SECTION 1
Components of a Computer System

a) Define hardware, giving examples

Hardware is the term used for the parts of the computer that you can touch and handle. Hardware is the collective name given to all the devices that make up a computer system. Hardware includes:

- CPU
- Input devices (keyboard, CD-ROM drive or DVD, mouse, 3.5 inch floppy disk drive, hard disk, scanners)
- Backing storage – which consists of the disk drives used to store data when the power is switched off. (DVD's, CD-R's, CD ROM, Magnetic tape, tape cartridges)
- Output devices (printers, VDU's, speakers, 3.5 inch floppy disk drive)

b) Define software, giving examples

Software is the word used for the actual programs that allow the hardware the to a useful job. Without software, hardware is useless. Software is made up of a series of instructions that tell the computer what to do. To understand the difference between software and hardware, think of a tape recorder and a blank tape. The tape recorder and the tape are the 'hardware' because they are tangible (can be touched). However, if we recorded some music onto the tape, then the music would be the 'software'.

c) Describe the difference between hardware and software.

Hardware is tangible and software is not. Hardware refers to the physical components which make up a computer system whereas software refers to the programs which are run on the computer (Windows, Microsoft Office, Internet Explorer, Corel Draw).

d) Identify the main components of a general-purpose computer: central processing unit, main/internal memory (including ROM and RAM, input devices, output devices and secondary backing storage).

- CPU (Central Processing Unit) – The 'brain' of the computer. The CPU processes the raw data and turns it into information. There are three main elements of the CPU;
- the **control unit,** responsible for coordinating the input and output devices
- the **arithmetic and logic unit** in which all the calculations and logical decisions are made
- the **immediate access store**, which provides immediate memory for holding data and programs.
- Main/internal memory (including ROM and RAM)
- RAM is held on a chip but data in RAM is held only temporarily, which means that the data disappears when the power is switched off. RAM is known as volatile memory. RAM is used to hold both data and programs during processing.
- ROM is held on a chip inside the processor and is used to hold data which cannot be changed by the user. Programs are stored on ROM chips when a computer is manufactured. Usually, the data held on ROM will be the software that tells the

computer how to load the operating system (called the boot program). Since data is permanently stored on ROM it will stay stored even if the power is switched off. ROM is referred to as non-volatile memory.

- Input devices/output (see section **a**)
- Secondary backing storage (see section **a)**

e) Identify operating systems, including Graphic User Interface, command line interface.

Operating systems software is the instructions which control the general day to day running of the computer. It looks after the way memory is organised schedules all the tasks running on your computer and allows the user to communicate with the computer. Sometimes the operating system comes together on one CD-ROM with the user interface software (the user interface software is software which allows the user to communicate with the operating system). Both are installed at the same time.

User interfaces

The user interface allows us to give commands to the computer. Today most personal computers have GUI. The interface allows the user to communicate with the computer's operating system, so providing the user with overall control of the tasks. A GUI is also known as a WIMP interface (Windows, Icons, Menus, Pointer) and this is because each task is displayed in an individual window (which is basically a rectangular box on the screen with a process's output or folder's contents displayed in it. Windows can also display the contents of folders (directories), which may contain software like a word processor or documents like a letter you wrote using the word processor. A picture (icon) represents each item such as a document or piece of software. An icon is just a small graphical picture. (Note that a folder usually contains a selection of documents, programs/software and perhaps, other folders.

In addition, at the top of some windows you may see words which, when you clickon them, give you a series of options to click on. These are called 'pull down menus'.

Finally, the 'Pointer' referred to in a WIMP environment is the pointer displayed on the screen as a result of moving the mouse. As the pointer moves over an object it is possible to click and select that particular object.

SECTION 2: INPUT DEVICES

 Digitiser	 Mouse	 OMR	 Magnetic Stripe
 Flat bed scanner	 Keyboard	 Microphone	 Joystick
 Tracker ball	 Digital camera	 Hand held scanner	 Remote control
 MIDI	 MICR	 Graphics tablet	 Sensor
 Touch pad	 OCR	 Video camera	 Bar code reader

INPUT DEVICES

1.
They contain their own chips. Each key acts as a switch which closes when the key is pressed
The microprocessor scans the keyboard hundreds of times a second to see if a key has been pressed. If it has, a code that depends on which key has been pressed is sent to the processing unit. The CPU translates this code into an ASCII (American Standard Code for Information Interchange).
KEYBOARD

2.
An input device that translates its movements on the desktop into digital information
This is fed to the computer which in turn causes the cursor to move on the screen
MOUSE
3.
Is like an upside down mouse
The ball is rotated by the user but in this case the mouse stays still
TRACKER BALL
4.
Commonly found on notebook computers
You move your finger across the pad and this moves the cursor on the screen
MOUSE PAD
5.
A combination of hardware and software that converts an analogue video signal into a digital signal in the computer's memory
Each frame from a video is converted, using the video digitiser and it may be played back in any required sequence
This is known as 'image grabbing' or 'frame grabbing'
VIDEO DIGITIZER
6.
A device which acts as a communication line between the signals and the central computer
REMOTE CONTROL
7.
Similar to a tracker ball
Whenever the stick is moved, the cursor moves in a similar direction on the screen
JOYSTICK
8.
A short length of magnetic coating printed on to the surface of a ticket or card. The stripe usually contains information to identify the ticket or card or its user. You can read the information on the magnetic strip by 'swiping' card with a magnetic strip through a reader
MAGNETIC STRIPE
9.
A device used to examine pictures, text or other information and represent them as computer data
Two main types:
A hand held device which is moved across the picture
A flat bed scanner. Picture is laid flat and the scanner remains stationary on a table while picture is scanned

SCANNER

10.
Can take photos that are digitised and stored in the camera
No need for film or development process
Images are transferred to a computer
Images can be sized, altered, and incorporated into a DTP (Desktop Publishing) document
DIGITAL CAMERA
11.
Input device for a speech recognition system
The voice pattern of the user is converted into instructions to the operating system or application software or into text on the screen
May be used as an input device to a voice mail system
MICROPHONE
12.
Used to obtain data automatically
Traffic lights have a sensor which records the frequency of the traffic
A microprocessor can then alter the sequencing of the lights to improve the flow of the traffic
Burglar alarms and central heating thermostats both contain sensors
SENSOR
13.
Software and hardware designed to MIDI standards. They are able to send electronic messages to MIDI devices such as keyboards, musical synthesisers and drum machines
MIDI INSTRUMENTS
14.
Rather like electronic tracing paper
A cursor is used on a on a graphics tablet to trace over technical drawings put on the screen using a computer aided design package such as AutoCAD
GRAPHICS TABLET
15.
Numbers seen at the bottom of a cheque
Characters are printed using an ink which contains iron and may be magnetised. The magnetic pattern of the numbers is read by a special reader called a magnetic ink character reader
MICR
16.
They are able to sense marks made on a special form in certain places such as when collecting student enrolments.
OMR
17.
A method of inputting text using a scanner along with special software to turn the scanned image into standard ASCII code
The text is no longer treated as a picture, since each individual letter is recognised on its own and can therefore be edited using word processing software.
OCR
18.
Can read a numerical code on goods
Saves having to type it in

BARCODE SCANNER

19.

This is a device which can produce a recording that captures full motion. The camera can record, manipulate and display moving images, especially in a format that can be presented on a television.

VIDEO CAMERA

20. A light-sensitive stylus wired to a video terminal used to draw pictures or select menu options. The user brings the pen to the desired point on screen and presses the pen button to make contact.

LIGHT PEN

21. A camera designed to take digital photographs and transmit them over the Internet or other network.

WEB CAM

SECTION 3 – Storage Devices and Media

Describe common backing storage media and their associated devices including:

- magnetic tapes,
- CD ROMs,
- CD Rs,
- CD RWs,
- DVD ROMs,
- DVD Rs,
- DVD RWs,
- floppy discs and hard discs,
- Zip discs,
- Jaz discs,
- memory sticks,

Identify typical uses of the storage media, including types of access (e.g. serial/sequential, direct/random) and access speeds.

Explain the use of each of the media.

- Discuss which type of access (serial or direct) would be used by each device to access data on the media.

- Give examples of the speed of data access of each one.

Describe the comparative advantages and disadvantages of using different backing storage media.

For each device give an example of when it might be used and give reasons why the other media/devices would not be suitable for that particular use.

Define the term backup and describe the need for taking backups.

Explain the implications of losing data.

Describe the difference between main/internal memory and backing storage, stating the relative benefits of each in terms of speed and permanence.

Discuss the volatility of data in RAM when compared with ROM and backing storage.

IGCSE ICT
Theory

Section 4
Computer Networks

Networks

- A network is developed by linking computer systems so that they can communicate with each other, share computing power and storage facilities.
- The network includes the individual computer systems, the connections and the hardware that allows communication to happen.
- The link may be between computers in the same building or between computers in different parts of the country or the world.

Local Area Networks (LANS)

- LANS are confined to small areas.
- Usually this area is within a single building although it need not be confined to a single office. Sometimes LANS spread through several buildings on the same site.

Wide Area Networks (WANS)

- WANS cover a wide geographical area.
- Banks and building societies have their main computers situated in one place with connections made by telephone wires to all the various branches.
- Using WANS, computers may be linked together in different countries using satellites, microwaves or telecommunication links.

Modems

- A modem (short for modulator/demodulator) allows data to be passed along telephone lines from one computer to another.
- This device coverts the digital signals produced by the computer into analogue signals.
- These analogue signals are sent along a telephone line to another modem, where they are converted back into digital signals for the receiving computer.
- An analogue signal must be converted into digital form before it can be processed by a computer.
- The speed at which data is transferred is measured in bits per second (bit/s or bps for short).The faster the modem, the quicker the data can be transferred.

Analogue Data

- Can be any value within a defined range.
- An analogue sound signal can have any loudness between zero and the maximum recorded any frequencies between the highest and lowest recorded.

Digital Data

- Is made up of 0's and 1's. Text, music and images all have to be converted into digital data before they can be processed and stored by a computer.

What is the Internet?

- The Internet can be described as a network of networks.
- Almost any type of information or person can be found on this network.
- You access the Internet through Internet Service Providers (ISP) such as AOL or BT

What can ISP's offer?

- **Instant messages –** You can hold a conversation
- **Electronic mail –** anyone connected to the Internet can be contacted
- **Message boards –** you can have discussions or post a message and wait for replies
- **Access to news, weather, sport, financial pages**
- **Access to the Internet**
- **Access to on-line shopping –** Many on-line stores provide goods at less than high street prices
- **Member services –** Keep track of the on-line costs
- **Software downloads –** Free software and downloads
- **Directories of members –** Members with similar interests can be found

Advantages/Disadvantages of using common network environments such as the Internet.

Advantages

- You can access the internet from anywhere and a huge amount of information is provided to you from all over the world. The use of laptops and Internet access using televisions and mobile phones has meant that users can also access the Internet in a non-traditional setting.
- Information is up to date. By the time books are written, edited and printed the information they contain can be dated. Information on the Internet can be continually updated. However, you do still need to make sure that any information you use is up to date.
- Multimedia can be used. Information can be presented in the most interesting way possible, using video clips, animation, sound, etc.
- You can access huge amounts of information. Encyclopaedias, dictionaries, newspapers, magazines and many research papers are available on the Internet. You don't even need to leave your house to access them.
- Search engines are available to help you find the information you are looking for. Searching in traditional books is very slow; using a search engine can Internet make browsing very easy.
- Using e-mail you can access experts all over the world on certain subjects. If you have a question about something on a website you can send an e-mail to its author and they can send you their reply using e-mail.

Disadvantages

- The equipment and connection needed are relatively expensive. Computers, modems (or ISDN adaptors), telephone and/or Internet service provider (ISP) costs must all be met. The costs, however, are decreasing quite rapidly.
- You need some knowledge to perform searches successfully. If searches are constructed incorrectly, then you will get either no information or too much, most of it irrelevant.

Describe what is meant by the terms user id and password, stating their purpose and use.

User ID – This is a number or name that is unique to a person using the network. The person who looks after the network uses this to allocate file space for each user's work. It is also used to permit users to access certain files. A user ID tells the operating system that a certain person is using the terminal.

Password – This is a string of characters (letters and/or numbers) that the user (or the person who looks after the network) can select. It is used to authenticate the user to the system. Only if you type in the correct password, will you be allowed access.

The user ID will normally be shown on the screen but any password is hidden. As each character of the password is typed, an asterisk is shown on screen, to ensure that is cannot be read by anyone watching the screen as the log-on takes place.

Identify a variety of methods of communication such as fax, e-mail, bulletin boards and tele/video conferencing.

Facsimile (fax)

A fax is when a copy of a document is sent over communication lines. This could be printed out immediately at the other end of the line. A fax is an image of a document. It is sent to a particular fax number and is not necessarily private since it is not to a private address of an individual person. It cannot be transmitted if the fax number is busy.

Electronic mail (e-mail)

Electronic mail is when a message is sent from one person directly to another using computers which are connected to a network. There is a special computer which receives all mail and sorts it out, deciding which mailbox it needs to go to. This is called a mail server and it acts a bit like a post sorting room. Each user has their own mailbox which is labelled with their own personal e-mail address. This means that this method of communication is very private. All sorts of documents can be attached to the e-mail including pictures, sound and video.

Tele/video conferencing

Teleconferencing allows groups of people in different locations to talk together over communication lines as though they were all sat round a table in a meeting, even though they are far apart. This saves on travelling costs and on travelling time to the meeting. It is very convenient except that it is sometimes difficult to exchange ideas when people are not talking to one another face to face in one another's company.

Videoconferencing is similar to teleconferencing except that people in the meeting can now see one another because video cameras are used. Desktop videoconferencing systems are available which have the correct software, video and sound systems attached to them. Often users can work on the same document.

There are now videophones (telephones which have a screen to display a picture of the person at the other end of the line) which have been developed commercially. This

experiment is very expensive when compared with an ordinary telephone facility. As digital communication becomes more commonplace and speed of transmission increases, the sound and vision synchronisation problem will become far less difficult to replicate. This will result in videophones being more readily and widely available and at reduced cost to the user/business.

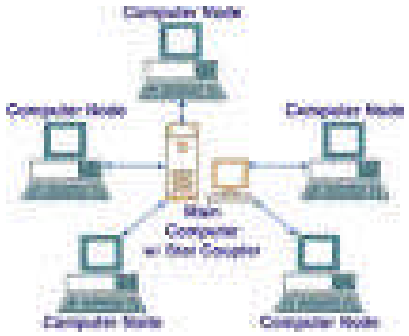
Bulletin boards
A bulletin board is an area where one user of a viewdata system can leave messages and information which is then available to all other users. Viewdata is an interactive information system where the telephone is used to link users to the host computer. Normally the user has a modem used with a terminal or a microcomputer. The user can send messages back t the computer.

Define the terms Local Area Network (LAN) and Wide Area Network (WAN) Describe the differences between LANs and WANs, identifying their main characteristics.

A LAN is a group of computers which are linked together on the same site or within the same building. A LAN exists at school where the computers are connected together by cables.
A WAN exists where computers are connected together over a much wider area, perhaps many miles apart. Computers may be scattered all over a country and many sites may be involved including those located in other countries.

Network Topologies

- Each workstation has its own direct line to the server. Connections to the server are made with hubs or switches.
- Hubs connect many lines together.
- Switches allow the network manager to connect certain workstations to specific servers.



A Star Network

Advantages:

- Reliable – if one connection fails, it does not affect others.
- Good performance, fewer data collisions as each workstation has its own line.
- Good Security – no workstation can interact with another without going through the server first.

Disadvantages

- Expensive to install – lots of cables required.
- Installation is an expert job.
- Extra hardware required such as hubs, switches and wiring centres.

A Bus Network

This is the simplest way to connect workstations, servers and other components of a network by using a single cable. One or more of the workstations act as the File Server, whilst the other machines are used as workstations or terminals.

Advantages

- Cheap
- Easy to install

Disadvantages

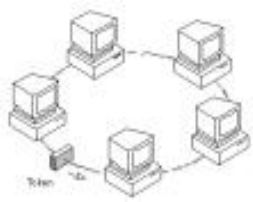
- If there is a problem with the cable, the entire network stops working.

- If many workstations are using the network at the same time, response can be very slow, thus frustrating users who want to work quickly. The technical term for data trying to travel simultaneously along the cable in different directions is called ‘data collision’. A busy network will have many data collisions.

A Ring Network
The workstations are attached to a cable arranged in a ring

Advantages
- Very fast – all data traffic occurs in the same direction so there should be no data collisions.

Disadvantages
If a single machine is switched off then the network does not work. If the cable breaks, once again, the network does not work.



Section 5
Data Types

When a database is designed, all the fields are set to accept a particular data type. This helps check for the wrong type of data being entered and makes sure the data is stored as efficiently as possible. It also means it will be sorted correctly.

Alphanumeric/text - a field of this data type will accept both numbers and text.
When to use - if you want to enter text or a mixture of text and numbers.
When NOT to use - if you want to store only numbers or only dates. You can enter numbers or dates into text fields but they would get sorted as if they were words and could not easily be used for any calculations.
Numeric - a field of this data type is used to store numbers. There are two types of numeric field you need to know about:
Real - used for decimal numbers such as 3.4, 3.1427 and 6.0 etc. Real numbers can be formatted as currency (i.e. £5.67) or to a fixed number of decimal places (i.e. entering 3.1427 into a real number field formatted to two decimal places would mean it appeared as 3.14)
When to use - if the field is going to be used to store numbers with decimal places such as 'height', 'length' etc.
Integer - used for whole numbers.
When to use - if the field is only going to be used to store whole numbers, i.e. 'number of children', 'car doors' etc.
Logical/Boolean - a field of this data type will only let you enter a 'Yes' or a 'No'. This may be as text (YES/NO or TRUE/FALSE) or as a tick/blank.
When to use - when you only need to store something as 'true' or 'false' or store whether something exists or does not exist.
Date - this special field stores days, months and years so that records can be sorted correctly. Date fields can display the date information in different formats such as the full name of the day/month (28th August 1961) or the numerical versions (28/08/61)
When to use - for any field which will be used to store date information.
Examples of use:
A football club uses a database to store details of its players.
Data such as Surname and First name is stored in text fields.
The players car registration is mixture of text and numbers so it is stored in a text field.
The height of the player (in metres) is a decimal number so it is stored in a real number field.
The number of goals scored is a whole number so it is stored in an integer number field.
The player's date of birth (DOB) is a date so it is stored in a date field.
The players telephone number has a space between the code and the actual number so it is stored in a text field.
Information such whether the player is right or left footed is stored using a logical/Boolean field. The field is labelled as 'Right footed?' and the entry is either a TICK or left blank.

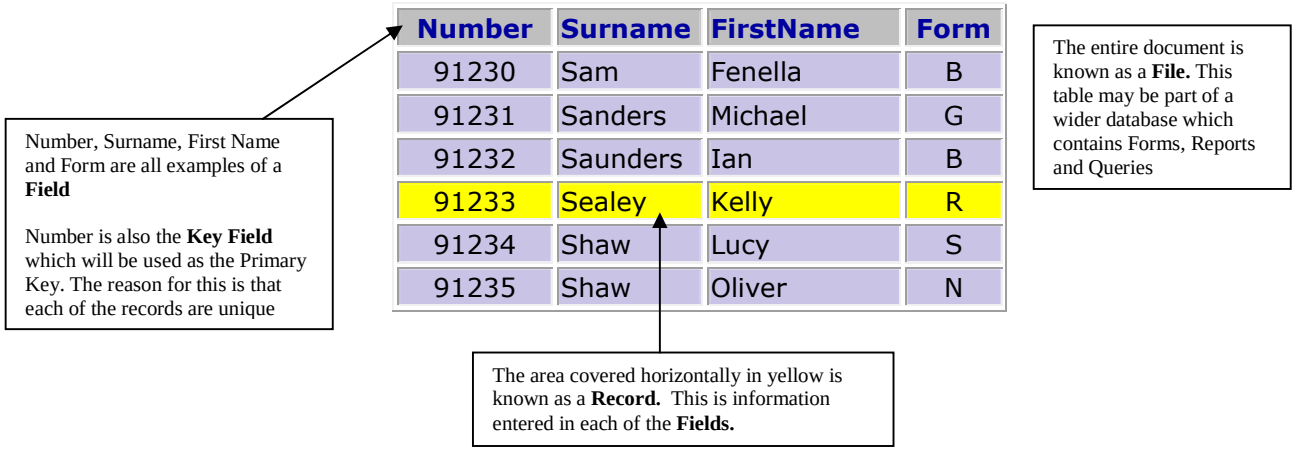
Database terminology:
Describe what is meant by the terms file, record, field and key field

Field - a field is used to store an individual item of data.
Example: typical fields might be 'surname', 'colour', 'height', 'DOB' etc.

Key Field - a field that is unique for each record in the database and can therefore be used to identify just that record.
Example: A field like 'surname' would not make a good key field because two records in a database of people could easily have the same surname.

Record - a record is a group of related fields.
Example: In a database of doctor's patients, each patient would be a separate record, with fields for 'surname', 'DOB', 'address', 'allergies' etc.

File - a file is the group of records that make up the database.
Examples of use:
A school has a database with all the pupil details on it.
The whole database is a file.
Each pupil is a separate record in the file
Each record is made up of fields such as 'first name', 'surname', 'DOB', 'tutor group', 'emergency contact number', 'tutor group' etc.
The key field is the unique 'admin number' given to each pupil when they join the school. This is what is set as the Primary Key



Section 6 The Effects of Using IT
The Copyright, Designs and Patents Act

The Copyright Act makes it illegal to copy and use a file or software without the owner's permission.
The Computer Misuse Act makes it illegal to...

- gain unauthorised access to a computer's software or data (**hacking**) - including the illegal copying of programs.
- gain unauthorised access to a computer's data for blackmail purposes.
- gain unauthorised access to a computer's data with the intention of altering or deleting it. This includes planting viruses.
- copying programs illegally (software piracy)

Copying computer software is a criminal offence. The Act covers stealing software, using illegally copied software and manuals, and running purchased software on more machines than the license allows.
The legal penalties for breaking the copyright law include unlimited fines and up to two years in prison.
All the software that you use should be fully licensed. When you purchase software you usually are licensed to use it on just one computer. It is illegal to make copies of the software to use on other computers, even if they are your own.

