety of halftones to which only high levels of resolution can do justice. Also, there is much greater variety of options available with fonts and clip art. For example, both fonts and clip art can be scaled to a variety of sizes - can be created or edited, as well.

Electronic Mail

Electronic mail (or E-mail) is the second largest EUC applications area, behind word-processing. It refers to the technology used to send messages or documents from one electronic workstation to another.

For instance, employees within a large organisation may have electronic mailboxes that are managed by a mainframe, minicomputer, or local area network. When these employees access a workstation (many of them have workstations at their desks), they can call up their personal file - or mailbox - on the E-mail system to see if there are any messages. Or, they can send a message to place in someone else's mailbox. These types of E-mail systems are typically standard components in integrated office packages.

Digital Image Processing

Images can be created using output devices or electronically copied from other sources. It could contain text, graphics or photographic data or a combination of these. The data can be stored, distributed, accessed and processed by computers and special-purpose workstations.

Digital image processing requires certain basic hardware and software. A scanner will be used to transform physical images into electronic digitized images, which must be indexed and compressed. Database management software handles the accessing of the indexed images. Workstations will be used to view and manipulate the image data. These workstations comprise high resolution monitors to display images as well as large storage capacities to store image files.

Voice Processing

Voice processing is a relatively new area. It can be limited to voice input processing, voice output, or both.

In the case of voice input processing, hardware and software are used to decipher speech and transform it into computer signals. Often the system has to be "taught" how to recognise commands of the main person who will be using it. An example is found in some PCs where a microphone is attached to process voice input. These systems are called speech recognition systems.

Voice output is also starting to be seen in some offices where the result of processing is a verbal message. For example, lifts in offices may be programmed to announce the floor. Often this is actually a prerecorded message. The challenge is to be able to perform voice synthesis such that the computer can actually pronounce any word.

A truly interactive system where commands and questions are issued verbally and where a machine can interactively respond (both in action and in verbal responses) is still some time in the future.

Intelligent Building

Many end-user computing tools help to automate the office and therefore, these concepts overlap. For example, a fax machine is an office automation product, and the incorporation of a fax/modem card into a personal computer is an example of the convergence of computing and office systems (office automation). But this example also demonstrates that computers can be used to direct or manage office automation facilities.

What are the common office facilities that must be managed? These include lighting , airconditioning, etc.

Imagine that you are designing a new building and that you are asked to make it intelligent. What are some considerations?

(a) Types of telecommunication services

The services to be considered include computer data (including electronic mail), telephones and faxes, videoconferencing and so on. The media used is usually the telephone network but there are different options which must be considered to meet the traffic requirements.

(b) Transportation

The lifts, escalators and other transportation means must be carefully integrated. An intelligent building will ensure that lifts are sent to the floors which need them most. For example, at 8.30am, all lifts not occupied could be sent to the ground floor if most human traffic is from that level.

Summary

- (a) Application Software is the set of instructions or programs which make the computer performs a particular task which will satisfy a processing requirement of the user.
- (b) Systems Software is the set of instructions or programs which create a computer environment within which the applications software can work.
- (c) A word processor is an application software which allows the user to manipulate text so as to produce documents accurately and efficiently.

- (d) A spreadsheet is essentially a grid made up of columns and rows. Numbers can be input into cells and formulas defined to perform numerical computation.
- (e) A database is a collection of related data items that are stored together for use in many application systems.
- (f) Desktop publishing involves the use of microcomputer systems to produce documents that look as though they were done by a professional print shop.
- (g) Electronic mail (or E-mail) is the technology used to send messages or documents from one electronic workstation to another.
- (h) Images can be created using input devices or electronically copied from other sources. The data can be stored, distributed, accessed and processed by computers and special-purpose workstations.
- (i) Voice processing involves voice input processing, voice output, or both.
- (j) Computers can be used to direct or manage office automation facilities like lighting, airconditioning, etc.

Some considerations when planning for an intelligent building are :

- * Types of telecommunication services
- * Transportation

System Software

Operating Systems

The operating system can be defined as a set of programs which supervise and control the whole computer configuration. This includes control of the input and output of data from the computer and control of the peripherals. It also handles error routines and communication with the operator. One aim of the operating system is to ensure the efficient use of the CPU and other devices.

