

COMPUTER APPLICATIONS

This chapter deals with the areas where computers are used, what they are used for, how they are used, the advantages and disadvantages of their usage in such areas.

Computer Aided Design (CAD).

This is whereby computers are used in the designing and development of new products in a variety of applications both at home and on a commercial/industrial basis. Models of infrastructure like bridges are designed and tested for their strength before building actual structures on the ground. A **model** is a computer representation of a real object/process, often involving some formula that determines its behaviour, e.g. a bridge, house, etc. CAD is used in fields like:

- Aerospace
- Architecture
- Car/vehicle design
- Construction (e.g. Roads, services, surveying, tunnels, bridges, etc.)
- Consumer goods (e.g. kettles, toasters, etc.)
- Digital circuits
- Factory layouts (e.g. Ergonomics)
- Fashion design
- Heating systems
- Interior designs (houses, offices, etc.)
- Lighting systems (e.g. to get lighting effects at a concert)
- Machinery design
- Plant design (chemical, nuclear, etc.)
- Ship building engineering, architectural design, etc.

CAD Requirements

- considerable processor power
- Input devices like:
 - Light pens
 - Tracker balls,
 - mouse
 - graphics tablets
- Output Devices like:
 - Large high resolution screens
 - Plotters to draw scale and full size drawings
 - High specification graphics cards
- Some systems support stereoscopic drawings where 3-D spectacles can be worn and the user sees a 3-D image.

Features of the CAD software which are used in design are:

- Can zoom, rotate, scale, and crop images
- Has a library of geometrical shapes that will be used in drawings
- Has inbuilt library of components and templates.

- Have ability for labelling and adding text
- use 2-D and 3-D modelling
- has library of parts which can be used in new drawings
- use colour fill feature
- Validation and verification of designs against original specification
- Ability to link with **Computer-Aided Manufacture (CAM)**
- Facility to calculate the mass of the actual object once built
- Facility to calculate the cost of producing the article
- Simulation of designs without the need to build a prototype
- Import and export to allow the exchange of data with other software packages
- Kinematics (i.e. check moving parts in assemblies don't interfere with each other)

Advantages of Computer Aided Design

- Saves a lot of time spent in drawing and testing objects.
- Saves costs of designing items
- Produces accurate scale diagrams.
- Images are easily manipulated on the screen.
- One can produce drawings in 3-dimensions as in buildings, gardens, bridges, etc.
- Images can be saved on the disk and retrieved at a later date.
- Drawings can be easily scaled up and down.
- It is easier to modify drawings
- A library of parts can be kept for future use
- Ability to do automatic costing of items
- Ability to model the design
- Can do ergonomic study.

NB: Ergonomics: the design and functionality of the computer environment and includes furniture setup, ventilation, security, space, noise, etc.

Disadvantages of Computer Aided Design

- Can lead to deskilling (skills which were highly valued are taken to be useless or of less value by the introduction of computers and workers degraded to less important jobs)
- Involves very high training costs to use the packages
- Can move work overseas
- Can lead to unemployment as one CAD operator can do work of 5 manual draftsmen.

Virtual Reality (VR)

It is an artificial 3-D environment created by a computer system. It is the creation of simulated multi-dimensional representation of real things, e.g. armies fighting against each other.

Requirements for Virtual Reality (VR)

- **Data goggles/helmets** – these use display screens and optical systems that send 3-D images to the eyes.
- **Motion sensors:** measure the position and orientation of the head; this information is sent back to a computer which enables it to adjust the image being sent to the user.
- **Data gloves, suits containing sensors and joysticks** are all used to interface with a virtual reality system depending on the application.

NB. User wears data goggles, data helmet or data gloves to give a feeling of “being there”. Apart from feeding sensory input to the user, these devices also monitor user actions e.g. data goggles track eye movement and respond by sending new video input.

Areas of use for Virtual Reality (VR)

1. Entertainment:

- a) Used in films/television as special effects where the studio audience wear VR helmets in a space simulation.
- b) Also used in computer arcade games like Need for Speed.

2. Marketing

- a) Used in virtual tours around houses and hotels, kitchen designs, ergonomics, etc.

3. Training:

Areas of use include: military training, medical/dental training, teaching personnel how to use equipment and in general areas where training is dangerous and/or expensive e.g. flight simulators, car driving simulators, operating devices under water or in outer space, etc.

4. Design:

Design of chemical and nuclear plants, ergonomic studies (e.g. factory layouts), helping to develop devices for handicapped people, etc.

How to create virtual reality images for use on a computer system

When a virtual tour of a house is shown on a website, the images need to be first created and then manipulated. The following summarises how this can be done (a similar method/technique could be used for various applications):

- take photos with, for example, a digital camera
- the photos are taken from a single point (reference point)
- the camera is rotated around the room as a number of photos are taken
- the images are “stitched” together using special imaging software
- photo images are re-sized and re-configured for Internet use
- Use hotspots on the web page to allow a user to move around the house (e.g. from room to room).
- Integrate plans and maps into the image to allow user to navigate the house.

Developments such as *broadband*, large computer memories and compression software have allowed virtual tours to be offered on the Internet and/or CD/DVD files.

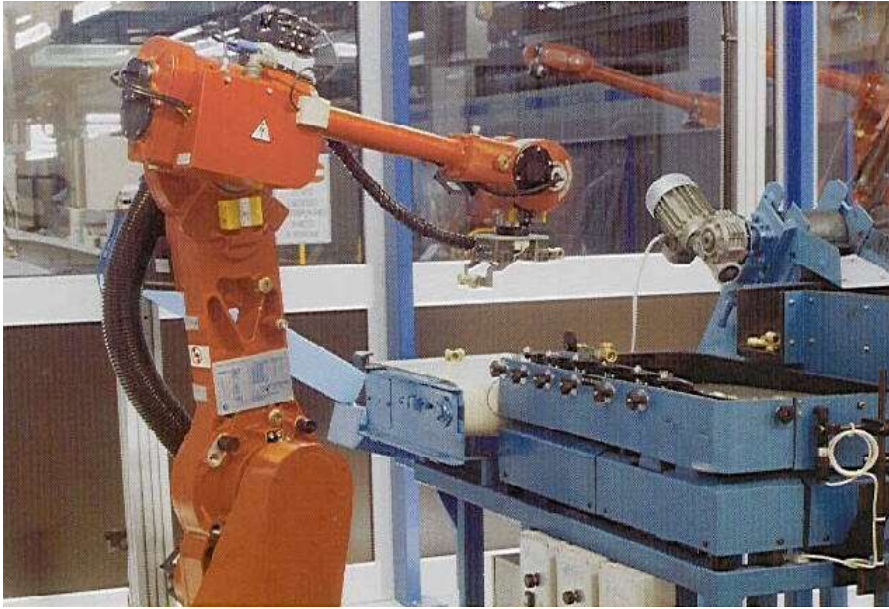
Advantages of using virtual reality

- it is safer to use than testing real objects (if mistakes are made the results would be harmless; e.g. doing a medical task on a “virtual” patient is much safer in case of mistakes)
- Saves costs since there is no need of building the real thing e.g. testing out a real moon rocket or building a part of a chemical plant would be very expensive).
- It is possible to do tasks which would normally be impossible (e.g. walking inside a nuclear reactor, doing a task in outer space, etc.)
- There is a feeling of “being there” which makes the training more realistic
- Allow a number of very realistic scenarios to be tested out e.g. how to deal with an emergency on a chemical plant which could be made to be really realistic

ROBOTICS

- A **robot** is a reprogrammable, multifunctional computer controlled device designed to perform multiple tasks in industries, replacing human beings; e.g. for spray painting, welding, fixing parts of a car, etc.
- **Robotics** refers to the science of developing and the use of computer controlled devices to replace human beings in manufacturing.





- Robots can contain embedded processors or be linked to a computer system.
- They are pre-programmed to do a specific task or “taught” to remember instructions from a human operator carrying out the task manually e.g. teaching a robot to spray a car with paint.
- Robots rely on processors and sensors. The sensors gather information so that the robot knows it is the right time to do the task (e.g. is a car in position to be sprayed, is there an obstruction to prevent the robot doing its task, etc.)
- They are capable of doing some pseudo-intelligent tasks (e.g. different sized cars to be painted)
- Robots are mostly used (suitable) in the following areas:
 - **In very dangerous areas for human beings to work**, e.g. fire fighting, nuclear power stations, underground mining, chemical, nuclear factories, deep in the ocean, in space, etc.
 - **In areas where heavy items are to be lifted**, e.g. for loading containers in ships, in production lines, etc.
 - **In areas where the degree of accuracy is of utmost importance**, e.g. manufacturing of computer chips. Thus producing standardised goods.
 - **Where work is repeatedly executed and boring**, like traffic control at road junctions

Features (parts) of a Robot

Robots have the following features (parts/characteristics):

- **Actuator (Manipulator):** - A moving part which resembles a moving arm used for lifting and fitting items.
- **Transducer:** They convert analogue signals to voltage signals.
- **Sensors:** capture information and data from the environment in analogue form
- **Analogue-Digital Converter(ADC):** Convert analogues signals to digital signals

- **Microprocessor:** Processes data collected from sensors
- **Power supply:** - Usually electricity through compressors or stepper motors.
- **Controlling Computers:** - Connected through an interface to give instructions to the robot.
- Have some form of **interface** (connection points to power supply, human interface, etc.)

Robots can move from one position to another, e.g. when lifting cars into the warehouse and when going for recharging their batteries.

They **keep a record** of the distance they have travelled and the angles they have turned through so that they can return to original position

They can sense (using light sensor) and stop if unwanted object gets on their way.

They need information and programming for them to work. Information is provided by sensors.

Advantages of Using Robots

- Reduces labour costs as less people will be employed.
- High quality work is produced, which is also of high standard and consistent.
- Reduces cost (price) of goods due to reduced labour costs.
- Increases production volumes of goods since more goods are produced in a very short period of time.
- Ensures high degree of accuracy when producing goods.
- Robots can operate in the dark thereby saving electricity costs.
- Robots do not take breaks and holidays as they do not get tired.
- Robots can work 24 hours a day; they can work non-stop; they don't need a break
- Robots reduce accidents at traffic lights.
- Robots improve traffic flow.
- Robots can work in dangerous conditions.
- Create employment as the robots need to be serviced and installed.
- Eliminates human errors involved in the production process.
- Removes the need to do boring, very repetitive tasks leaving humans free to do the more skilled work such as quality control.

NB: However errors still exists due to:

- Loss of power to the robot.
- Fault in the software (wrongly programmed).
- Occurrences of hardware break down.
- Some robot components can be missing or misplaced.

Disadvantages of Using Robots

- Leads to unemployment as humans are replaced by robots
- Electricity expenses are very high.
- they can find it difficult to deal with “unusual” circumstances e.g. a door is missing from a car waiting on the paint spraying line
- leads to de-skilling since many tasks are taken over by robots

ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) is the science of developing computer systems that have the ability to learn from experience and mimic human reasoning in specific areas, as in medical diagnosis, mineral prospecting, etc. Expert systems are a branch of Artificial Intelligence

EXPERT SYSTEMS

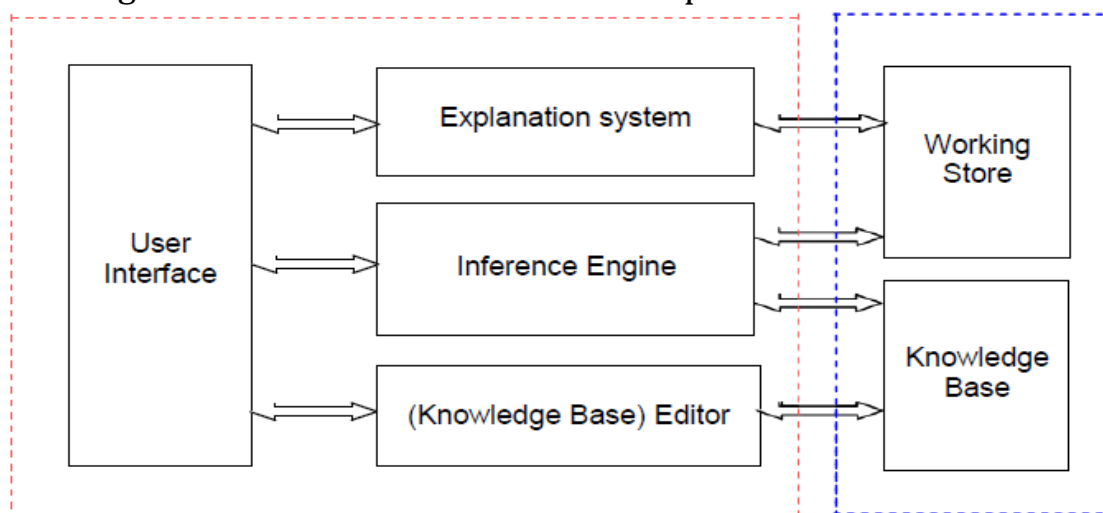
These are computer systems developed to mimic human reasoning and work at the level of an expert in a particular field, e.g. in medical diagnosis. A good example of an expert system is MYCIN that diagnose bacterial blood disease and then recommend appropriate antibiotic therapy for patients.

Expert systems are used in the following fields:

- oil or minerals prospecting,
- diagnosing a person's illness,
- Diagnostics (e.g. finding faults in a car engine, etc.),
- tax and financial calculations,
- complex “thinking” tasks such as *chess*,
- weather forecasting,
- criminology/forensic science,
- career choices, *etc*

Components (Elements) of an Expert System

- The diagram below shows some of the components:



- **Knowledge Base:** a representation of facts (data) in a particular field (e.g. diseases, symptoms, treatments, etc. as in medical diagnosis)

- **Inference procedure (engine):** contains reasoning methods used to arrive at a conclusion using information in the knowledge base. It contains interrogation technique/questions and answers.
- **User interfaces:** these enable people to form queries, provide information, and interact with the system.
- **Explanation facilities (system):** enable the systems to explain or justify their conclusions, and they also enable developers to check on the operation of the system themselves.
- **Rule Base:** This is found in the **Working Store**. It contains inference rules and the inference engine uses these to draw its conclusions.

The system uses a rule base and an inference engine together to simulate human reasoning when analysing a problem and arriving at a conclusion. To simulate human processes it is necessary to have a vast amount of information stored in the knowledge base and the reasoning set out as a set of rules in the rule base.

Steps Followed When Producing an Expert System

- Gather information from experts in the field.
- Design the knowledge base.
- Input data into knowledge base.
- Design the rule base.
- Design inference engine
- Design display of results
- Design appropriate user interface

Ways of Improving Expert Systems

- Frequently carrying out researches and making updates.
- Quickly inputting new data into the knowledge base.
- Assigning its control to a number of highly experienced personnel who will monitor and make updates as soon as possible.

Advantages of Expert Systems

- Provides consistent answers
- Fast identification of solutions to problems by quickly analysing data.
- They produce reliable and accurate results.
- There is no need for an expert to be present since they can act as a prompt to an expert.
- They can deal with complex situations much faster than humans.
- They could be used in hazardous areas (e.g. Oil prospecting).
- They are less likely to make errors.
- They do not forget as humans do.
- Many copies can be made at a low cost.
- Knowledge of several experts is combined.
- Save costs on wages and salaries for staff.