Software licences can be:

Single user - licensed for installation on one computer
Multi-user - the license allows you to install the software on a named number of computers
Site-licence - the licence lets you install the software onto an unlimited number of computers, as long as they are on one distinct site such as a school.

Software protection

Software companies try to prevent illegal copying of their disks using the following methods:
Copy protection - the disk (*or CD-Rom*) may be formatted in a special way so it cannot easily be copied.
Product registration - the software has to be registered with the software company, usually by giving them a unique code that came with the product and in return being given an 'unlock' code.
Restricting the number of installations - each installation is recorded on an installation disk and only a certain number are allowed.
Installation code - the software cannot be installed without a unique code provided with the software.
Encryption - data can be scrambled up and cannot be read without the correct software. Details of the user are built into the software when it is ordered so it displays the users name as it is used. This does not prevent the copying but it makes is obvious if you are using an illegal copy.

Hacking

This involves attempting to gain unauthorised access to a computer's software or data. This includes the illegal copying of programs.

The Effects of Information Technology on patterns of employment, including areas of work where there is increased unemployment.

Information Technology can contribute to rising unemployment in areas where technology with the assistance of robotics and mass production can contribute to making certain jobs obsolete.

The Effects of microprocessor-controlled devices in the home, including their effects on leisure time, social interaction and the need to leave the home

Advances in ICT have also allowed teleworking to become a significant factor in employment patterns. This involves carrying out work away from the office and communicating with the employer through the use of computer and telecommunications equipment. This has obvious advantages for individuals but society as a whole benefits in terms of reduced commuting and hence savings in costs and pollution, as well as allowing employment to those working in remote areas. Reduced commuting means that workers may be able to take advantage of the time which they save by working from home.

Teleworking involves setting up a workstation at home which allows workers the opportunity to carry out the same tasks as if they were in their office at work. The use of emailing and video conferencing allows this situation to occur.
In terms of **Social Interaction** teleworking is not necessarily a positive. Individuals working from home are no longer exposed to the experience of human company from their fellow workers which may harm cooperative learning in addition to missing out on the normal and healthy experience of human interaction.

The Capabilities and Limitations of IT

- The jobs replaced by computers are the mundane and boring. People are free to do more interesting jobs.
- Higher productivity enables people to work fewer hours and yet have the same standard of living. A greater amount of leisure time may be available which may assist in improving quality of life.

Discuss issues relating to information found on the Internet, including unreliability, undesirability and the security of data transfer

The **good** points

- information is easy to find using search engines.
- it can be accessed from any computer linked to the Internet
- the information should be up-to-date

- sounds, pictures, video clips may be available.

The **bad** points...

- the information may not be up-to-date if the web-site is not frequently updated.
- there may be too much information available (search engines return thousands of links) so it may be difficult to find exactly what is wanted.
- not available if there is no computer connected to the Internet.
- data may not be secure if transferred over the Internet.
- many viruses are spread using the Internet.

SECTION 7
The ways in which IT is used

7.1

a) Communicating applications

Newsletters – are an effective communication method which can distribute the same information to a wide audience. Although they can be distributed in hard copy, in modern organizations, newletters are electronically created and then posted either in group emails and/or on an electronic bulletin board.

Websites – All organizations, including schools are reaping the benefits of having their own websites. Basically, a website allows communication between the organization and the outside world. For commercial organizations, it allows potential customers to learn about the organization, its products or services. Some websites allow the user to place electronic orders. The cost of conducting business on the web is low compared with other traditional methods. Websites can be written using Hypertext Markup Language (HTML) or website authoring software such as Frontpage or Dreamweaver. When you make up your own website, it is stored on space allocated to you by your ISP (e.g. AOL, BT, etc.)

Multimedia presentations – Power point is an example of software which can be used to deliver a multimedia presentation. Power point allows for the creation of an attractive yet informative presentation. Some of the things which can be achieved with Power point include changing slide transitions (how slides appear on the screen), animation (changing the format in which titles, sub-titles, text and bullet points appear), timing (slides and images can be timed to appear at certain times or stages of the presentation).

Tele/video conferencing
Video and Teleconferencing are other examples of multimedia presentations. Teleconferencing allows groups of people in different locations to talk together over communication lines as though they were all sat round a table in a meeting, even though they are far apart. This saves on travelling costs and on travelling time to the meeting. It is very convenient except that it is sometimes difficult to exchange ideas when people are not talking to one another face to face in one another's company.

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This will result in videophones being more readily and widely available and at reduced cost to the user/business.
Music Scores – are digital sheet music files which can be downloaded and accessed played using a MIDI (Musical Instrument Digital Interface) instrument. Music scores allow for the easy transfer of sheet music from one location to another and can also enhance the characteristics of the music based on user preferences, in a similar way that one can alter a photograph to project events of World War One in colour.

Cartoons – are useful modes of display and communication which can perhaps transmit information in an easily and sometimes entertaining fashion. Cartoons can be used in advertisements, comic books or to create entire movies. Sometimes, cartoons are used in combination with real actors/actresses. (e.g. 'Who Framed Roger Rabbit?')

Flyers – Flyers are an effective and cheap medium for mass communication. Many small businesses use flyers in an effort to achieve mass distribution with minimal cost. One of the easiest methods is to simply photocopy or mass print the flyer and distribute through putting under doors of houses, on car windshields, in letter boxes. There is a problem with this form of communication. Local councils do not take too kindly to this as the most common response people have to flyers is to pay no attention to them and simply throw them away. This can cause increased litter in streets. Additionally, if they are produced in a simple, cheap and often unimpressive format, consumers tend not to take them too seriously. This is often why they choose to simply throw them away without actually reading them.

Considering this, there are many occasions when a well produced flyer will have the desired effect of communicating effectively to a large audience. Flyers tend to work well in localised communities such as schools where an event such as a sports day can be quickly communicated days or weeks in advance. The best produced flyers are those completed on a desk top publishing tool such as 'Publisher' or 'Word'.

Posters – Similar to flyers except that posters are generally used to communicate a larger body of information. They may also be used for a school project which is then displayed on a notice board.

b) **Data Handling Applications**
Surveys – are conducted with a view to achieving patterns in response. They are most commonly used by marketing companies to determine if a new product is likely to be successful or if a product which has just been released has received favourable reviews. Most service industries now monitor phone calls from consumers to determine quality of service and customer satisfaction. A survey sets out a list of questions or perhaps even just one and makes note of the type of people are who are generating the responses, (age, gender, occupation, salary, location of residence, socio-economic status, etc). Surveys can be created using most software such as Excel or Word and then analysed using charts and graphs which are common to both programmes.

Address Lists – When an organisation sells a product, it usually adds you to its' address list along with a record of the product you have just bought or the service you have used. This means in the future, the company will contact you concerning any promotions or special offers it may have or simply because it thinks, based on your past purchases, that you may be interested in the product or service it is trying to sell.

Tuck shop records – A 'tuck shop' is a small shop such as a school café. The size of the business and the level of customers means that it can use simple software to analyse records. Excel is the most common means used for entering financial data. Past sales can be entered and compared with what is contained in the inventory. In this way, future purchases for the tuck shop can be calculated to avoid having an over supply of stock. The tuck shop can use Excel to generate profit/loss statements, balance sheets, and cash flow forecasts.

Clubs and society records – Similarly, clubs and societies can use Excel to generate financial reports concerning membership payments, profit/loss, balance sheets and cash flow forecasts. These can then be presented in the form of charts and graphs if need be.

School Reports – School reports can be created using Access (Database). All the relevant information can be input into the database such as (Student details, grades, contact details, teachers, conduct, contributions to the school, subjects taken, year group, form group). Access allows for these records to be changed whenever necessary which can update every other record about the student.

School Libraries - When a new member joins a library, a membership card is issued which has a bar-code printed on it.
Every book in the library has a bar-code printed inside it.
When a member takes a book out on loan, the barcode of the book is read by a barcode reader - also the barcode of the member's card. Together with the date, this constitutes a 'transaction'.

Input :
- the barcode from the book
- the barcode from the member's card
- the date, librarian's name etc

This 'transaction' is then stored in the library's database.
Note : Barcodes contain a check digit which is used for automatic validation by the barcode reader.
Database :
The library's database would have files (tables) containing details about ...
- the books, magazines etc..
- the members
- the transactions

Information Retrieval :

The librarian will need to be able to find out whether a book is currently in stock in the library or whether it is out on loan - searches would have to be performed on the database.
There may also be a link to other libraries.
results of searches.
The library system is a real-time system as data is updated immediately a book is loaned out.

Process :

The computer system will need to be able to calculate which books are overdue and whether any fines are due.

Output :

- summary reports
- results of searches.

The library system is a real-time system as data is updated immediately a book is loaned out.

c) **Data logging and measurement applications**

A data logging system automatically collects data over a certain period of time. As well as being able to alter this time, you can alter the frequency with which the measurements are made. Since there is no human error, the measurements will be more accurate than before.

Weather reporting is an application of data logging. Data logging involves recording quantities automatically over a set period of time. Most data loggers do not need to be connected to a computer all the time. Instead, they store the data in the logger for a period (50 hours for on particular package). It is also possible to display the data continuously, but this ties up a computer and prevents it from being used for other things.

d) **Control applications**

'Turtle graphics' is an example of a control application and is one of the features of a programming language called LOGO. Using LOGO it is possible to instruct the turtle on screen to move and leave a line drawn behind it to show its path.

When the turtle is facing a certain way, it can move only in that direction. To move in another direction you have to turn the turtle before moving it. For example:
FORWARD 30 moves the turtle 30 units forward. How far this is depends on the screen you are using.
BACKWARD 10 moves the turtle 10 units backward.
PENUP raises the pen and stops the line being drawn
PENDOWN puts the pen down so that is line is drawn behind the turtle moving across the screen.
LEFT 90 turns turtle to the left by 90 degrees
RIGHT 90 turns the turtle to the right by 90 degrees
CLEARSCREEN clears the screen

Example: Monitoring Temperature:
If we wanted to look at how coffee cooled when placed in a polystyrene cup we could just use a stop clock and a thermometer and take a reading every minute over a period of an hour. Of course, this would mean we would need to sit with the apparatus for an hour and take a reading every minute for an hour. Or you could use data logging. Here, it is possible to use a computer, suitable software and a temperature sensor to perform this experiment easily. One we have loaded the software and told the computer which sensors we have connected we then need to tell the computer how frequently the measurements are to be made and over what period. We can then go away and allow the computer to get on with the job.

Logging interval
This is the frequency with which the individual readings are taken (i.e. per second, per minute, per hour). If you wanted to determine the average daily temperature you would probably choose to take a temperature measurement every hour. In one day you would have 24 separate measurements which could be added together and then divided by 24 to give the day's average.

Logging period
This is the time period over which the measurements take place. If you wanted to investigate the cooling of a cup of tea in different types of cup, you might choose a logging period of around one hour since this would be near the time taken for the drink to cool to around room temperature.

Other examples of computer control:
Cold Tea
The Problem: Make a system that warns you when your hot tea has cooled enough and is ready to drink. You should be able to cancel the alarm when you go to your drink. Here is the control program:

WHEN TEMPERATURE IS
BELOW 70 THEN SWITCH ON 6
WHEN INPUT 1 IS ON
THEN SWITCH OFF 6

e) Modelling applications
Imagine you are the Finance Minister for Egypt. Your job will be to control the economy as best as you can. You will have to make decisions about what to do. For instance, you can alter the amount of taxes people pay, how much the government spends on education, benefits, the NHS, etc. Changes in any of these will affect the economy. One false move could plunge the country into a recession and make life miserable for millions of people.

Before making any decisions, you need to ask 'what would happen if I did this?'. For instance, if a minimum national wage were to be enforced (no one could be paid below a certain amount), what would the result be? Would it reduce poverty or lead to mass unemployment? A computer simulation can be used to provide an answer to these sorts of

questions. Using this simulation, it is possible to create on the computer a ‘pretend’ economy and then take certain courses of action and see what the results are. Doing this, we can see the effect of any disastrous decisions on our artificial economy rather than have to suffer the consequences on the real economy.

Different models use different equations. For example, the model used by the UK Treasury has about 1300 equations. This example uses the words model and simulation. There is a difference in the meanings of these words. A model consists of a set of equations which describes the behaviour of a process or object. In a computer model we use the computer to solve these equations so that we can carry out a simulation. An equation for part of the economic model might be

Unemployment = people able to work – people working

A simulation involves feeding values into the model to see how the model behaves.

3-D Modelling

3-D models are often set up by architects and design engineers to see what a finished building or product will look like before it is built or produced. For instance, Tesco, the food retailer, uses CAD (computer assisted design) and 3-D models to produce three dimensional views of stores and can show the effects of varying light sources, intensity of colour and different finishes of materials. Tesco also uses 3-D modelling to look at the way a new store will blend into an existing main street. 3-D models are also used to plan the outside of stores.

Model Builder

Model Builder is a very useful software package where you can use Windows Paint to design illustrations for the model. You then have to decide where to place the blocks, which are like spreadsheet cells. These blocks can contain numbers, text, pictures, graphs or actions (formulae). Like spreadsheet cells, these blocks react when they are sent messages from other blocks. Graphs are easily drawn from the results of the model. As with a spreadsheet, you can produce a rough model and then refine it to give a better resemblance to the real thing. Models you can make include:

- Population growth
- Supply and demand
- Chemical reactions
- Nutrient cycle
- Nitrogen cycle
- Carbon cycle
- Growth of algae in a pond
- Personal Finance
- Tuck Shop Records

Simulations

Simulations are useful in experiments that would be too difficult, too dangerous or too costly to carry out. Examples of simulations include:

- Experiments in chemistry
- Nuclear physics experiments
- Airline training
- Queues at petrol filling stations
- Traffic light systems
- Queues at supermarket checkouts

Flight simulators

Airlines find it very expensive to tie up aircraft for the training of pilots, so they use simulators instead. In addition, all manner of dangerous flying conditions, some of which the pilot would never be likely to experience, can be simulated. A landing simulation with ice on the runway, thick fog and only one of the four engines working would really test the pilot's ability. A flight simulator is a windowless capsule that looks like a spacecraft. The legs can propel the machine in six directions, simulating the pitch and roll of a real plane. In helicopter simulators a vibrating pilot's seat is used to add reality; and in fighter plane simulators the seat has air pumped into it to simulate the 'g' forces when the pilot performs tight turns.

The scene out of the 'window' is as realistic as the behaviour of the plane. When a particular airport is chosen the scene looks identical to the surroundings of that particular airport.

7.2

a) Communication applications

The Internet

The Internet can be described as a network of networks. Almost any type of information or person can be found on this network. Almost anything can be accessed through Internet service providers such as AOL and BT. From a corporate perspective, data can be rapidly transferred around the world.

Electronic mail

E-mail is a method of sending messages from one terminal to another via a communications link. There are various providers of electronic mail, including Internet information service providers. Tesco like most large companies, have realised the benefits of using e-mail. Conventional methods of communication can have a variety of problems such as low cost, unanswered telephones, engaged fax machines, people not at their desks, etc. E-mail eliminates many of these problems.

Some of the advantages to Tesco of using e-mail are as follows:

- Unlike with a telephone call, the recipient does not need to be there when the message is sent. People can receive their mail at any terminal connected to the system
- The sender can be sure that the messages are received.
- It is possible to send mail to a whole department or a group of people without knowing anyone by name.
- The electronic mail system can be used as a company information and noticeboard.

Fax (Facsimile)

This is when a copy of a document is sent over communication lines. This could be printed out immediately at the other end of the line. A fax is an image of a document. It is sent to a particular fax number and is not necessarily private since it is not to a private address of an individual person. It cannot be transmitted if the fax number is busy. Businesses uses e-mail to send information with documents attached. They can also broadcast the same message to a large number of people very fast.

Electronic Conferencing (Tele/video)

Teleconferencing allows groups of people in different locations to talk together over communication lines as though they were all sat round a table in a meeting, even though they are far apart. What businesses need for groups of people to tele/video conference:

1. appropriate hardware.
2. relevant software
3. people to be available at the same time
4. systems which can work together

Mobile telephones

The development of the Internet and other messaging systems means that mobile phones can now offer many new ways of communicating.

SMS (Simple Message Service) – SMS is the service that is commonly used to send and receive text messages using mobile phones. The message has to be basic text and is restricted to a certain length of characters.

WAP (Wireless Application Protocol) – WAP mobile phones are able to connect up to the Internet. Using a mobile phone with WAP allows you to receive text and simple images over the internet. You can send and receive e-mail and text messages, as well as obtain limited Internet services that allow you to check the latest news, receive football results, order goods and services from e-commerce sites. WAP banking allows you to check your balance, pay your bills and transfer money from a mobile phone.

b) Applications for publicity and corporate image publications.

Business cards

These are used as a useful form of communication between representatives from corporations. A business card can be constructed and printed out using ICT which can be distributed amongst prospective business partners, clients and consumers. The information which is found on a business card usually lists:

- Company name
- Representative name

- Title of representative
- Contact business number (landline/mobile)
- Company address
- Fax number
- E-mail

Letterheads

A letterhead appears at the top of a document and lists the name of the company which has produced the document which may also contain information in the header or footer such as:

- Company Name
- Address
- Phone numbers
- E-mail
- Company website

A letterhead is a professional edge which is expected from any prospective client or customer and is produced using Desk Top publishing software such as MS Word or Publisher.

Flyers

Flyers are produced using Desk Top Publishing software and are promotional forms of communication. Flyers are usually produced on a single page and can be used to promote:

- A school prom within a school
- An apartment for rent
- Job openings

At the corporate level flyers can be used for:

- Advertising new mobile phones or mobile phone plans
- Advertising for restaurants (usually fast food)
- A new business opening up
- A new service being offered

Brochures

Produced using Desk Top Publishing software, brochures are used to great effect by travel agencies to promote holiday package deals, flights, accommodation, etc. Brochures are also used to promote an organisation. Financial reports are produced in brochure form by private limited companies. Schools produce brochures with pictures and faculty write-ups to advertise what subjects and facilities are offered to prospective students and teachers.

c) Applications in manufacturing industries

Robotics in manufacture and production line control

Roberts are used in manufacture (predominantly in factories) because they can reduce labour costs and improve the quality of the finished products. A robot can be defined as an reprogrammable, multi-functional manipulator designed to move material, parts, tools or specialised devices through various programmed motions for the performance of a variety of tasks. An industrial robot being used in a factory to make motor cars can be called a robot, whereas a washing machine would not be regarded as one. An industrial robot is most effectively deployed on a production line assembling cars. Of course, the disadvantage to this socially is that the increased use of robots eliminates positions for humans to carry out. From a company perspective, robots are effective cost savers as they work for 24 hours, 7 days a week, don't go on strike, do not take holidays and do not call in sick for work. They are extremely expensive to begin with, however they save money from the day they begin working.

There are many factories where robots are used on a production line. The jobs that the robots do are generally jobs which humans would find boring and repetitive, or jobs that may be dangerous.
These jobs would previously have been done by humans, but they may have been re-trained for other jobs - or possibly have been made redundant.
There will be some initial costs in purchasing the equipment and installing it, but the advantages of a robotic system would include..

- robots work 24 hours a day - no need for breaks.
- robots do not need to be paid.
- robots work consistently - they do not get tired or make mistakes.

Example :
Computer-controlled robots may be found in car-making factories. The jobs they do may include..

- welding or assembling parts
- paint spraying
- moving heavy parts around the factory.

The robots will have been programmed to perform the jobs they do.

Body panels being painted by industrial robots.

In CAD/CAM processes, CNC machine tools are connected to computers and used to manufacture products which have been designed on the computer using design software. The program consists of numerical data. Robotic systems will be realtime systems. Any data the processor receives will be processed immediately.

This picture shows a CNC milling and boring machine.

d) Applications for finance departments

Billing systems

An example of a billing system is - electricity payments. Every customer receives an electricity bill which must be paid. The electricity company has a large database (master file) of all its customers. The file will also include information such as latest meter readings, how much electricity the customer has used this year, how much has been paid etc. At regular intervals, meter readers go round each house to read the electricity meter. The reading is recorded onto pre-printed forms.

The forms are all collected and input to the computer system. This may be done using OMR or OCR, or by manually keying in the data.
The data must be validated before it is processed to make sure no 'silly' data is input.
Keyed data will need to be verified to check for transcribing errors.

The electricity bill for each customer is calculated by the computer and printed. These bills will be posted to the customers.

The customer then pays the bill by either sending a cheque or by credit/debit card. Some customers may pay by monthly standing orders or direct debits. Payments received will need to be recorded as transactions on a transaction file and used to update the master file.

For some billing systems statistical analysis can be done on ...

- customer usage or spending patterns (eg seasonal variations)
- payments

Stock control and order processing

The stock level of an item is the number of that item in store.
When a shop sells items, it is sometimes important that the shop..

- does not stock too many of an item eg The item might be perishable and those not sold will become unsellable.
- does not stock too few. A customer may want to buy one and there are none available.

For these reasons shops set reorder levels and reorder quantities. When the number of items is reduced to the reorder level, then more of that item are ordered. The number of items ordered is determined by the reorder quantity.
Stock Control is the administration of stock levels.

A good stock control system will...

- keep track of exactly how many of each item are in stock.
- be able to say which items need re-ordering.
- analyse which items are selling well or needed most and which are not.

Some shops use barcodes and POS terminals for automatic stock control. A computer stores a master file with records of every item held in stock. One field would be the item's stock level.

Every time an item is bought, the barcode is scanned and the computer will deduct 1 from the stock level for that item. The computer will know exactly how many of that item are in stock.

A similar system would operate in a warehouse. Each item removed would be logged and the stock level automatically adjusted.

This would be an example of a real-time system. Data is processed s soon as it is received and the system is always up-to-date.

Order Processing.

Customers may buy goods from a business by sending an order - which will have details of which items they want to buy and how many.

Orders may be received...

- ...through the post on order forms. These will need to be entered onto the computer as records on the orders file.
- ...online. Customers send orders by email or over the Internet. These orders would be saved in the orders file.

The orders file would have fields with information about ...

- the date of the order
- customer details
- item details and quantities
- money owing or received from the customer.

Appropriate data validation will take place when the orders are entered. When the goods are dispatched, an invoice is sent requesting the amount of money due for the order. The customer may then pay by cheque.

Online orders are usually paid for using credit (or debit) cards.