The functions of an operating system are discussed below.

(a) Loading Into Memory

When a program needs to be executed, it must first be transferred from storage device to main memory as required. Similarly, when data is to be processed, it must be read into memory first.

(b) Queuing of processing Tasks

This concerns the scheduling of processing tasks, or jobs, so as to attempt to keep the central processing unit constantly active.

(c) Control of Peripheral Devices

This concerns the selection of input and output devices and the control of their operations. For example, when data is to be printed, the operating system would check the device address and ensure that the print file is sent to the right printer.

Language Translators

All computer languages must be converted to machine language which can be executed by a computer.

The software used to convert source programs to object programs is called a program translator or language processor. While there are a few types of translators, only the compiler will be discussed.

The compiler translates a high level program into machine code. In a high level language, fairly complex concepts can be expressed with the use of single commands. Consequently, each high level statement can be translated into several (sometimes several hundred) machine code statements.

Computer Languages

Computer languages can be categorised into :

- (a) Machine Language
- (b) Assembly Language (Low level)
- (c) High level Languages
- (d) Very high level Languages

(a) Machine Language

Machine code or machine language is the lowest level of computer language and is in binary notation. This is the actual "language" that the computer can understand and execute. However, it is very difficult to code using nothing but binary notation.

(b) Assembly Language (Low level)

Assembly Languages are also called symbolic languages or low level languages. They must be translated into machine language by an assembler program.

The assembly language is not written in binary notation. Instead, mnemoins or abbreviations are used to represent operations (e.g SUB for SUBtract). This makes the language much easier to write in than machine code but it is still relatively tedious for a programmer who has to code in very detailed steps.

(c) High Level Languages

High level languages are a group of languages which closely resemble the structure of English and are the easiest in which to program. There is less requirement on the programmer to specify so many details. One high level language command can represent several machine code instructions which means that the same can be achieved with fewer instructions in a high level language.

High level languages are more complex to translate into machine code and the language processors which perform this task are called compilers.

(d) Very High Level Languages

Very High Level Languages are also known as Fourth Generation Languages (4GL). This name is given to a group of languages that allow users to specify what the output should be without describing all the details of how the data should be manipulated to produce that result.

What is a 4GL?

A fourth generation language is an easy-to-learn, easy to use, high productivity language product that competes primarily in the applications domain once monopolised by 3GL.

The choice of programming language is important in determining how lengthy the program will be and how long it will take to code. In general, using a 3GL takes longer to code than if a 4GL were used. 4GLs were introduced to give programmers an alternative to writing programs using a 3GL. Some authors claim a 10 to 1 improvement when a 4GL is used over COBOL.

The 4GL is a family of products rather than one specific product. Some 4GL products consist of only a language, designed to be used with one or more DBMS. Others are complete application environments that include a language and a DBMS. Each individual 4GL product may perform one or more of the following functions :

(a) Report Generation

This enables a user or a programmer to produce reports quickly. Facilities are provided to allow data to be extracted from files or databases easily, and then classified or summarised in a report format.

(b) Retrieval and Update

A typical 4GL will also be capable of performing online queries. This enables a user to make a quick inquiry and if necessary, to perform an update as well.

(c) Graphics Generation

A user will use this function to extract data from the database and present it in graphical format, e.g. line charts, bar charts, pie charts, etc.

(b) Application Generators

4GL with this capability enables the user or programmer to develop a set of programs that comprise an entire application system.

Utilities

Introduction

Utilities are programmes which perform tasks that are often required by end-users, or other programmes. Many of them, especially for microcomputers, come as part of the operating system. With larger systems, some of the utilities are separate. Most of these are file

handling utilities such as copying and moving files which allow the user to perform housekeeping activities.

Functions of Utilities

(a) File Management

This covers a wide variety of tasks that users will perform to copy, delete, rename files and so on. Typical file management utilities are :

- Producing directory listings of files
- Copying files
- Renaming files
- Deleting files

(b) Backup and Restore

Making backup copies of the contents of the entire harddisk is rather difficult without a utility. Backup utilities compress the contents so that less diskettes are used. They also facilitate recovery should it be necessary.

(c) Anti-virus Software

Anti-virus software are used to detect and remove viruses.