Disadvantages of Expert Systems

- They lack creativity.
- They are unable to learn outside the system.
- They lack sensory experience.
- They take time and are difficult to develop.
- They need to be constantly updated to keep pace with recent developments in the field they are applied.
- This may be difficult and time consuming to use.
- Data is entered by humans who may make mistakes in doing so. This can lead to incorrect decisions being made
- lacks common sense in some of the decision making processes
- cannot adapt to changing environments unless the knowledge base is continually updated
- expensive system to develop and set up in the first place
- needs considerable training to ensure system used correctly by operators

DATA LOGGING

The process of automatically collecting data from source at set intervals, over a period of time, for use at a later stage. A device that automatically collects data from source at set intervals for use at a later stage is called a **data logger**.

Features of Data Loggers:

- They contain processor inside them.
- **Have Interface:** Devices that act as connection point between data loggers and the computer.
- **They have own storage facility:** For storage of data collected from sensors
- They contain or are connected to **sensors** that are used for collecting data in analogue form. All physical properties can be measured with sensors e.g. light, heat, sound, pressure, acidity and humidity.

Sensor type	Purpose
Mercury Tilt switch	Detects if device is tilted, e.g. a vending machine
Light sensor	Detects the intensity of light (light level), e.g. so as to turn on or off street lights. Can detect light reflected from a barcode
Push switch	Used to turn on or off interior light, e.g. inside a fridge if a door is opened or closed
Temperature sensor	Detects temperature levels
Sound sensor	Records sound levels from beer halls, houses, etc
Proximity sensor	Detects how close to each other are two parts, e.g. if a window is opened; an alarm is raised because the proximity between the window and the sensor is

	changed.
Position sensor	Senses the angle of an object from a certain point, e.g from a robot
Pressure/motion sensor	senses when someone has walked over an object e.g. used in burglar alarm systems, automatic doors
pH sensor	Measures the acidity or alkalinity of objects e.g. of soil and water
Humidity sensor	Measures humidity (moisture) levels in air
Distance sensor (could be proximity)	Measure the distance from one point to another

- They can be connected to small keyboards or other special reading devices.
- They are connected to an Analogue to Digital Converter (ADC), which converts data signals in continuously varying form (analogue) collected by sensors into discrete (digital) values that can be accepted by the computer.

Types of data loggers

a. Data loggers with permanent computer connection

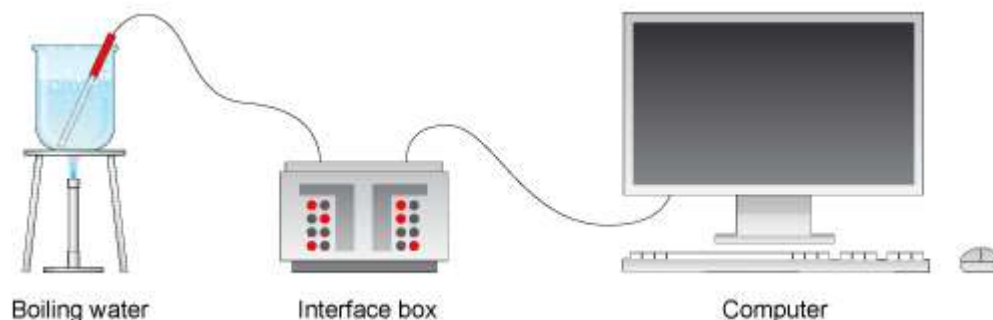
- These take readings and send them to the computer in offices through connection cables or through wireless connections.
- The time intervals (time between each reading) and the period over which the logging takes place can vary
- The computer may process the readings instantly and produce graphs
- The readings may also be stored on the disk for processing at a later date
- These are suitable for experiments in laboratories

b. Data loggers with temporary connections

- These are not always connected to the computer, but are connected when necessary
- They are mostly used in monitoring environmental conditions over a period of time
- The time intervals (time between each reading) and the period over which the logging takes place can vary. 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.
- Readings are stored by the data logger and loaded into the computer at a later date for processing
- They can be used in remote areas (not directly connected to the computer): **remote data logging**.

Performing the data logging process

This can be illustrated by the diagram below:



- Connect sensor to the interface
- Connect interface to the computer
- Load data logging software (if not loaded already)
- Enter time interval (e.g. 30 seconds)
- Specify total reading time
- Display results as a list on the screen
- Produce graphs for analysis of data. Other graphs can be plotted automatically
- Save data on disk for use at a later date
- Export data to other applications like spread sheet

Benefits of computerised data logging

- Data loggers are a very fast method of data collection than manual methods.
- Data can be processed immediately (real-time)
- Data loggers are very accurate than humans in collecting data.
- Data loggers enable collection of data on events that happen too quickly than human beings could do.
- They can also record data on events that happen too slowly and boring for human beings to carry
- Data loggers stored data for a very long period of time.
- Data loggers can work 24 hours a day, thus ensuring continuous data logging process.

MONITORING AND CONTROL SYSTEMS

Monitoring System: A computer program that keeps track and verifies the operations of a data-processing system and warn the user if an anomaly occurs, e.g. patient monitoring in hospital, monitoring key parameters in chemical and nuclear plants, monitoring for intruders in houses using burglar alarms, etc. In monitoring, there is human intervention.

Control system

- It is a system in which one or more computers are used to monitor and regulate the operations of non-computer equipment like in oil refineries.

- Control systems involve monitoring and logging of physical quantities, provide an analysis of performance and allows some user interaction.
- Feedback is an essential element as well as timing.
- Most control systems are real-time systems, e.g. in oil refining, chemical processing, traffic lights (controlling the sequence of lights to maintain optimum traffic flow), chemical and nuclear plants (opening and closing valves, safety systems, etc.), etc.

Components of Computer Control

- A **computer** (or microprocessor).
- **Sensors** to enable the computer to detect quantities such as temperature or pressure.
- **Motor**: Devices which actually turns on or off other devices, e.g power supply, windows, vents, water pipes
- **Devices** for the computer to turn on and off.
- An **interface** to connect the sensors and devices to the computer.
- **software** to read data from the sensors and turn the devices on and off

Automated Systems: -

- These are control systems that are dedicated to one particular task and lack the ability to collect and analyse data as in digital cameras.
- They do not allow for or act on user interaction, e.g. washing machines, cameras, watches.
- Most control systems have embedded computers systems inside them.

NB: Embedded Computers: -

- Refers to use of microprocessors in non-computer equipment like in cameras, washing machines, watches, etc. They do not have mouse, monitor and keyboards.
- These are normally dedicated for a specific task they are designed for. Embedded computers are also found in household items like camera, microwave, washing machine, video recorder, fridge, sewing machine, air conditioning, electronic toys, rice cooker dish washer, Televisions, alarms, clock, radio, DVD players, etc.

How monitoring and/or control is done

- Sensors gather information from the application being monitored or controlled in analogue form.
- The Analogue to Digital Converter (ADC) translates the analogue data into digital form that can be understood by the microprocessor.
- The microprocessor compares the incoming data with the data values already stored in memory.
- If it is a **monitoring** system the computer system will warn the user in the form of a sound (e.g. a siren if a burglar alarm, a loud beeping sound if monitoring patients in a hospital)

- If it is a **control** system, the computer will send a signal to a device to switch on or off (e.g. if controlling a central heating system, if temperature > set temperature a heater will be switched off and/or a cooling fan switched on; if the temperature is below the set point then the heating will be switched on and/or a cooling fan switched off). The digital signal will be converted to analogue form using a DAC (Digital to Analogue Converter). Actuators are usually employed to operate devices like valves, heaters, etc.
- The computer/microprocessor system will continually monitor the data coming from the sensors
- In chemical and nuclear plants, there is often a combination of monitoring **and** control taking place. Information from sensors is often displayed on a control panel where operators can see key values and alarm conditions (e.g. if a system monitors temperatures and 110°C is the normal temperature and 120°C is the alarm temperature, the control panel will show normal, present and alarm values in the form of read outs – **either** the computer will automatically take action if necessary or the operator will take action (override the system if necessary))

Differences between Control and Automated systems

Control Systems	Automated Systems
Can have several tasks	Dedicated to one task
Can collect and analyse data	lack the ability to collect and analyse data
Allows user intervention	They do not allow for or act on user intervention
Has an element of feedback	Do not involve feedback

Feedback: The process in which part of the output of a system is returned to its input in order to regulate its further output.

Benefits of monitoring and control systems

- It is safer to use computer control than human beings, e.g. in monitoring temperature in a blast furnace, monitoring radiation level in a nuclear reactor, etc.
- It is faster to respond to problems that may affect the system, e.g. nuclear reactor can automatically shut down in response to earthquake
- They don't get tired, thus computers can work 24/7
- Computer systems do not miss key data that must be entered into the system as humans do.
- Computer control is more reliable than human beings
- computers are more accurate and can take more frequent readings (e.g. if readings need to be taken every 30 seconds, humans can make mistakes or miss readings or even find it impossible to take readings at such short time intervals)

- data can be automatically displayed and analysed without the need to enter data manually (which in itself could introduce errors into the system)
- Data can be automatically stored and used in other programs.
- The results of the system can be automatically stored in a spreadsheet package or a database package for future reference.

Disadvantages of monitoring and control systems

- High initial costs because computer-controlled devices are more expensive to buy and to set up.
- Fewer workers will be employed leading to a rise in the numbers of the unemployed.
- The software for the control system is very expensive
- If the computer malfunctions the system will not work
- If there is a power cut the system will not work
- The computer can't react to unexpected events like a human could. It can only respond in the way it has been programmed to.
- It can cause some concern if total control for a system and the decisions are handed over to a computer.

COMPUTERS IN GREENHOUSES

- The environment must be kept constant if plants are to grow successfully in greenhouses.
- Temperature and humidity in the air needs to be controlled so that it is kept constant
- Sensors are used to record humidity and temperature levels in analogue form. The analogue signals are sent to the computer
- The computer will have stored **(pre-set)** values of minimum acceptable level and maximum acceptable level for both temperature and humidity
- If the sensor records humidity level below the minimum acceptable level, the computer will send signal to the actuator to close the windows and switch on the pump for a certain period of time, which will spray water as a fine mist inside the greenhouse.
- Too much humidity will cause the processor to send signals to the actuator to open windows to assist ventilation and drying out air.
- In case of temperature, if the greenhouse becomes too hot, the windows are opened and heater turned off. If it becomes too cold, windows are closed and heater switched on.

Inputs:

Humidity/moisture (collected from humidity/moisture sensor),

Temperature (all in analogue form; collected from temperature sensor)

Processing:

- detecting temperature/humidity level

- Processors compares pre-set values in the computer with data collected from sensors
- Processor instructs actuator to take action if values exceed or are less than minimum/maximum pre-set values

Outputs:

- Windows open or closed (digital form)
- Heater on or off (digital)
- Pump for water supply on or off (digital)

MINERAL AND OIL PROSPECTING

An Expert System called prospector asks the user to enter geological formations of a particular area such as rock and soil type and then gives advice on the possible mineral deposits that can be found in that area.

Inputs

Geological data such as rock and soil type

Processing

Draws conclusions from rules and facts using geological data entered and the mineral data stored in the knowledge base

Output

Possible mineral deposits that can be found in that area

COMPUTERISED TRAFFIC CONTROL SYSTEM

Input:

- Data is read from sensors(light sensor, motion/pressure sensor, weight sensor, sound sensor, etc)
- Data is read from camera images

Processing:

- Computers analyse data from sensors.
- Computers calculate average traffic flow and speed.
- Computer sends signals to actuators to adjust change of lights and timing

Output:

- Change of lights at junction.
- change timing plan

Advantages of using computerised traffic control systems

- Ensures improved traffic flow control.
- Reduces traffic accidents.
- Keeps delays to a minimum.
- Reduces pollution. cars use less fuel

In case of an emergency, the computerised traffic system may perform any one of the following:

- Give uninterrupted path through the system of linked traffic lights.
- Give green link – wave for all traffic to pass.

- Turn all lights to red.
- Activate emergency generator.
- Sound an alarm.

MICROPROCESSOR-CONTROLLED STREETLIGHTS

Input:

- Pre-set values of Sunset time and Sunrise time
- Light level (Light sensor sends measurement of light to microprocessor, ADC converts this to digital)

Processing:

- Processor compares sunrise time, sunset time and current time.
- If sunrise time = current time or higher, the processor send signal to actuator so that it switches off lights, else,
- if signal equals sun set time, the processor send signal to actuator so that it switches on light.
- Also the amount of light is compared with pre-set value. If higher – nothing happens, If lower or equal sends signal to send signal to actuator so that it switches on the streetlights.

Output:

Lights switched on or off

REFRIGERATORS

Inputs:

- temperature level (from temperature sensor/ or entered manually through the number pad),
- Pressure (from pressure sensor/contact switch/push switch) ,
- push switch setting

Processing:

- Analogue data from sensors is converted to digital by the ADC
- Processor controls temperature level by comparing with pre-set values.
- If temperature is higher than pre-set value, the processor sends signal to motor to switch on compressor
- If not higher, the compressor is switched off by the actuator
- Processor controls the display panel.
- Processor sends signals to display panel and to the motor to switch lights on or off.

Outputs

- Switch on lights if door is opened and off when closed
- Light emitting diodes indicating current temperature of the inside of refrigerator.
- A warning buzzer (sound) if light is left open.
- Cold temperature

AIR CONDITIONERS

Inputs:

- Pre-set temperature level
- Temperature from temperature sensors
- Pressure from pressure sensors: monitors pressure of refrigerant

Processing

- Processor controls temperature.
- Processor sends signal to motor to change fan speed
- If temperature is below pre-set value, the processor gives motor signal so that it switches off fans
- If temperature is above pre-set value, the processor gives motor signal so that it switches on fans
- Processor controls timing and the display panel

Output

- Cool temperatures in the room
- Fans switched off or on depending on the situation

DIGITAL CAMERA:

Input:

- Light mode(night or day mode)
- Film speed
- Colour setting

Processing:

- Processor sends signal to automatically adjust film speed,
- Processor positions the end of film,
- Processor sends signal to adjust distance from object,
- Processor sends signal to adjusts light.
- Processor sends signal to save image on the memory card

Output

- Sound to indicate that the film/picture has been taken
- Image/film captured and stored
- Light flashed to indicate film/picture is taken

SPEED CAMERAS:

These are used on roads to take photographs of cars which have exceeded the speed limit. Some of these cameras use microprocessor controlled chips to store information.

The advantages of speed cameras with microprocessor controlled chips are that:

- Data and images can be transferred automatically which will be faster.
- Image can be viewed straight away.
- Can store considerably more data and photos.
- Can store other information (apart from photo image) e.g. road conditions.
- Chips can be re-used.

Inputs

- Maximum speed (speed limits)
- Road condition

Processing:

Tasks which would be carried out by the microprocessor as a speeding car approaches a camera include:

- Sense and record speed of vehicle.
- Compare speed of vehicle with stored value(s) and decide whether photograph should be taken.
- Check on value of light intensity.
- Adjust focal length, focus image, adjust shutter speed and set exposure.