When an order is processed....

- stock levels are adjusted for the items sent.
- financial information is stored and analysed. Who owes what and how much has been received etc
- statistical information is updated - numbers of sales, best selling products etc.

Payroll

At the end of each pay period, a business needs to pay its employees.

A payroll system uses a computer to calculate the wages of each employee, print out pay-slips and record the information for accounting purposes.

Input : This may come from ...

- a database of employees details (salaries, pay rates, bonus rates etc)

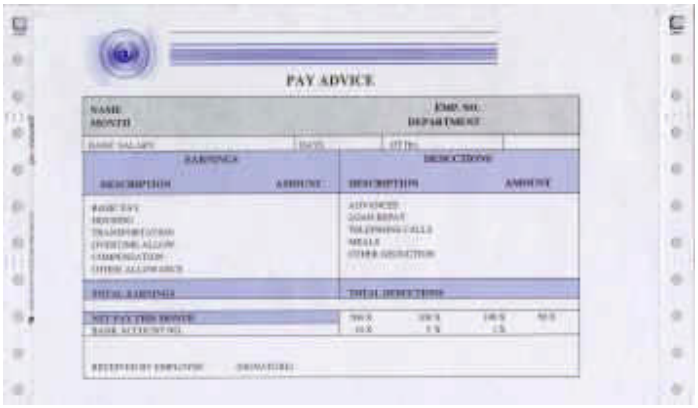
- if employees are paid by the hour then timesheets would be used to input and validate the number of hours worked and number of hours overtime. (possibly using OMR or OCR techniques)

Process : The computer needs to calculate ..

- the gross amount earned by each employee.
- any bonuses
- any deductions such as tax, national insurance etc
- the net amount earned by each employee.

Output : The computer would need to ..

- print pay-slips with amounts and deductions(using pre-printed stationery)
- update the employee database.
- output details of payments to BACS (Bankers Automated Clearing Service) to pay money directly into employees' bank accounts.
- print summary reports.



Payroll system is usually run as a batch processing system. Data may be entered for a number of departments or branches of a company and then the processing is done when all the data has been collected. As there is no urgency for the output, the payroll processing may be run at off-peak times (eg overnight).

The database of the employees and the time sheets will need to be kept secure from unauthorised access. (Employees must not be able to alter their data!) The employee database is updated in the payroll process. A backup copy of the database is made before this is done. The new database is called the 'son' and the backup is the 'father'. Previous generations of backups are referred to as 'grandfather' etc.

e) School management systems

Registration, records and reports

CAL and computers in school administration

CAL stands for Computer Assisted Learning.

CAL courses may use:

- text - notes and other resources

- graphics
- sound - a commentary or music background
- animation
- self assessments - for the student to know how much has been learned.

CAL systems use interactive computing.
Benefits of CAL...

- more interesting learning with interactive systems and multimedia - so greater motivation
- students can learn at any time
- students can learn from any place eg home
- students proceed at their own pace
- not so many teachers needed

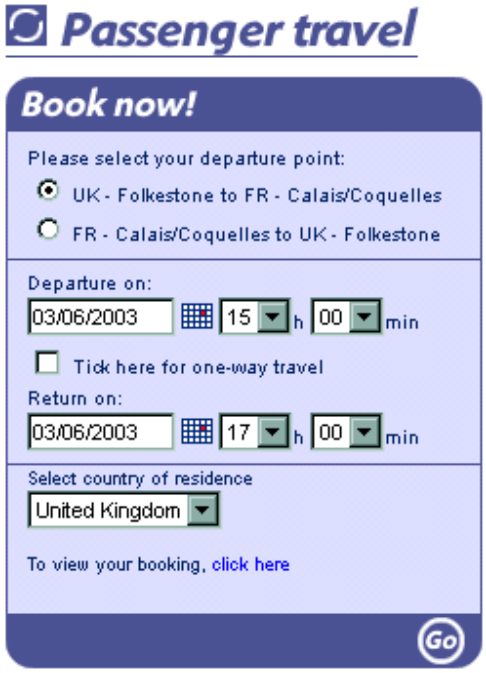
Computers in School Administration
Most schools now have a large database of pupil details. This database will store personal data about the pupils as well as the classes they take, their teachers, medical information etc.
This database can be searched to produce eg class lists
Pupil assessments may also be recorded (test and exam results) so that pupil progress can be monitored.
Spreadsheets may be used to calculate and monitor the school's financial budget.
Word processing or DTP software may be used to produce documents for the teachers or pupils.
Timetables are produced using special software.
A school which has networked computers may have an Intranet which provides web-based resources available at any workstation. Some school may have on-line registration systems where pupils use swipe-cards (with magnetic strips).

Booking systems

It is now possible to make bookings on-line for holidays, trains, planes, hotel rooms, theatre performances...and many others.
A travel agent for example, may have computers in all its branches directly connected to a central computer where a database of all bookings is stored. This is an example of a multi-access system.

When a booking is made, the customer will need to provide input details (name, date, place, number of people etc). These details may be entered ...

- at a computer terminal in a multi-access system.
- on a form on an Internet web page.
- by transcribing them from a paper booking form.
- by typing them in when in telephone communication with the customer.



This form (on an Internet web page) is used for collecting details of a passenger's booking on the Eurotunnel. These details are then used as input data when the booking is made.

This data is validated to check if the details are sensible. The computer will check to see if the booking is available, and, if it is, the booking is made and it will then store the booking details in the database. Documents will need to be output to give to the customer, confirming the booking and giving details about it.

As soon as a customer makes a booking it has to be processed immediately, so that no other customer can make the same booking. This means it is a real-time (transaction processing) system. It is essential that no data is lost, so the database will have to be regularly backed up - possibly using a tape streamer.

If payments for the booking are required, then these can generally be done on-line using a Credit card or a Debit card. If details of these are transmitted over the Internet, the website must be secure so that this information cannot be stolen.

Applications in banking

The need for carrying and using cash is lessening.
EFTPOS (Electronic Funds Transfer at Point of Sale) systems allow customers to pay for goods using a debit card.
The card (which has a magnetic stripe) is swiped through a card reader. The computer sends a request (through the telephone system) for the correct amount of money to be transferred from the customer's bank account to the shop's account.
To reduce possible fraud, the customer is asked to sign the receipt - and this should match with the signature on the debit card.

ATMs (Automated Teller Machines) can be used to take cash out of your bank account.

A bank card needs to be inserted into the ATM - containing information about the customer account number and a PIN (Personal Identity Number) which has to be entered as authentication.
ATMs can also be used to check the balance of your account or order new cheque books.
ATMs ...

- are available 24 hours a day every day
- mean fewer bank staff need to be employed

Home banking allows customers to manage their money from home using an Internet link. Money may be transferred between accounts, payments can be made.

Credit/Debit Cards
Debit cards are used as an alternative to cash and cheques. When goods are bought using a debit card, the money is immediately transferred from the shopper's account to the store's account. Cash cards are used to obtain cash from a cash dispenser.

Credit cards, as the name suggests, enable people to obtain instant credit either against goods bought or for cash from a cash dispenser. Obtaining credit for goods involves the retailer filling in a docket either manually or by using the till and then asking the customer to sign the docket. If the card signature and the signature on the docket are the same then the customer is given the goods and the retailer sends the docket to the credit card company, where the transaction is recorded and the retailer paid. The cardholder receives a statement at the end of each month which outlines:

- The balance at the start of the month
- The interest payable on this outstanding balance
- The amounts and details of any transactions that have taken place during the month
- The balance owing at the end of the month.

Cheque clearing

If someone wants to buy a colour television from Comet Electronics and pay by cheque. The customer banks with Lloyds and Comet Electronics banks with Barclays. The cheque goes to Comet and the money is debited from the customer's account added to Comet's bank account. This process is called 'cheque clearing' and, because of the huge number of cheques cleared each day, computers are used for nearly the entire process.

h) Applications in medicine

Doctor's information systems, hospital and pharmacy records, monitoring, and expert systems for diagnosis.

An expert system:

- has a large database of knowledge.
- allows the database to be interrogated.
- has a set of rules (inference engine) for making deductions.

An expert system is a computer system which simulates the knowledge and expertise of a human expert.
For example, in Medicine, expert systems are being used for disease diagnosis.

The patient's details and symptoms are input, and the system outputs probable diagnoses, recommended treatments or drugs which may be prescribed. Some patients would feel happier typing medical information into a computer than discussing it with a human doctor...but others would prefer the 'human' touch. The advantages of an expert system over a doctor are...

- a large database of knowledge can be added to and kept up-to-date - it can store more knowledge than a person.
- the system cannot 'forget' or get facts wrong.
- it survives forever. There is no loss of knowledge as there is when a doctor retires.
- the computer can access specialist knowledge that a doctor may not have.

An expert system would be programmed using an AI (Artificial Intelligence) language such as PROLOG.

A visit to your doctor's surgery today could result in a consultation with your doctor using a microcomputer to help. If diagnosis of your condition is not a simple matter because your problem is not so common details of your symptoms could be typed into the computer. The medical diagnosis system may offer a range of possible illnesses based upon these symptoms. Your doctor may use these suggestions to help him diagnose your problem. The system could help even more if the doctor selects the illness he thinks you have and asks for suitable medicines to help with the problem. The system could then display a suggested list of medicines and details of when certain medication may not be appropriately prescribed. For example, people with allergies or asthma may not be allowed to take certain types of medicine.

This is the simplest type of medical diagnosis system. The input is a list of symptoms and the output is a list of possible illnesses or medicines. The processing carried out by the computer is to take the symptoms and match it against the data it has stored about those symptoms.

More sophisticated medical diagnosis can be found in hospitals where the input is collected from sensors attached to the patient's body. It may be an electrocardiograph which measures heartbeat. Also tumours may be scanned using special scanning machines. Whatever the form of input the computer will process the input data and produce information that will assist with a diagnosis.

In intensive care units computers are also used to monitor vital signs of life, like respiration, heartbeat/pulse rate, brain signals and blood pressure. The processor matches this data against acceptable ranges stored in the computer's memory and raises the alarm if the readings are out of range.

i) Applications in libraries

Records of books and borrowers and the issue of books

Library systems

Computerised library systems have been installed in most libraries, for example, universities and public libraries. By keeping data about books and members it is possible to monitor the whereabouts of books and when they are overdue.

When a member joins the library their details are added to the members file. Similarly when new books arrive their details are added to the books file. When a member wishes to borrow a book the librarian scans the code (usually a bar code) on your membership card and the code in your chosen book. Because book details and member details are stored on the system the computer makes a link between the book and member record and stores details of the due date of return. The librarian stamps your book so that you know when to bring it back.

j) The use of expert systems

Mineral prospecting and car engine fault diagnosis

Expert Systems
An expert system is a program, which aims to bring together human expertise in one knowledge base (set of data and rules). Expert systems are sometimes known as knowledge based systems or information knowledge based systems (IKBS). The main features of an expert system are:

1. Only one specialised area is covered by the expert system.
2. There are many rules specified. For example if patient has spots and a temperature then Measles is a probable diagnosis (strength 50%). Many rules similar to this with different probabilities (strength of belief) could be specified.
3. The user is often asked to respond to questions, which cause certain rules to be triggered. The user can provide 'don't know' responses and give the degree of uncertainty attached to the answer.
4. Advice and diagnosis may be given.
5. Explanations may be provided.
6. Reasoning is part of the processing to be carried out.

An expert system has a knowledge base (facts and rules provided by the experts) and an inference engine which is the computer program which works out the diagnosis or advice by checking the rules, knowledge base and the input from the user.

Typical examples of expert systems application are:

- Medical diagnosis
- Car engine fault diagnosis
- Geological surveys

Steps in creating an expert system:

1. Interview experts and use other expert sources such as text books to gather as many facts and rules as possible.
2. Design the knowledge base.

3. Select software to use. This may be an expert system shell (already built inference engine) or a computer language appropriate for building the knowledge base and an inference engine.
4. Implement the design, making sure the interface is easy to use.
5. Test the design.
6. Document the system and create a user manual.
7. Check the system with the experts to make sure it produces sensible advice or diagnosis.

Creating an expert system is very time consuming and the fact finding stage is often very difficult because the systems consultant often finds it difficult to understand the area of expertise due to its complexity.

k) Applications in the retail industry.

Stock control

Eftpos

Eftpos stands for electronic funds transfer at point of sale and is the method used by Tesco to transfer money from customers' credit card companies or debit cards directly to the Tesco bank account. A debit card is rather like a cheque, since the money comes straight out of the bank account. However, there is no limit to the amount you can spend using one of these cards, provided that you have the money in your account. This is in contrast to cheques where there is a limit (usually £50 or £100) to the value of the cheque that is covered by the guarantee card.

Using checkout information for planning bakery production

Sales information from checkouts is used by in-store bakeries to plan the production for the same day for the next week. This reduces wastage and means stores are less likely to run out of bread.

Sales-based ordering

Sales-based ordering is the automatic re-ordering of goods from the warehouse using the sales information from the checkouts. If, for example, 200 tins of baked beans are sold from a certain store in one day, then 200 tins will be automatically re-ordered and delivered to the store the following day from one of the Tesco distribution centres.

The large articulated vehicles you see are specially constructed: they have compartments which can be kept at different temperatures, so, for instance, chilled food, frozen food and other types of food which do not need cooling may be carried in the same vehicle.

Stock control

All ordering is performed by computer. There are fast electronic communication lines between the shops, the distribution centres and the head office. There are also direct links to the major suppliers, which means that orders can go straight through to production lines. One advantage of this is that stock arrives just in time before sale so it is always fresh. Another advantage of this system is that money does not need to be tied up in stock and can be used for more productive purposes.

Electronic shelf labelling

Tesco is developing a system with liquid crystal shelf labels containing the price, description and ordering information about goods. The label is operated from the computer using radio signals and this avoids human error, where a price change on the computer is not transferred to the shelf. This means that changing a price on the computer database and shelf can be done at the same time so the price stored and that on the shelf will always be the same.

Electronic data interchange (EDI)

Electronic data interchange is a method of speeding up the transfer of orders to suppliers. Using EDI eliminates the need for paperwork, since the ordering is done by data being transferred between the supplier's computer and Tesco's computer. This system is less expensive and faster than sending the orders by phone, post or fax and cuts out errors, such as lost or wrongly printed orders. Tesco can send information to suppliers 'regarding sales forecasts and information about stock levels so that they may plan production appropriately.

Once an electronic order has been placed the electronic invoice is generated automatically by the supplier's computer. This is sent back and checked by the Tesco computer before payment is made.

Section 8 Support Notes

Systems Analysis

The stages of systems analysis (often called the system life cycle) are

Analysis

- A preliminary study to decide exactly what the problem is.
- Undertake a feasibility study - an investigation into whether a new system is realistic.
- Study of present system - collection of data, interview staff

Design

- Design hardware, software specifications, data storage and methods. Design of security methods.
- Top-down design involves repeatedly breaking down the design into smaller and smaller parts.
- Evaluation criteria must be specified. These are the standards by which the success of the new system will be measured.

Development and Testing

- Write new programs, prepare documentation.
- Devise a test plan which involves **normal data, extreme data, abnormal data** and null data.
- Test and debug the system.

Implementation

- Convert to new system, install hardware and software, train staff. Methods of Implementation (Direct, Pilot, Parallel and Phased).

Maintenance

- Monitor system and solve problems as they arise. Keeping documentation up-to-date. There may slight adjustments to make as the business changes.

W&W Steelstock is a small company in the West Midlands which deals with buying and selling steel. It is owned and run by Winifred Habberley and Keith White. The company employs a number of manual workers, office staff, an engineer and the owners, who themselves are involved in various aspects of the business. The company currently uses a computer for recording invoices and for producing payslips. Most

operations carried out in the office are manual or a mix of operations carried out manually and on the computer. Apart from the payroll system no aspect of the business is fully computerised.

Feasibility study

This is a study to see if an organization does in fact need to computerize its operations. There are several things which the feasibility of a project can be measured against. One of these is whether a particular solution in terms of the necessary software is available and is it capable of meeting the users' needs. Another is whether the organisation can afford the cost of the project in terms of the Systems Consultant's time as well as the cost of the hardware and software. Will it be successful in reducing errors and improving the accuracy of the input? Will it improve customer service? Will it speed up the system in terms of input and data processing time? If the answer to most of these questions is yes then the next stage of Systems Analysis can proceed.

Analysis

W&W Steelstock decided as a result of the feasibility study that they will go ahead and have a new IT System to help them run their business. The job of the Systems Consultant is now to produce an IT system which will solve particular problems in the organisation. In order to do this the consultant must identify what the new system is required to do.

There are three possible types of system, which may be studied by a Systems Consultant. These are:

(i) a manual system

(ii) a system which is a mixture of manual and computerized parts

(iii) a fully computerized system

MANUAL SYSTEM

A manual system relies totally on paper filing systems. Records are kept on paper, which is put into folders and kept in filing cabinets. People who have this type of system probably use some sort of card index system to keep track of where everything is kept.

MIXTURE OF SYSTEMS

A system, which is part manual and part computerised, uses both paper and computerised records. A company might keep invoices and correspondence on paper but may have other aspects like payroll done in a computerised format. W&W Steelstock have a system like this. They have a computer but perhaps do not use it to its full potential. For example, when they sell some steel the person who has made the sale writes down the details on an invoice form using information on prices kept in a card index system and a calculator to work out the price. This is then passed to an office

junior who uses a typewriter to type the details of the sale. One copy is sent to the customer and the other is given to the person who is responsible for keeping details of accounts. They then key the information into the computer and these details are stored on a database. Other aspects of the business are dealt with in a similar fashion.

COMPUTERISED SYSTEM

A computerised system is one where all parts of the business are computerised . Payroll, stock control, invoices, employee and customer records and correspondence are all done using the computer.

Problems which may be faced by companies

Whichever system is being used there may, however, be problems.

A manual system will be difficult to organise because it is difficult to find information quickly. In order to find a particular customer record somebody in the office will need to find information from the card index system before looking in the correct drawer of a filing cabinet.

A mixed system will be frustrating to use. Imagine how annoying it would be if the customer records were on paper and employee records were on the computer. You would soon discover that to find the record of one of the workers would be very much quicker than trying to find a particular customer record.

With a computerised system the problems may be different. It is very easy to get used to the fact that everything seems to be quicker using this type of system. After a while, however, this type of system may seem to be fairly slow, which could be because the software or the hardware are both old. It may be more economical to replace the whole system with a new system rather than try and upgrade the existing system. Another problem could be that although all the different parts of the business are computerized they might not be linked together.

Whichever type of system is currently in use, it is very likely that the users are still quite happy with it. It has probably evolved to match their needs over the years and th will be used to it. What usually happens is that a business has grown or it now does different things from those it used to. The system, which the users are currently using, is no longer capable of coping with this expansion or change of business.

User Requirements

The most important feature of any information system is that it must meet the needs of the people who are using it. The Systems Consultant needs to talk to these people and find out what they require. Most organisations that need new information systems already have ways of working which have developed over the years. It will be essential when talking to the users to find out exactly what jobs the employees have to do and how they do them. There must be problems and shortcomings with the existing system otherwise there would not be a need for a new system. It is important to discover what these problems are. When a new information system is developed its success depends on involving the users of the

existing system. Even the cleverest Systems Consultants, designers and programmers on their own cannot design a successful system without involving the people who will be using the system. Although all the workers within a company will, to a certain degree, be users of the system, it is the management who will be involved at most stages in the development of the new system. In our example the management are Winifred and Keith. They will be interviewed so that their requirements are identified. It will be their job to test various parts of the new system. They will be asked for their views on the new system. When the new system is put in place they will be trained to use it and they will then become the users of the system. Before all this happens, information has to be collected from them and the other workers. Fortunately, there are many methods for doing this.

Identifying and using methods of collecting information

Interviewing

This is the most common method of fact finding used by Systems Consultants. In order to make sure that interviews will produce accurate and useful information several things need to be considered. The first is to identify who will be interviewed and when.

Systems Consultants have to put a great deal of planning into the questions they are going to ask. They have to write them down and use them like a script. They might leave spaces after the questions to make notes about the answers they receive. After the interview they need to write up the results of the interview into a report.

Observation

Watching people doing their normal day-to-day work. can often be better than interviewing them formally. Because the workers are relaxed they may provide the analysts with more relevant information. The analysts might see some unusual situations or problems that the worker may forget to mention in an interview. Watching people also gives a clear idea of what documents people need to use. It also becomes very clear how efficient the system is.

There are a number of questions which can be answered as a result of observation. Do people have to get up out of their seat to get the documents they need? Do they have to wait for documents to arrive at their desks? The time taken to complete a task can be accurately recorded, rather than relying on people's memories. Where a task may involve a number of different people, observation gives a broader view of the system than relying on each individual's description of

their role in the process. For example, the W&W system for dealing with invoices (outlined above under the heading 'mixture of systems') involved three different people. All three would have to be interviewed to identify this problem. Each person would describe their particular role. This would take a long time. The reports from all three interviews would have to be examined carefully in order to understand the system, which again would take a lot of time. Observation would allow the Systems Consultant to see all three people dealing with their part in the invoice process. This would make it easier to understand the whole process and the Systems Consultant's job would be done a lot more quickly.

Collecting Documents

During the course of the observations and interviews Systems Consultants collect blank and completed documents. These will help in working out the inputs, the processing and the outputs of the system. They then carry out analysis of the documents. This will help to identify the amount of data on different documents as well as how much data there is in total. The Systems Consultant will work out the volume of data going into and out of the system. This will prove very helpful when the type and size of storage media is being decided upon. The number of lines of data on a document and the number of documents are used to calculate how much data there is. In our example the Systems Consultant would collect documents such as invoices, examples of customer records, examples of employee records and so on.

ADVANTAGES

- They can be used to accurately calculate the amount of data in the system.
- The rate at which errors are made can be calculated.
- The nature of the input data can be easily identified.
- The nature of the outputs can be easily identified.

DISADVANTAGES

- It is difficult to see how long the current process takes.
- It is difficult to work out who is responsible for doing what when you are just looking at pieces of paper.

Questionnaires

This is a form of interview where the questions are written on a form. Members of the workforce answer these questions and their answers are analysed. A great deal of planning has to go into the creation of a questionnaire.

1. Questions can be framed so that they are open-ended. This means that

the person filling in the questionnaire can write a sentence or two in answer to the question. A typical question might be:
What outputs would you require from the system?