(d) User Interfaces

This type of utility includes both menuing software and graphical user interfaces (eg Windows). It is used to run a particular software.

Summary

- (a) The operating system is a set of programs which supervise and control the whole computer configuration. This includes control of the input and output of data from the computer and control of the peripherals.
- (b) All computer languages (source programs) must be converted to machine Language (object program) which can be executed by a computer.
- (c) The software used to convert source programs to object programs is called a program translator or language processor.
- (d) Computer languages can be categorised into :
 - ◆ Machine Language
 - ◆ Assembly Language (Low level)
 - ◆ High level Languages
 - ◆ Very high level languages

- (e) A fourth generation language (4GL) is an easy-to-learn, easy-to-use, high productivity language product that allows the user and programmer to make enquiries or produce reports quickly and easily.
- (f) Utilities are programs which perform tasks that are often required by end-users, or other programs. Examples are file management, backup and recovery, anti-virus software and user interfaces.

Methods Of Software Acquisition

Introduction

There are two approaches to acquiring software :

- (a) Develop the software specially for your company
- (b) Buy software already developed and sold as a package

Custom Developed Software

Introduction

Some businesses consider that their processing requirements are specific to their own organisation and they have the application software developed specifically for themselves. To achieve this, there are two basic approaches :

(a) In-house development

This would mean employing programmers and analysts and setting up an internal IT group.

(b) Contract an external software

The company could use the services of a computer bureau or software house, especially if it is a small organisation which couldn't afford a fulltime development team.

The resultant software is known as custom-developed or tailor-made software since it exactly fits the requirements of the organisation, just as a tailor-made suit exactly fits the purchaser.

Advantages

The advantages of this type of applications software development is that the resultant programmes will exactly fulfill the processing requirements.

Higher Cost

Firstly, the cost of producing tailor-made software is high, just as tailor-made clothing is expensive. This is because the costs of developing the software are entirely borne by the one organisation instead of them being borne by many organisations.

SchoolByte

(a) Software Defects

Secondly, it is very unusual for software to be perfect when the programmers have finished. There is typically a period when the software is first operated where faults, or bugs, become exposed and have to be corrected. This can often cause serious inconvenience to the end-user and, in terms of lost time and efficiency, increases the overall cost of the software.

There is an alternative approach of procuring applications software. This is to purchase software in the form of packages.

Packaged Software

Introduction

Application packages are applications software which are commercially produced for a large market.

Packages form the larger part of applications software market so the advantages clearly outweigh the disadvantages in many cases. In any event, it is up to the individuals concerned to assess whether it would be better to buy a package or have some tailor made software developed. This choice will depend on the particular business function (i.e. how “normal” or “abnormal” it is) and how much is available to the organisation.

Advantages

(a) Lower Cost

The most obvious and important advantage is that packages are significantly cheaper to buy than custom-developed software. This is because package is sold to a large market and the development costs can be spread among a large number of purchasers.

(b) Less Software Defects

Given the large market to which packages are sold, most of the problems which commonly beset new software have been ironed out prior to the introduction into the market place. It is good policy, however, to avoid pioneering by buying new software. It is always better to purchase software that has been available for some time and will be well tried and tested.

(c) Better Documentation

Again, given the scale of the applications package market, it is more feasible for the producers to provide good documentation to accompany the software. Clearly, this will make the package easier to use, which will make it more attractive to the market and therefore easier to sell.

(d) Training Easily Available

The ease of use is also improved by the fact that it becomes viable for consultants and training organisations to offer training courses in using the packages.

Disadvantages

(a) May not meet all requirements

The facilities that are offered by a package are not as specific to a business as tailor-made software and might not quite satisfy the processing requirements of the business.

(b) Less efficient

Since the system is designed for more general purposes than the tailor-made software, the design may be less efficient. For example, a user may have to go through some unnecessary steps in processing which cannot be avoided.

Documentation

User Documentation

The first type of documentation is the user manual, also known as the user guide. The user manual contains screen and report layouts, with explanation of how to use a transaction or read a report. It also has other features like a list of error conditions and how to correct the error. The user manual should be referred to by the user who has a question or a problem about the system before he or she refers to the IT person supporting the application.

Operations Documentation

The operations section of an information service department has to operate the system after it has been implemented. This group needs information on normal operating procedures and on how to respond to errors. Such information is found in the Operations Manual.