Tasks which would be carried out by the microprocessor as the photograph is being taken include:

- Log the time.
- Log the date.
- Log the speed.
- Record the road conditions.
- Operate —flash.
- Operate shutter.
- Instructs storage of the image.
- Check on value of light intensity.
- Adjust focal length and focus image.

Outputs

- Video/pictures of cars captured
- Alarms of over-speeding cars

MONITORING SYSTEMS IN HOSPITALS

These are systems designed to monitor critically ill patients or premature babies. Some biosensors connected to the computer are attached to the patient for tracking and recording vital signs such as heart beat, blood pressure and brain activity. The biosensors will transmit readings to the central computer should the situation go beyond a critical warning level and:

- issue a warning on the computer display for nurses on standby
- sound a warning siren, beep or sound to alert medical staff
- flash a light to draw attention of medical staff

Patients in intensive care are monitored through sensors. The sensors measure and give feedback pertaining to: blood pressure, temperature level, weight, pulse rate, etc

The computer is pre-set with normal range of values. It compares these with feedback from sensors.

Computers record patients' medical data over some time for later analysis. Data recorded includes:

- **Taking** measurements on patients, for instance: blood pressure, temperature level, weight, pulse rate etc. This relieves nurses of some duties that will be boring, making them faster and more reliable.
- There are however some hospital tasks that are more suitable for human beings to perform than computers. These include dressing patients, bathing patients, etc

In hospitals, computers also perform the following:

- Used to **hold data** for children's immunisation processes.
- **Monitoring** of patients during surgery as they control body scanners and sensors.
- **For Stock control** : For hospital blood stocks, food stocks, drug stocks, etc
- **For patient Booking system** : For out-patients and in-patients to see the doctor
- **For keeping Personnel records** : For keeping and management of employee records

MICROWAVE COOKERS

Function by switching a microwave unit **on** for a sufficient time to either defreeze frozen food or cook it. It is used to cook food quickly by using waves (similar to radio waves) to heat the food.

Inputs:

Modern cookers have sensors attached to a microprocessor for detecting as inputs:

Weight of food

Temperature of food

Some cookers will also have additional sensors for detecting:

Amount of steam produced during cooking

Amount of alcohol produced

Processing:

- The microprocessor continually monitors sensor readings and by referring to a programmed in-built database of food types.
- The microprocessor determines **time** needed to cook or defreeze food.
- IF a temperature in the food indicates the food is cooked OR the time set on the oven clock is reached THEN microwaves are not produced

Output: Heat for cooking, Light indicating that food is cooked, power turned off if food is cooked,

SIMULATION AND MODELLING

Modelling

A model is a representation of a real-life process/object which consists of a set of equations which describes the behavior the process or object.

Modeling is the creation of a programmed simulation of a situation/process in order to predict future trends.

It involves the use of **mathematical formulas** and calculations to predict what is likely to happen based on data recorded.

In modeling, we use the computer to solve equations so that we can carry out simulation.

An equation for part of an economic model could be:

$$\text{Unemployment} = \text{people able to work} - \text{people working}.$$

You can develop and evaluate your own models or use the models that have already been set up to simulate a real life situations

3-D Models can be built using CAD, e.g for planning stores.

Advantages of modeling

- No equipment is damaged
- People are not put in any danger
- Expensive prototypes don't need to be built
- Time can be sped up or slowed down
- Models can be run and re-run over and over
- Modifications can easily be made and re-tested quickly

Disadvantages of Modeling

- The results depend on how good the model is and how much data was used to create it in the first place.
- Models and simulations can't ever completely re-create real-life situations.
- Not every possible situation may have been included in the model.
- The equipment and software are expensive to purchase.
- Staff need to be trained how to use the software and equipment.

SIMULATION

Simulation is the study of the behaviour of a system using models in order to predict future real life events, like population growth, flight simulator, etc. It involves feeding values into a model to see how the model behaves.

In simulation, past and present data, as well as models are analysed in order to predict the future. Simulation is used in the following areas:

- Training (e.g. pilots, drivers, medical doctors, etc.)

- running/testing chemical plants and nuclear plants
- trying out equipment to be used under sea or in outer space
- crash testing cars
- financial simulations (e.g. stock market predictions based on various scenarios)
- population growth (i.e. predict how the world's population will increase based on a number of different scenarios)
- queues (e.g. simulating queues at supermarket checkouts)
- weather forecasting

Advantages of simulation

- saves cost (rather than doing the real thing)
- safer (scenarios tried out on the simulation first before used in reality)
- possible to try out various scenarios in advance
- Some environments make simulations the only way to carry out a task beforehand (e.g. outer space, under sea, chemical processes, nuclear reactors, etc.)
- faster (no need to build and test real system, so it is possible to get results more quickly)

FLIGHT SIMULATOR

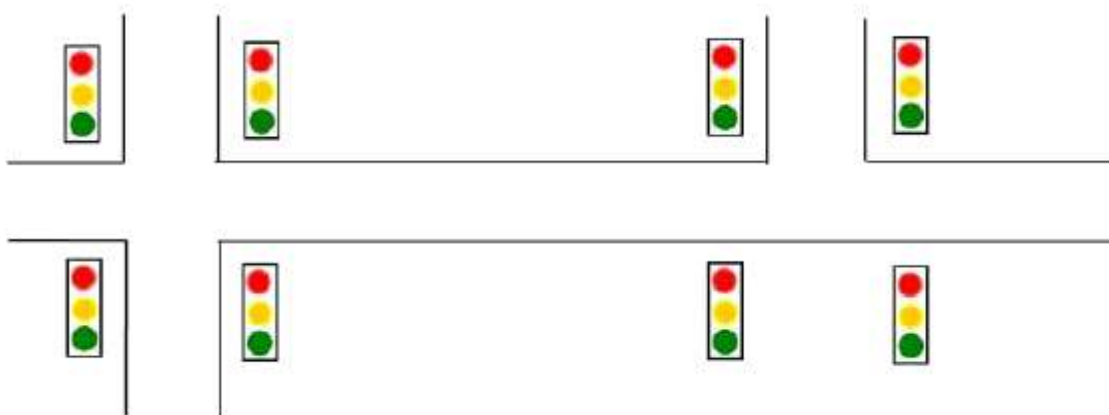
- Flight simulators are used to train pilots how to fly aircraft.
- They can also be used to test new aircraft before they are actually flown for the first time.
- Flight simulators are expensive to buy but are much cheaper than actual aircraft.

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

Flight simulators enable pilots to experience turbulence, snowstorms, thunderstorms, fog, etc, without leaving the ground.

Simulation at Road Junction

The following is a series of traffic lights at two busy junctions:



In this simulation it is necessary to consider

- In this simulation it is necessary to consider:

- how and what data is gathered
- how the simulation is done
- how the system would work in real life
- why simulations are done

How data is gathered

To make this as realistic as possible, data needs to be gathered over a long period of time. This can be done by sensors in/near the road, using cameras or manual data collection. Data gathered includes:

- number of vehicles passing in all directions at each junction
- number of vehicles passing in all directions at each junction at a particular time of the day
- Number of cars build up at a junction before lights change
- is it a week day or weekend or public holiday
- how long it takes to clear vehicles at a junction
- other data (e.g. pedestrian crossings)
- time taken for largest/slowest vehicle to pass through a junction
- other factors (e.g. filtering of traffic to the right or left)

How simulation is done

The data is entered into the computer and the simulation is run. The following scenarios may be tried out:

- timing of lights is varied to see how the traffic flow is affected
- build up number of vehicles stopped at a junction and change timing of lights to see how it affects the traffic flow
- increase/decrease traffic flow in all directions to see how the traffic is affected
- try out the impact of accidents
- consider passage of emergency vehicles
- effect of adding in pedestrian crossings
- once the simulation is run, the timing of the lights is determined and how they interact so that the maximum traffic flow is achieved;
- fault scenarios (e.g. an accident) and their impact are considered

How the system works in real time

- Sensors in/near the road gather data (these can be light/infra-red sensors, induction loops, pressure sensors, etc.)
- the data is usually number of vehicles passing a particular point
- the data is sent to a control box or computer system
- the gathered data is compared to data stored in the system (the stored data is based on simulation runs, how the number of vehicles at a junction at a particular time of day affects the traffic flow, etc.)
- the control box or computer “decides” what course of action to take and sends signals to the traffic lights to change timing if necessary

- as with any system involving sensors, ADC and DAC interfaces may be needed

SIMULATION IN WEATHER FORECASTING

Another example of simulation is predicting weather (i.e. a weather forecaster).

How and what data is collected

- Super computers are used since they control satellites in orbit.
- sensors measure the following variables in analogue form
 - o pressure,
 - o temperature,
 - o relative humidity,
 - o wind speed and
 - o wind direction
- sensors are placed in weather balloons and/or weather stations
- information is also got from satellites
- pilots also send in information regarding weather conditions during long flights
- The data collected by the data loggers will be in analogue form and the ADC device converts this to discrete values (digital) for the computer to accept.

How the simulation is done

- Data and information from the sensors/satellites is sent to computer for processing
- This data is compared to information stored on files which contain known weather patterns from the past
- predictions are made based on these comparisons
- Calculations are made to produce expected minimum and maximum temperatures, pressure, moisture content, rainfall patterns, etc
- the computer produces weather maps showing isobars, temperatures, etc.
- computer can show graphically how weather (e.g. cloud formations) will change with time (i.e. predict weather patterns) – this is often presented as a computer generated video showing how clouds build up, how temperature and pressure changes over, for example, the next 7 days, wind speeds etc.
- it is also possible to do statistical analysis and predict the percentage probability that certain weather conditions will occur.

How future environment/climate changes can be predicted

- Weather forecasting uses the concept of simulation and modelling i.e. predicting the weather by studying a mathematical weather model.
- The measurements are then entered into a mathematical weather model which then makes complex calculations to come up with the weather reports.
- based on changes in weather patterns, the processor carries out a statistical prediction
- model is able to change parameters to see how future climate can be affected
- there is need to review a lot of previous data over a number of years to check if changes are genuine , for example 20 years, predictions compared to actual climate conditions to validate/further refine the model
- can make use of spread sheets and statistical software packages for other calculations

Output:

- Information obtained is displayed on the computer screen ready for presentation on televisions
- Information can be printed documents.
- Tables and graphs are produced
- Rainfall maps and isobars are produced.
- Expected minimum and maximum temperatures are produced
- Areas of pressure change with time so it is possible to predict rainfall, strong winds, etc. in advance
- Show how the clouds patterns will change with time so it is possible to predict rainfall

Advantages of this automatic weather forecasting system include:

- Computer can take readings during weekends and public holidays without the presence of human beings.
- Computer readings are more accurate.
- Readings can be taken more frequently.
- Readings can be taken any time of day or night.
- Graphs can be produced more easily.
- Readings can be taken more reliably.
- Humans can be more productive if not collecting data.

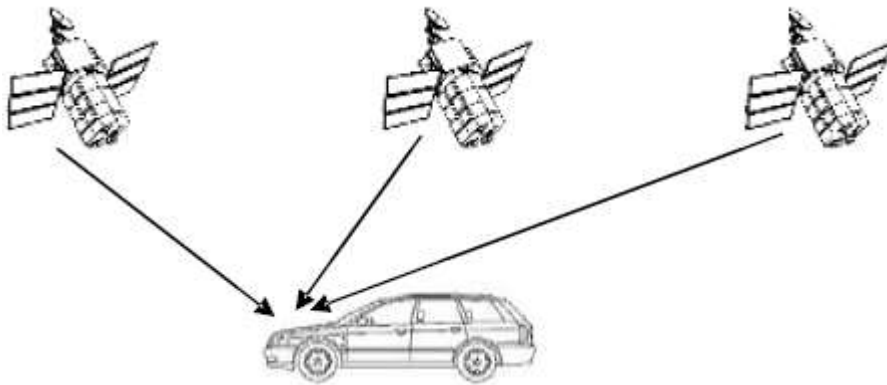
Embedded web technology (EWT)

- This is a new technology that uses the Internet in real time to control/interact with a device which contains an embedded microprocessor.
- The user needs to be authorised to do this and can control a device anywhere using a web browser (e.g. from a computer or even a mobile phone which is web-enabled).

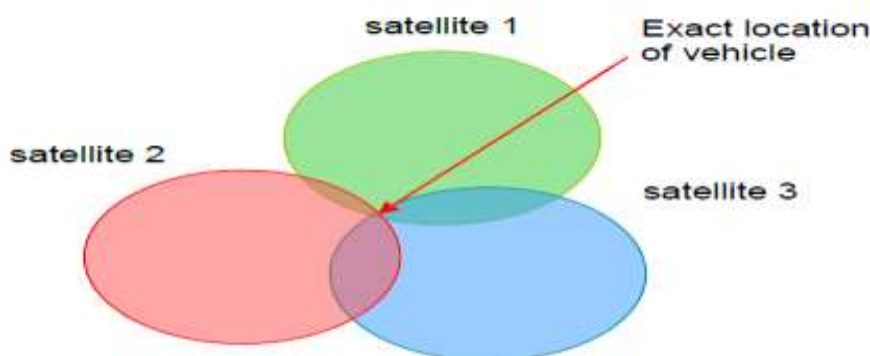
- Example: An oven contains an embedded processor. The owner can use a web ready mobile phone anywhere to control the oven remotely.
- By accessing a web site one is able to send instructions to control the oven.
- It is possible to control any device in this way if it contains an embedded processor e.g. television, DVD player/recorder, washing machine, scientific experiments in remote areas such as outer space

GLOBAL POSITIONING SATELLITES (GPS)

GPS - A navigational system involving satellites and computers that can determine the latitude and longitude (position) of a receiver on earth by computing the time difference for signals from different satellites to reach the receiver.



- GPS systems are used to determine the exact location of a car, airplane, ship or any form of transport which travels from one place to another.
- In vehicles these systems are called Satellite Navigation Systems (sat nav).
- Satellites in outer space transmit signals to the Earth.
- Computers in vehicles (e.g. car, airplane or ship) receive and interpret these signals.
- Positioning depends on very accurate timing – atomic clocks are used because of their accuracy to within a fraction of a second per day.
- Each satellite transmits data indicating its position and time.
- The computer in the vehicle calculates its location based on the information from at least three satellites as shown below:



- In motor vehicles the system is called satellite navigation (sat nav).
- The on board computer contains pre-stored road maps.
- The vehicle's exact location, based on satellite positioning, can be shown on the map; the driver can then be given verbal directions e.g. *"turn left into Josiah Tongogara Road"* **OR** a screen output showing the vehicle moving on the map

Advantages

- It is far safer since a driver of a vehicle doesn't have to consult maps whilst driving.
- it also removes error (e.g. going the wrong way down a one-way street).
- Sat nav systems can also give additional information such as position of speed cameras, estimate time of arrival, etc.
- GPS can monitor a vehicle's position if it has broken down or has been stolen (vehicle tracking system).
- In airplanes GPS can pinpoint its exact location in case of an accident which enables search teams to quickly respond to the incident.