2. Questions can be multi-choice. This means that the analyst has tried to predict the answers which people might come up with. They have to choose from a list of possible answers. The previous question, if it was used with the W&W Steelstock office staff might have been set out as:
Which of the following outputs do you require?
a) invoices;
b) re-order forms;
c) warnings when stock is running low;
d) standard letters to customers;
e) standard letters to employees;
f) §tandard letters to suppliers;
g) balance sheets;
h) payslip information.
The users would tick some or all of these.
3. Questions can be asked so that the people filling in the questionnaire have to put their answers in order. This is virtually the same as multi choice. The only difference is that instead of ticking their choices they put them in order of preference i.e. 1 is the most important, 2 for the next important and so on.
4. Other types are yes/no questions. For example:
Do you use a computer for any current aspect of your business?

Yes ☐ No ☐

Questionnaires are most useful where the views of a large number of people have to be obtained.
Whereas it would take a lot of time to organise and then interview a large number of people, it would not be as time consuming or difficult to organise the distribution and
collection of a large number of questionnaires. Another situation where it would be difficult to interview people is when they are so busy that they cannot spare the time. The
use of questionnaires would be a better way of getting information from employees as it would be where people do not all work in the same office or even in the same building.

ADVANTAGES

- It is a relatively quick way of collecting information from members of an. organisation.
- Responses can usually be analysed easily by computer.
- Some workers, though by no means all, find it easier to give answers which are and honest as they feel no pressure due to personal contact with the interviewer.

DISADVANTAGES

- Good questionnaires are very difficult to construct. Systems Consultants have to know exactly what information they want so that they can ask the right questions.
- The answers cannot be examined in more detail by asking another question as.can be done in an interview.

W& V Steelstock only have 13 employees and so interviewing is a possibility as a metitd of collecting information. The Systems Consultant would need to produce scripts for interviews. There would need to be a fairly fixed set of questions asked of the workers but there would need to be a degree of flexibility built in to the interview. This would be so that the different requirements of each person (in terms of what they would need from an information system) could be taken into account.

Three of the workers are involved in driving lorries, delivering the steel to customers, so it would be difficult to organise interviews for them. As they work mainly off site, it would be unlikely that they would be interviewed. A questionnaire might be more appropriate for them.

For most of the workers it will be possible to observe them at work, seeing what situations arise. The office staff will be observed to determine how information is put into the existing system. This observation will also show how the information is dealt with or processed. The manual workers will be observed to see what instructions they receive and in what form they receive them.

Analysing the collected information

Having collected a great deal of information, Systems Consultants are able to clearly identify the problems which exist with the current way of doing things. The way this is done is to analyse the results of all the activities which they have carried out such as observation, interviews, collecting documents and so on. Using the W&W Steelstock example, a Systems Consultant would soon realise when reading the interview notes, the observation notes and looking at an invoice, that the current way of dealing with invoices is not satisfactory. The result of looking at all the problems, which have been identified this way, is to produce a system requirements specification This will include recommendations/ requirements for specific hardware and software as well as ways of using them. The whole point of the Analysis stage in the Systems Design cycle is to look at the results of your research to decide exactly what sort of system you have to produce.

Writing up the system requirements specification

The final part of the Analysis phase is the writing up of a report, which will contain recommendations. They are often called the user requirements because the needs of the user

have been identified. The typical contents of a systems requirements specification are:

- the type of information which needs to be produced from the new system;
- the type of hardware which should be considered;
- the type of software to be considered;
- the type of user interface;
- whether or not on-line help will need to be available;

- the type and helpfulness of error messages.

This report will need to contain all the recommendations in a straightforward style with a minimum of technical jargon. It will need to be to the point and easy to understand, if the users are to agree to the recommendations.

Design

The next phase of the systems lifecycle is *Design.* This is when the solutions to all the identified problems begin to take shape. There are many aspects within the design phase. During the design stage the Systems Consultant will decide what sort of system should be developed.

Specifying hardware and software

After all the existing data and its uses have been analysed the next stage is to decide what hardware and software are needed. The Systems Consultant will have already identified the hardware and software (if any), which is already being used by the organisation. The Systems Consultant will calculate how long this equipment is likely to last, given the recommendations stated in the system requirements specification. The consultant will also need to identify a supplier based on their reliability and the hardware and software support they can offer. The amount and level of training they can provide will also influence this decision. The software recommended may well be the existing software, which will then be adapted to the users needs. This is more than likely to be the case with W&W Steelstock because of their small size. Big organisations would probably require the software to be especially written for them.

The next thing that Systems Consultants have to do is to actually design the information system. They will need to design:

- the outputs from the system
- the files and/or databases needed to store the data
- the inputs to the system.
- any validation checks which will be needed;'
- the processing required to produce the outputs,
- the data needed to test the system.

Design of outputs

When Systems Consultants start to design the outputs from the system they have to consider:

1. Layout:

The way the output is important. This could be in the form of:

- tables
- lists
- single records from a database
- graphs

2. Form:

- The way the. output is produced has to be taken into consideration. This could be:
- hard copy (on paper)
- a screen display
- sound output.

When Systems Consultants design the output they have to have the user firmly in mind. What the user wants in terms of style and layout must be taken into consideration. The Systems Consultant will decide on what outputs are required having looked at documents and examined the results of the interviews which have taken place.
The style will have also been decided upon using the same methods. When designing invoices, for example, the Systems Consultant will give careful thought to who will need to see them. The style and content of the invoice will have to match the needs of the user.

Systems Consultants have to take many points into consideration when designing outputs. When designing printed output, for example, they must take style of output into consideration. Some of the output will go to customers or clients. The right impression must be given to these people so style of output becomes very important. It is important to involve the user in the design phase. Some examples of output can be produced and the user can comment on its suitability. In addition it is important to make the design of the output flexible. In other words, the user should be able to adapt the printed output to suit their needs.

Screen output must be kept simple. The results of the output must be clear to the user and not cluttered up with irrelevant material. Screen output should have a consistent layout so that it is easy to use. On screen instructions should be designed in order to help the user move from one screen to another or back to previous screens. There are many different types of screen output such as: individual record printout, output in the form of tables, output in the form of graphs. The screen needs to be designed taking into account the purpose of the output and the needs of the user.

At this point the Systems Consultant will choose the output devices which will be required. The type of monitors and printers will need to be identified. These will be dependent on the type and form of output to be displayed. High volume. ou u sill obviously require a printer that can cope with this. In our example the volume of output will not be too great and so a fairly basic laser printer would probably be sufficient, as it would provide the quality of presentation required.

Design of files

Another part of the design process for our example is to design the database and the file or files within it. The volume of data, and therefore the number of records, will have already been worked out. The next stage will be to decide on the number of fields and the names of each of these fields. Each field will have a name and a description. As well as this the analyst will need to decide on the type of data it will contain. Decisions will need to be made on whether the type of data is alphanumeric (i.e. a text field, able to contain any type of character), an integer (a whole number), a decimal number, a yes/no piece of data, a date etc. The size of each field will also have to be decided. For a text field this means deciding how long each field will be. For a numeric field it means deciding the range of values the field could hold. If the field contains decimal numbers the format will have to be given i.e. how many decimal places. If the field is numeric the units used will need to be decided upon e.g. £ for currency, metres for distance, hours for time etc. The medium to be used to store the file will also be a decided by the consultant. The choice will be from floppy disks, hard disks, magnetic tapes and optical disks.

Minimising data entry errors

One other aspect of design is to ensure that the data entered into the database is sensible. To achieve this the database structure must include the design of validation routines.

One way of minimizing data entry errors can be achieved in some fields by the use of effective coding. Where data is shortened this reduces the number of errors. The use of the single character 'F' in a GENDER field will result in fewer errors than if the person typing in the data had to type in 'Female' every time. The advantage of using coding is that simpler validation checks can be used. An appropriate method of data entry has to be chosen. This can result in fewer data entry errors. Direct data entry methods such as bar-code reading and optical mark reading cause far fewer errors than manual typing.
Where possible there should be a validation check on data being entered into each field. For numeric fields it is usual to have a range check. Using our example it would be highly unusual for a customer to order more than £20 000 worth of steel. A check could be put on the COST field to make sure it was not more than 20 000. For some text fields it is possible to have length checks. The Order Number has 4 figures and cannot be more or less than this. There are other validation checks which can be used such as invalid character checks (no letters in the Order Number) and existence checks (customer name).

Let us look at the simple problem that W&W were having with their recording of invoices. The Systems Consultant will need to design a database structure for this part of the system. This database could be called the Order file. Some method of uniquely identifying the customer would be one field. The name of the customer would be another. Their address, phone number and fax

number would be needed to contact them. The cost of the order, the VAT charged and what was ordered would have to be included. The invoice number would be included as would the date of the invoice, and the order number. The details of the order, the customer's name and address would be text fields and no validation checks would be placed on these.

The Customer reference would be a six character text field. A validation check which could be used would be a length check to make sure it was no more or less than 6 characters long. Another check could be a format check which would check that the first 3 characters were letters of the alphabet and the other three were digits. A length check could be used with the phone and fax numbers as they must be either 11 or 12 digits.

The cost field would be numeric with 2 decimal places as would the VAT field. The maximum value of the cost is set at £99999.99 because the company never have orders greater than this amount.

The invoice number is a 5 figure number but would be designed as a text field. A length check could be used on this.

The date of the invoice would be a date field.

The order number is a 4 digit number but would be a text field. A length check could be used to ensure that 4 digits were entered.

All this information could be set out in a table like that on the next page:

Field name	Field description	Data type	Length or maximum value	Units	Validation Check
Account Number	Reference number of each customer	Alphanumeric	8 characters		length <8 OR length >8
Customer name	Name of the customer	Alphanumeric	20 characters		
Invoice number	Number of the invoice	Alphanumeric	5 characters		length <5 OR length >5
Invoice Date	Date of the invoice	Date	Maximum value = today's date		
Order Number	Number of the order	Alphanumeric	4 characters		length <4 OR length >4
Description of order	The details of the order in terms of amount and type of steel ordered	Alphanumeric	50 characters		
Cost	The price which the customer is being charged	Fixed point, decimal or currency	99999.99	£ before the value	Value >= £100 000
VAT	Value Added Tax on the order	Fixed point, decimal or currency	99999.99	£ before the value	Value >= £17 500
Address	The address to which the invoices should be sent	Alphanumeric	40 characters		
Phone	The phone number of the customer	Alphanumeric	12 characters		length <11 OR length >12
Fax	The fax number of the customer	Alphanumeric	12 characters		Length <11 OR length >12

Design of data capture forms and input screen layouts

Whether a form or an input screen is being designed several factors need to be taken into consideration. The layout must make it easy to use. The layout will have to be attractive and it must ensure accurate entry of data. The layout must be simple. Complicated layouts with many colours and font styles will only confuse the user, possibly leading to inaccurate data entry.

Data capture forms must be easy to fill in by the user and easily read afterwards. The use of boxes for each character of input will help to make sure that there are fewer errors when typing in the data. There needs to be a clear layout. In other words headings for each section of the form should help the user identify these different sections. The Systems Consultant will need to design the form so that there are instructions provided with, or on, the form. This will help the user to know how to fill it in.

Screen designs must:

- be kept simple and consistent from one screen to the next;
- have clear prompts on the screen should be provided on how to complete the form;
- allow the user to move from one screen to the next fairly easily;

provide opportunities for editing the input.

Screen displays allow the use of a variety of different icons and buttons. The consultant, when designing these, should ensure that these are not overused. Too

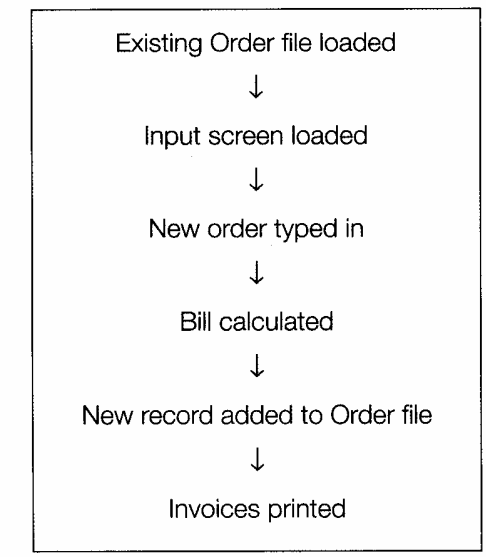
many icons and buttons could confuse the user leading to inaccurate data entry.
Data capture forms must:

- be easy to fill in by the user;
- ensure accurate data entry. The use of boxes for each character of input helps with this;
- have a clear layout. For example, headings for each section of the form should help the user identify these different sections;
- have instructions provided with, or on, the form. These should make it clear to the user how the form is to be completed.

Input devices will also be chosen when considering input layouts. For example in our example system for stocktaking it might be decided that each piece of metal in stock has a bar code. This would therefore require software and hardware capable of reading barcodes. It may be that all input will be dealt with using keyboards. All decisions regarding the type of input devices will be taken at this stage.

Design of overall processing

The Systems Consultant will now have to produce some diagrams to give an overall view of how the system will operate and what processing will take place. Using the above example, the new system will involve the person taking the order for steel typing in the details onto a screen. The bill will be calculated and the details will be stored and copies of the invoice will be printed. One copy will go to the customer, one will go to the person who will deliver the steel and another copy will go to sales person.
A simple flow diagram showing this would be:



There are many different types of diagrams used by Systems Consultants to show the processing involved in any part of the system. The processing involved in all parts of the new system would need to be described using diagrams.

This design process will produce the final *design*, which it is then possible to put onto the computer. Putting the design onto the computer is known as the 'Development' stage. This is when we are using the hardware and software to develop our final system.
It is also important during the design or development stage to draw up a test plan, which can be used during the development of the system to test whether the computer processes work. One possible framework for a test plan is shown below:

CUSTOMER RECORD:

Purpose of test	Test data	Expected Outcome	Actual outcome
To check the	Invalid Cust No. = 3456	Error message for 3456	{left blank for later test}
Customer No. is valid	Valid Cust No. = 133	Cust 133 added	

The first column identifies the purpose of the test. The second column identifies the set of test data with the expected outcomes for each data item listed in column three. The last column is left blank for details of what happens during development and testing later on.

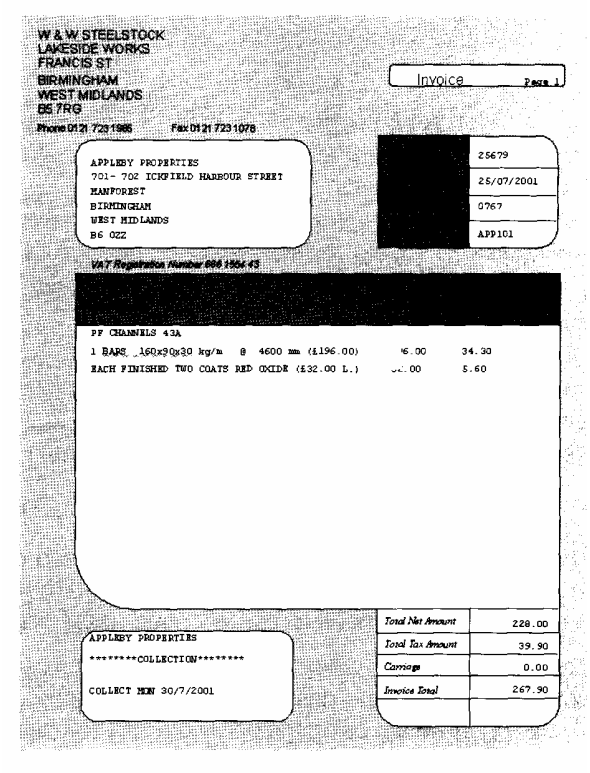
During development and testing any amendments necessary are noted and details of any evidence shown in printed outputs can be entered in this final column, so it is important to leave plenty of space for later comments.

The first thing the Systems Consultant will have to do is to create the file structure. All the fields will be defined for each file. In our example, there will be separate files for the customer records, orders, payroll and employee records.

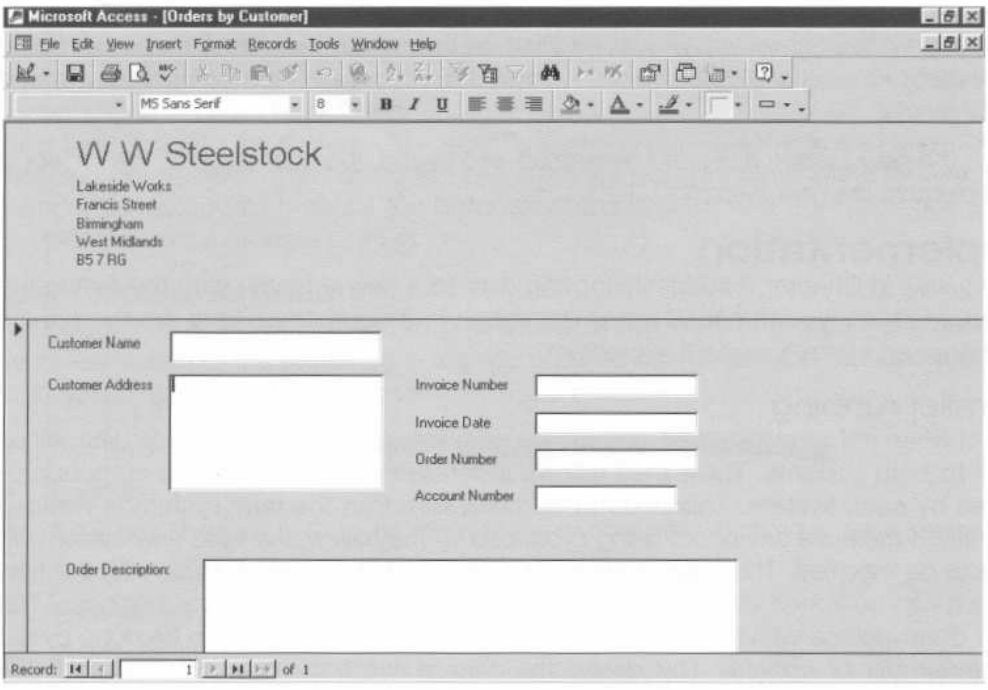
If we just look at the Order file we can see that each field will need to be defined. The structure as given in the design section will be used.

- Systems Consultants will give each field a name.
- They will define the type of data for each field. Most of the fields on the Order file are text. The only exceptions are the Invoice date field and the cost and VAT fields. They will type in the length of each field if it is text or the maximum value expected if the field is a numeric field.
- If the field is numeric the units need to be given i.e. a £ sign if it is an amount of money.
- They will type in the validation rules which each field will use.
- They will type in a description of each field.

The next step will be to create the output formats. These, again, will be based on those produced for the design section. An example report is shown below:



The final part of the development of the system will be the creation of the input screens.Again the Systems Consultant will create these screens and they will be based on the designs already produced. An example of an input screen is shown below:



Testing

During the development of the information system there is a certain amount of testing as the system develops. There will also be some involvement of the users of the system. However, before the users test the system, the Systems Consultant will have to test it. Each part of the system is tested using specially selected test data. Putting data into the system, which tests the validation rules will test the file structure. For example at W&W:

- Seven and nine character Account numbers will be entered. This should produce an error message that there are not enough or there are too many characters. However, most software packages will not allow you to type in more characters than the length of the field.
- Four and six figure Invoice numbers will try to be entered. Again this should produce an error message warning the user that this data is invalid.
- Three and five figure Order numbers will try to be entered.
- Costs greater than £100 000 will try to be entered.
- A ten figure and a thirteen figure phone number will be entered.
- A ten figure and a thirteen figure fax number will be entered.

Performing searches on the files will also test the database system. The Systems Consultant will perform various searches:

- The addresses of a range of companies by typing in their names.
- The names of a range of companies by typing in their account number.
- The value of a certain order by typing in the order number.

This is just a small selection of tests which the Systems Consultant could carry out. The Systems Consultant will test that the input forms and outputs work correctly.
Getting the users to test these aspects of the system is a good way of doing this. As a result, they will comment on the ease of use of the system.

Finally the whole system should be tested with real data. This means that data that has been used in the old system should be used on the new system. In all these examples, the expected results will have been recorded and these will be compared with the actual results.
When the new system has been developed and tested, the next stage of the project is to implement the new system.

Implementation

Moving over to a new system using the method of *direct changeover* can cause major disruption in a company. There are three main methods used to try to ease this problem (along with a fourth less common one, Pilot – doing so on a trial basis).

Parallel Running

This is when the new system is run together with the old system. The same data will be input to both systems. There then follows a detailed comparison of the outputs produced by each system. This is done to make sure that the new system is working properly. If there are any errors being produced by the new system the new system will have to be modified. The major advantage of this system is that all faults with the new system can be ironed out with no effect on overall performance of the business. The main disadvantage with this system is that twice as much work has to be done by the same number of workers. This delays the date at which the new system can finally replace the old system.

Phased Implementation

This is where the new system gradually replaces the old system, First of all one part of the old system is replaced and when that is working properly the next part is replaced and so on. This approach has two advantages. Any initial problems with the new system can be sorted out and there is less likelihood of disruption to the business if things start to go wrong. The major disadvantage with this method is that it may take too long before the new system is fully in place.

Direct Changeover

A third method is less widely used and is called the direct changeover approach. This is when the old system is discarded and the new system is introduced overnight. This is the least popular method. It is obviously the fastest way to introduce the new system. There are big risks involved, however, since once the old system has gone it cannot be brought back. It can only be successful if extensive testing has been carried out beforehand. Users must be able to adapt because the old system will no longer be available.

Monitoring and maintenance

It is a good idea to monitor the system by checking to see that it is still working well. It is likely that problems with a new system may not show themselves in the early days. This can be because parts of the system such as payroll may only be needed every month. It may well be that problems are only seen at this point. The other possibility is that the users get used to the system and start to adapt it to suit themselves. They may not realise it at the time but they may be adapting it in a way, which was never intended by the developer of

the system. It is a good idea to get the developer of the system to come back and look at the system to check on any problems, which may have developed. Any errors or bugs, which are found in the system, have to be removed or corrected. This means that the system is constantly being maintained. Other reasons for maintenance could be changes which have occurred outside the control of the Systems Consultant. Such an example was the year 2000 bug. Systems had to be changed all over the world to cope with this problem. The need for constant monitoring and maintenance of a system was highlighted by this problem. As new hardware and versions of software (eg Windows 2000) become available the system will need to be upgraded.