The Operations Manual will contain information about starting and shutting down the system, plus details about how to run the batch jobs. For each batch job, a complete systems flowchart that shows the input required, the files necessary, and any printed output must be documented. It is important for operators to know possible error conditions and how to respond to them.

Open and Proprietary Systems

In the past, vendors developed hardware and software according to their own internal specifications and standards. This resulted in customers not being able to connect machines from different vendors and share the processing workload. Each vendor's systems were proprietary.

Open systems are based on public, non-proprietary operating systems, user interfaces, application standards and network protocols so that software can operate on different hardware platforms.

Summary

- d) There are two approaches to acquiring application software :
 - ◆ develop the software specially for your company
 - ◆ buy software already developed and sold as a package
- e) Custom-developed or tailor-made software can be achieved by :
 - ◆ In-house development
 - ◆ Contract an external software developer
- f) Application packages are application software which are commercially produced for a large market.
- g) In many cases, the advantages of application packages clearly outweigh the disadvantages.

Systems Theory

What is a System?

A system is any collection of components which interact to serve a common goal. All systems exhibit certain characteristics as discussed below.

Characteristics of Systems

Goals

Components

Structure

Behaviour

Life cycle

It is very broad and can be applied to both a business as well as a computer context. Examples of systems are a personal management system, a clinic and a personal computer.

All systems are composed of the same basic elements : input, processes and output.

Input are elements that enter the system for transformation. The elements may be material or information. Output is the outcome of the transformation.

Boundaries and the Environment

The features which define the extent of a system are its boundaries. In a business organisation, boundaries are determined by management. For example, each department has a boundary with other departments, in terms of employees and responsibilities.

Changes in boundaries are an inevitable consequence of organisations adapting to change. Changes at the boundary of interacting systems can be a source of friction if not handled properly.

The environment of a system comprises :

- (b) external elements which, when changed, affect the system;
- (c) external elements which are changed by the system's behaviour.

The environment is diverse and dynamic. The elements in the environment may affect the organisation or be affected by the organisation's actions or output. Where necessary and possible, organisation do attempt to influence their environment.

Open and Closed Systems

A closed system is one that is isolated from its environment. Closed systems are self-contained so that external environment does not influence the behaviour of the system, nor does the system influence its environment.

An open system is a system which interacts with its environment. It receives input and influences from the environment and in turn, passes back output and influences to the environment.

All social organisations are open systems. The way that organisations adapt to changes in the environment is the key elements in an organisation success and indeed its very survival.

What is the Systems Approach?

The systems approach is a method or framework which helps us to analyse and explore the operation and interactions which exist in the system around us. It is also known as systems thinking or General Systems Theory (GST).

To further understand the General Systems Theory, the main features will be discussed here. The systems approach has many facets of which the following are the most important.

(d) Holism

All systems are composed of inter-related parts or sub-systems and the systems can only be explained as a whole. This is known as holism or synergy.

Hierarchy

Systems are hierarchical in that parts of the sub-systems are made up of other smaller parts.

Interdependence

The parts of a system cannot be altered without affecting other parts.

Optimality

The sub-systems should work towards the goal of their higher systems and not pursue their own objectives independently. Where sub-systems do pursue their own objectives to the detriment of higher objectives, then a condition of sub-optimality is said to exist.

Hard and Soft Properties

Organisational systems contain both hard and soft properties. Hard properties are those that can be assessed in some objective way. The soft aspects of a system are a matter of individual values or taste.

Shared and Overlapping Subsystems

Sub-systems can belong to more than one system and there is a need to recognise this overlap and design operations and processes accordingly. The recognition of overlap is particularly important when changes are made in one of the systems which share the same sub-system.

Overlap is often an efficient and economical arrangement. However, such overlaps are likely to increase communication difficulties and may have longer response times.

Interconnections

Since each sub-system has many input and output, many interconnections may exist within the same system. For example a system containing 4 sub-systems has a possible 6 interconnections.

In a large organisation, there may be a very large number of interconnections. This would cause problems in coordination and communication. One of the ways to reduce the number of interconnections is by decoupling.

