**AS ICT Revision Notes**

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Networks

**Advantages of a Network**

* Hardware resources can be shared
* Software resources can be shared
* Data can be shared
* Electronic communication between users is possible
* A user can use any computer on the network
* Centralised control is possible

**LAN**

* A network in a single location / building
* The connection of computers within the house comprise a LAN

**WAN**

* A network spread over a wide geographical area
* Internet is a global WAN
* The pupils could access the school network from home

**Hub**

* Passes all communications / data it receives
  + To all the computers in the network

**File Server**

* To manage communications from network stations / nodes
* To store shared application software
* To store shared files such as documents, databases
* To control central resources such as storage media / printers

**Switch**

* Acts as a traffic control centre for the LAN
* When the switch receives a data packet
  + Reads the address from the header
    - The data packet is then routed to the destination
* Check the destination of all communications / data it receives
  + Forwards it to the computer it is intended for

**Firewall**

* Consists of software or a combination of hardware and software
* Controls / filters the flow of traffic into the network
  + By implementing security rules / levels of security
* Traffic which does not meet the security rules is blocked
  + Such as viruses / spam / denial of service attacks / backdoors / hacking
* It can control the flow of traffic out of the network
* It can control how users connect to web sites
  + And which files are permitted to leave the network
  + Allows the monitoring of users’ Internet access
* Filters all messages entering / leaving the network
* Examines each message and blocks those that do not meet security criteria
* Prevents unauthorised external access
* Prevents unauthorised internal access
* Prevents malicious access
* Prevents virus attacks / hacking
* May act as a router, forwarding packets between the LAN and the Internet

**Fibre Optic Cable**

* Supports broadband / multiple data transmissions
* Flexible medium and can be used in awkward layouts
* Minimal signal loss over distance
* Uses light
* Cable consists of glass or plastic wires / cores / filaments
  + Bundled together
  + Encased in a jacket
* Each core has a mirror-lined wall or cladding
  + Which reflects light back along the core (total internal reflection)
  + Minimises signal degradation
* Light is transmitted in pulses
  + Which represents a range of frequencies / that is modulated
* The cable can vary in length from a few metres to hundreds of kilometres
* Impervious to electromagnetic interference
* Not susceptible to interference
  + Signal difficult to intercept without destroying it

**Converting a network into a wireless network**

* Each PC will require a wireless network adapter / card
  + With a radio transmitter / receiver / antenna
    - To communicate with the hub / server
* A wireless router / hub / switch will be required
  + With a radio transmitter / receiver / antenna
    - To communicate with each PC
* A wireless modem may be used
  + To connect directly to the ISP / Internet
* Appropriate software / drivers will be required

**Bus Network**

* All computers are connected to a single cable or backbone
* Data travels from the source in both directions along the bus
* A terminator is positioned at each end of the bus cable to prevent the signal from bouncing back
* A computer sending data identifies the recipient
* Each computer on the bus network checks if it is the intended recipient
* If it is, the computer accepts the data
* If it is not, the computer ignores the data
* The CMSA / CD protocol is used

**Star Network**

* All computers / work stations / nodes are connected to a central hub / computer
* Each computer is connected directly to the hub
* Data travels from the source to the central hub
  + Boosts / repeats / rebroadcasts the data signal
  + Sends it directly to the intended recipient

**Bus / Star Network**

* Single backbone cable
  + To which a number of star networks are each connected directly
* Communication within a particular star is controlled by its hub
* Communication between different star networks is vie the backbone
* There is a high level of traffic within each star
* There is a lower level of traffic on the bus connection
* The network consists of a number of hubs
  + Each of which is configured as a star network
* The hubs are connected together along a bus connection
  + Known as the “backbone”
  + Which has terminators at each end
* Typically, the hubs are located on different floors in a building
  + Where the backbone uses fibre optic cable
  + And the workstations are wired to the hub with UTP (Unshielded Twisted Pair) cable
* A common example is a large Ethernet network with multiple hubs

**Adding new nodes to a Network**

* Bus
  + New computers connected directly / by its own cable
    - To the bus backbone
* Star
  + New computers connected directly / by its own cable / wirelessly
    - To the central / controlling computer
* Ring
  + New computers added by splitting existing connection between two nodes
    - New computer connected between these existing connections