Documentation

Documentation comes in two main forms. Both are meant to be guides to how the system works. Both are meant to help the reader to understand the workings of the system. One is called **User Documentation** and is written for users and is designed to help them operate the system. The other is **Technical Documentation** and is written for people who are either maintaining the system or are going to develop the system. Both will contain information about the purpose of the system and the limitations of the system but from a different point of view.

User Documentation

This documentation is produced to help a user of the system. It does not go into the technical details of the system. It is a guide showing how to use the various aspects of the system. It will show you how to:

- Log on to the system.
- Load the software.
- Save any changes to files you might make or new files which have been created.
- Get printouts from the system.
- Enter data into the system.
- Edit data.
- Search the database.
- Sort the database.
- Produce graphs.
-

There will be a troubleshooting guide on how to avoid errors and what to do if any are encountered.

Technical Documentation

This is used for those systems for which the Systems Consultant has either written new software or has adapted existing software.. It is essential for the maintenance and

development of the system when the Systems Consultant cannot be reached. Technical Documentation is designed to help a technical expert who may be called in to fix a known problem or asked to develop the system. It is necessary at all stages of the systems design cycle. However, documentation of the final system can also help with the training of people to use the system.

One of the problems with most systems is that not enough systems or Technical Documentation is produced. This is mainly because there is generally no additional payment to the Systems Consultant for documenting the system. Systems are constantly changing but, in the meantime, the Systems Consultant has moved on to another project so there is nobody available to update the documentation.
For small systems this will contain very detailed information on how the input forms, file structures, output forms were created.

Evaluation

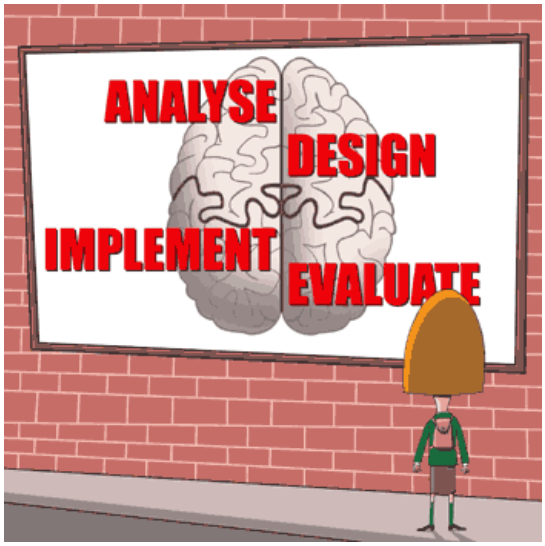
This normally takes the form of a written report to the management of the organisation. There will be a description of the purpose of the system and the limitations of the system from a user's point of view. There will be a description of the hardware and software being used. Evidence that the system works, as it was required to do by the management, will be provided.
The evaluation will be based on the results of the testing carried out by the Systems Consultant. In addition, users will be given questionnaires to complete. The Systems Consultant, in his final report, will use their responses. Evaluation is a comparison of the final system, which has been produced, with the list of user's requirements as outlined at the beginning of the project.

ICT Exam Revision '09

Most exam questions about computer systems analysis do not actually mention the words 'system' and 'analysis'. Look out for questions asking about introducing a new system. Don't be surprised by the question. You may read it first time and think you haven't prepared for it, but the question may be asking you about something you know, but just not in the way you expected.

The GCSE ICT course is all about **ICT systems**, but what exactly is an ICT system? For the exams you need to know:

- The general structure of information systems, and how they work.
- The role of input, output, processing and feedback.
- The integration of ICT devices and ICT information systems.



ICT and computers are **NOT** the same thing. An **ICT system** is a set-up consisting of hardware, **software**, **data** and the people who use them. It very often also includes communications technology, such as the **Internet**. **Computers** are the **hardware** that is often part of an ICT system.

This is why your GCSE is **not just** about computers, but about **how, why and when** people use them. It is the power of computers and communications that has allowed ICT systems to become so important. Like any piece of equipment, the important thing about it is what it lets us do.

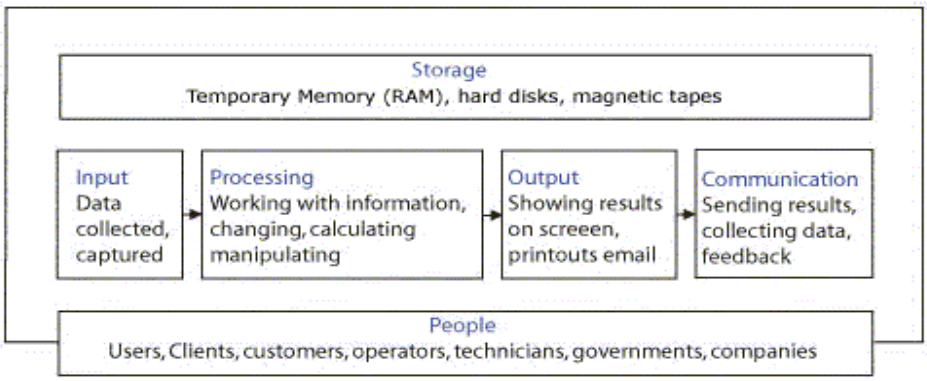
ICT Systems are used in a whole host of places such as offices, shops, factories, aircraft and ships in addition to being used in activities such as communications, medicine and farming. They are everyday and ordinary yet extraordinary in how they can add **extra power** to what we do and want to do.

By using ICT systems we have become:

- More productive - we can complete a greater number of tasks in the same time at reduced cost by using computers than we could prior to their invention.
- Able to deal with vast amounts of information and process it quickly.
- Able to transmit and receive information rapidly.

There are three main types of ICT system to be considered for GCSE:

- **Information systems** are focused on managing **data and information.** Examples of these are a sports club membership system or a supermarket stock system.
- **Control Systems** have **controlling** machines as their main aim. They use input, process and output, but the output may be moving a robot arm to weld a car chassis rather than information.
- **Communications Systems** have outputs that involve the successful **transport of data** from one place to another.



An ICT system diagram

A system is an assembly of parts that together make a whole. ICT systems are made up of some or all of the parts shown in the diagram. Various devices are used for input, processing, output and communication.

What comes out of an **ICT system** is largely dependant on what you put into the system. The acronym **GIGO** is a good way of thinking about this.

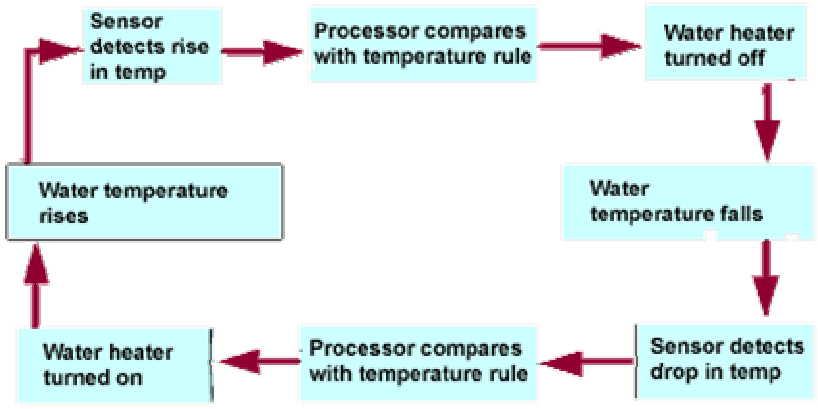
GIGO can be interpreted in 2 ways:

1. Good Input, Good Output
ICT systems work by taking inputs (instructions and **data**), processing them and producing outputs that are stored or communicated in some way. The higher the quality and better thought-out the inputs, the more useful will be the outputs.

2. Garbage In, Garbage Out
ICT systems cannot function properly if the inputs are inaccurate or faulty; they will either not be able to process the data at all, or will output data which is eroneous or useless. That's why the term GIGO is sometimes used to stand for "Garbage In, Garbage Out".

GIGO is a useful term to remember in the exam - it can help explain many issues such as why **validation** is needed and why accurate data is valuable.

It is sometimes good to have feedback in an **ICT system**. This is when the output from a system **feeds back** to influence the input, in a circle. A good example is a system set-up to control temperature in a tropical fish tank. The temperature of the water is taken as an input from sensors. Processing will occur and the state of the water will be compared against set rules. The outputs includes the automatic decision to turn on a heater to warm the water.



When this happens the output will **feedback,** changing the input temperature - and so on...

Water temperature control in a tropical fish-tank: an example of feedback in an ICT system

Feedback can occur in information-based systems as well. Often an output will have a result on further inputs e.g. the output of accepting an online booking for an air ticket will be to reduce the number of tickets available for other people to buy.

Input and output formats are the different kinds of **media** that are used to:

- EITHER gather up and collect **data** and instructions
- OR to display, present or issue the outputs of processing.

Until recently most media formats required dedicated devices to run on – digital cameras to take digital photographs, scanners to digitise images for use on a computer, or VCR players for video playback - so you needed the correct matching device in order to work with each media format.

There is now a growing tendency for multi-purpose ICT devices. The driving force is the communication power of the **Internet**, and the increasing availability of small high-powered electronic technology. This means that you can now get an all-in-one box that can do the same thing as several different ones did before.

- combined printers, **scanners** and photocopiers
- televisions with built in Internet connections and web **browsers**
- mobile phones with Internet access and digital cameras.
- laptop, palmtop and table computers that have mobile Internet access and built in handwriting recognition.

There are now single devices available which incorporate the following features: phone, camera, disk storage, TV and Internet access.

Alongside the joining together of technologies, there is also a tendency toward the integration of common *public information services*.

Digital television (DTV) by satellite, cable or terrestrial aerial now gives access to many channels that have interactive content, which can be used in a similar way to the web. DAB digital radio provides large amounts of text data to be transmitted along with the signal, and can be listened to via digital TV. The Internet now enables broadcasts from radio and TV stations to be 'time-shifted' by the user, who watches or listens to the programme whenever they want to.

News services and the mass media such as newspapers, radio, and television are making themselves available so that people can access them when they want and wherever they are. Two of the key reasons for this are:

- the growth of broadband Internet access that allows lots of information to be viewed quickly and effectively
- the success of digital broadcasting, the signals of which can carry very much more content than old style **analogue** TV and radio.

There are five main stages in setting up a new computer system which together are called **systems analysis**.

- Identify – select a project for analysis to see if improvements are necessary or possible
- Analysis - studying the problems
- Design - designing a solution
- Implementation - putting the solution into effect and testing it
- Evaluation - checking that the solution is working as intended. Evaluation is the final stage of developing a new system after implementation. This checks that the system has met the original requirements, is working properly and easy to use. Can it be improved further? Does it need modifying? It is really re-analysing - starting the same systems analysis process all over again.

Analysis

Analysis is developing and activating a new computer system is a long process. Because of this, it is important to break the process down into smaller stages, each one requiring a different set of professional skills. An important part of this process is the first stage - analysis. This involves finding out whether the new computer system is needed at all and exactly what it will be used for. Analysis is all about looking at how a job is done at present and seeing if the job could be done better by upgrading or developing a new system. To find out, the systems analyst might:

- observe staff at work
- interview staff about their work
- send out questionnaires about working practices
- inspect documents such as forms, invoices and receipts

Feasibility study

Having investigated the present system, the **systems analyst** will produce a **feasibility study**. This will look at whether the new system is:

- **technically feasible** - is the new system technically possible to implement in the time available?
- **economically viable** - will the cost of the new system be offset by savings once it is implemented? In other words, will it save the organisation money, time or allow them to perform more effectively?

Only if the answer to both these questions is *yes* is the project likely to continue to the next stage. At this point the decision-makers in the organisation, such as the board of directors in a company, decide whether to go ahead.

Requirements specification

Once it has been decided that the new system should go ahead, the next step is to draw up a **requirements specification** saying exactly what the new system will do. For example, it will say:

- what **hardware** is needed
- what **software** is needed
- what inputs are needed
- what processing must take place
- what information needs to be output

Designing the system

Once the requirements are known, the system can be designed. For the system to work, any or all of the following might have to be designed:

- data capture forms
- output formats
- file structures e.g. what fields are needed
- what hardware is needed e.g. will it be networked?
- what software is needed
- flow diagrams to show how the system works

The design will look at different possible solutions at each stage and give reasons for any decisions made. For example in deciding what hardware to use, the design will consider what type of computer is best and what sort of printer is needed. The design will also include a test plan to explain exactly how the new system will be tested. The test plan will include the expected outcomes for each test. The designs are then used by other members of the team during the implementation stage, for example the programmers. The design phase may include the development of bespoke software or purchasing an off-the-shelf package.

Implementing the system

Implementation is the next stage of developing a new system, after design. This is where the new system is installed, including:

- writing programs
- writing user documentation
- installing networks
- purchasing hardware and software
- testing the system using the test plan
- training staff

If the tests are not satisfactory then any problems will need to be corrected and the system tested again. User documentation will be written to help staff become familiar with the new system. It will include:

- a user guide
- input and output samples
- error messages (troubleshooting)
- installation details
- screen shots

When the system is ready to go on-line there are different ways of changing to the new system:

- Parallel running - running both the old and new system until you are certain the new system is working correctly. Parallel running is likely to be the most expensive as it involves doing the work twice for a period of time. However, it is the safest. If there are any bugs in the new system, you can always go back to the old system while the problems are corrected.
- Pilot changeover - changing over in a small part of the company to start with. Only when the system is deemed satisfactory will it be rolled out to the rest of the organisation. A supermarket introducing a new 'self-scanning' system might choose to introduce it in two or three stores at first. This is a pilot changeover.
- Direct changeover - the old system is scrapped and immediately replaced by the new system. With this option there is a danger that there may still be problems with the new system. Even though it is the most risky type of changeover, many companies use this method.

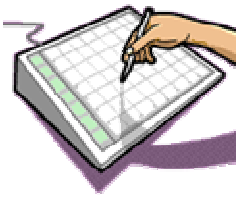
Input/Output

Input devices allow us to enter raw data into a computer. The computer **processes** the information and then produces outputs that we can understand using an **output device**.

There are many input formats which enable us to gather up and collect information, and enter data and instructions into the computer. Input devices can be manual or automatic.

Manual input devices include:

- **Keyboard** - including **concept keyboard**. This is a flat board that contains a grid of buttons. Each button can be programmed to follow instructions. An overlay sheet is placed on the grid with an explanation for each button. They are used in primary schools with young children. Many modern fast food restaurants have overlays with either a description or picture of the meals that are available to make ordering easier.
- **Mouse**
- **Tracker ball**
- **Joystick**
- **Light pen**
- **Digital camera** - this allows you to take pictures and to store a digital photographic image that can be read by a computer. You can then transfer the images directly from your camera on to your computer.
- **Microphone** - A microphone is a device to input sound information and can be used with a voice recognition system which processes the information. This can be used with a word processing program to enter text. It can also be used as part of security systems - only certain digitally stored voices will gain access.
- **Touch screen** - this is a special type of **VDU**, which has a grid of light beams or fine wires criss-crossing the screen. When the screen is touched (usually to choose an on-screen option), the computer senses where you have pressed. The information is stored on the computer and the touch screen is simply an interface. Touch screens have the benefit of being very robust and easy to operate and reprogram, hence why they are used in public places.
- **Video digitiser** - this takes an image from a video camera or television and converts it so that it can be used by, and stored on, a computer. Video sequences captured using a video digitiser are often used in multimedia presentations.
- **Graphics tablet**

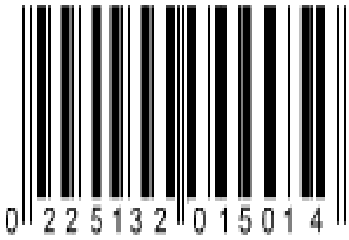


This consists of a flat pad (the tablet) on which the user draws with a special pen. As the user draws on the pad the image is created on the screen. Using a graphics tablet a designer can produce very accurate on-screen drawings.

- **Scanner** - these are a cheap and common way of getting images into a computer. They can also be used with **OCR** (Optical Character Recognition) software to scan in text.

Automatic input devices include:

- **Sensors**



- **Barcode reader**

Barcodes are different groups of vertical bars that can be read by a barcode reader. Barcodes are printed on nearly every product that you can buy. Shops use barcodes because they enable the shops to maintain their stock control system. The barcode contains the product details such as product name, size, manufacturer, country of origin. The price is looked up from the shop's database. When the bar code is scanned, the shop's stock is automatically reduced by one.

- **MICR (Magnetic Ink Character Reader)** - magnetic ink characters are the strange looking numbers that appear at the bottom of cheques. Banks use MICR to read the numbers from the bottom of cheques to obtain data such as account numbers and bank sort codes. This particular font is used because it is easy for a machine to discriminate between characters. The ink is magnetised because it makes it immune to creases or dirty marks.

- **Magnetic strip (or stripe) reader**

Magnetic stripes are built into many plastic cards such as cheque guarantee cards, cash-point cards and personal identity cards. The magnetic strip on the back of the card can hold the personal details of the card owner and, with the necessary PIN, will allow access to secure information e.g. bank account details. Data stored on the strip is scanned and input into a computer system by a magnetic stripe reader.

- **OMR (Optical Mark Reader)** - this reads marks made by pencil on a printed form into the computer. OMR systems are suited to reading pre-printed forms and check-boxes such as National Lottery number selection sheets and multiple-choice exam papers.

Common output formats are printed-paper, saved disk file, sound, video and on-screen documents. They are all of those things that let your computer 'talk' back to you and present information. Examples of devices for these formats are:

Monitors or Visual Display Units (VDUs) or screens

These are the most common output device and include:

- **Desktop monitors** which are also known as Cathode Ray Tube (CRT)
- **Liquid Crystal Displays (LCD)** which are also known as Thin Film Transistors (TFT)

Printers

- **Laser printers** produce a very high quality output, are very quiet and very fast. Laser colour printers are quite expensive to buy.
- **Ink-jet printers** offer black and white or colour printing with reduced levels of quality and speed. Colour ink jet printers are cheaper to buy than colour laser printers.
- **Dot-matrix printers** are not so common today. They are comparatively noisy and low quality but are cheap to run and are used when carbon copies or duplicates need to be made, such as for wage slips. Also, they are useful in dirty environments such as a garage because they are much sturdier than the other two types of printer.

Plotters

A plotter can be used to produce high quality, accurate, A3 size or bigger drawings. They are usually used for Computer Aided Design (**CAD**) and Computer Aided Manufacture (CAM) applications such as printing out plans for houses or car parts.

- Speakers
- LCD projectors

Output can also be in the form of instructions to a device such as a robot arm.

Data storage

A computer uses two types of storage:

- A main store, consisting of ROM and RAM, and
- Backing stores, which can be internal (a hard disk) or external memory stick

Main store, or computer memory, is divided into ROM or **Read Only Memory** and RAM or **Random Access Memory**.

ROM is memory that **cannot** be changed by a **program** or user. ROM retains its memory even after the computer is turned off. For example, ROM stores the instructions for the computer to start up when it is turned on again. The operating system is loaded from the hard disk and stored in RAM whilst the machine is being used.

RAM is a fast **temporary** type of memory in which programs and **data** are stored whilst the computer is switched on. For example, when you load a word processing **program** it is loaded into RAM. The contents of the computer's screen is also held in RAM. If the computer loses power, data stored in RAM is lost.

The main ***internal*** **backing store** is the computer's **hard disk** or hard drive.

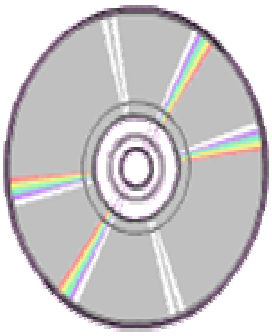
These are disks which spin at very high speeds (around 7,000 revolutions / minute) within a sealed unit inside the computer. Hard disks can usually store very large amounts of data - 120 gigabytes is common in desktop computers. The data stored here will stay where it is until deleted, but needs to be loaded into main store RAM before it can be used. Your hard disk is where you store:

- the **operating system**
- software applications or programs
- the majority of your data files

External backing stores: optical disks

There are several different types of optical disk, although they all look pretty much the same.

CD-ROM stands for Compact Disk - Read Only Memory. They are optical disks that use the same technology as musical compact disks. They store up to 700 Mb of **data** and a laser beam is used to read the data off the disk.



Data is written onto the CD-ROM disk before it is sold and cannot be changed by the user. As CD-ROMs can store large amounts of data, they can be used for multimedia applications such as encyclopaedias, and can store pictures, sounds and video clips.

CD-R and CD-RW

CD-Rs are blank optical disks onto which you can write data with a piece of hardware called a CD writer. They have a similar capacity to CD-ROMs and can be set up as multi-session disks and so you can write to them many times. Eventually of course, you will run out of disk space as you never go over the same area twice. CD-RWs are blank optical disks which can be written and re-written to.

DVD stands for Digital Versatile Disk. There are several formats on the market, the more expensive ones being recordable like CD's. They are the same size as CDs, but hold much more data - a single sided disc can hold up to 4.7 gigabytes. Now DVDs are commonly used for video recordings, so you will often see them measured in minutes e.g. 4.7Gb = 120 minutes. DVD drives are often found on computers as combined DVD and CD-RW drives, so the computer can read and show DVD films, as well as read and write CDs.

Advantages:
1. They can hold a lot more data.
2. They can hold more multimedia material

External hard drives

These can store very large amounts of data - up to a terabyte - and can be plugged in to your computer via a USB or Firewire port to provide extra storage.

Memory sticks

A memory stick is a small 'pen top' sized device that holds a large amount of memory - from 512Mb to 1Gb upwards depending on the price paid. This is a USB device and can be used in a similar way to a **floppy disk**, but is inserted into the USB port - it is then seen by the computer as a removable drive.

Advantages :
1. Both portable hard drives and memory sticks hold large quantities of data.
2. They are extremely portable, so the user can take them wherever they go.