Decoupling

If sub-systems are tightly connected, then close co-ordination may be very difficult. This is because there must be exact matching of output of one sub-system to the input of the next. Any delays in the first sub-system's output will cause a delay in the second sub-system's process.

One solution is to decouple or loosen the connection so that the two systems can operate with some degree of independence.

Decoupling, both in a physical and information sense, allows sub-systems more independence in planning and control. It is likely that with some decoupling, the organisation is better able to deal with unexpected disturbances.

Two major costs are involved with decoupling :

- (e) the cost of the decoupling mechanism itself
- (f) the possibility of sub-optimisation

Summary

- 1) A system is any collection of components which interact to serve a common goal.
- 2) The features which define the extent of a system are its boundaries.
- 3) The environment of a system comprises :
 - external elements which, when changed, affect the system.
 - external elements which are changed by the system's behaviour.

A close system is one that is isolated from its environment. An open system is a system which interacts with its environment.

The systems approach is a method which helps us to analyse and explore operation and interactions which exist in the systems around us. The systems approach is also known as systems thinking or General Systems Theory (GST).

The main features of the General Systems Theory are :

- ◆ Holism
- ◆ Hierarchy
- ◆ Interdependence
- ◆ Optimality
- ◆ Hard and Soft Properties

Sub-systems can belong to more than one system and there is a need to recognise this overlap and design operations and processes accordingly.

Since each sub-system has many inputs and outputs, many interconnections may exist within the same system.

Decoupling (Loosening the connection) may be necessary in cases of tight coupling so that the systems can operate with some degree of independence.

Information & Information Systems

Data and Information

The difference Between Data & Information

In everyday English, the terms “data” and “information” are used interchangeably. However, each term carries a different meaning when used in the context of IT and MIS.

Data are facts, events, transaction and so on which have been recorded. They are the input raw materials from which the information is produced.

Information is data that have been processed such that it becomes useful to the recipient.

a) Data

Data are facts obtained by observation, counting, measuring, weighing, etc. which are then recorded. Frequently, they are called raw or basic data and are often records of the day to day transactions of the organisation. An example is the class attendance at a school. We record the class code, number of students, etc.

Data are derived from both external and internal sources.

b) External Sources

Most external data are in readily usable and concrete forms, e.g. supplier invoices.

Internal Sources

Here, internal activities require appropriate measuring and recording systems so that facts can be captured. Data may be produced as an automatic by-product of some routine but essential operation. For example in the process of preparing invoice, accounts receivable (AR) information is also produced. Alternatively, a special measuring procedure must be introduced and results recorded. For example, to know how much a machine produces, we either introduce a human or mechanical counting method.

In addition to the attention given to the methods of processing data, the *quality* of the source data must not be overlooked. If the source data is incorrect, then all the resulting information will be worthless.

Information

Information is data that have been interpreted and understood by the recipient of the message. It will be noted that the *user*, and just the sender, is involved in the transformation of data into information. There is a process of thought and understanding involved before the message can be understood.

As a result, we can also say that:

- ◆ a given message can have different meanings to different people.
- ◆ the mere act of processing data does not itself produce information
- ◆ the user determines whether a report contains information or just processed data.

Classification of Information

Information has many characteristics and can be classified in numerous ways. The following gives some examples.

c) By Source

e.g internal, external, primary, secondary, Government, etc.

By Nature

e.g. quantitative, qualitative, formal, information, etc.

By Management Level

e.g. strategic, tactical, operational, etc.

By Timeframe

e.g. historical, present, future.

By Frequency of Update

e.g. continuous (real time), hourly, daily, monthly, annually, etc.

By Frequency of Production

e.g. at planned intervals, occasional, on demand etc.

By Intended Use

e.g. planning, control, decision making, etc

By Medium

e.g. written, aural, visual, sensory, etc.

By Level of Detail

e.g. detailed, summarised, aggregated, abstract, etc.

Characteristics of Good Information

Good information is that which is used and which creates value. Experience and research shows that good information has numerous qualities.

- a. The data itself ...**
 - a. is relevant
 - b. is sufficiently accurate
 - c. is complete enough for the problem
 - d. contains the right level of detail
- b. The data is communicated...**
 - a. to the right person
 - b. in time for its purpose
 - c. by an appropriate channel of communication.
- c. The user...**
 - a. has confidence in the source
 - b. can understand the data
 - c. can use the data

The Value of Information

Information has no value in itself. Its value derives from the value of the change in decision behaviour caused by the information being available minus the cost of producing the information.