Disadvantages

- maps may not up to date therefore instructed to turn into a road which no longer exists
- road closures due to accidents or road works may cause problems to a sat nav system
- signal loss can cause problems with GPS systems
- potential interferences from external sources (major problem on aircraft)
- incorrect start and end point entered into system can cause problems

THE INTERNET

Internet stands for INTERnational NETwork and it is a global (world-wide) connection of computer networks. On the internet, one is able to access data stored on a server in any part of the world as long as it is connected to the internet itself. The internet can be accessed from anywhere. It is also available to anyone. No one controls the internet as computers in different countries are connected yet the countries have different laws. However, each country may regulate internet usage in its own territory.

Definition of Terms

Information Superhighway (ISH): A global network of computers for moving huge amounts of information via satellite and cable connection. Information found on ISH includes home shopping, entertainment, news,

software downloads and help, online banking, stock market dealing, jobs, (vacancies), university placements, etc.

Information Technology (IT): - The use of computers in information handling and communication.

Information Age: A period beginning in the last quarter of the 20th century when information became easily accessible through publications and through the manipulation of information by computers and computer networks.

Global Village: the use of the internet to access information from any part of the world.

Information and Communication Technology (ICT): The use of computers and related method as a tool for information communication, for instance through e-mails, cell phones, etc.

Web page: a document or page on the internet that contains information about an organisation

Website:-a collection of web pages at the same domain, often with a common name and maintained and provide information of a single organisation, e.g. www.zimpapers.co.zw .

It is a page/pages on the internet that contains information about an organisation

Hyperlink :- an area of a page, usually text or image, that contains a links to another web page. It is usually underlined or has a different colour to show that it can link the user to another site.

Home page: A web page that loads first (by default) when one logs on to the internet. It then provides links to other sites on the internet.

Hardware Requirements for an Internet Connection

- **Modem (MODulator DEModulator):-** a device that converts analogue data to digital form and vice versa, often for internet connection using a telephone line. Alternatively one may acquire a GPRS (general packet radio service) modem.
- **Communication link:** Acts as a transmission media for data, e.g. telephone line, satellite transmission, etc.
- **Network cards** for each computer:- a device that identifies computers to the network, has an interface where network cables are plugged on the computer

Software Requirements for an Internet Connection

These are: Communication Software, web browser and Network operating system

(a) Communication Software like TCP/IP – Transmission Control Protocol Internet Protocol. Allows devices to connect to the internet even if they have different manufacturer standards by use of pre-set rules or international standards.

(b) Web Browser: refers to software used for opening web pages on the internet, for example Microsoft Internet Explorer, Netscape Navigator, Mozilla Firefox, Opera, etc.

- **Web browsers** are used view web pages from the World Wide Web (www).
- A web page is a site on the internet that provides information about an organisation.
- The World Wide Web (www) is a group of websites on the internet.
- Web pages can be created using any of the following software:
 - HTML (editor),
 - word processing package,
 - desktop publishing software,
 - web publishing software,
 - Presentation software.

Web Developing Software Features:

- Feature for changing the background colour or background image on a page.
- Feature for formatting text (size, font, colour, bold, italic, underline etc.) or frames.
- Able to work with tables.
- Features for inserting graphics/pictures/sound clip/video clip/animations.
- Features for working with links/creating buttons/list box.
- Features for switching to a browser to check the appearance of a page.
- Use templates.

Website features

The following are the general features of a good website

- shopping basket
- offer security when using credit/debit cards
- search facility for artist, tile, item, etc
- drop down boxes to choose categories
- help facilities
- currency converters for international customers
- date/sales confirmation by automatic email
- saved customer details/customised pages
- ability to track status of orders
- ability to listen to/view/see video/see product, etc
- recognise customer as soon as they log on
- buttons to navigate to other web pages

When designing web pages it is necessary to supply the correct spacing for customer information (and/or use drop down menus), buttons to navigate to other web pages, etc

(c) Network operating system: manages the network and offers security to internet users.

NB: internet account: a unique personal identifier given by the Internet Service Provider (ISP). An ISP is an organisation that links users to the internet, for example, Mweb, Ecoweb, Africaonline, Yahoo, Google Inc, etc.

Advantages of the Internet as a Source of Information

- Can be accessed from anywhere in the world.
- Information on the internet is up-to-date.
- Multimedia can be used.
- Huge amounts of information can be accessed; e.g., magazines, encyclopaedia, dictionaries, newspapers, textbooks, etc.
- Search engines are available to assist in finding information.
- Using emails you can access experts from all over the world on certain subjects.

Disadvantages of the Internet as a Source of Information

- Equipment and connections needed are very expensive (computers, modems (ISDN adapters) ISP, telephone).
- One needs knowledge to perform searches effectively.
- Problem of hackers.
- Breaches of copyrights are very common.
- Rampant spread of rumours on the internet.
- Spread of pornography to young people.
- Leads to loss of privacy.
- Some people become internet addicted and tend to interact with computers more than with human beings.
- Credit card fraud is rampant.
- Cultural erosion and replacement of local culture by a global culture

Searching information from the internet

- **Search Engines:** These are programs used to search data, information and other websites from the internet, e.g. Google, Yahoo, etc. however, it requires good skill from the user to efficiently use search engines in searching data from the internet.
- **Hits:** these are many irrelevant (unwanted) results that can be displayed by the search engine if the search engine is not used efficiently.
- To avoid hits when a search condition is entered, inclusion of statements such as AND (+) and OR will help narrow down the search. E.g. *ZIMSEC+syllabus*.

Internet and Security

Security is concerned with protection of data from unauthorised access and from deliberate or accidental loss.

Below are some of the security concerns and some suggestions on how they can be rectified / prevented.

Security Problem	Solutions / safeguards
Hacking	<ul style="list-style-type: none"> - Use of passwords and (usernames) ids to prevent illegal access to files. - Locking the computer itself or locking the computer room. - Encryption stops the information from being read even if access has been gained to a file but won't stop hacking!! - Installing firewalls
Viruses	<ul style="list-style-type: none"> - Use ant-virus software like AVG, Avast, Esat NOD32, etc, - Use firewalls to prevent viruses from entering a computer. - Do not open emails/attachments from "unknown" sources; - Only load software from disks/cds which are originals
Corruption/Loss of Data due to the following ways: <ul style="list-style-type: none"> - viruses - hackers - accidental damage to data - hardware faults - software faults - incorrect computer operation 	<ul style="list-style-type: none"> - Prevention of viruses is as given above
	<ul style="list-style-type: none"> - Prevention of hackers is as given above
	<ul style="list-style-type: none"> - Accidental damage to data can be prevented by: keeping back-up files or use the Grandfather-Father-Son (GFS) method; - use of passwords and ids can also help by restricting access in the first place
	<ul style="list-style-type: none"> - protection against hardware faults could be through keeping back-ups or use Grandfather-Father-Son; - use of UPS (Uninterruptible Power Supply), in case of power loss - Running parallel systems also help
	<ul style="list-style-type: none"> - Software faults can be solved by keeping back-up files or
	<ul style="list-style-type: none"> - Can also be solved by using Grandfather-Father-Son would help - Incorrect computer operation can be solved by: backing up files would guard against problems caused by incorrect shutting down of the system

Definition of terms (in the table above)

Hacking: Obtaining unauthorised access to protected and secure computer systems or network, usually using intelligent methods like cracking the password.

Hacker: A person who gains unauthorised access to protected and secure computer systems or network, usually using intelligent methods like cracking the password

Virus: A computer virus is a program which replicates itself, damages or corrupts files and memory of the computer, for example, the Love Bug virus which attacked computers in 2000.

Anti-Virus: These are programs that detect and remove (clean) computer viruses and reduce the risk of computers being attacked by viruses, e.g. Norton Antivirus, MacAfee, Avira, Avast, AVG, etc.

Encryption: data encryption is the scrambling of data before sending, for security reasons, so that it is not readable unless it is decrypted using.

Back-up file: A duplicate (copy) of the original file that is created and stored at different location with the original file, for security reason.

Grandfather-Father-Son files: Also called file generations: these are three versions of files that are kept at an organisation and are created as a result of sequential file updating.

UPS: Uninterruptible Power Supply (A device with rechargeable batteries that provide continuous supply of electricity to computers for a given period of time if there is power cut.

Parallel systems: Refers to the running of two different systems but doing the same job in the same organisation. Each system will have its own files.

Password: A password is a secret group of alphanumeric characters used to protect a document or file from unauthorised access

PIN: Personal Identification Number- a secret number used by individual account holders to access bank account and get service at the ATM, phone, Point of Sale terminal (POS) using debit cards, etc.

Firewall: Hardware and associated software used to protect networked private computer systems from unauthorised access by preventing outside data/users from entering the system while at the same time preventing internal data from leaving the system.

NB: Note

- Viruses do not only infect computers, they can also affect mobile phones, MP3 players etc. – any device which can download files from a source such as the internet is potentially at risk.
- Backing up may allow files that have become lost/corrupted (due to hacking or viruses) to be reinstated; however, this would not recover the system nor would it prevent hacking/viruses affecting a system in the first place.

- Problems like spam, pop-ups, cookies, etc. are more of a nuisance (they can also slow down the operation of a computer). These can however be blocked (or made inactive) by using suitable software.

When using the Internet, security can be enhanced using encryption.

Credit and debit card transactions can also be protected by a special type of password control.

For example, if a user chooses the password **COMPUTE34** to protect their credit card, when they buy something over the internet the card issuer will ask the user an additional question such as: "Please type in the 2 , 4 and 7 character of your password in the following boxes:

□ □ □ "

The user will then type in **O P E** and the card purchase will be authorised. This additional protection is used as well as encryption.

Some of the new systems allows user slots the card into the side of the keyboard and is required to type in a PIN before the Internet can be accessed. This gives an additional level of security since it is necessary to have the card, know the PIN associated with the card AND also know the user's log in id and password!!!

People's fear of the Internet

People's worries about the risks when using the Internet include:

- Encountering offensive websites while searching for goods or services, e.g pornographic sites, sites with hate language, etc.
- downloading viruses during a transaction
- being deceived by a bogus website and paying for counterfeit or non-existent goods
- interception of shopping account, card payment or banking account information making them vulnerable to unauthorised access to their accounts ('hacking') or fraudulent transactions
- Browser 'cookie' files identifying their computer to a web server, enabling a trader to 'retarget' them.
- receiving unsolicited email after they have been required to supply a valid email address in order to register for an account
- Erosion of local culture by global culture.

Services Provided by the Internet

1. Electronic Mail (E-Mail): A form of communication in which written/typed messages are send electronically over networked computers. In-order to send and receive e-mails, the following is needed.

(a) An internet connection

(b) An E-mail Address for both the sender and receiver:

- This is a unique identifier of the storage location of a person's mailbox.
- An e-mail address is made up of two parts that are separated by the "@" symbol, for example, kapondenit@gmail.com.

- The first part (kapondenit) is the username and is used to identify the name of the person or organisation that has the mailbox. The username is unique.
- The second part (gmail) is the domain name and is used to identify the server where the person has a mailbox.
- The other part (the one after the dot (.)) indicates the domain type e.g.
 - o .com – commercial organisation
 - o .edu – educational organisation
 - o .org – non-profit making organisation, etc
- An e-mail address should be known by many people so that they will know the address where to send the emails.
- Every mailbox is protected from illegal access by use of password.
- A **password** is a secret group of alphanumeric characters used to protect a document from unauthorised access.
- **NB.** When creating an e-mail, one is requested to enter the password twice in order to verify if it is the one you intend to use.
- **Mailbox:** - An electronic folder used to store electronic mails. It contains the inbox; which contains incoming mails; and the outbox; which is used to save outgoing messages.

Process of sending e-mail

- the user first logs on to email address,
- the sender composes the message and attaches a file (if required)
- The user then sends it by clicking on the send button.
- The message is transmitted to the sender's ISP/central host server.
- The message is stored on a central host computer of the sender.
- The mail server examines the address of the message
- The message is transmitted to the recipient's ISP mail server
- The message is stored in the recipient's electronic mail box.
- The addressee logs in to a local computer and receives the mail

Reading/retrieving the message

- the recipient logs on to their mail server
- the message is then retrieved from the inbox and sent to the recipient's computer
- the recipient reads own message (can be printed if there is need)

Advantages of e-mails as compared to ordinary mails

- It is very fast in sending messages (can be delivered promptly while ordinary mails can take days to reach their destination).
- It is very cheap to send e-mails since there is no need for envelopes, stamps, paper and pen, which are needed in conventional mail.
- They are reliable since e-mails rarely get lost.

- E-mails are time independent as they can be send any time of the day other than conventional mails which can be send during the normal working hours.
- E-mails allow multiple addressing, that is, one e-mail message can be send to several recipients simultaneously without having to retype it.
- E-mails can be saved for future use or reference.
- E-mails are more convenient to use as there is no need to travel to the post office or to shops to buy stamps and envelopes.
- In e-mails, attachments in form of reports, scanned documents, pictures and curriculum vitae can easily be attached to the e-mail.
- there are no language problems (systems can translate messages sent)
- - it is possible to read emails whenever you want – there are no issues of time differences as would be the case with video conferencing. If some delegates lived in the USA and the others lived in India, for example, the time difference is 10 to 14 hours which could be a problem)

Disadvantages of e-mail

- Not everyone has equipment to send e-mails.
- Junk mail (spam) is a problem.
- You waste a lot of time looking through mails that are just adverts.
- E-mails are not as secure as traditional mails.
- The system relies on people checking their mails regularly.
- Old people feel left out as they consider themselves too old to learn.
- Equipment used to send and receive e-mails is very expensive as compared to traditional methods.

However, despite the increase in the use of e-mail, there has been a sharp increase in the amount of paper used. This is because:

- People print copies for meetings and then destroy them afterwards, but if needed again, print out another copy.
- Some people find it difficult reading large amounts of text on the screen.
- People often e-mail colleagues rather than use the phone who then print out the document.

2. Teleconferencing: A method of conducting discussion with several people in different locations using the telephone.

3. Video conferencing: Conducting meetings with several people in different locations and seeing each other on the screen of networked computers. Video images and audio are seen/heard in real time on large monitors/through speakers. Delegates do not need to leave their homes

or work places or conference rooms. Video conferencing requires the following:

- A computer with a codec (which converts and compresses analogue data into digital data for sending down digital lines.)
- Video cameras or Webcam to take video images
- Microphone to speak through.
- Loud Speakers for delegates' voices to be heard.
- Large and high resolution monitor.
- Internet/WAN/modem to transmit data
- An integrated Services Digital Network (ISDN) line with a high bandwidth to transmit video data at fast speed.
- Sound card.
- Video card
- Compression software to compress video and sound
- which converts and compresses analogue data into digital data for sending down digital lines
- requirement for echo cancellation software (this allows talking in real time and keeps communications synchronised)

Advantages of tele and video conferencing

- It cuts transport cost incurred in travelling to the venue of the meeting.
- Reduces costs involving paying hotel bills and meals for the delegates.
- Saves time spend in travelling to the venue of the meeting.
- It becomes safer for employees since no travelling is done (no travelling accidents).
- There is no need for delegates to leave home/office.
- It becomes easier for several delegates to take part simultaneously.
- communication links are now much faster therefore images, sound quality etc. are now far better
- safety reasons (increase in world-wide terrorist activity, frequent travelling, etc. are all risks to company employees if they have to travel to meetings)
- improvements to the work/general environment (employees can work from home,
- less travel means less stress to employees but also means less pollution, disabled employees are no longer disadvantaged, etc
- more economical to have short notice meetings

Disadvantages of video and tele-conferencing

- Communication expenses are very high.
- Hardware and software requirements are expensive.
- People will lack personal contact and will socialize less.