Software

Word processing (WP) applications allow users to produce and edit text. All word processing programs allow you to:

- enter and edit text
- save
- print
- cut/copy/paste - you can copy from one part of a document to another
- check your spelling

Text formatting is important to make the text appear as you would like it to look. The normal features are:

- different fonts
- different text sizes
- different alignments (left, centre, right or justified)
- bold print
- underline
- italics
- bullet points

Mailmerge is a word processing feature which allows users to 'personalise' letters with names and addresses from a database. The four main steps in setting up a mail-merged letter are:

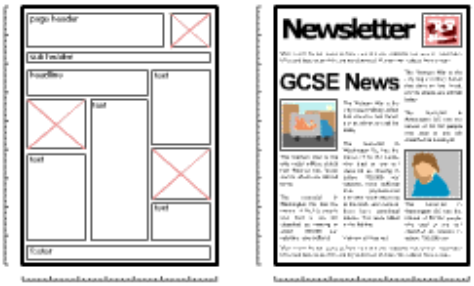
1. Create the database with fields for the names and addresses of the people to send the letter to.
2. Write the letter using a word processing package and link the letter to the database.
3. Use a query to find a subset of relevant people and send a targeted letter to them.
4. Using the mail merge wizard, enter codes in the letter where the name and address of the customers should appear.
5. Merge-print, taking the data from the database and inserting it in the letters, producing one letter for each person in the subset of relevant people from the database.

Other features that may be expected include find and replace, which replaces one word with another, and the ability to import graphics e.g. from a clip art library. Headers and footers and page numbering are very useful.

The **benefits** of using a standard layout include

- Creates a professional image for your company
- All employees send out letters that look similar and it helps the reader identify the sender
- Helps staff layout their letters rather than worrying about how to lay them out

Desktop publishing (DTP) applications allow users to create page layouts using text and pictures.



A word processor is not always the best package to use to produce a document. If more control over the layout of a page is required or the document is to include a lot of graphics, then a **desktop publishing package** such as Microsoft Publisher would be more suitable. Desktop publishers are often used to produce newspapers, magazines and leaflets.

Frames

The main advantage of desktop publishing is that it is **frame based**. Text and picture frames can be laid out on the page, and moved and resized if necessary. Images can be imported from clip-art libraries and other software. The view of the page is **WYSIWYG** (**w**hat **y**ou **s**ee **i**s **w**hat **y**ou **g**et).

Benefits of using a DTP package include:
DTP packages contain most features of a word processing package as well as layout and design features;
DTP is frame based you can be more creative with layout and the layout can be easily changed;
Text and picture frames can be moved and resized as required;
Images can be easily imported from clip-art libraries and other software
You can create a professional looking document with little knowledge of graphic design but you give a good image for your company

Graphics

The range of pictures, drawings and images which can be produced by a computer are called **graphics**. The main types of graphics packages are **painting**, **drawing** and **CAD**. A painting **program** allows freehand drawing and colouring, usually with a mouse. Generally the features are:

- a palette from which the user can choose colours
- freehand pens and brushes offering different styles and line thickness
- a range of standard shape tools such as rectangles and circles
- colour fill tools
- spray cans and eraser tools
- cut, copy and paste
- zoom in options to work in finer detail
- save and print

Images produced with painting packages are made up of tiny dots called **pixels**. They are stored as **bitmap** images. These images use a lot of memory and lose their quality when their size is changed. Images produced with drawing packages are made up of lines, shapes and co-ordinates. Drawing packages are also known as **vector drawing** packages and change little when re-sized. **Computer Aided Design** packages are more sophisticated drawing packages. They are used by engineers, architects and designers to produce detailed design plans and technical drawings.

Spreadsheets

A spreadsheet is an application that allows the user to enter numbers and text into a table with rows and columns and perform calculations on them. A **spreadsheet** appears as a **grid** or **table** divided into rows and columns. Each cell in the grid has a **cell address** or **reference**, for example **C5** means column C row 5. A **range** of cells can be referred to as a single unit, for example **E4:E12** means all the cells from E4 to E12 inclusive.

Why is a spreadsheet better than using a calculator or pen and paper?

1 - More effective data handling

- It is easy to change the **data** and the **spreadsheet** instantly recalculates the totals for you. For example, the builder can change his call-out charge and instantly recalculate the totals of the bills.
- You can carry out "what if?" investigations. For example, the grocer could increase his prices to see the effect on sales and the builder could increase his hourly charge to see the effect on his daily total.
- The information can be presented in different ways. For example graphs and charts.
- It is easy to make these changes, save your work and print it out again.

2 - More flexible presentation

- You can alter column widths and easily delete or add columns and rows
- You can underline, embolden text and use different fonts and graphics
- You can justify your data to the left, centre or right
- You can control the types of numbers you enter - for example you can choose percentage, currency or set the number of decimal places

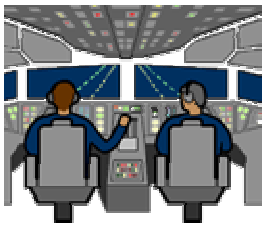
Modelling: what if?

A spreadsheet can be used as a modeling tool.

The model is controlled by a set of rules produced by the formulae. These rules can be changed easily to vary the model, and provide information about, eg, running costs and profit margins. Being able to answer "What if?" questions like this is vital for enabling a company to predict future trends in its income and outgoings. For example, suppose a company wants to know, "What if we reduce the price of our product? What effect is this likely to have on our income from sales?" Using a spreadsheet, you just vary the data in the *Price* column and the data in the *Income from Sales* column will automatically be recalculated (downwards). And if the reduced price makes sales go up - simply adjust the data in the *Number of Sales* column, and the *Income from Sales* data will again be recalculated (upwards).

- As well as financial modelling, spreadsheet software can be used for many other kinds of computer model, for example modelling the stresses which will be borne by a new bridge or traffic flow in a new road system
- Computer models are cheaper to set up than other methods of predicting what will happen in a system - for example, building a prototype
- You can make alterations and quickly see the outcomes
- You can repeat tests as often as you like
- You can look at "what if?" scenarios
- You can model dangerous situations safely

A **computer simulation** is a **program** designed to imitate a real-life situation. A good example is software which simulates the experience of piloting a plane. Simple simulation **software** running on a PC offers the user entertainment and practice in simple controls and navigation. A real-life flight simulator - used for training pilots - is far more sophisticated, and is very expensive.



The pilot sits inside a specially designed cockpit on hydraulically controlled struts which move the cockpit to give the feel of the pitch and roll of a real plane. **Sensors** detect the actions of the pilot and move the cockpit accordingly. The view from the cockpit window is replaced with computer generated images.

This sort of computer simulation gives many benefits:

- **different flying conditions** can be presented to the pilot e.g. poor weather, night flying
- **emergency situations** can be simulated without danger e.g. frozen runways, fog, engine failure
- the **landing procedures** at different airports can be simulated
- **cost effective** - no fuel is needed and there is no risk to plane or crew

However, computer simulation can never be the real thing. In this example, you can never account for the human factor. The pilot's reaction to a real-life crisis is never going to be the same as sitting in front of a computer. It is difficult to design simulation **software** to cover every eventuality such as extreme and unexpected conditions.

Virtual Reality (**VR**) is a computer **simulation** which allows the user to **interact** with the system. Special interfaces give the user the feel, sound and view of the virtual system. The user wears a head-mounted display through which the virtual world can be seen.

- Nuclear power stations use simulation to improve output by looking at temperature, pressure and gas flow in the plant.
- Scientific experiments (for example plant growth) can be observed in varying conditions.
- Coastal erosion (the effect of the sea on the coastline) can be studied to anticipate possible flooding, so that defences can be best positioned etc.
- Traffic flow can be simulated in major cities to investigate the need for new roads and/or traffic lights.
- The aerodynamic effect on cars can be investigated by simulating air flow over different body shapes.

Advantages of Simulation

- It can avoid danger and loss of life.
- Conditions can be varied and outcomes investigated.
- Critical situations can be investigated without risk.
- It is cost effective.
- The **simulation** can be operated more quickly than the actual system, so behaviour can be studied easily over a long period of time.
- Likewise, if the system occurs very quickly in real life, the simulation can be slowed down to study behaviour more easily.

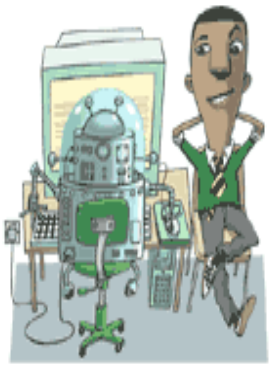
Disadvantages of Simulation

- It can be expensive to measure how one thing affects another to take the initial measurements to create the model (such as aerodynamic wind tunnels).
- Some things cannot be effectively simulated because we do not know enough about them, for example, earthquakes.

Computer control

A control system typically comprises:
- a **computer** or **microprocessor**
- a control program which handles **data** from **sensors** and sends signals to output devices
- an **interface box** to convert signals between the sensors and **processor**

The role of computers in control

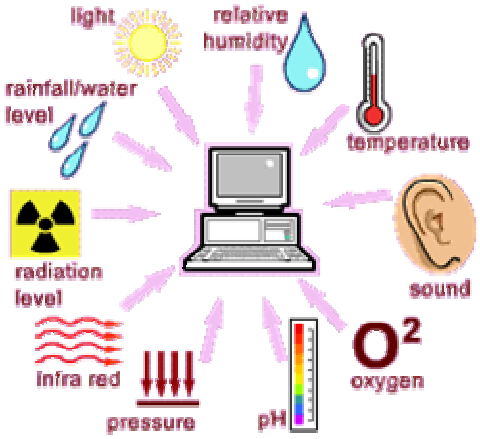


Computers can respond very rapidly to change.
Systems can run 24 hours a day, 365 days a year.
Control systems can operate in places that humans would find dangerous or awkward.
Outputs are consistent and error free.
Computers can process data quickly and machines can operate faster than humans.

- Computers are now used to control many types of devices such as:

Air conditioning and central heating systems in large buildings
Security systems and burglar alarms
Manufacturing processes
Traffic lights and pedestrian crossings

Sensors are used to measure physical quantities such as temperature, light, pressure, sound, and humidity. They send signals to the processor. For example:

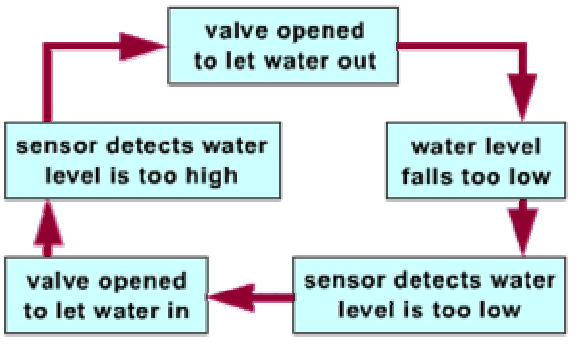


A security alarm system may have an infra-red sensor which sends a signal when the beam is broken.

A heat sensitive sensor in the corner of a room may detect the presence of a person.

Temperature sensors could be used to control the heating in a large building.

Magnetic sensors are inductive loops in the tarmac to detect metal above them and could detect traffic.

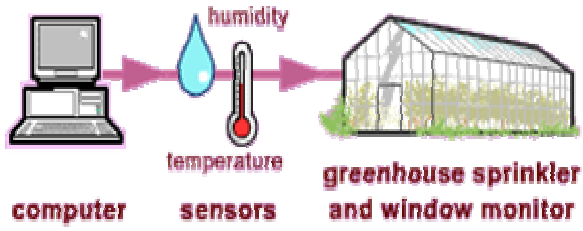


The diagram shows a control program for maintaining the water level in a fish tank. This continuous process repeats itself and is called a **feedback cycle**.

Data from a **water level sensor** is continually sent to the **processor**. The computer has a **control program** which usually stores the required water level settings. When the water level gets too high a valve is opened to let water out, and similarly, when it drops too low a valve is opened to let water in. The **control program** stores the details of the water level and the action it must take.

Example: a computer-controlled greenhouse

The **system** monitors the conditions night and day with immediate response to any changes. To alter the growing conditions the values in the computer program can of course be changed.



To get the best plant growing conditions **temperature** and **humidity** (moisture in the air) have to be controlled.

The greenhouse therefore has temperature and humidity **sensors** linked to a computer, and the computer has a **program** storing details of the correct temperature and humidity settings. The greenhouse is fitted with a **heater**, **sprinkler** and **window motor**, also linked to the computer.

If the humidity falls below the values stored in the program, the computer activates sprinklers and closes the windows. If the temperature falls outside the values stored in the program, the heater is activated by the computer.

Data Logging is the collection of **data** over a period of time, and is something often used in scientific experiments. Data logging systems typically monitor a process using **sensors** linked to a computer. Most data logging can be done automatically under computer control. **Sensors** have an important role in the data logging process. All physical properties can be measured with sensors such as light, heat, sound, pressure, acidity and humidity. The sensors send signals to an **interface box**, which is linked to a computer. The interface box stores and converts the signals into a form the computer can understand.

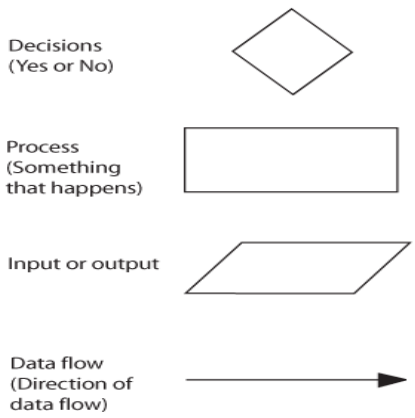
The computer controlling the process will take readings at regular intervals. The **time interval** for data logging is the time between readings. The **logging period** is the total length of time over which readings are taken. The readings are stored in tables and can be displayed in graphs or passed to a **program**, such as a **spreadsheet**, for later analysis.

Sometimes it is necessary to record data 'out in the field'. This is called **remote data logging**. Readings are stored and brought back to a computer where they are downloaded and analysed. The equipment in these situations needs to be very robust - equipment used to monitor water levels would have to be waterproof; similarly equipment working in a satellite would have to be able to withstand vibration during launch and recovery.

Experiments using **data logging** equipment:

- can take readings with high degrees of accuracy
- can be left without human intervention
- can be set to take readings over a long period of time e.g. hourly temperature readings every day
- can be set to take many readings in a short period of time
- can be used when there is a safety risk involved e.g. extreme cold or heat
- The **data** collected from the science experiment can be processed by specialist **software** or put into a **spreadsheet**
- Line, pie or bar graphs can be generated
- A table of values can be displayed.
- These can be exported to a **desk top publishing** (DTP) package.
- Text can be added explaining the experiment and results shown.
- Clip art can be imported to outline and show the experiment.
- The report can then be saved and distributed in different ways.

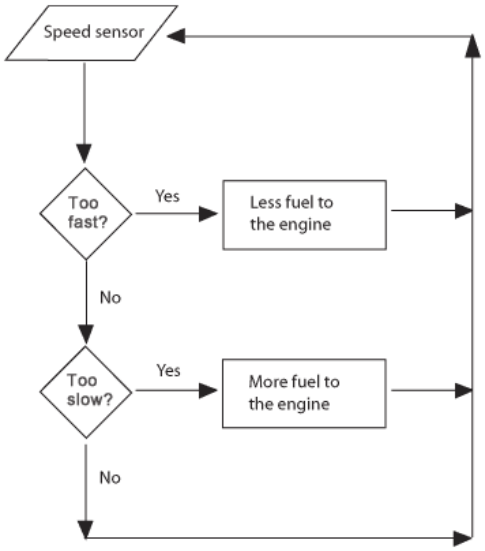
System flowcharts are a way of displaying how **data** flows in a system, and how decisions are made to control events. There are lots of symbols used. Basic ones include:



These - and other symbols - are used to show how **data** flows and how decisions are made. They are connected together to show what happens to data and where it goes.

Note that system flow charts are very similar to data flow charts. Data flow charts do not include decisions, they just show the path that data takes, where it is held, processed, and then output.

Using system flowchart ideas



This system flowchart is a diagram for a 'cruise control' for a car. The cruise control keeps the car at a steady speed that has been set by the driver. The flowchart shows what the outcome is if the car is going too fast or too slow. The system is designed to add fuel, or take it away and so keep the car's speed constant. The output (the car's new speed) is then fed back into the system via the speed **sensor**.

Other examples of uses for system diagrams include:-

- aircraft control
- central heating
- automatic washing machines
- booking systems for airlines.

For the system to work there is an input and an output. The process is taking the input and doing something with it - modifying it in some way - and producing an output. In a computer system the processing will be done by a **microprocessor** of some kind. Feedback is the output fed back to the input. The 'Cruise Control' flowchart is an example of negative feedback because the result is that the speed is always pushed towards the desired speed. Positive feedback would push the speed AWAY from the desired speed!

Inputs can include typing on a keyboard, mouse, voice, scanner, camera, pressure sensor, temperature sensor, magnetic sensor, moisture sensor, light sensor

Outputs can include printers, speakers, motors, monitors, heaters, electromagnets, bulbs/LEDs

The **Internet** or **Net** is a global network connecting millions of computers. When we refer to the Internet we are usually talking about the **World Wide Web** (**WWW**) which is the most used feature of the Internet.

The WWW stores millions of **web pages** on **web servers**. These pages can contain text, pictures, movies, animation and sound. Web pages are written in a language or code called **HTML** (Hypertext Markup Language). A set of web pages is called a **website**.

Each web page has its own unique address or **URL**. The URL will have the format "http" and a domain (such as ."co.uk"). What goes in between is arbitrary, but often has the term "www "such as in **"http://www.name.co.uk"**. but it doesn't have to (e.g. http://news.bbc.co.uk).

Most sites have a page that links the user to the other main areas of the site. This is called the **homepage**. Web pages are connected by **hypertext links**. When a link is clicked you will be taken to another page which could be on another server in any part of the world. When you move around web pages you are said to be **surfing** the net. For this you need a **program** to read the pages (called a **browser**), such as Firefox or Internet Explorer. To search for a particular item or topic on the net you use a **search engine**. There are many different kinds of search engine, each using slightly different ways of searching and indexing web content. *Google*, *MSN* and *Alta Vista* are all examples of search engines.

To connect to the internet you need:

- A computer
- A telephone line
- A modem - the type of modem you need to use is dependant on the type of connection you have. Some of the choices are:
  (a) An analogue **modem** and an ordinary phone line. This type of **modem** links your computer to the phone and converts computer signals to analogue phone line signals - and back again. This is the slowest and oldest type of connection and becoming less common with the introduction of broadband.
  (b) An **ISDN** line and terminal adaptor. This digital connection is slightly faster than an analogue connection.
  (c) An **ADSL** or cable telephone line and broadband modem. *Broadband modems* are much faster than the other two options and their use is increasing.
- An account with an ISP (Internet Service Provider)
- Browser software
- **ISPs** are the companies who provide you with access to the **internet**. Commonly used ISPs include Freeserve, AOL, Virgin, Tesco, BT and many more. Most offer the same basic package of Internet access, **email** addresses, web space for your own pages and local rate call charges.
- A **browser** is a **program** that allows you to view the pages on the Web. The most widely used are Internet Explorer and Firefox. All browsers will have a number of similar features to help you use the Web e.g. forward and back buttons to move between pages, a history folder which stores details of recently visited web pages, a stop button if a page is taking too long to load, favourites and bookmark options to store often visited pages, options to cut, copy, save and print the information viewed etc.

Talking to people over the net is as easy as picking up the phone. **Instant messaging** (or real time chat) and **chat** functions allow users to talk to friends or join in discussions online. **ISPs** usually provide links to **chat rooms**. **Newsgroups** are areas on the net where you can get in touch with people sharing the same interests or find out about a particular subject. Newsgroups are named according to their subject and users can post messages and read other people's answers. Links to newsgroups can be found via your ISP or **browser** software.

Factors behind internet growth

- The internet-connected PC is becoming commonplace in homes and workplaces, and more and more people feel comfortable using them.
- **Analogue** phone lines are being replaced by much faster high-speed digital **broadband** connections, making the internet much more convenient and speedy.
- Worldwide developments in communication technology via mobile, satellite, wireless and cable will continue to enhance **Internet** access.
- The use of the Internet by business, organisations and the general public has led to a rapid increase in the number of websites.

All these developments are changing the way we work and live our lives.

The future

Increased speed of access combined with **digital**, satellite and wireless technologies means that **Internet** use and the resources it offers will both continue to grow. In the home digital TV offering Internet access enables home viewers to shop, bank, play games and send **email**. Digital phone lines offer companies and households high-speed communication enabling business to be conducted quickly, efficiently and with reduced costs. Access to **video conference** links is becoming more commonplace.

Wireless technology eg **WAP** supports mobile phones offering hand-held Internet access. Mobile phones and other handheld devices enable users to link to email, weather, news, travel, entertainment listings and holiday information. As connection speeds improve, banking, shopping and video conferencing will take place on the move, in the car on the bus, train or plane. On the road, new systems are able to pinpoint your location, using an internet-linked onboard computer which provides access to nationwide map, road and traffic data (SAT NAV).

New **networks** are being built that allow a laptop to be connected wirelessly to the Internet from places such as airports, hotels, shops, and other public places (WiFi Hotspots, Internet Cafes). New ways of displaying and inputting **data** are being developed, e.g. virtual keyboards that use infra red detect where you type on a image projected onto a flat surface. Screens that roll up for portable use are being produced and may soon find use in various ways.

Much work is being done to enable people to use computers in new ways - not just as PCs on their desks - but as part of their clothing and lifestyle. It is too early to predict what sort of direction these ideas will develop into.

To set up **email** you need:

- A computer
- An internet connection via an analogue modem (ordinary phone line) or terminal adaptor (ISDN) or broadband modem (ADSL and cable)
- An account with an ISP (Internet Service Provider)
- Email software

Your Internet Service Provider will give you an email account, a password and a mailbox such as **yourname@hostname.co.uk**. You can also set up an email account with a mailbox and passwords with non-ISPs such as Google and Hotmail. With a dial-up connection, you have to pay the cost of your internet phone calls (local rate), and in most cases a subscription to your provider (though some are free). A broadband connection is 'always on', with only a flat-rate subscription. Very few people pay by the minute nowadays and the majority of people pay a monthly fee for broadband access. Anti-virus scanning is becoming standard on email accounts and many email providers now offer an anti spam (electonic junk mail) service.