**Cable Failure**

* Star Network
  + Each node is directly connected to the hub / server by a cable
  + Failure of a cable will only affect the node connected by the cable
  + All other nodes will be able to communicate via the hub
* Bus Network
  + All nodes are connected to a backbone
  + Failure of the backbone will affect the rest of the network
  + Failure of a cable connecting a node to the backbone will only affect that node

**Wi-Fi**

* Wi-Fi enables two or more devices to connect (wirelessly) for data sharing
* A computer with a Wi-Fi network card
  + Can connect wirelessly to a wireless router
  + Over a limited distance (60m /90m)
* A Wi-Fi network can either be open (anyone can use them)
  + Or closed (password is needed)
* An area with wireless access is called a wireless hotspot

**Wireless Network – Benefits**

* No cabling required
  + Saves installation cost and time
* Computers on the network are not restricted to a physical location
  + They can be used anywhere there is network coverage

**Resources required to connect to the Internet**

* A broadband Internet connection / modem
  + To support high-speed internet connection / AD conversion
* Router / hub
  + To communicate directly to the Internet connection
  + To communicate directly with each computer / node
* Adapter / network card in each computer / WiFi / Bluetooth / transceiver
  + To enable the PC to send / receive data without a physical connection / send data to the router
  + Software drivers for the wireless router / wireless adapters
    - To configure / install the router / adapters
  + A micro filter
    - To separate data signal from voice signal
* ISP
  + To provide access to the WWW

**IP Address**

* A unique number
  + Assigned to any device / computer connected to the Internet
* IP address consists of four sets of numbers
  + Separated by full-stops / periods
    - E.g. 123.45.67.254
* The computer processes this as a 32-bit pattern / four octets
* First octet identifies the network
* Last octet identifies the actual computer on the network

**SMS**

* Enables a short text message to be sent between mobile phones
  + Short Message Service
* The text messages can be up to 160 characters
* Messages can be received whilst making voice calls
* Messages generated by SMS are immediately delivered directly to the recipients phone / recipients’ phones
* If the recipient’s phone is out of coverage, in use or turned off
  + The service holds the message until the phone comes back into the area

**Bluetooth**

* Bluetooth wireless technology enables electronic devices to communicate without cables
* Operates over short distances / up to 100 meters
* Uses very little power
* Can be blocked by solid walls / is a ‘line of sight’ method
* Uses radio waves (in the 2.4 gigahertz range)
* Was designed to connect a range of portable devices / laptops / PDAs / mobile phones
* A common use of Bluetooth is to connect desktop computers and printers
* A device has to be “Bluetooth Enables” i.e. contain a Bluetooth chip

Data

**Data**

* Data is raw facts and figures
* No meaning on its own
* 42137 is just a number / sequence of digits

**Information**

* Information is data that has been processed to give it context / meaning
* 42137 could be a patient ID

**Knowledge**

* The application of information

**Direct Data Source**

* Direct Data Source has been created for a specific purpose and used for that purpose
* E.g. purpose of a questionnaire is to gather data about eating habits

**Indirect Data Source**

* Indirect Data Source is used for a purpose for which it was not originally intended
* Membership details could used for a survey / passed to a third party for example
* Benefits
  + Can be very cost effective
    - Data has already been collected / processed / paid for
  + Should be immediately available
    - As data has already been collected using the data source
* Drawbacks
  + The source was designed for a different purpose
    - May not provide exactly the data required / additional filtering or processing may be required

**Distributing Information**

* Using a website
  + With graphical / multimedia / interactive representations of the information
  + Visitors will be directed to the website via search engines
    - Or they can go directly to the website using its URL
* Using an online bulletin board / message board / forum / social networking / blogging / VLE / podcasts
  + Where information can be posted / threads created
  + And readers can post responses or to post new messages

**Quality of Information**

* Being up to data
* Relevance
* Effective presentation
* Complete
* Accurate

**Quality of Information**

* How up-to-date the data source is
  + The information will not reflect the current situation if not up-to-date
  + Some data may have changed
    - E.g. change of address
* How relevant the data source is
  + The information may not include all the essential / required details
  + The information may include the wrong details
  + The information may include unnecessary details
* How complete the data source is
  + The information may omit essential details
    - E.g. some fields may not have been completed
* How accurate the data source is
  + The information may be incorrect / inaccurate
    - E.g. Invalid data in a field due to transcription error
* How well presented the information is
  + It may not be appropriate for its intended audience
    - E.g. Inappropriate format / lack of annotation