- The hardware and software needed to run video conferencing is very sophisticated and expensive.
- Confidential documents may need to be seen in their original form, which may be difficult in this situation
- There is no direct eye contact, which plays a large role in group discussions.
- The quality of video or audio may be low, depending on the bandwidth.
- There may be interruptions due to breakdowns in transmission
- Power cuts may prevent the conference from continuing.

4. View data (videotext) systems: These are interactive systems on which users view data when they access specialized databases like Prestel. The requirements include:

- the telephone line or cable TV,
- specialized keyboard and
- A Television set.

Information on the database is provided by companies that advertise their products like news, weather reports, and so on. View data systems have the following advantages:

- they are interactive and
- service is provided for free to the public.

However, its requirements are expensive.

5. Teletext: It is a broadcast service that comes as a television transmission. It is cheaper than the internet service. However, it is non-interactive.

6. Facsimile (Fax): A method whereby output from a scanned document is sent over telephone line and reproduced on a fax machine on the receiving end. Fax method has the following advantages:

- It is very cheap to send messages.
- It is very easy to use.
- It is a very fast method of sending messages.

However, it has the following disadvantages:

- Its requirements are expensive (fax machine).
- There must be a person at the receiving end to attend to the fax when receiving messages.

NB: The use of fax, e-mail, view data, teletext, teleconferencing and video conferencing in an office brings about an electronic (paperless) office.

- An electronic office is an office in which the storage and processing of data as well as communication are done electronically.
- An electronic office is efficient because:
 - Communication is easier and faster.
 - Less paperwork is involved.
 - Current and up-to-date information is provided.
 - Ensures a clean office environment.

However, it is very expensive to setup and maintain an electronic office.

***NB**- The use of computers to perform all clerical and office duties is called Office Automation.

- Tele and video conferencing as well as networking bring about **tele-commuting** (tele-working). Tele-commuting is carrying out work without leaving home.
- Communication is done through networked computers.
- Requirements for telecommuting includes: modem, very fast communication links (for example telephone line), computers, internet services, etc.

Benefits of telecommuting

- Easier to concentrate on work in a quiet environment than in a noisy office.
- It saves time spent in travelling to the work place thereby increasing productivity.
- It cut costs involved in travelling to work place.
- The employer saves costs of office space and overheads like water and electricity.
- People can be recruited from a wide geographical area.
- People with disabilities like the handicapped can be employed.
- People in different locations can work as a team.

Disadvantages of tele-commuting

- Workforce not in office is difficult to control.
- Workers would not understand corporate goals and will not be loyal to the organisation.
- Employees feel isolated and miss the environment of an office full of colleagues.
- People may find it difficult to work in teams.
- It is difficult to separate work from home duties while at home.
- Unions find it difficult to mobilise workers for demonstrations and strike.

7. File Transfer : allows users to transfer files from host computers on the internet to their personal computers.

8. News groups: a global electronic bulletin board system in which users exchange information on different topics.

9. Entertainment: the internet provides an option for users to download and listen to music, newspapers, radio stations, etc.

10. Internet Shopping: (Internet buying, electronic commerce, online shopping): The internet provides a facility for customers to purchase products from the internet without visiting shops. Credit cards are used in internet buying.

Advantages of buying from the internet

To the customers

- Programs are available to search for the cheapest products on offer.
- Customers have more time to choose.
- Shopping is done any time of the day, thus providing a 24 hour service.
- A wide choice of products is available.
- Shopping can be done by setting up a file.
- It is very convenient to use as customers do not leave their homes for shopping.
- It cut travelling costs to the shops.
- Customers do shopping without being jostled by crowds.
- There are less cases of impulse buying.
- Product reviews are obtainable before purchase.
- Goods and services usually cheaper on the internet.
- Customer need not to go to shop and therefore save travelling time.

To businesses/shop managers

- Business is carried out any time of the day (provides a 24 hour shopping service).
- Increases sales due to greater number of customers from all over the world.
- No wastage space for goods is involved.
- Ensures huge saving on overheads like rent, warehousing, employee facilities.
- More goods can be made available.
- It is cheaper to use as there are no leaflets, pamphlets, etc.
- Can reduce the number of shops on the streets.
- Organisations can employ fewer workers thereby cutting labour costs.
- No need to travel to the shop as business can be run from home.

Disadvantages of buying from the internet**To customers**

- There are chances of losing money through credit card fraud and hacking.
- Customers lack interaction with others.
- Customers fear of rogue companies (customers may not receive the goods).
- Customers cannot physically see the goods before purchasing.
- Not everyone has a computer and is connected to the internet.
- Not everyone has credit cards.
- Problem of spam (Unwanted e-mail, usually of a commercial nature sent out in bulk).
- Customers cannot have the goods immediately.

To businesses

- Increase in cases of industrial espionage.

Industrial espionage involves selling of company secrets by employees to rival companies and the use of destructive methods by competitors to destroy other organisations.

Effects Of E-Commerce and E-banking To The Community

Positive effects	Negative effects
Shops and banks are open 24/7	Close down of shops/banks in city centres
Access to shops and banks is worldwide	Increased risk of fraud/hacking
Less pollution since less travelling	Less personal service/more impersonal
Disabled people are not disadvantaged (no need to travel)	Loss of jobs due to closures of shops/banks
Busy people can shop/bank when they want and where they want	Less social interaction between people – just sit at home using computer
If you live in a remote area, it is much easier to access shops/banks	Less activity for people – leads to a less healthy/overweight population
Less expensive (cost savings to shop/bank + more competition – savings are passed on to the customer)	Less environmentally friendly since more goods sent out by post – waste from packaging significantly increases
Less money is spent in travelling	The gap between the rich and the poor widens as the rich get savings from shopping on-line.

Increase in small businesses.	Lower profits for companies that do not engage in e-commerce.
Decline in leisure shopping as goods are bought on-line.	deskilling of the work force (e.g CAD has taken over draftsman skills, word processors have taken over many office-based duties, etc.)

A lot of money is wasted by the need to re-train the workforce in the use of new software/computers

Computer systems have allowed companies to set up call centres in other countries where potential cost savings can be made. This, of course, can lead to job losses in the host country.

Advantage to companies adopting call centres overseas includes:

- if strikes or other problems occur in one country it is possible to transfer work elsewhere
- reduced costs in countries where labour costs are lower
- reduced costs due to incentives/grants by countries keen to set up call centre offices
- round the clock customer support (one of the **advantages** of time differences is the possibility of 24/7 cover)

Disadvantages to having call centres overseas:

- language and culture problems
- animosity (hatred/enmity) to overseas call centres (leading to loss of customers)
- need for extensive re-training which is time consuming and expensive
- time differences (can lead to health problems in call centre work force who need to work unsocial hours to target key markets)
- Technology differences between different countries (does the infrastructure exist to service high tech equipment?)

THE CASHLESS SOCIETY

This refers to the use of electronic commerce thereby reducing handling of hard cash amongst individuals. However, it seems impossible to completely have a complete cashless society.

Benefits of A cashless society

- More convenient to pay bills, mortgage loans, gas, phone and electricity bills since these are paid automatically.
- Customers no longer need to carry large sums of money thereby reducing cases of robbery.
- Customers no longer need to queue on banks to get cash.

Problems of a Cashless Society:

- Credit is normally given only to those who are working and have a steady source of income.
- People will spend more than they can afford thereby getting into debt.
- Wrong information about individuals is kept as more information about people is kept in computers for their credit rating.
- It is difficult for individuals to track how much they spent.

INTRANET

- Intranet stands for **INT**ernal **R**estricted **A**ccess **NET**work. It is a restricted private organisation's network that uses internet technologies for the benefits of such an organisation.
- An intranet is a computer network based on internet technology that is designed to meet the internal needs for sharing information within a single organisation/company
- Intranet requires password entry.
- Intranet is protected by a firewall.
- Intranet only gives local information relevant to the company/organisation
- It is possible to block access to certain sites using the intranet, e.g Facebook.
- it is not always necessary to have external modems when using intranets
- information for use on intranets is stored on local servers

Many companies use intranets as well as the internet. The main reasons for doing this include:

- it is safer since there is less chance of external hacking or viruses
- it is possible to prevent employees from accessing unwanted web sites
- companies can ensure that the information available is specific to their needs only
- it is easier to keep "sensitive" messages to remain within the company only

Differences between internet and Intranet

Internet	Intranet
the INTERNET is INTER national NET work	an INTRANET is INT ernal R estricted A ccess NET work
Internet gives all information including that which is not relevant to the organisation	the intranet only gives local information relevant to the company/organisation
Always need external modems for internet connections	it is not always necessary to have external modems when using intranets
Information on internet saved in different computers	information for use on intranets is stored on local servers
the internet can be accessed from anywhere	Intranet is accessed within the range of the organisation's network
the internet is available to anyone without password restriction	whereas the intranet requires password entry

Extranet: It is an intranet made available off -site to members or business partners of an organisation. It is an extension of the intranet giving authorized outsiders controlled access to the intranet.

WIRELESS TECHNOLOGY (WIFI) AND BROADBAND

Broadband: a communications network that provides for high quality and high speed voice, data and video transmission usually over wireless networks or over high bandwidth media like fiber optics and satellites.

Wireless Communication:

This is a method of networking (linking) computers and computer devices without the use of cabling (wires), e.g. using Bluetooth, radio, satellite, infra-red, microwave, etc. The devices that can be used in wireless technology include:

- Mobile phones /cell phone/remote key pad/remote control/ remote keyboard.
- Infra-red mouse.
- Multimedia mobile handsets and notebooks.
- GPRS (General Packet Radio Service) modems.
- Wireless LAN(or Wi-Fi –Wireless Fidelity: A local area network that uses high frequency radio signals to transmit and receive data over distances of a few hundred feet; uses Ethernet protocol).
- PDAs (personal digital assistants).

Advantages of wireless communication

- Cheaper as no wires are needed for networking.
- Ensures fast wireless Internet access.
- Wireless LAN is faster than a modem or mobile.
- Wireless LAN enables working at home.
- Users can create and send multimedia messages to mobiles or e-mail while in transit.
- Users can send greetings from mobiles to mobiles/PCs.
- Ensures instant transmission.
- Users can download e-mail and file attachments while on mobile. Users can watch live web cast on mobile.
- Users can listen to streaming video on mobile.
- Users can watch news, weather, sport, games while travelling.
- Users can access information from mobile anytime.
- Users can send, receive, delete e-mail while travelling.
- Users can view business appointments while out of office on mobile.
- Users can send corporate e-mail while out of office - even behind a firewall on mobile.
- Users can use wireless internet connection from chat rooms for discussions with colleagues while travelling.

Most areas in the world now offer broadband rather than dial up for connecting to the internet. The advantages of broadband over dial up include:

- the system is always “on”-no need to dial into ISP every time you want access
- the connection rate/data transfer rate is much higher (for example broadband operates at 11 000 kbps compared to the dial up rate of 60 kbps)
- there is a flat monthly rate with broadband (dial up is charged per hour of usage)
- it is possible to use the telephone at the same as the internet with broadband/the line isn't tied up
- broadband permits other facilities such as “skype”
- Wireless technology (WiFi) allows connection of a computer to the Internet without the need for connecting cables. A router (containing a modem and external aerial) is connected to a telephone line and it is then possible for any computer within range to communicate with the router and allow Internet access – the link between computer and router is completely wireless.. The main advantage of doing this is clearly the portability (i.e. can go anywhere within range since no wires are needed).

Disadvantages of Wireless Technology

- Wireless LAN speeds are slower than Net access at work due to narrow bandwidth.
- Anyone within the Wireless LAN nodes range with an appropriate device can use your Wireless LAN and broad band link.
- Anyone who walks past your house or WLAN linked into a corporate system can access sensitive information like credit card details.
- 3G phones are not compatible with 2G phones.
- Signals can be blocked, distorted or will be weak.
- Can lead to health problems from microwaves
- the range can be very limited, e.g. using Bluetooth.
- possible interference from nearby electronic devices
- security issues (i.e. tapping illegally into WiFi networks) is very common
- access speed/transfer rate is often slower using wireless systems

It isn't just computers that can be linked without wires, various peripheral devices can be linked to a computer system without the need for a physical, wired connection.

For example:

- Printers
- Keyboards
- Mouse
- Digital cameras

COMPUTERS IN ENTERTAINMENT

Music

Computers are now used for playing and composing music. Computer hardware and software advances have changed how music is generated and produced. Software used includes Fruit Loops, Virtual DJ, etc.

Musical instruments can be connected to a MIDI (Musical Instrument Digital Interface).

MIDI is a type of serial interface built into a piece of electrical equipment so that it can communicate with the computer. It also converts output signals from the instrument, e.g. guitar, into digital form.

Some of the key reasons for the widespread development of music using computers are:

- the recording process for music is faster
- there is no need for tapes during the recording process
- It is easier to remove or add sounds to a track.
- Sampling of sounds is very easy
- actual musical notes can be generated from the music itself by software
- music samplers and mixers give an almost limitless ability to alter the original tracks recorded in a studio
- don't need to understand music notation to write a musical score

- electric instruments (such as guitars and organs) play back through electronic machines
- synthesisers combine simple wave forms to produce more complex sounds
- electric organs can now mimic almost any instrument (including a full orchestra)
- automatic rhythm
- music notes automatically printed out in the correct format
- There are many other software and hardware developments; the above is just a summary of the more common elements.
- A performance can be directly recorded onto the computer and stored in a MIDI file, which can be edited later.
- Synthesisers are also used to generate notes and desired sounds from pre-recorded electrical signals. These signals can be combined with signals from conventional instruments and recorded to produce songs.

Music can be compressed to produce MP3 (motion picture expert) format.

Music can be played using software like Microsoft Windows Media Player, JetAudio, Nero Show Time, Real Player, etc.

ANIMATION/CARTOONS IN FILMS AND VIDEO/TELEVISION

Computer Graphics

These are computer generated images designed by graphic artists for producing logos, news inserts, cartoons, animations, etc. The artists use graphic software like Microsoft Paint. 3-D images can also be produced using graphics packages.

Image processing: The images can be darkened, sharpened, changed colour, cropped, etc.

Animation

- Animation consists of displaying a rapid succession of 2-D or 3-D graphics arrangements to create the illusion of movement. It is used for web presentations and advertisements and for film.
- Computer animation is the art of creating moving images via computer hardware and software.
- For 3-D animation, objects are designed on a computer and a 3-D skeleton is produced.
- The limbs, mouth, eyes, etc. are moved by the animator using key frames. A frame can just be a picture/graphic image.
- A start and end of frame is produced.
- Software is used to produce animation between the different frames automatically.