Webmail, as its name suggests, is web-based email. To use webmail, you do not need any email software - just a computer connected to the internet via any one of the connection types listed above, and a browser. Users simply sign up to the webmail service of a web portal such as MSN or Yahoo. They are given a unique user name and a personal mailbox on the portal's email server, and they can then send and receive messages via a special web page. A basic webmail account is usually free, although this will have a very limited amount of storage. The advantage of webmail is that users can receive and send mail from any computer in the world with internet access. If you have a dial-up connection you can download your emails and then read them offline to avoid staying on-line for long periods. Some ISPs will enable their regular email customers to access their mailbox via webmail as well as through the email software on their PC.

Features of email

- Automatic reply to messages
- Auto forward and redirection of messages
- Facility to send copies of a message to many people
- Automatic filing and retrieval of messages
- Addresses can be stored in an address book and retrieved instantly
- Notification if message cannot be delivered
- Automatically date and time stamped
- Files, graphics or sound can be sent as attachments, often in compressed formats
- Webmail and mobile email can be used to receive and send messages while on the move. .

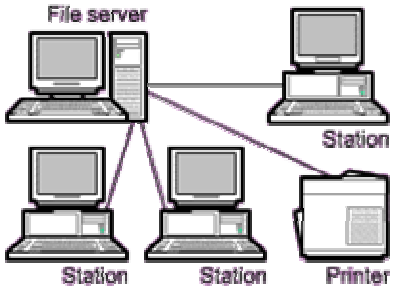
Dial-up email
- Prepare your message **offline** as typing your message **online** will increase phone charges.
- Connect to the **internet** and log on to your email account.
- Send your message and download any incoming mail sitting on your service provider's computer.
- Log off and close your connection.

Many mobile phones already allow messages to be sent to the recipient's email inbox while the sender is on the move. The latest generation of mobile phones enables users to send and receive wireless email in exactly the same way as a static computer. Email can be sent and received via digital TV, specially adapted phones, public kiosk terminals and the latest generation of games console. A spreading network of wireless 'hotspots' in public places allows people to send and receive email via laptop computers. A new range of in-car phones will enable motorists to check their email on the road.

Networks

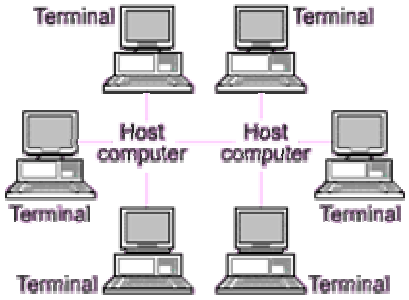
A **computer network** is a number of computers linked together to allow them to share resources. Networked computers can share **hardware -** such as a printer, **software -** they may be able to load up the same program, **data -** they can load up the same files.

There are two types of network: **LAN** and **WAN**.



A **LAN** is a **Local Area Network** covering a small area such as one building e.g. in a school or a college.

- A school network is a LAN.
- LANs use dedicated cables or wireless technology.
-



A **WAN** is a **Wide Area Network** covering a large geographical area.

- The **Internet** is a WAN.
- A network of bank cash dispensers is a WAN.
- LANs are often connected to WANs, for example a school network could be connected to the Internet.
- Telephone lines are often used to connect WANs. LANs use dedicated cables or wireless technology.

Advantages

- Sharing devices such as printers saves money.
- Site licences are likely to be cheaper than buying several stand-alone licences.
- Files can easily be shared between users.
- **Network** users can communicate by **email**.
- Security is good - users cannot see other users' files unlike on stand-alone machines.
- A **file server** is easy to back up as all the **data** is stored in one place.

Disadvantages

- Purchasing the network cabling and **file servers** can be expensive.
- Managing a large **network** is complicated, requires training and a network manager usually needs to be employed.
- If the file server breaks down the files on the file server become inaccessible. E-mail might still work if it is on a separate server. The computers can still be used as stand alones.
- **Viruses** can spread to other computers throughout a computer network.
- There is a danger of **hacking**, particularly with wide area networks. Security procedures are needed to prevent such abuse.

Databases

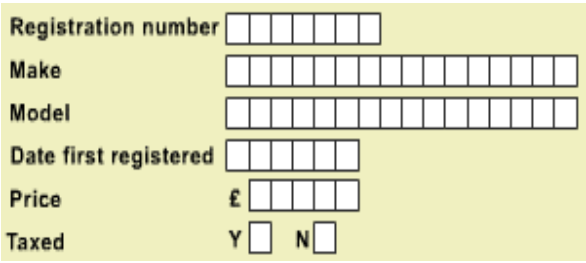
Information adds context and meaning to the **data**. This gives it meaning so that people can understand it. **Data** must have some kind of headings or structure around it to become information. Computer input devices often collect data automatically. **Sensors** can continually measure a temperature, or **barcodes** can be scanned at a till. This data becomes information once it is put into a framework or structure that provides context. In both these cases the data will be read into a **database** for processing.

Common ways in which you may have used data and turned it into information are in using spreadsheet or database **programs** to solve problems.

Knowledge is where we take in and understand information about a subject, and then make decisions, form judgements, take opinions or make a forecast. We do this by using rules about the world that we have worked out through having lots of information from the past. Data leads to information, and information leads to knowledge.

A **database** is a collection of **data** that can be used as information. It becomes information because of the headings and structure used in the database file. A **field** is the single piece of information about a person or thing and the smallest unit of information you can access in a database. Lots of fields make up a record which is a collection of database fields - all of the data or information about a person or thing, whilst records make up a **file** or collection of database records. Field types include alpha, numeric, alpha-numeric, currency, Boolean (Yes/No)

A collection of database fields - all of the data or information about a person or thing. Before setting up a database, the **record structure** must be decided, to make best use of the memory and backing store and to make searching and reporting easier. A database in which ALL the data is stored in a single table is known as a **flat file** database (e.g. Excel). Another type of database stores different types of data in different files, with an application called a **database management system** to link the files together. This type is called a **relational database** (e.g. Access). A database should always contain a **key field**. The key field is unique - different for all records.



Before setting up a **database**, the **data** must be collected. This may be done using a **data capture form**.
A data capture form is a form especially designed for collecting data. An example of a data capture form is the form completed by a customer buying a car from a showroom. This form may consist of rows with the field name followed by character spaces where information can be inserted.

Data capture forms normally use boxes or spaces for the answers to help you. **Data** is often put into a code in a **database**, for example in the file above Y is used for yes and N for no. Codes like this are used because:

- It is quicker to type in
- It uses less disk space
- It is easy to validate
- Less likely to make typing mistakes if there is less to type

Data which is coded and entered into a database is **not** normally used as a form of security.

It is very important that data is entered correctly. **Validation** and **verification** are both ways of checking the data that has been entered into a computer.

Validation is an automatic computer check to ensure that the **data** entered is sensible and reasonable. It does not check the accuracy of data. For example, suppose you type in a secondary school pupil's year of birth between 1987 and 1993. The computer can be programmed only to accept numbers between 1987 and 1993. This is a range check. However, this does not guarantee that the number typed in is correct. For example, a student's year of birth might be 1987. If 1993 is entered, then this is valid, but it is not correct.

There are a number of validation types that can help check the **data** that is being entered. They are used in many different ways:

Validation type	**How it works**	**Example of use**
Check digit	The last one or two digits on a code are used to check the other digits are correct	Bar code readers in supermarkets use check digits
Format check	Checks the data is in the right format	A National Insurance number is in the form LL 99 99 99 L where L is any letter and 9 is any number
Length check	Checks the data isn't too short or too long	A password which needs to be six letters long
Lookup table	Looks up acceptable values in a table	There are only seven possible days of the week
Presence check	Checks that data has been entered into a field	In most databases a key field cannot be left blank
Range check	Checks that a value falls within the specified range	Number of hours worked must be less than 50 and more than 0
Spell check	Looks up words in a dictionary	When word processing

Verification is a check to ensure that the **data** entered exactly matches the original source.
There are two main methods of verification:

- **Double entry** (typing the data in twice and comparing the two copies) - This can take much more time and means higher wage costs.
- **Proofreading data** - This method involves somebody checking what is on the screen is the same as on the input document. Again, this is time consuming and costly.

Advantages

- **Databases** can store very large numbers of records efficiently (they take up little space)
- It is very easy and quick to find information.
- It is easy to add new data and to edit or delete old data.
- **Data** can be searched easily (eg, 'find all Ford cars').
- Data can be sorted easily, for example into 'date first registered' order.
- Data can be taken into other applications, for example a mail-merge letter to a customer saying that an MOT test is due.
- More than one person can access the same database at the same time - multi-access.
- Security may be better than in paper files.

Data security is about keeping data safe. Many individuals, small businesses and major companies rely heavily on their computer systems. If the data on these computer systems is damaged, lost or stolen, it can lead to disaster.

- Data can be lost or damaged during a system **crash** - especially one affecting the hard disk.
- Data can become **corrupt** as a result of faulty disks or **disk** drives, or power failures.
- **Data** can be lost by accidentally deleting or overwriting files.
- Data can be lost or become corrupted by computer **viruses**.
- Data can be **hacked** into by unauthorised users and deleted or altered.
- Data can be destroyed by terrorist activities, war, bombs and fire.
- Data can be deleted or altered by unpleasant employees wishing to make money or seek revenge on their employers.

Measures that can be taken to keep data safe include:

- Making regular back-ups of files. (**Back up** copies should be stored safely in fireproof safes or in another building.)
- Protecting yourself against viruses by running anti-**virus software**.
- Using a system of passwords so that access to data is restricted.
- Safe storage of important files stored on removable disks - eg locked away in a fireproof and waterproof safe.
- Allowing only authorised staff into certain computer areas, eg by controlling entry to these areas by means of ID cards or magnetic swipe cards.
- Always logging off or turning terminals off and if possible locking them.
- Avoiding accidentally deletion of files by write-protecting disks.
- Using data **encryption** techniques to code data so that it makes no apparent sense.

Searching Field-and-Record databases

Fields and Records **databases** can be searched using filtering techniques where criteria, such as surname and/or forename, are used to find particular pieces of information.
A **simple** search looks at **one** criterion. For example, in the database shown here, SURNAME = "GILL" would find Narinder Gill. The same search looking for "SMITH" would find both Smiths.

ID number	Surname	Forename	Date of Birth	Gender
002	Smith	Rob	22/10/67	M
003	Gill	Narinder	04/03/78	F
004	Ngomo	Peter	09/11/01	M
005	Smith	Pete	08/09/01	M

A **complex** search narrows down the search by looking at **two** criteria:
Surname="Smith" AND Forename = "Pete", to find Pete Smith.

Who uses databases?

- The police have details of all known criminals in a database.
- Your school will probably use a database to store details of its pupils.
- A hospital will store details of all its patients on a database.
- The Government uses a database to store records of people's income tax payments.
- A database is used to keep track of all the drivers in central London who have paid their Congestion Charge.

Data Protection Act 1988

The Data Protection Act was developed to give protection and lay down rules about how data about people can be used. Usually this data is stored on a computer. Any organisation or person who needs to store personal information must apply to Register with the **Information Commissioner**. A register of data controllers is kept detailing the **data** that will be stored so they have to say in advance what information will be stored and how they will use it.

Each Register entry contains the following information:

- The data controller's name and address
- A description of the information to be stored.
- What they are going to use the information for.
- Whether the **data controller** plans to pass on the information to other people or organisations.
- Whether the data controller will transfer the information outside the UK.
- Details of how the data controller will keep the information safe and secure

The Act only applies to people who are alive. It sets up two types of personal data. There are more safeguards about **sensitive data** than ordinary **personal data**. Usually, a person must be asked specifically if sensitive data can be kept.

- **Personal data** is about living people and could be their name, address, medical details or banking details

- **'Sensitive' personal data** is also about living people, but it includes one or more details of a data subject's racial or ethnic origin, political opinions, religion, membership of a trade union, health, sexual life, criminal activity.

All **data controllers** must keep to the **Eight Principles of Data Protection**.

1. It must be collected and used fairly and inside the law.
2. It must only be held and used for the reasons given to the **Information Commissioner**.
3. It can only be used for those registered purposes and only be disclosed to those people mentioned in the register entry. You cannot give it away or sell it unless you said you would to begin with.
4. The information held must be adequate (enough), relevant and not excessive (too much) when compared with the purpose stated in the register. So you must have enough detail but not too much for the job that you are doing with the **data**.
5. It must be accurate and be kept up to date. There is a duty to keep it up to date, for example to change an address when people move.
6. It must not be kept longer than is necessary for the registered purpose. It is alright to keep information for certain lengths of time but not indefinitely. This rule means that it would be wrong to keep information about past customers longer than a few years at most.
7. The information must be kept safe and secure. This includes keeping the information backed up and away from any unauthorised access. It would be wrong to leave **personal data** open to be viewed by just anyone.
8. The files may not be transferred outside of the European Economic Area (that's the EU plus some small European countries) unless the country that the data is being sent to has a suitable data protection law. This part of the Act has led to some countries passing similar laws to allow computer centres to be located in their area.

People whose **personal data** is stored are called **data subjects**. The Act sets up **rights** for people who have **data** kept about them. They are:

- **A Right of Subject Access**
  A data subject has a right to be supplied by a data controller with the personal data held about him or her. The data controller can charge for this: usually a few pounds.
- **A Right of Correction**
  A data subject may force a data controller to correct any mistakes in the data held about them.
- **A Right to Prevent Distress**
  A data subject may prevent the use of information if it would be likely to cause them distress.
- **A Right to Prevent Direct Marketing**
  A data subject may stop their data being used in attempts to sell them things (eg by junk mail or cold telephone calls.)
- **A Right to Prevent Automatic Decisions**
  A data subject may specify that they do not want a data user to make "automated" decisions about them where, through points scoring, a computer decides on, for example, a loan application.
- **A Right of Complaint to the Information Commissioner**
  A data subject can ask for the use of their personal data to be reviewed by the Information Commissioner who can enforce a ruling using the Act. The Commissioner may inspect a controller's computers to help in the investigation.
- **A Right to Compensation**
  The data subject is entitled to use the law to get compensation for damage caused ("damages") if personal data about them is inaccurate, lost, or disclosed.

There are some **complete exemptions** and some **partial exemptions** where **personal data** is not covered by the 1998 Act. These mean that the people storing **data** do not need to keep to the rules.

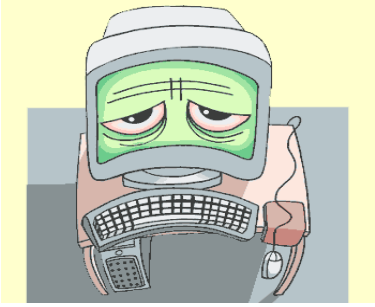
Complete exemptions:

- Any personal data that is held for a **national security** reason is not covered. So MI5 or MI6 don't have to follow the rules. They do need to get a Government Minister to sign a certificate saying that they are exempt.
- Personal data held for **domestic purposes** only at home, eg a list of your friends' names, birthdays etc

Partial exemptions:
Some personal data has partial exemption from the rules of the Act. The main examples of this are:

- The taxman or police do not have to disclose information held or processed to prevent crime or taxation fraud. Criminals cannot see their police files. Tax or VAT investigators do not have to show people their files.
- A **data subject** has no right to see information stored about him if it is to do with his/her health. This allows doctors to keep information from patients if they think it is in their best interests.
- A school pupil has no right of access to personal files, or to exam results before publication.
- A **data controller** can keep data for any length of time if it is being used for statistical, historical or research purposes.
- Some research by journalists and academics is exempt if it is in the public interest or does not identify individuals.
- Employment references written by a previous employer are exempt.
- Planning information about staff in a company is exempt, as it may damage the business to disclose it.

Data and Computer Misuse



You need to be familiar with the following ideas about data and computer misuse:

- That **data** stored electronically is easier to misuse.
- That **software** should not be copied without permission.
- The consequences of **software piracy**.
- That **hacking** can lead to corruption of data, either accidentally or on purpose.

Misuse of computers and communications systems comes in several forms:

1. Hacking
Hacking is where an unauthorised person uses a **network**, **Internet** or **modem** connection to gain access past security passwords or other security to see **data** stored on another computer. Hackers sometimes use **software** hacking tools and often target, for example, particular sites on the Internet.

2. Data misuse and unauthorised transfer or copying
Copying and illegal transfer of data is very quick and easy using online computers and large storage devices such as hard disks and CDs. Personal data, company research and written work, such as novels and textbooks, can all be copied without permission.

3. Copying and distributing software, music and film
This includes copying music CDs with computer equipment, making copies of music tracks and distributing it on the Internet. This is a widespread misuse of both computers and the Internet that breaks copyright regulations.

4. Email and chat room abuses
Internet services such as Chat and Email have been the subject of many well-publicised cases of impersonation and deception where people who are online pretend to have a different identity. **Chat rooms** have been used to spread rumours about well known personalities. A growing area of abuse of the Internet is email spam, where millions of emails are sent to advertise both legal and illegal products and services.

5. Pornography
A lot of indecent material and pornography is available through the **Internet** and can be stored in electronic form. There have been several cases of material, which is classified as illegal, or which shows illegal acts, being found stored on computers followed by prosecutions for possession of the material.

6. Identity and financial abuses
This topic includes misuse of stolen or fictional credit card numbers to obtain goods or services on the Internet, and use of computers in financial frauds. These can range from complex well thought out deceptions to simple uses such as printing counterfeit money with colour printers.

7. Viruses
Viruses are **programs** written by people and designed to cause nuisance or damage to computers or their files.

The Computer Misuse Act (1990)
This was passed by Parliament and made three new offences:
1. Accessing computer material without permission e.g. looking at someone else's files.
2. Accessing computer material without permission with intent to commit further criminal offences e.g. **hacking** into the bank's computer and wanting to increase the amount in your account.
3. Altering computer **data** without permission e.g. writing a **virus** to destroy someone else's data, or actually changing the money in an account.

Regular backups and security.
Just making something illegal or setting up regulations does not stop it happening. So responsible computer users need to take reasonable steps to keep their data safe. This includes regular backup and sufficient security with passwords.

Copyright law
This provides protection to the owners of the copyright and covers the copying of written, musical, or film works using computers. FAST is the industry body which is against **software** theft. The **Federation Against Software Theft** (FAST) was founded in 1984 by the **software** industry and is now supported by over 1,200 companies. It is a not-for-profit organisation aiming to prevent **software piracy** and has a policy of prosecuting anyone found to be breaching copyright law. There have been cases where laws such as copyright have been used to crack down on file sharing **Internet** sites or individuals who store and distribute music illegally. There is a massive problem with many people around the world obtaining copyrighted material illegally.

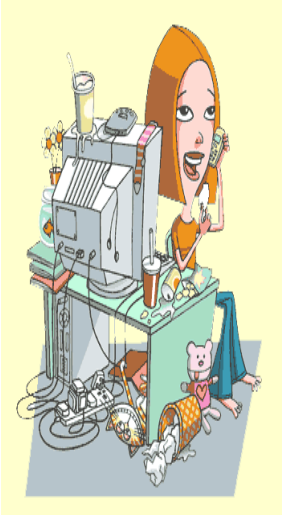
Computer users must follow the **copyright law** which also applies to other media such as videos, music cassettes and books. When you buy **software**:

- you do not have the right to give a copy to a friend.
- you cannot make a copy of the CD with a CD writer and then sell it.
- you cannot use the software on a **network** unless the licence allows it.
- you cannot rent out the software without the permission of the copyright holder.

Software companies take many steps to stop **software piracy**:

- The licence agreement is normally part of the installation process and you have to press ‘ok’ or ‘I agree’ to be allowed to install the software. This applies equally to downloaded software.
- You are usually asked to type in a licence key which is a set of letters and numbers, when you install the software.
- Some programs will only run if the **CD-ROM** is in the CD drive.
- Some programs will only run if a special piece of **hardware** called a **dongle** is plugged into the back of the computer.

Moral and social issues



Some effects of the development of information technology have given people cause for concern.

Some **chat rooms** have been closed down due to abuses, especially where children are vulnerable. Some have "moderators" who help to prevent abuses. Advice about sensible use is important; especially to never give personal contact details or arranges meetings without extreme caution.

Spamming may be reduced by never replying to anonymous emails, setting filters on email accounts, reporting spammers to ISPs, who are beginning to get together to blacklist email abusers, governments passing laws to punish persistent spammers with heavy fines

Many people are concerned about organisations storing personal, confidential details on computer.

Other concerns about the development of IT are:

- **The 'haves' and the 'have-nots'**. IT skills are now seen as vital in the employment market. Those with such skills can get on while those without might not get a job. This is creating a divided society - those with IT skills and those without. See the Revision Bite **Changing work patterns** for more information on this topic.
- **Dependence on IT**. What happens if a computer breaks down? We are now so dependent on IT for our lifestyles that we cannot survive without them. Businesses often go bankrupt if their computer system fails. To avoid this they may have to have one or even two back-up computer systems.
- **Viruses**. Computer systems can break down when viruses corrupt data. See the Revision Bite on **Viruses** for more information on this topic.
- **Health and safety issues**. Computers can be bad for our eyes, our backs, our wrists and our fingers. See the Revision Bite on **Health and safety** for more information about this topic.

New technology brings with it new crimes and as a result some governments are setting up special units to deal with **Internet** crime. A major concern is Internet **fraud**. For example, phishing scams are common, identity theft and denial of service attacks are common techniques used by criminals today.

Other concerns surround:

- the interception of credit card details and transactions online
- **hacking** into personal, private files with criminal intent
- fraudulent **websites** taking credit card details from customers
- the spreading of **viruses** via the Internet

The **internet** is a fantastic source of information but it can also be used to peddle pornography or quack cures, invade people's privacy with unwanted advertising, and make it easier for paedophiles and terrorists to organise their activities.

However, it is not the case that anyone can post anything over the internet. For example:

- the Chinese Government heavily censors its citizens' use of the Internet.
- libel (written defamation of someone's character) laws apply equally well to the Internet.
- copyright law is being actively used to suppress websites, for example, Apple Macintosh suppressed an employees' blogging website by using copyright law.

A number of steps are being taken to reassure the general public that the Internet is safe:

- Data is encoded before transmission using **encryption** techniques which scramble the data. The data is then decoded at the receiving end (**decryption**).
- The use of passwords and access level restrictions.
- The use of **firewalls**
- Tough penalties for offenders under the **Computer Misuse Act.**

Arguments for control

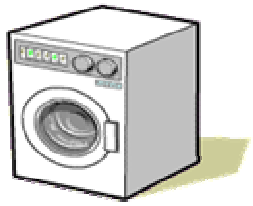
- To prevent illegal (eg, racist or pornograhic) material being readily available.
- To prevent young children accessing unsuitable material.
- To ensure copyright laws are maintained.