**Costs involved in the production of information**

* Hardware costs
  + The cost of purchasing / leasing computers / peripherals
  + The cost of consumables
* Software costs
  + The cost of purchasing application software licences / the operating system
* Personnel
  + Employing / training someone to develop the application / input data / run reports

**Validation**

* Enables the computer / automatic process
  + To ensure that data is
    - Meaningful
    - Reasonable
    - Complete
    - Correct type
    - Correct format
    - Sensible
  + Within a range
* Length check
  + The number of characters in a field must be a set length
* Range check
  + The value of a field must lie within a specified range between a max and a min
    - E.g. Month
      * The value must lie in the range of 1 to 12 inclusive
* Lookup Table
  + All valid values of a key field are held in an electronic list / stored list
* Type check
  + E.g. the value must only consist of text
* Boolean or YES/NO
  + E.g. Gender
    - E.g. the value can only take one of two values, M or F
* Presence check
  + This is used with a field that is mandatory / compulsory / required
* Format check
  + This is used with a field whose characters must comply with a pre-set pattern / picture

**Data Verification**

* To check that the data which has been entered / input
  + Is as intended / matches the source data
* The user entering the data
  + Performs a visual check / proofreads what has been entered
  + And confirms that it is as intended
  + Click the proceed button if it is correct / edit button if it is not
* Example
  + Double entry
    - Entering an email address twice
  + Proofreading
    - User must confirm that the data is as intended by clicking the Save button

**Access Rights**

* Each authorised user is allocated specific access rights
  + E.g. Read Only / Read & Write
* This allows the user to read a file but not modify it / read a file and modify it
* Rights are identified in an access table
  + Which is checked by the DBMS whenever a user requests access

**Data Encryption**

* Data is coded / translated
  + Before transmission
  + By the application of a key / function / password
* On receipt the data is decrypted / restored to plain text
  + Using the appropriate decryption key
* Intercepted data is meaningless without possession of the key

**Input / Output / Processing / Storage / Feedback ATM Example**

* Input
  + The cash card is inserted
  + PIN is entered
  + Menu choice is selected
  + Amount is entered or selected
* Output
  + Instructions / menu choices are displayed on ATM screen
  + Receipt may be printed
  + Sum of money is issued
* Processing
  + Customer’s data is retrieved from the banks database
  + PIN is validated
  + Amount is checked against the customers balance
  + Amount is deducted from the customers balance
* Storage
  + Customer data is stored in the cash card
  + Customers details are stored in the banks database
  + Details of the transaction are stored in the banks database
* Feedback
  + The amount is instantly deducted from the customers balance
  + If the card is invalid / incorrect PIN / withdrawal amount is not possible an error message appears on the ATM screen

ICT Laws & Legislation

**Data Protection Legislation**

* Legislation requires personal information is:
  + Processed fairly and lawfully
  + Processed for one or more specified and lawful purposes, and not further processed in any way that is incompatible with the original purpose
  + Adequate, relevant and not excessive
  + Accurate, and, where necessary, kept up to date
  + Kept for no longer than is necessary for the purpose for which it is being used
  + Processed in line with the rights of individuals
  + Kept secure with appropriate technical and organisational measures taken to protect the information
  + Not transferred outside the European Economic Area (the European Union member states plus Norway, Iceland and Liechtenstein) unless there is adequate protection for the personal information being transferred

**DPA**

* Need to register with the DP Registrar
  + Must state what data it will store and for what purpose
* Should appoint a data protection controller
  + Who will be responsible for ensuring the data complies with the legislation
* Must only store original data identified
  + Use this data for specified purpose
* Need to ensure relevant staff are trained
  + To comply with legislation
* Must keep data up to date / accurate
  + By ensuring if details change, the data base is updated
* Must establish procedures to keep data secure
  + Such as user names / passwords
* Data should be deleted
  + That is no longer needed
* Must respond to requests from data subjects
  + And inform them of data held about them / correct any erroneous data
* Data must not be passed on to third parties
  + Without appropriate safeguards / authorisation

**Computer Misuse Act**

* Unauthorised access to computer material is against the law
* This offence covers using someone else’s password to log onto their user area
  + And even looking at their files
* Unauthorised access with intent to commit or facilitate a crime is against the law
* This offence covers gaining access to someone else’s system with the sole purpose of doing something illegal
* Unauthorised modification of computer material is against the law
* This offence also covers purposely introducing a virus into another person’s computer system