- The differences in appearance between key frames are automatically calculated by the computer – this is called *TWEENING* or *MORPHING*. The animation is finally *RENDERED* (i.e. turned into a realistic image).
 - Computer animation uses a technique called *avars* (animation variable) which control all movement of the animated character.
 - Finally, surfaces are added requiring a process called *rendering* (i.e. turned into a realistic image).
 - *avars* can be set manually using a joystick. Software produces a level of quality for movie animation that would take many years to produce by hand and would employ several cartoonists/animators.
 - This all saves considerable time and money to the film and television producers.
-
- Avatars are another example of animation. These are often used to represent people either in 3-D (as used in computer games) and in 2-D (as used in internet message boards).
 - Some avatars are animated consisting of a sequence of images played one after the other.
 - Ultimately, animators want to create a human image which moves and interacts with its background in such a way that the viewers can't tell if a particular scene is computer generated or produced by real actions in front of an actual movie camera.
 - Sounds can be added to the animation to produce advertisements, cartoons and films.
 - Computers with large hard disk and powerful processors are needed, as well as high resolution monitors
 - Special effects in many modern films (televisions) all use computer animation to produce fantasy worlds.

COMPUTER BASED TRAINING (CBT)

- CBT makes use of a computer system to train people in a number of applications.
- It makes use of multimedia and self-assessment with minimum input needed from a human trainer.
- The advantages of training people using computer systems (such as CBT) include:
 - trainees can work at their own speed
 - trainees can learn when they want
 - it is possible to re-run sections of the training program if necessary
 - possible to come back at any time/pause training program at any point
 - user gets immediate assessment of performance
 - possible to include multi-media elements in the training package

- no need to have a teacher/classroom – potential cost savings therefore possible
- it is easier to keep up to date/amend

AUTOMATIC STOCK CONTROL SYSTEM IN A SUPERMARKET

At the POS terminal, the hardware required includes:

(a) Input Hardware:

- **barcode reader** (automatically enter details of goods purchased into the computer by scanning them),
- **keyboard** (manually typing in product code if the barcode reader fails to do so),
- mouse (selecting item by clicking)
- **touch screen:** for selecting menu and entering data into the computer
- **swiping machine:** for entering PIN and swiping debit cards

(b) Output Devices:

- **printer** (producing receipts),
- **monitor** (VDU) -displays item details and items that are being purchased by the client, amount paid and change

(c) Communication devices

- **Network Cables:** connecting the VDU to the main computer in the manager's office
- **Telephone line/high distance communication link:** for online linkage of the POS terminal and the bank.

Procedure of automatic stock control

- bar codes are attached to all goods/items sold by the supermarket as a means of identification
- each bar code is associated with a stock file on a computer database
- the customer takes their basket/trolley to the POS terminal
- the bar code on the product is scanned at the point of sale (POS) terminal using the barcode reader
- if the bar code can't be read, the POS operator has to key in the bar code number manually using a keyboard/key pad
- the bar code is searched from the database
- once the bar code is identified/found, the appropriate file/record is accessed
- the price of the good/item is found and sent back to the POS
- the stock level of the item is reduced by 1
- if the stock level is less than or equal to the re-order/minimum stock level then the system automatically re-orders goods/items from the suppliers
- this procedure is repeated until all the items in the customer's basket/trolley have scanned

- when all items/goods have been scanned, the customer is given an itemised bill showing a list (with prices) of everything they have bought
- the computer also updates the files containing the daily takings
- if the customer has a loyalty card, the system automatically updates their points total
- when new goods arrive, the bar codes are used to update the stock files
- some newer supermarkets now allow customers to scan their own basket/trolley and pay for the items/goods using credit card or cash (essentially the stock control system is the same for both methods)

The POS terminals can also be connected to the main server in banks like CABS, Barclays, etc. This enables customers to purchase goods electronically without the burden of carrying cash around. This is called **Electronic Funds Transfer at Point of Sale (EFTPOS)**. Customers can also be given cash back at the EFTPOS after purchasing goods using debit cards.

After purchasing the goods, a receipt is produced. The receipt will have the following details:

- date of purchase,
- time purchased,
- shop attendant,
- item (s) bought,
- quantity bought,
- unit price,
- total price,
- amount tendered,
- change,
- cashier name
- etc.

Advantages of Electronic POS terminal to supermarket workers

- no need to remember (memorise) price of goods
- their work load is reduced
- ensures accurate calculation of customer change
- ensures better working environment which means less stress
- fast means of entering data which is less manual

Advantages of Electronic POS terminal to customers

- customers are served quickly
- customers are assured that their change is correctly calculated
- customers can get cash back if the POS is linked to banks
- no need for customers to carry cash around once the system is linked to banks thereby reduces theft of their cash

Advantages of Electronic POS terminal to supermarket managers

- It is automatic and more accurate to control stock.
- Automatic updating of stock file is ensured.
- Automatic reordering of stock items is involved.
- Less staff and wages needed.
- Sales statistics are always available.
- Faster throughput is ensured.
- Itemised receipts are produced quickly.
- The system records every transaction.
- The system records staff work rates.
- Less pilfering by staff as it is easier to identify pilfering.
- Fewer errors are produced. Faster calculations are made.
- There is no need to remember prices of goods.
- Manager is freed from the task of manually counting the stock items and placing some orders.

NB. The system updates the master file when an item is sold. It first searches the master file. Using the barcode number (or product code) it decrease the number in stock and increase the quantity sold

***NB:**

POS –Point of Sale terminal: the point where customers pay for goods purchased in shops, either by cash or otherwise.

Difference between Electronic Point Of Sale (EPOS) and Electronic Funds Transfer at Point Of Sale (EFTPOS).

EPOS terminal only involves scanning of goods electronically by use of barcodes and by keyboard entry. **EFTPOS** involves electronic scanning of goods at point of sale by use of scanners and barcodes (and use of keyboard) and has an added feature of allowing customers to transfer money from one account to another, usually to the account of the shop where the goods are being bought. Customers can also get cash-back at the EFTPOS terminal in shops.

CAM(COMPUTER-AIDED MANUFACTURE)

This is automated manufacturing process where computers are used to regulate (control) and monitor the production process in industries.

CAM uses some industrial robots or computer-controlled sensors for detecting:

Excessive heat

Faults

Acceleration forces

CAM works well with CAD systems. Machinery is programmed automatically

A real CAD/CAM system enables any engineering component to be designed and manufactured using numerically controlled machine tools.

The computer make some calculations for defining the tool path and generates the instructions necessary to produce the part. A machine tool such as a lathe is controlled by a computer which sends it instructions to select tools and to use them to make metal components.

CAM and CAD system systems are integrated. Data from CAD system is converted to a set of instructions for the processor controlling the CAM equipment. Once a part has been designed using the CAD software, the other processes are automatic. The following are involved:

- (a) Conversion of data into a set of machine tool instructions;
- (b) Operation of the CAM system:
 - a. Selection of tools, e.g. cutter, drills, etc.
 - b. Selection of speed e.g. for drills
 - c. Movement of the tool to machine the part being manufactured.

CLOSED-CIRCUIT TELEVISION (CCTV)

- Closed-circuit television is the use of one or more video cameras to produce video signals that are not broadcast, but displayed on a monitor screen. The images may be recorded.
- The camera may be remotely controlled by an operator or by a computer that receives data from sensors signalling an event of interest in a particular area.
- The computer's software could react by tilting and zooming the CCTV camera onto the area protected by the sensor and starting to record the camera's video stream.
- Mostly used in shops to record all transactions, e.g. capturing video of customers. It can be easy to identify shoplifters and thus reducing theft of goods in shops.
- CCTV is now being used even to record street events. This has been triggered by rise in terrorist activities especially in Western countries and the United States.

URL: Uniform Resource Locator: This is a unique address that identifies a website/page on the internet, e.g. <http://www.econet.co.zw>. This only identifies one (unique) web page for Econet Wireless which is found in Zimbabwe (.zw). Thus a URL is a unique address for each web page. A typical URL looks like:

<http://www.google.co.zw/computing/student.html>.

This address has some a number of parts:

http:// - protocol

www. - host computer

google.co.zw – Domain name and country

computing – folder

student. – Document name

.html – document type (HTML type of document in this case)

"http" (HyperText Transfer Protocol) and a domain name (such as ".co.uk"). Other domain names are as follows:

.zw Zimbabwe

.za South Africa

.zm Zambia

.bw Botswana, etc

Phishing is a way of fooling someone into handing over the security details for their bank account. The phisher sends an email that looks as if it comes from the recipient's bank and contains a link to a website controlled by the phisher. It can be prevented by not clicking on the link and instead going to the bank's website directly.

Spam is unwanted email, often advertising products or services. It can be prevented by using an anti-spam filter, which is often provided automatically by an ISP.

Pharming is an attack by hacking. It intercepts a browser request and redirects it to another website on which the attacker attempts to steal authentication credentials or debit or credit card details, as in a phishing attack. It can be discouraged by changing the password on a router (especially a wireless router) so that the hacker cannot redirect the DNS information.

COMPUTER NETWORKS

Definition of Terms

a. Network: A connection of computers for them to share data, files and resources like a printer.

b. Data communication: The process of transferring data through networked computers

Advantages of Networking

- Expensive peripherals like printers and scanners can be shared between users.
- Messages can be sent easily and faster between users whether on WAN or LAN.
- Avoids duplication of information as users can access the same file on the network.
- Network software can be purchased cheaply than buying individual packages for each computer.
- It is possible to access data or programs from any terminal or workstation.
- Data and programs can be stored centrally making it easier to maintain and backup.
- Users can be easily prevented from accessing files not intended for them.
- Allows sharing of files, software and data held in computers.
- Allows emails to be send between users.

Disadvantages of Networking

- Sophisticated equipment is needed, which may be expensive to buy.
- Security of data can be a problem due to hacking.
- Wiring can be expensive both to buy and to install; wiring can be sunk on the ground to avoid trailing cables.
- If a server breaks down, the whole network becomes unusable.
- Networks need experienced network managers, who will be highly paid to keep the network running.

TYPES OF NETWORKS

- Computer networks are grouped into **Local Area Networks (LAN)** and **Wide Area Networks (WAN)**.
- However we also have **WLAN (Wireless Local Area Networks)**, **MAN (Metropolitan Area Networks)** and **PAN (Personal Area Networks)**; and these are described below.

1. LOCAL AREA NETWORKS (LAN)

This is the connection of computers over a very small geographical area, like in a single room, for user to share files, data, software and hardware like printers. Other LANs can link different departments (e.g. Sales, Accounts, Warehousing, Despatch, etc) within an organisation's complex.

A LAN is usually owned by one organisation. However, if an organisation uses internet service within its restricted private Local Area Network, such a network is called an Intranet (private network).

NB: Intranet is a private organisation's network that uses internet technologies for the benefits of such an organisation.

Extranet: an extension of the intranet giving authorized outsiders controlled/limited access to the intranet.

REQUIREMENTS FOR A LAN CONNECTION

A. Hardware Requirements

1. Host computer / Server: This is the main computer that control and manage other computers on the network.

2. Terminals: These are computers that are on the network and are linked to the host computer. If the terminal has its own processing and storage capabilities, it is called an **intelligent terminal**. However, if the terminal does not have its own processing and storage facilities and relies on the host computer for it to work, it is called a **dump terminal**.

3. Network cables: These act as pathway for data from one computer to another. Cables can be coaxial, fibre optics, twisted pair, etc.

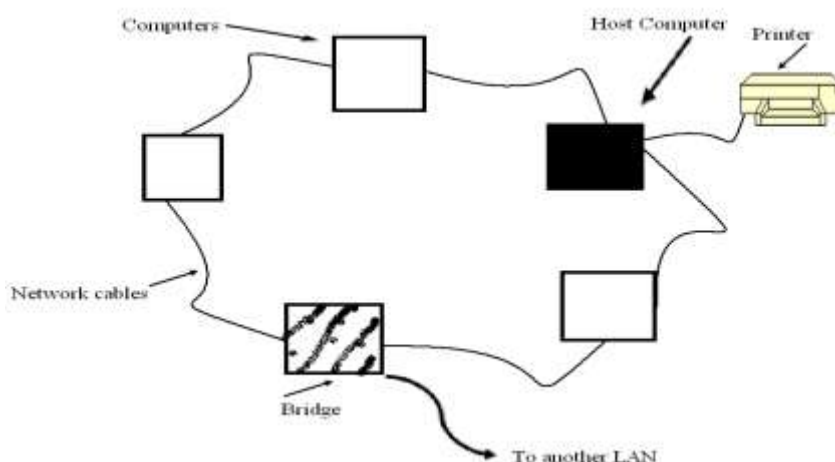
4. Hub: a device used as a connection point for devices and computers on a Local Area Network. Usually used when connecting computers to a star network.

5. Network cards for each computer/terminal: - a device that identifies computers to the network, where network cables are plugged on the computer

NB: A bridge can also be connected to link a Local Area Network to another network and is **an optional** requirement.

However, some networks are now using wireless technology and these are called **Wireless Local Area Networks (WLAN)**. WLAN uses radio signals and therefore no cabling is required.

The diagram below shows the structure of a LAN that can be connected to another network.



Software Requirements For A LAN Connection

- a. Communication software like TCP/IP** – Transmission Control Protocol Internet Protocol. A protocol is a set of rules followed by devices when they are communicating.
- b. Network operating system:** manages the network and network devices

2. MAN (Metropolitan Area Network)

A network similar to a LAN, but usually extends to a larger geographical area, usually the whole city and is owned by a consortium of users. The network is only accessed by a group of users as defined by the organisation, e.g students of a certain university. It enables users to do researches, share files, libraries, local email and video conferencing.

3. WIDE AREA NETWORK (WAN)

Refers to the connection of computers over a large geographical area, often over 1 km, e.g. covering the whole district, province or different countries. Internet is also part of WAN. WANs can also be wireless.

Hardware Requirements for a WAN

- a. Modem (Modulator Demodulator):-** a device that converts analogue data from the telephone line to digital data that can be understood by the computer and vice versa; often for internet connection using a telephone line. They can be used as gateway for connecting LAN to a WAN
- b. Communication link:** Acts as a transmission media for data, e.g. telephone line, satellite transmission, etc.
- c. Network cards** for each computer:- a device that identifies computers to the network, where network cables are plugged on the computer

Software Requirements for a WAN

- i. Communication Software like TCP/IP** – Transmission Control Protocol Internet Protocol.
- ii. Web Browser:** refers to software used for opening web pages on the internet, for example Microsoft Internet Explorer, Netscape Navigator, Mozilla Firefox, etc.
- iii. Network operating system:** manages the network and network devices.

4. PAN (Personal Area Network)

This a very much limited network, usually used by one person. This can also be Wireless Personal Area Network (**WPAN**), for example connection through Bluetooth. Bluetooth connects different devices, usually over a short distance.