Arguments against control

- Unsuitable material is easily available in other ways.
- Control would cost money and users would have to pay.
- Control would be very difficult to enforce.

Many home shopping **websites** set up secure accounts for their customers protected by a username and password. These allow storage of personal details so customers can return without having to type in every detail of their address. Payment can be made **online** using a bank card, such as a credit card or a payment service, where the items are charged to your card. Secure socket technology has been developed so that sensitive personal and bank information is encrypted (scrambled) while it is being sent online.

Home and leisure



Many of the machines we take for granted at home are controlled by **microprocessors**. These include microwave ovens, washing machines, dishwashers, central heating boilers

Many of the things we do in our leisure time are increasingly dependent on information technology. These include watching digital or satellite TV , watching videos and DVDs , playing computer games , listening to music on CD and MP3 players, surfing the **Internet** etc

Online booking tickets

Online bookings are growing as fast as **online** shopping. Theatre, cinemas, concerts, air tickets, train tickets, hotels and package holidays are all available on the **World Wide Web**, often at cheaper prices than buying them from high street shops. Bookings can be made across the world by **Internet** connection.

The advantages are:-

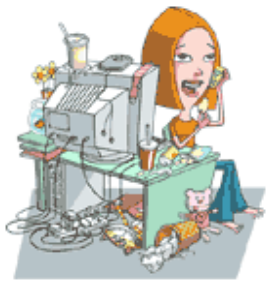
- Bookings can be done out of office hours.
- A person can choose exactly which ticket they want from many available.
- Payment and confirmation can be done immediately.

Loyalty cards

A card is given to customers to reward them for regular shopping at a particular shop. Such schemes encourage customer loyalty. Points awarded are usually worth about 1p for every pound spent. It is a way of trying to stop people going to the competition down the road. Loyalty cards are also a way of collecting **personal data**, as they are dependant on computer systems which keep a file on each customer and identify them with a card number, storing the information in a large **database**.

Swiping a loyalty card is an example of **data capture**. With most points cards the customers have to give their **personal data** in exchange for the card which has a unique number. Every time the customer visits the shop the card is "swiped" to read the number so the customer can be identified and points added to their name. The tills, of course, use **barcodes** to identify each item bought.

Loyalty cards provide companies with information about spending. This allows the shops (usually supermarkets) to gather up information about the kinds of spending done by the customer. Mailing lists are built up from loyalty cards systems. Shops can send adverts that are aimed at particular customers. For example, someone who regularly buys garden magazines might be sent special offers on garden products. They can also use the information to see where the customers come from, and help work out if it is worth building a new store in particular places. The Data Protection Act applies to the personal data gathered by the schemes. The mailing lists which supermarkets gather from loyalty cards can also be sold to other advertisers as long as Data Protection law is followed.



Electronic money

Most workers now have their **wages** paid into their bank account **electronically** - the money is transferred directly into their account from their employer. Being paid in cash is now rare.

We don't use cash to pay for **goods** and **services** as often as we used to because there are now many **electronic** methods of payment, for example direct debit, standing orders, debit cards (Switch/Delta), smart cards, using Internet bank accounts etc

Electronic Commerce

Electronic Commerce - often shortened to E-commerce - is the name given to selling and buying things using the **Internet**.

E-commerce is important because:-

- Many people now have Internet connections.
- Setting up a company **website** and doing business through it can be a lot more cost effective than using purely traditional shops.
- Companies can have a national or even international customer "reach" with a website.
- Information about goods and services for sale can be put on the **World Wide Web**.
- People can find exactly what they need without hunting round shops or phoning around.
- Online catalogues can offer more detail than can be found from a shop assistant.
- Online catalogues can be examined at leisure rather than in a hurry at a shop.
- People do not leave their homes to shop using E-Commerce.
- The costs of delivery of goods are low and many carriers are available.

There are some **disadvantages** of e-commerce for the customer

- No human interaction
- Returning goods can be inconvenient and/or expensive
- There is a risk of fraud - goods may not arrive or be late
- A substitute product may be sent if your requested product is out of stock

Computerisation is changing the way we shop in a number of ways...

- Computerised **stock control** means shops can accurately predict demand. Ordering of stock is automatic.
- IT supports the growth of big stores but every business has access to the same technology, and so they all have the same opportunity to grow.
- Points cards (or **loyalty cards**) offer regular customers discounts and this puts smaller shops under threat.
- These cards enable the stores to build huge **databases** of customer preferences. Their personal details can be used in direct mail-shots for marketing goods.
- **Internet** and **digital** TV shopping means we can shop without leaving home.

The growth of large stores and Internet shopping has inevitably affected small shops:

- More small shops may go out of business.
- Local town centres are threatened by the closure of small shops.

Internet shopping

Home shopping options are many and varied and changing all the time. Most major supermarkets are now online, offering home delivery of goods and increasingly the major high street stores are competing for trade online. The Internet lends itself to shops selling goods which are easily transportable, such as CDs and books. Most websites are set up to do this work by having an online catalogue which you can browse, letting you add items to virtual basket, sending you to a virtual checkout, arranging delivery. Some things such as music can be delivered online in the form of downloads.

The benefits of home shopping to the customer include:

- You can avoid queues, save time and shop from the comfort of your own home.
- You do not have to travel into city centres or pay for car parking costs.
- You can shop around for the best prices and shop abroad for cheaper goods.
- It can offer the customer a wider range of shopping, 24 hours a day all year round.
- People who are house-bound have the ability to shop and have goods delivered.

The possible drawbacks of home shopping include:

- Security worries about payment by credit card over the Internet.
- You do not get to see the goods before purchase.
- You may worry that the the goods will never arrive!
- There may be concerns over retailers collecting details about the buying habits of customers.

Benefits to the company include:

- It opens the market to customers nationally and internationally.
- It enables smaller companies to compete with larger companies.
- There may be a possible reduction in staffing and/or shopping outlets, thereby reducing costs.
- You can offer 24 hour shopping at minimum cost.

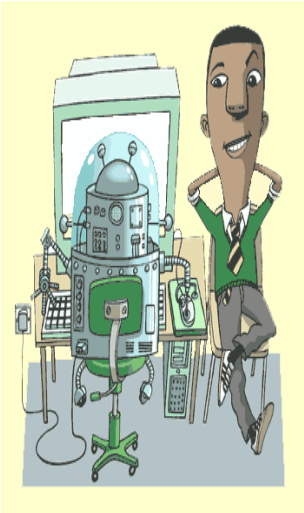
Home banking

Banking can be done 24 hours a day using a computer and **Internet** connection. Most major banks now offer **online** banking and some are offering Internet only banking. Without the overheads of running and staffing high street branches they can offer higher rates of interest to customers. Services offered include you can pay your bills from the comfort of your home or the workplace, it is possible to transfer money immediately to high interest accounts, you can check balances and daily transactions on line, it is possible to set up direct debits and order stationery on line.

Benefits to the customer include all services are from the comfort of your home or workplace, 24 hrs a day, 365 days a year, higher interest rates are available to Internet bankers, it is easy to shop around on line for the best interest rates and switch funds automatically.

Concerns include small branches are closing or having opening hours reduced, reductions in staffing at the major banks, the move towards banking from your PC, **digital** TV or mobile phone will only increase these concerns, some customers have worries about security because of possible credit card fraud.

Changing work patterns



Information technology has led to many changes in **how** we work, **where** we work and even **when** we work.

Until the middle of the 1990s you could not shop **online**.

- The closest thing to remote shopping was telephone ordering.
- The same was true for banking and all the host of Government and other services which now exist online.
- **Email** was in its infancy. Instead of messenger services you had to chat to your friends on the phone.
- Instead of mobile phones there was a craze for CB (Citizen's Band) radio.
- You could not send a document as an attachment. You had to fax it (which involves turning an analogue document into a digital file, sending it down a telephone line, and then turning it back into an analogue document which cannot be edited by the recipient!)
- If you lived away from towns you needed to travel to get essential services.

With the advance of communications and ICT, it is now difficult to do business or exist as an organisation without using email or a **website**. The sides of company vans carry web addresses as well as telephone details now, and it is normal to expect a company to have an informative web address.

Effects of e-commerce

Shops, banks, travel and entertainment companies have adapted to the **Internet** by developing **websites** that often do parallel business to their shops based in the high street. They can sometimes offer a discount for ordering **online** as it reduces their costs.

The many effects of E-commerce include:

1. **Distances are reduced**. People can find even specialist shops in their living rooms on the computer.
2. **Isolation is reduced**. Banking and other services that used to be concentrated in the town are now available wherever an **Internet** connection is available.
3. **Competition is encouraged**. The Internet allows people to research their shopping or other needs very thoroughly, checking prices and product details.
4. **Job availability**. **E commerce** can take business away from local shops and businesses and so affects the availability of jobs. But many companies have also started and developed based on E-commerce alone. Others have developed it as a response to competition.
5. **Increased convenience**. For consumers buying on the Internet has become convenient and safe.
6. **Increased dependence on the Internet**. Now, both for companies and individuals, there is pressure to have Internet access to do everyday things such as submit orders or look up details in a catalogue. There are initiatives to make as many services available on the Internet as possible, including E-government, where government departments such as the Inland Revenue can be dealt with using secure websites.

Better quality products

Products made with computers should be of a better quality than before. For example, car bodies are welded more accurately by robots than by humans.

- Robots don't get tired so the quality of work is consistent.
- Machines controlled by computer are more reliable than those controlled by humans.

Miniaturisation - many electrical items, such as mobile phones and video cameras, have become much smaller due to developments in technology

Employment patterns

The introduction of information technology has caused some unemployment, for example:

- Computer-controlled warehouses need only a handful of staff to operate them.
- Computer-controlled robots are now common on production lines, replacing human workers.
- The old skills of workers in the printing industry are now out-of-date.
- Some jobs have disappeared as they can now be done automatically e.g. checking football pools coupons, marking multiple choice exam papers.

However, it is fair to say that the development of information technology has led to many new jobs such as computer technicians, programmers, web designers and systems analysts.

Old jobs, new jobs

IT is more likely to have **changed** someone's work rather than led to them losing their job. This probably meant that people have had to be retrained to use technology:

- Secretaries now use **word-processors** and not typewriters.
- Travel agents book holidays by **computer**, not by phone or letter.
- **Telephone banking** has meant that many bank staff now work by phone in front of a computer, instead of being behind a counter.
- **De-skilling** has taken place. Some jobs which needed a high level of skill in the past can now be done more easily. For example, print workers today can use **DTP software** to lay out their work.
- Designers now use **CAD software** rather than pencil and paper on a board.

Teleworking, sometimes called telecommuting, means working from home using modern technology to keep in touch with your business. Jobs can be relocated to places where it is more attractive, more convenient or cheaper to live. The technology do need for teleworking includes a computer, E-mail facilities, perhaps a fax machine, a mobile phone, videoconferencing equipment e.g. web camera

Benefits to the employer:

- Office running costs and overheads (rates, electricity, heating etc.) can be reduced, which in turn may reduce the need for office space.
- Travel-related problems may be reduced.
- It may tempt better staff to come and work for the company.
- However, employers need to be able to trust their staff and be prepared to have less direct control over them.

Benefits for the employee:

- You can work from the comfort of your own home.
- There is no time wasted travelling and no travel costs.
- It enables you to work around the needs of your family and/or children, giving you greater flexibility.
- It is more convenient - you can plan the working day to suit you, which could help reduce stress levels.

Drawbacks include:

- There is less opportunity to meet people and share ideas - teamwork is more difficult
- There may be more temptation to spend time on non-work-related activities
- people often work longer hours than they should and find it hard to switch off and close the door on their work and emails.

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Video conferencing

Video conferencing means using computers to provide a video-link between two or more people. Instead of just talking to someone by telephone, you are able to see them as well.

What do you need for video conferencing?

- A high-specification computer
- A video camera. Small cameras, little bigger than a cassette tape box, can be purchased for around £100.
- A microphone
- A loudspeaker
- An **ADSL** connection or a phone line with a high-speed **modem**
- Video conferencing **software**

It is possible to buy a special video conferencing machine just for this purpose.

The benefits of video conferencing

- Meetings can take place without leaving the office.
- Travel costs and the time taken to travel can be reduced significantly.
- Meetings can be called instantly worldwide with little notice.
- Delegates can still attend meetings even if they are physically unable to.

Drawbacks to video conferencing

- May not be as productive as a discussion around a table.
- Confidential documents may need to be viewed and signed in person.
- There will always be times when you need to be able to meet face to face.

Health and safety

There are various health problems associated with the regular use of computers, and because of this employers must be aware of the regulations surrounding computer health and safety.

The law states that an employer must:

- Provide tiltable screens
- Provide anti-glare screen filters
- Provide adjustable chairs
- Provide foot supports
- Make sure lighting is suitable
- Make sure workstations are not cramped
- Plan work at a computer so that there are frequent breaks
- Pay for appropriate eye and eyesight tests by an optician

Note: These regulations apply only to offices - not to students or pupils in schools or colleges.

In order to provide the satisfactory equipment for their employees, employers use **ergonomics** to assist the equipment design process. It is the science concerned with designing safe and comfortable machines for humans. This includes furniture design and the design of parts of the computer like keyboards.

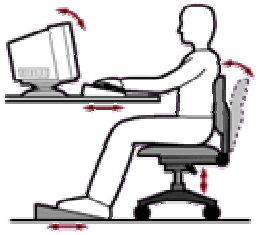
Don't forget that rules for all electrical appliances apply in a computer room. This means:

- There should be no trailing wires
- Food and drink should not be placed near a machine
- Electrical sockets must not be overloaded
- There must be adequate space around the machine
- Heating and ventilation must be suitable
- Lighting must be suitable with no glare or reflections
- Benches must be strong enough to support the computers.

Illnesses

Within Information Technology it is important that people have an awareness of the various health and safety issues. Steps should also be taken towards preventing common problems rather than trying to cure them at a later date.

Back problems - Many computer users suffer serious back problems. This is probably due to a poor posture or an awkward position while sitting at a computer.



A fully adjustable chair should avoid poor posture

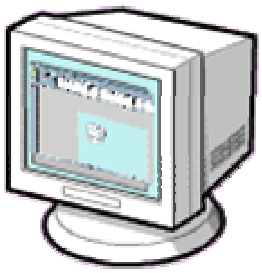
- Footrests can reduce these problems
- Screens should tilt and turn to a position that avoids awkward movements

Repetitive Strain Injury (RSI)

Repetitive Strain Injury (RSI) is damage to the fingers, wrists and other parts of the body due to repeated movements over a long period of time.

To prevent RSI, make sure your posture is correct, use wrist rests and have a five-minute break from typing every hour.

Eyestrain



Eyes can become strained after staring at a computer screen for a long time, particularly if working in bad light, in glare or with a flickering screen.

Screen filters can remove a high percentage of the harmful rays emitted from a computer screen

Use screens that do not flicker

Take regular breaks - do not work for more than one hour without a break

Lighting must be suitable and blinds fitted to windows to reduce glare

Ozone irritation

Health experts have suggested that ozone emitted from laser printers can lead to breathing problems. It is recommended that laser printers should be situated at least one metre away from where people are sitting and there should be good ventilation in the area.

Glossary

- **digital**
  Digital means having discrete values such as 1 or 0, unlike analogue which can have continuous values. Digital watches are called digital because they go from one value to the next without displaying all intermediate values.
- **hardware**
  Machinery and equipment such as the monitor, the mouse, the processor, CR Rom, memory stick etc.
- **ICT system**
  A set up consisting of hardware, software, data and the people who use them.
- **scanner**
  A device that can read text or pictures printed on paper and translate the information into a form the computer can use.
- **software**
  Instructions for a computer. Software tells the hardware what to do.
- **analysis**
  To examine and break down into parts.
- **data capture form**
  A form specially designed for collecting data.
- **direct changeover**
  Where an old system is scrapped and immediately replaced by a new system.
- **feasibility study**
  A report written by systems analysts advising the management on whether to introduce a new computer system.
- **flow diagrams**
  An drawing showing how a system will work.
- **hardware**
  Machinery and equipment such as the monitor, the mouse, the processor, floppy disks etc.
- **parallel running**
  Running a new and old system in parallel when introducing a new system in a company.
- **pilot changeover**
  A way of introducing a new system in a company by changing a small part of the company over to the new system first and ironing out any problems there before introducing it into the rest of the company.
- **systems analyst**
  The person whose job it is to investigate the current system and design and implement the new computer system.
- **test plan**
  An explanation of exactly how a new system will be tested and the expected outcomes for each test.
- **barcode**
  A group of vertical bars that can be read by an barcode scanner. The price is held on the database and the barcode is the primary key that is used to access the price.
- **VDU**
  Visual Display Unit - a monitor.
- **CD-ROM**
  Compact Disk Read Only Memory. These disks are optical disks that use the same technology as musical compact disks. They store up to 700Mb of data and a laser beam is used to read the data off the disk.
- **RAM**
  Random Access Memory - a fast temporary type of memory in which programs and data are stored whilst the computer is switched on.

- **ROM**
  Read Only Memory - a type of permanent memory where the content cannot be changed by a program or user.
- **hard disk drive**
  Magnetic disks which are used as a backing storage system and are fixed inside a computer
- **clip art**
  Pre-prepared images which can be used to illustrate a word processing or desk top publishing document.
- **desk top publishing**
  Using a computer to produce documents with page layouts made up of images and text.
- **frame based**
  A feature of desk top publishing where text and picture frames can be laid out on the page and moved and resized if necessary.
- **mail merge**
  The ability to 'personalise' letters with names and addresses from a database.
- **word processing**
  A type of package used for entering and manipulating text and images.
- **WYSIWYG**
  'What you see is what you get' - the view of the page in desktop publishing.
- **bitmap**
  Bitmap images consist of tiny dots called pixels. These images use more memory than a comparable vector graphic and lose their quality when re-scaled.
- **Computer Aided Design**
  CAD - a system which helps the user produce accurate drawings.
- **graphics**
  The range of pictures, drawings and images which can be produced by a computer.
- **pixels**
  Short for Picture Element, a pixel is a single point in a graphic image.
- **vector drawing**
  Images produced with a drawing package made up of lines, shapes and co-ordinates.
- **ADSL**
  Asymmetric Digital Subscriber Line - a fast method of connecting to the Internet.
- **browser**
  A program that allows you to view web pages
- **HTML**
  Hypertext Markup Language - language used to make a web page.
- **home page**
  A page that links the user to the other main areas of the site.
- **hypertext links**
  The feature that allows a text area, image, or other object to become a link that retrieves another computer file (another web page, image, sound file, or other document) on the Internet.
- **internet**
  A global network connecting millions of computers.
- **newsgroups**
  Areas on the net where you can get in touch with people sharing the same interests or find out about a particular subject.
- **search engine**
  A service used to search databases of web page files. It is the technology behind search providers such as Google.

- **surfing**
  Moving from web page to web page or moving between web pages.
- **URL**
  Uniform resource locator - the unique address of any web document.
- **WWW**
  World wide web - a network of web pages and sites.
- **web pages**
  Pages on the internet which may contain text, pictures, movies, animation and sound.
- **web servers**
  A computer that is connected to the internet and has server software installed which allows it to deliver (serve up) web pages via the World Wide Web.
- **website**
  A set of web pages.
- **data**
  Data is numbers, words or pictures without context or meaning.
- **file server**
  A file server stores files centrally so that other computers on the same network can access them.
- **hacking**
  The act of accessing computer systems illegally.
- **LAN**
  A Local Area Network covering a small area such as one building e.g. in a school or a college.
- **network**
  A number of computers linked together to allow them to share resources.
- **virus**
  A virus is programming code which spreads from computer to computer causing damage to the computer and/or software. A virus spreads by duplicating and attaching itself to other files.
- **WAN**
  A Wide Area Network covering a large geographical area.
- **Alpha-numeric**
  The mixing of numbers with alphabetic letters eg name, address, town, postcode. A phone number is usually an alphanumeric field. Most phone numbers begin with an 0 and may include spaces and brackets. If it is stored as a **numeric** field, leading zeros and any non-numeric characters will be removed.
- **data capture form**
  A form specially designed for collecting data.
- **database**
  A database is a collection of data which is stored in a logical or structured manner.
- **numeric**
  A type of field that is only numbers
- **range check**
  Checks that a value falls within the specified range.
- **validation**
  An automatic computer check to ensure that the data entered is sensible and reasonable.
- **verification**
  A check to ensure that the data entered exactly matches the original source.
- **back up**
  Copying information onto an alternative form of storage eg different server or CD.
- **corrupted data**
  Data that has been damaged in some way.

- **data security**
  Keeping data safe.
- **disk**
  A means of storing information eg floppy disc, hard disc, CD.
- **encryption**
  The encoding of data so that nobody can read it unless they know how to decode it.
- **Data Protection Act**
  A law designed to protect personal data stored on computer.
- **Information Commissioner**
  The official who supervises the enforcement of the Data Protection Act.
- **data controller**
  the nominated person in a company who applies to the data commissioner for permission to store and use personal data.
- **data subject**
  The person about whom data is stored.
- **data user**
  Anyone who uses the personal data as part of their job.
- **personal data**
  Information about a particular person.
- **cell address**
  The reference for each cell in a grid eg C5 means column C row 5.
- **cell reference**
  The address for each cell in a grid eg C5 means column C row 5.
- **grid**
  A table that's divided into rows and columns.
- **spreadsheet**
  An application that allows the user to enter numbers and text into a table with rows and columns and perform calculations on them
- **interact**
  Users are able to enter data or commands.
- **simulation**
  A program designed to imitate a real-life situation.
- **VR**
  Virtual Reality - a computer simulation which allows the user to interact with the system. Special interfaces give the user the feel, sound and view of the virtual system. The user wears a head-mounted display through which the virtual world can be seen.
- **copyright law**
  The law which makes it illegal for a person to copy an item such as a magazine article, a photo or a CD without the agreement of the owner.
- **data**
  Data is numbers, words or pictures without context or meaning.
- **FAST**
  Federation Against Software Theft - it is a not-for-profit organisation aiming to prevent software piracy and has a policy of prosecuting anyone found to be breaching copyright law.
- **hacking**
  The act of accessing computer systems illegally.
- **software piracy**
  The production of illegal copies of software.