There is a tendency to assume that more information , earlier or more up to date information, more accurate information etc. is all better information. It may be better information but only if it improves the resulting decisions, otherwise it has no value.

Summary

- a) Data are facts, events, transactions and so on which have been recorded. They are the input raw materials from which information is produced.
- b) Information is data that have been processed such that it becomes useful to the recipient.
- c) The user determines whether a report contains information or just processed data.

- d) Good information must be relevant and sufficient, be communicated to the right person on time and this person must be able to understand and use it.

Data Files & Databases

Introduction

Before databases were introduced, all data was stored in files. Files are still used today, but are much less common. A file stores only 1 type of record. On the other hand, databases can store different types of records.

File Organisation

Data files must be organized logically into files and be accessible and updated as needed. There are three major methods of file organisation : sequential, direct and indexed-sequential organisation.

Sequential File Organisation

This is the simplest form of file organisation. Records are stored in sequential order by a particular record key. For example, if the file contains employee data, then the likely data field chosen to be the record is the NRIC number or the Employee Number.

Sequential Files can be stored on both magnetic tape and magnetic disks. However, magnetic tapes can only store sequential files, and not the others.

Data which is stored sequentially can only be accessed sequentially. For this reason, it is called sequential access method (SAM) file.

Direct File Organisation

In a direct file, data records are not read (accessed) sequentially. Instead, the data management systems (the software which controls these files) is able to determine the exact location on the disk (address) where the data record is stored. Hence this method of access is called direct access and the file is called direct access method (DAM) file. This is only found in disks and not on tapes.

How does that data management system determine the address on the disk to store and retrieve a particular data record? The most common method is to use a program specially created for this purpose. The input will be the record key field, and the output from this program is the address. This program maps the record key into a storage area with the objective of spreading the data records as uniformly as possible in the disk.

Indexed-Sequential File Organisation

The indexed-sequential file organisation is a combination of the earlier two methods. Like the direct access method, it is found only on disks. The physical space on a disk where records are stored is called a track. A track is the storage area of the disk consisting of a circular band.

In an indexed-sequential file, data records are stored sequentially by record key. More specifically, a few data records are stored on any one track. An index is created automatically by the data management system. The index will carry the highest record key of those records in a track. When a particular record is to be accessed, the index is looked up to find the track where the record can

be found. Then the records in this track are read sequentially until the particular record desired is found.

Redundancy in Data Files

In the traditional data files, the same data may be stored in several functional files. This situation duplicates data unnecessarily, creating what is referred to as “redundancy”.

Consider a typical situation. Those responsible for payroll would keep their data in a data file. The data could comprise employee records, and each record could contain details of individual employees, including name, identity card or social security number, employee number, address, salary, department, bank account number, etc.

Those responsible for personnel administration would typically keep a separate file which also contains details relating to employees including many already existing in the payroll file. Data fields like name, identity card or social security number, employee number, address would be duplicated and hence, redundant.

Databases

A database is a data store for accepting, storing and providing on demand data for multiple independent users. It is essentially a means of organizing data in related file structure to allow quick, user specified access and manipulation of the data. They are controlled by systems software called Data Base Management Systems (DBMS).

The data in a database is accessible to authorised managers and other personnel for administrative purposes and for use in making decisions and controlling business operations. Databases may relate to specific functional requirements such as accounting or may provide for interfunctional information needs.

DBMS

The database management system (DBMS) is the software that builds and maintains the data base. It also provides the environment through which an end-user can access the data base.

What are the functions performed by a DBMS?

e) Record Creation and Updates

The database is maintained by the user creating, deleting or amending records. The Data Base Management System will also allow the user to process selected groups of records, the whole file or individual records. This is accomplished by selecting the required option from a menu displayed on the video screen or by keying in the relevant command from the keyboard.

Record Selection by Search Criteria

The processing can also involve the extraction of information from the selected records according to specified search criteria. In a student database, for example, if we wanted to list the students who have attended less than 80% of classes, this would be handled by the DBMS provided the required data is recorded in the database.