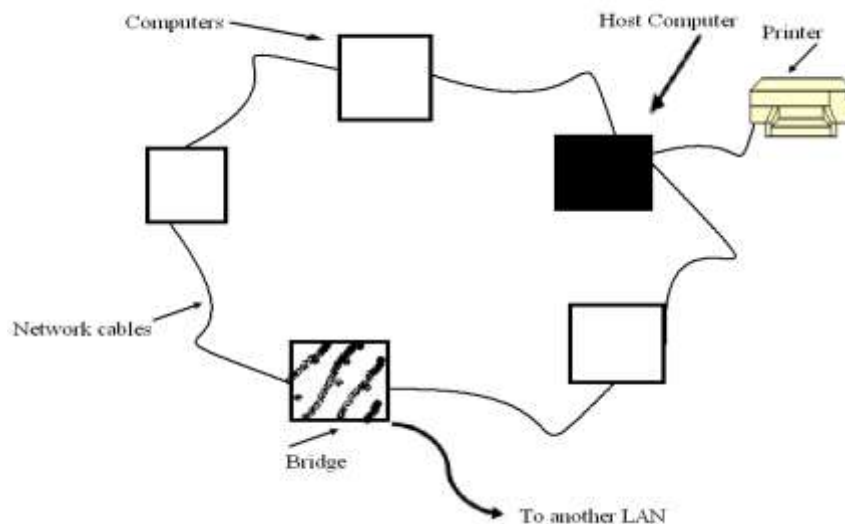
A PAN enables user to transfer files from a laptop to a PDA, camera or Personal Computer.

NETWORK TOPOLOGY (CONFIGURATION)

This refers to the shape/configuration of the network. Common network topologies are Ring, bus, star and mesh network topologies.

1. Ring Network:

- Computers are connected together to form a circle and uses a token when transferring data.
- Data/information travels in one direction only.
- Information moves around the ring in sequence from its source to its destination.
- As data passes from one computer to another in the ring, each computer removes any data relevant to itself and adds any data it wishes to send.
- The diagram below illustrates the physical configuration of a ring network:



Advantages of Ring Network

- Data processing is faster as each computer processes its own processor.
- Has very high data transfer rates.
- Uses a token to avoid data collision or loss
- it is possible to create large networks using this topology
- If one computer breaks down, others will remain working as they have their own processors and storage facilities.
- Performs better than star network when traffic is very heavy.

Disadvantages of Ring Network

- If one computer breaks down, the whole network is disrupted.
- a faulty connection between two stations can cause network failure
- Its requirements are expensive, that is buying several computers with processors and storage facilities.
- It is difficult to link the computers together.
- Difficult to add another computer without disrupting the networking.

- Only the computer with the token is allowed to send data at a given time. One may not send data when another node (computer) is still sending its own data.
- System is less secure as token together with data has to pass through other nodes that do not concern it.

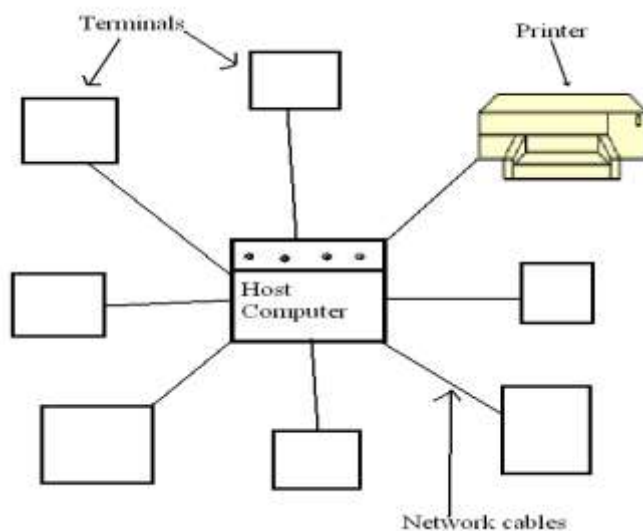
2. Star Network:

Computers form a star shape with host computer at the centre.

The Server (host computer) manages all other computers/terminals on the network.

If the terminals are not intelligent, they have to rely on the host computer for everything.

This network is as shown below:



Advantages of Star Network

- If one terminal breaks down, the network is not disrupted.
- It is cheap in terms of requirements since only the host computer can have a processor and storage facility.
- It is very easy to install.
- Management of data is easier as this is done centrally.
- It is very fast to process data.
- Easier to add new workstation without disrupting the network.
- No problem of collision of data since each terminal has its own cable to the host computer.
- Gives consistent performance even when the network is heavily utilised.
- More secure than other network topologies
- it is easier to identify faults using this type of topology
- It is easy to expand this type of network
- If one terminal breaks down, others will remain working.

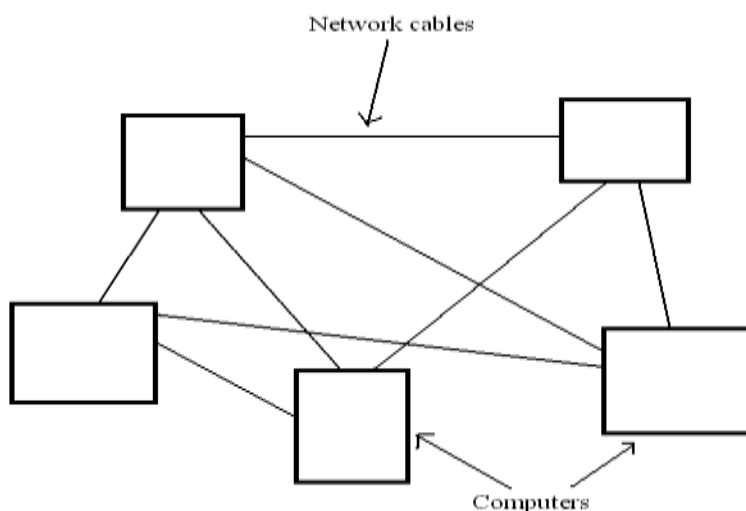
Disadvantages of a Star Network

- If the host computer breaks down, the whole network will be disrupted.

- If the host computer is down, all the terminals will not work as they depend on the host for processing and storage.
- It requires a lot of cabling, which might be expensive.
- Can be slower if overloaded

3. Mesh Network

- A network in which each computer serves as a relay point for directly sending information to any other computer on the network.
- No central device oversees a mesh network, and no set route is used to pass data back and forth between computers.
- Thus, if any one computer is damaged or temporarily unavailable, information is dynamically rerouted to other computers—a process known as *self-healing*



Advantages of Mesh Network

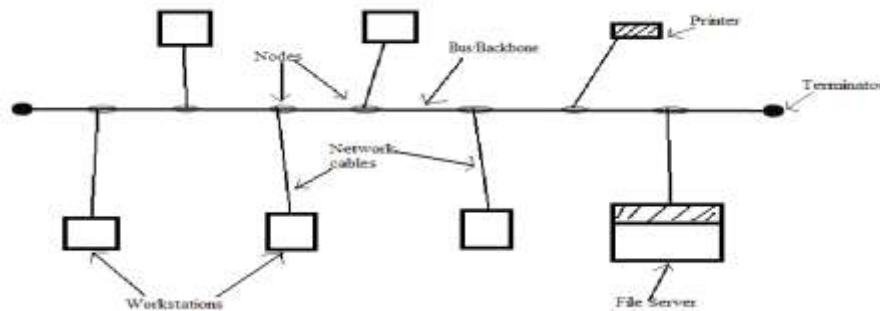
- If one computer breaks down, others will remain functional.
- If one computer breaks down, the network is not disturbed.
- Computers have their own storage and processing capabilities.

Disadvantages of Mesh Network

- Expensive to buy computers with their storage and processing facilities.
- Too much cabling is involved, which may be expensive.

4. Bus (Linear/Multi-drop) Network:

Computers are connected together through one main cable and all computers all signals transmitted by any computer connected to the network



Definition of Terms

- (a) **Bus/Backbone:** the dedicated and main cable that connects all workstations and other computer devices like printers.
- (b) **Nodes:** these are connection points for workstations and the bus.
- (c) **Terminator:** devices that prevent data in the bus from bouncing back, causing noise and prevents data from getting lost.

Advantages of Bus network

- If one workstation breaks down, others will remain functional.
- If one workstation breaks down, the network remains working.
- All computers have processing and storage capabilities.
- It is cheap to install due to less cabling.
- Easy to add workstation without disrupting the network.
- Requires less cabling than a *star* network.
- Less expensive network than the other systems

Disadvantages of Bus Network

- Computers cannot send data at the same time nor while there is data being transferred in the bus.
- Can cause collision of data during transmission.
- It is slow in transferring data.
- Its requirements are expensive, that is computers with their own processors and storage facilities.
- The system will be down if the main cable (bus) is disrupted at any point.
- Less secure.
- Performance worsens as new stations added

NB: Point – to-Point Connection: Point-to-point topology is the simplest connection, consisting of two connected computers.

NETWORK PROTOCOLS

A protocol is a set of rules that governs how communication between two devices will occur. Such devices might be computers themselves, between modems.

A network communication protocol: a standard method for transmitting data from one computer to another across a network. Some of the protocols that we are going to look at are:

i. TCP/IP (Transmission Control Protocol Internet Protocol)

TCP: It ensures that data is transmitted accurately

IP: It ensures that data is transmitted to its correct address (IP address). Every device on the internet has its IP address. It also ensures that packets are rearranged to the original message on arrival of their destination.

ii. HTTP (HyperText Transfer Protocol)

This is a protocol that defines the process of identifying, requesting and transferring multimedia web pages over the internet. It is used for transferring data across the internet, usually between servers and computers on the internet. It is based on the client –server relationship. It uses TCP/IP to transmit data and messages

iii. FTP (File Transfer Protocol)

it is a protocol used to transfer data from one computer to another. It is often used to download software from the internet, and it uses the TCP/IP protocol in doing this. However, FTP has no security to data as the data is not encrypted prior to its transmission.

iv. TELNET

This is a network protocol that allows a computer user to gain access to another computer and use its software and data, usually on a LAN and on the Internet. It allows users to access data stored on servers from their terminals. Telnet allows computers to connect to each other and allows sharing of data and files. Telnet has security problems especially on the internet.

v. VoIP (Voice Over Internet Protocol)

It is a method of using the internet to make ordinary voice telephone calls. Thus it is a way of having phone conversations using the internet as a way of communication. By VoIP, international and long distance calls are of the same price as local calls and sometimes are for free. However, the system does not offer emergency calls. An example of VoIP is Skype.

SYSTEMS ANALYSIS AND DESIGN

Systems Analysis is the detailed investigating the current system to determine its problems, requirements and the best way of solving the problems.

System: A group of elements working together to achieve a common goal. Systems are of two types:

Physical system: refers to tangible systems like schools, firm, shop, etc

Conceptual systems: these exist in mind or paper and cannot be touched. They just represent a physical system.

This chapter is concerned with the development and maintenance of systems like stock control, patient monitoring, banking and payroll which are part of physical systems.

The systems analyst

This is a person who identifies problems of the existing system and recommends the best solution to such a problem. The duties of a systems analyst are:

- Identifies the problems of the current system.
- Liaises with system users and determine their requirements.
- Finds out facts important to the design of the new system.
- Determines the human and computer procedures that will make up the system.
- Participates in the process of system implementation.

By performing such duties the systems analyst acts as:

- i. **A consultant:** can be called or hired to identify problems in a system
- ii. **A supporting expert:** draws together professional expertise concerning computer hardware and software and their uses in business.
- iii. **An agent of change:** bring new ideas into the organisation

Qualities of a systems analyst

- Must have good oral and written communication skills for all managerial levels of an organisation.
- Must be able to work as a team.
- Must be well educated, with at least a degree.
- Must be well experienced in computers and at top managerial levels.
- Must have good managerial skills.
- Must be a problem solver and see problems as challenges.
- Must be self-motivated. Must be well disciplined.
- Must be able to work under pressure and meet deadlines.

INITIATION (ORIGINATION) OF SYSTEMS ANALYSIS

Changes to a system can be triggered by many factors, some of which are:

- i. System users:** they may be dissatisfied with the current system since they are the ones who operate it. They will the sent requests to have a new system or some modification to the existing one.
- ii. Top management:** they may issue directives in order to meet new organisational objectives. It can also be due to change in management (new manager), new requirements, etc.
- iii. The need for improved operating efficiency:** Errors in the existing systems may be intolerable, especially to customers.
- iv. Changes in technology:** new hardware and software may force organisations to change their ways of operation.
- v. Change of government policies:** new government laws and policies can force organisations to change their systems
- vi. The user can change his mind**

SYSTEMS DEVELOPMENT LIFE CYCLE (SDLC)

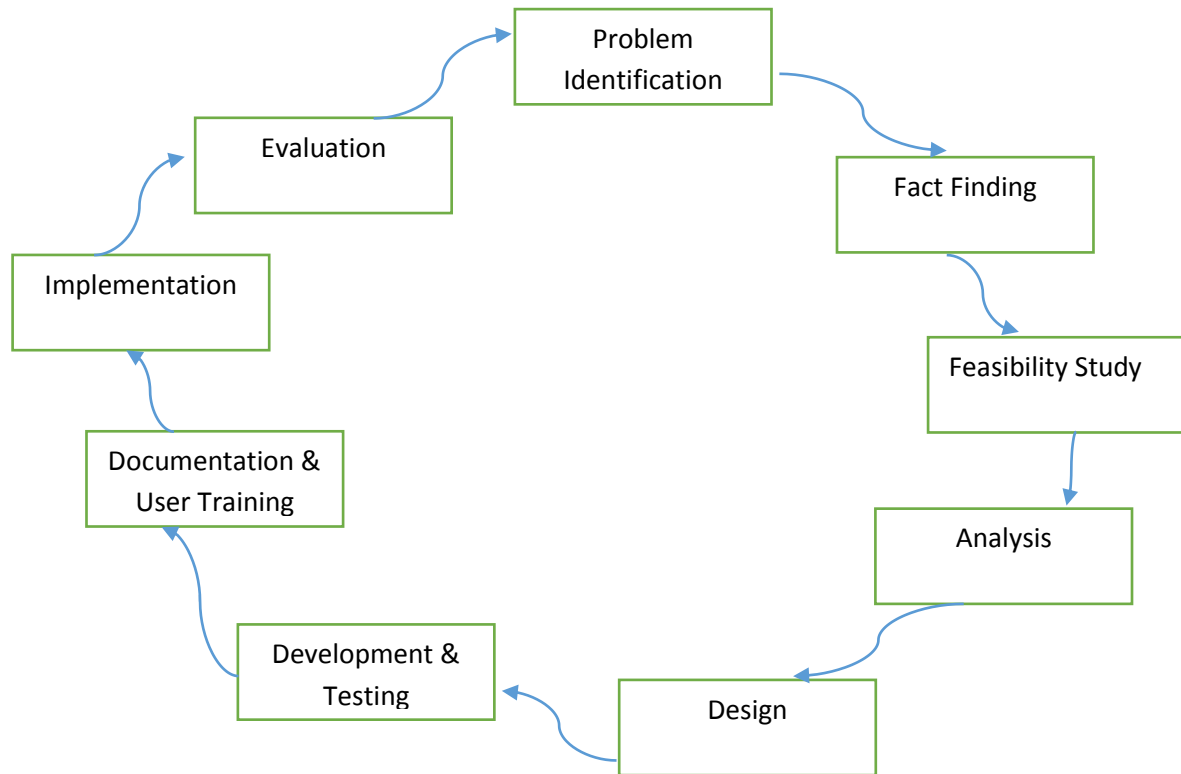
This refers to the stages through which a system develops from 'birth' to 'death', i.e. from the moment the system is incepted until it is modified or replaced with a new one.

Can also be referred to as the Waterfall Model

The stages, in their order, include:

- Problem identification,
- Fact Finding
- feasibility study,
- analysis,
- design,
- Development and testing
- Documentation and user training
- implementation,
- Evaluation/review/maintenance.

Below is a diagram that indicates the SDLC stages



Below is an explanation of each of the stages listed above:

1. Problem identification/Recognition/Definition/Realisation:

This is where the problems of the current system are stated.

These might have been realised by system users or by managers. The system might be producing wrong results.

This includes the general statement of the problems being experienced by the system.

2. Fact Finding/Data Collection/Investigation

This is the stage whereby the analyst collect data from users, management and the stakeholders, about the current system. Each data collection procedure is appropriate for a given situation, not in all cases. A number of data collection techniques are employed, including the following: Questionnaire, interview, Record inspection and Observation. Some automatic data collection procedures may be used also.

Data Collection Procedures

Terms used in data gathering include:

a. Interviewer: The person who asks questions in order to solicit information

b. Interviewee (respondent): interviewee is a person who is asked questions and is expected to give information to the interviewer.

c. Population: The average number of people in an area where a research is to be carried out.

d. Sample: Fraction of the population who actually take part in the research.

i. Interview:

This refers to the face-to-face communication between two or more people in order to obtain information. Interviews can also be done over the phone but the most common ones are face to face. Interviews are done when you want to collect information from a very small population sample.

Advantages of Interviews

- The researcher can ask for clarification on some points that may not be clear.
- Encourages good rapport between the researcher and the respondent.
- Non-verbal gestures like facial expressions can help the researcher to determine if the respondent is telling the truth.
- Information can be collected even from the illiterate since the respondent's language could be used.
- First-hand information is collected.
- The researcher can probe to get more information.

Disadvantages of Interviews

- It is impossible to remain anonymous on the part of the interviewee.
- It is expensive since the researcher has to travel to the interview venue.
- It is time consuming as more time is spent travelling and carrying out the interview.
- Good interview techniques are required as failure may lead to disappointments.
- Biased information can be given since the respondent may not tell the truth.

ii. Record/Document inspection:

- A fact finding method which involves scrutinising system documents in order to solicit information.
- Record inspection has the following advantages:
- Accurate information is collected from system records.
- First-hand information is obtained

Disadvantages of record inspection

- It is time consuming to go through all system records.
- Manual files can be tiresome to go through and some of the data may be illegible.
- Confidential files are not given to the researcher

iii. Questionnaire:

A document with carefully crafted questions to be answered by the respondent by filling on the spaces provided. Questionnaires are used when collecting information from a widely spaced population sample and when collecting information from many people. A questionnaire contains open-ended and closed questions. Open-ended questions are gap filling questions which require the respondent to express his or her own view. Closed questions are guided questions where the respondent just chooses Yes or No, True or False, or by just putting a tick on given options. Questionnaires can be distributed personally or by post.

Advantages of questionnaires

- Questions are very simple and faster to answer.
- It saves time as questionnaires can be distributed and then collected later.
- Respondents can fill questionnaires at their own pace.
- Give guarantees confidential of information, thereby encouraging respondents to give accurate information.
- They are cheap to use when collecting data from a very large sample

Disadvantages of questionnaires

- Some questions are left blank.
- Some questionnaires may not be returned at all.
- Biased information can be collected as people may lie.
- Respondents usually do not fill the correct information.
- It is difficult to analyse information collected using questionnaires.
- They are expensive to use if the postal system is used.
- Abusive information can be filled by respondents.
- It is difficult to prepare a good questionnaire

iv. Observations:

It is a fact finding method that involves viewing the actual system in operation by the researcher. The researcher can even take part in operating the system. It is used when the researcher wants to see for himself how the system operates.

Advantages of observations

- First-hand information is collected.
- Accurate information can be obtained.
- Areas of interest can be observed.
- The researcher can take part in operating the system thereby getting insight on how the system operates.
- the analyst obtains reliable data
- it is possible to see exactly what is being done

Disadvantages of observations

- People work differently if they feel that they are being observed, therefore inaccurate information can be collected.
- The researcher may not understand some of the activities being observed.
- It is time consuming to collect the required information.
- The researcher may interrupt some of the activities being done.
- if workers perform tasks that violate standard procedures, they may not do this when being watched!!

3. Feasibility Study:

It involves an evaluation of proposals to determine if it possible to construct a new system or just modification of the existing one. Feasibility can be measured by making the following considerations:

Economic feasibility: determining whether the benefits of the new system will out-weigh the estimated cost involved in developing, purchasing, assembling requirements, installing and maintenance of the new system. The cost-benefits analysis is carried out. Benefits can be tangible and quantifiable, e.g. profits in terms of monetary values, fewer processing errors, increased production, increased response time, etc. Other benefits are intangible, e.g. improved customer goodwill, employee moral, job satisfaction, better service to the community, etc.

Technical feasibility: determines if the organisation can obtain software, equipment and personnel to develop, install and operate the system and even to maintain it.

Social feasibility: a measure of the system's acceptance by the general public; if it will meet the norms and values of the society.

Legal feasibility: This is determining if the system can conform to the laws and statutes of the country. This is done by considering government legislation, e.g. Data processing system must comply with the local Data Protection Acts

Operational feasibility: determines whether the current work practices and procedures are adequate to support the system, e.g. effects on social lives of those affected by the system, can it work well with existing hardware, etc

Operational feasibility assessment focuses on the degree to which the proposed system fits in with the existing business environment and objectives with regard to development schedule, delivery date, corporate culture, and existing business processes

After carrying out the feasibility study, a feasibility study report must be produced and it contains the following information:

- A brief description of the business.
- Advantages and problems of the existing system.
- Objectives of the new system.
- Evaluation of the alternative solutions.

- Development timetable.
- Management summary.
- Terms of reference.
- Proposed solution.

4. Analysis stage:

This is the in-depth study of the system to determine how data flows within the system.

Analysis tools used includes:

- Decision trees
- Decision tables


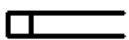



It involves use of flowcharts, data flow diagrams, structure diagrams, decision trees, and others, to describe the operations of the system in detail. The analysis stage determines whether computerisation will take place or not. The analysis stage also specifies the hardware and software requirements of the new/proposed system, the advantages and disadvantages of the proposed solution, etc.

Analysis stage also involves identification of the following:

- Alternative solutions: other solutions, not considering the chosen one
- Specification requirements: other system requirements like hardware, software, personnel, etc
- Carrying out the Cost-benefit analysis: weighing out costs of developing the new system versus the benefits that will be realised.

Dataflow Diagrams

These are diagrams that show how data moves between external sources, through processes and data stores of a particular system. Dataflow diagrams use the following symbols:

<u>Symbol</u>	<u>Explanation</u>
Process Symbol 	- Indicates where some form of processing occur
File Storage 	- Shows data storage in a file
Arrow 	-Shows directional flow of data
Entity 	- Shows an external source or destination of data for the system
Predefined Process 	- Shows a predefined process, like sorting of data.

5. Design Stage:

This stage is concerned with the design of the new computer based solution as specified by the analysis stage. Design stage involves:

Input Design: includes designing of data entry forms, input methods (e.g. by filling forms, use of barcodes, etc) and the user interface.

Output Design: Includes design of reports, data output formats, screen displays and other printed documents like receipts, etc

File design: Involves designing tables/files, records and validation rules. It also involves determining how data is to be stored and accessed, the media to be used for storage and the mode of file organisation. Fields in each files can be designed, their length and data type, e.g.

File Name: Student File

Storage Location: Hard Disk

Mode of Access: Direct/Random

File Structure:

Field name	Data type	Length	Example
Surname	Alphabetic	20	Kaponden
First name	Alphabetic	20	Tungamirai
Date of birth	Date	8	07/02/78
Class	Text	2	3A
Student number	String	7	0098/99

It also involves specifying how data is to be sorted and updated.

Program Design: Involves design of systems flowcharts, structure diagrams, dataflow diagrams, algorithms, etc.

Selection of appropriate hardware: Specify the input hardware, output hardware, processing hardware and speed, storage media, RAM size, etc. **Selection of appropriate software:** specifying the type of operating system, programming language or database package and other application packages to be used.

Design of test plan and strategy, Design of the user manual, Design of the technical documentation

In general, design stage involves the following:

- ✓ design the data capture forms/input forms
- ✓ design the screen layouts
- ✓ design output forms and reports
- ✓ produce systems flowcharts and/or pseudocode
- ✓ select/design any validation rules that need to be used
- ✓ design a testing strategy/plan
- ✓ file structures/tables need to be designed/agreed
- ✓ select/design the hardware requirements for the new system
- ✓ select/design the software requirements
- ✓ produce any algorithms or program flowcharts

- ✓ select the most appropriate data verification method(s)
- ✓ interface design(Command-line, GUI, form-based, menu-driven, etc

6. Development and Testing

The computer environment is prepared, the programs to be written are done and they are tested to determine if they run as expected.

Computer environment being prepared: electrical wires, network cables are installed, furniture, air conditioning are in place. The computers are installed and tested.

It also involves the construction and assembling of the technical components that are needed for the new system to operate. This includes preparation of the computer room environment, coding of the computer program using a specific programming language, testing of the coded program,

Testing strategies

- **standard data testing:** testing of data within the given range (should be accepted)
- **abnormal data testing:** testing of data outside the given range (should be rejected)
- **extreme data testing:** testing of the minimum and maximum values in the given range (should be accepted)

7. DOCUMENTATION AND USER TRAINING

Documentation refers to the careful and disciplined recording of information on the development, operation and maintenance of a system. Documentation is in two main types: user documentation and technical documentation

(a) User Documentation: It is a manual that guides system users on how to load, operate, navigate and exit a program (system). User documentation contains the following:

- ✓ System/program name.
- ✓ Storage location.
- ✓ System password.
- ✓ Instruction on how to install the program.
- ✓ Instruction on how to operate the system: e.g.
 - How to quit the program
 - how to load/run the software
 - how to save files
 - how to do print outs
 - how to sort data
 - how to do a search
 - how to add, delete or amend records
 - print layouts (output)

- screen layouts (input)
- the purpose of the system/program/software package
- error handling/meaning of errors
- troubleshooting guide/help lines/FAQs
- how to log in/log out

(b) Technical Documentation: This is a manual for programmers which aid them in modifying the system and in correcting program errors. The following are found in technical documentation:

- ✓ Algorithms of the program,
- ✓ Program testing procedures and test data,
- ✓ Sample of expected system results,
- ✓ Program structure showing modules and their relationships,
- ✓ System flowcharts,
- ✓ Programming language used,
- ✓ Program code,
- ✓ program listings,
- ✓ File structures.
- ✓ Validation rules
- ✓ Output formats
- ✓ Bugs in the system
- ✓ Hardware requirements
- ✓ Software requirements

User training:

Once a new system is put in place, existing employees are trained on how to operate the new system, otherwise new employees are recruited.

User training: users are trained on how to enter data, search records, edit fields, produce reports, handling errors, etc.

User training can be in the following forms:

i. On the job training: Users are trained at their organisation by hired trainers. This has the following advantages:

- ✓ Learners practice with actual equipment and the environment of the job.
- ✓ Learners can engage in productive practices while on training.
- ✓ This is cheaper for the organisation.
- ✓ Enough practice is gained on how to operate the system.

Disadvantages of on the job training

- ✓ Distractions occur in a noisy office.
- ✓ Instructional methods are often poor.
- ✓ The need to keep up output may lead to hasty teaching

ii. Classroom training: Users are sent to other colleges and institutions which offer courses on the subject matter. This could be expensive to organisations since employees take study leave while being paid at the

same time. Employees can also be trained on aspects that they will not apply when they finish the course. The gap between what is learnt and what is needed at the job may be too wide.

Considerations when training users:

1. All staff need training that is relevant to their work using the computers. However, others may find it difficult to learn the new system and may resist.
2. Age problem of trainees-older workers takes long to conceptualise concepts
3. Reluctance of employees to learn (use new system)
4. Computer based system means training on the computer
5. Regular updates means new training each time an upgrade is made
6. The type of training should be chosen carefully as it is important
7. Course type with trainer
 - It may restrict learning times
 - Can be intimidating to other employees
 - Difficult to satisfy all trainees' demands
 - Gives human contact

8. Implementation/ Conversion (Installation/Changeover)

This also involves putting the new computer system into operation, that is, changing from the old system to the new one. It involves file conversion, which is the changing of old data files into the current format. Different changeover methods can be used, and these include:

a. Parallel Run: This involves using of both the old and new system concurrently until the new system proves to be efficient. It involves operating the new and old systems simultaneously until management is confident that the new system will perform satisfactorily. Other workers will be using the old system while others use the old system but doing the same type of job.

Advantages of parallel run

- ✓ Results for both systems are compared for accuracy and consistency.
- ✓ If the new system develops problems, it will be easier to revert to the old one.
- ✓ There is enough time given to determine if the new system produces expected results.
- ✓ Employees have enough time to familiarise with the new system.

Disadvantages of Parallel run

- ✓ Running two systems at the same time is very expensive.
- ✓ Running two systems simultaneously is demanding to employees.
- ✓ It may be difficult to reach a decision when comparing the two systems.

- ✓ There is duplication of tasks which in turn stresses employees

ii. Abrupt (Direct) changeover: Involves stopping using the old system on a certain day and the new system takes over on the next morning. This is suitable for control systems like in chemical plants and for traffic lights.

Advantages of Direct Changeover

- ✓ Reduces cost as of running two systems at the same time.
- ✓ Faster and more efficient to implement.
- ✓ There is minimum duplication of tasks.
- ✓ Enough resources can be allocated to make sure that the new system operates successfully.

Disadvantages of Direct Changeover

- ✓ It will be difficult to revert to the old system if the new system fails.

iii. Phased / Partial conversion: This is whereby the old system is gradually removed while the new system is gradually moved in at the same time. This can be done by computerising only one department in an organisation this month, then the next department in two months' time, and so on until the whole system is computerised.

Advantages of phased conversion

- ✓ Avoids the risk of system failure.
- ✓ Saves costs since the new system is applied in phases.
- ✓ It could be easier to revert to the old system if the new system fails since only one department will be affected.

Disadvantages of phased conversion

- ✓ It could be very expensive since the organisation will be running two systems but in different departments.

iv. Pilot conversion: This is whereby a program is tested in one organisation (or department), and is applied to the whole organisation if it passes the pilot stage. It serves as a model for other departments. A pilot program can then be applied in phases, directly or using the parallel run method.

9. Maintenance/review/evaluation Stage:

This stage is concerned with making upgrades and repairs to an already existing system. Certain sections of the system will be modified with time. Maintenance can be to **Perfect** the system, to **Correct** some errors or to make it **adapt** to changing needs, e.g change in government laws.