A database has searching facilities ranging from limited searches on keywords to full text searching. This facility provides the means of extracting from a large volume of data useful facts which could not possibly be found by physical search methods in sufficient time to make a decision.

A query language is used to specify the search criteria. This language facilitates enquiries using English – style word to define commands, so greatly assisting users to find the information they are seeking.

Minimise Data Redundancy

If a data element or record (e.g. an employee address) appears twice in an organisation's records, this is called data redundancy, since logically, it should not be necessary to hold the data twice, hence one copy is redundant. Similarly, in a database, data redundancy should be eliminated, or at least, minimised and this is the task of the DBMS.

Security

The Data Base Management System is also responsible for providing security for the database, ensuring against unauthorised access and data corruption.

For example, if many end-users are given access to common data, there must be a way of controlling that access to ensure that no two users are able to change the data simultaneously. The DBMS is responsible for such control.

Data Dictionary

A data dictionary contains details of the data in a database. Just like an English-language dictionary, each data item is recorded together with its definition and explanation.

What role does the data dictionary play? The dictionary assists in the design of a database since the meaning of various types of data are easily located. It can be used to reduce the level of redundancy to a necessary minimum. It is easier to identify synonyms (data groups having more than one name).

Advantages of Databases

- a) Reduces data duplication which occurs using conventional file structure.
- b) Avoids duplicating input data to update multiple functionality independent files holding the same data.
- c) Offers useful query and report generation languages.
- d) Provides fast and flexible access to information.

Disadvantages of Database

- a) Data structures in a database are complex and therefore takes a longer time to design and implement.
- b) Costs more than conventional file systems.
- c) Requires high calibre, experienced and specialised personnel.

Creating a Database Environment

The concept of a database as a shared central repository of data is desirable, but is sometimes difficult to implement.

Departments have all along maintained their own data and have been jealous of it. Inter-departmental rivalry leads to reluctance to divulge data, let alone make it available in a central database. There must be a change of attitude in terms of who actually owns data.

The chief executive must set the tone. Appointing a Chief Information Officer is one way to give direction and focus, as the CIO will be responsible for the overall use of data and information in the company. A data administration function must be established and the CIO must plan the current and future data needs.

Physical and Logical Records

The form in which data which is actually stored is not the same as the form presented to the application program. The data structure that is actually on the computer media (e.g. disk, tape) is called a physical structure. The structure that the application program uses is a logical structure.

File Structure for Interrelating Data

a) Data Files and Databases

Database management systems (DBMS) do not replace the traditional method of storing data in data files. The data is still stored in sequential, direct or indexed sequential file structure even though a database management system is used to provide greater flexibility in accessing data.

There are a variety of methods that could be used by a DBMS to logically structure the data. Two methods that will be discussed are multilists and inverted files.

Multilist

A list links common items in a database. A list is like a chain and each link in that chain is a record with the desired attribute. By starting at the first record, the DBMS can retrieve, one by one, the records in the chain which share the desired attribute.

Inverted Files

In an inverted file, the addresses of each record with a desired attribute are stored in an index. In a fully inverted file, there will be one index for each type of data item. In a partially inverted file, only some of the attributes are indexed.

Summary

- a) There are three major methods of file organisation: sequential, direct and indexed-sequential organisation.
- b) In a SAM file, records are stored in a sequential order by a particular record key.
- c) In a DAM file, the address of a data record is computed by the data management software. Therefore, records can be retrieved directly.
- d) In an ISAM file, an index is created which carries the highest record key of those records in a track. When a particular record is to be accessed, the index is looked up to find the right track, and the records in this track are read sequentially until the particular record is found.

- e) A database is a data store for accepting, storing and providing on demand data for multiple independent users.
- f) Databases are controlled by systems software called Data Base Management Systems (DBMS).
- g) The functions performed by a DBMS are :
 - ◆ Record Creation and Updates
 - ◆ Record Selection by Search Criteria
 - ◆ Minimise Data Redundancy
 - ◆ Security

A data dictionary contains details (eg definition) of the data in a database.

The data in a database is still stored in a sequential, direct or indexed sequential file structure even though a database management system is used to provide greater flexibility in accessing data.

The name multilist refers to the capability of the DBMS to run multiple lists through a database.

In an inverted file, the addresses of each record with a desired attribute are stored in an index.

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