**Copyright, Designs and Patents Act**

* Gives the creators of literary / dramatic / musical / artistic works / sound recordings / broadcasts / films
  + Rights to control the ways in which their material may be used
  + Including broadcast and public performance, copying, adapting, issuing, renting and lending copies to the public
* The act refers to the intellectual property / ownership of software and associated documentation
  + In the same way as literary / artistic copyright
* Users need a licence to use copyrighted software
* It is against the Act to make copies / distribute unlicensed software

**Plagiarism**

* The vast amount of material on the internet has greatly increased the incidence of plagiarism
* Information about almost any topic can be obtained with a few clicks of the mouse via search engines
* Most of the information is free
* Many people are tempted to “cut and paste” material and pass it off as their own
* This is difficult to detect as this involves tracking down the source of the plagiarised material
* Such a problem that universities use special software to detect plagiarism
* Copyright, Designs and Patents Act
  + Makes plagiarism illegal

**Censorship**

* The suppression of speech or writing considered to have an undesired influence on society
* Has become more difficult for governments to control / suppress information
  + National borders are difficult or impossible to enforce
* Some websites publish information some governments would like to censor
* Residents in a country banning certain information may be able to access it on websites hosted outside the country
* Some countries have resorted to a complete ban on citizens using the Internet
* Some countries (e.g. China) use sophisticated techniques to block specific websites / portals / forums / blogs
  + By blocking or re-directing their IP addresses
  + Or by monitoring data packets for words such as “democracy”

Software

**Custom Built Software**

* Should meet the exact needs of the users
  + As it is designed specifically for the users / the users have a part to play in the analysis stage
* The developers will be on hand
  + To correct with any errors which arise during initial use of the system / during system review

**Off-the-shelf Software**

* Development cost is spread over many users
  + So the cost is relatively lower
* The software is readily available
  + So there is no need to wait for the system to be developed
* The software may already be widely used
  + So it should be well-tested / there could be existing user groups / support materials

**Obtaining Software**

* Off the shelf software
  + A generic / general purpose solution
    - Or read made / designed / readily available solution
  + Could be purchased ‘off the shelf’
  + From a computer store / specialist software shop / web site / downloaded
* In-house development
  + Purpose-built / tailored / bespoke software
  + Could be developed ‘in-house’
  + By ICT specialists / programmers
    - Within the business
* Outsourcing
  + Purpose-built / tailored / bespoke software
  + Could be ‘outsourced’
    - To ICT specialists
    - Outside the business
      * E.g. A Software House

**Presentation Software**

* Creating
  + Standard slide tempaltes are available
  + User defined templates can be created
  + Multimedia content can be added to each slide
    - Such as text / images / graphics / movies / sound / other objects e.g. buttons
  + Effects can be applied to slide components
    - Entrance, emphasis, exit animations
* Presenting
  + The slide show can be set to run automatically
    - Controlled by the presenter using mouse / cursor keys
  + Transition effects can be applied to slide
  + Audience hand-outs, outlines and speakers’ note can be produced

**Web Authoring Software**

* Allows the creation of pages for a website
* Provides a toolbox of components
* Pages can be based on standard templates
* New templates can be created
* Each page can include multimedia components (text / images / sounds / movie clips)
  + Navigation links / hyper links
* Creates the HTML code automatically
* HTML code can be edited
* Page can be previewed in a browser

**Internet Browser Software**

* Allows web pages to be viewed
* Converts HTML code to a multimedia display
* Provides a navigation bar / navigation buttons / refresh buttons
* Provides a home page / button
  + Page tabs / Search engine
* Records the history / favourites / bookmarks
* Plugins can be added
* Security levels can be set / filters applied
* Accessibility can be customised
* Tabs to open a number of websites in a single window
* Converts HTML code to display web pages

**Search Engine**

* Search criteria is keyed into the search engine
* Consists of key words (details) about the search query
* User then clicks on the matches / follows the links
* Matches will be listed in order of relevance
* User can modify the search (refine / widen / narrow / use advanced search)
  + Using AND, OR, NOT
* User can specify the type of result – images / video / maps

**Open Source Software**

* Software for which the copyright to source code
  + Is in the public domain
* No licence is required to use the code
* Users can use / change / improve the software
  + Redistribute it modified or unmodified
* Software is usually developed in a public, collaborative manner
* Advantages
  + The source code is available and can be modified without restriction
    - So the software can be improved or fine tuned
    - So the software can be ported to different hardware platforms
  + Modifications and improvements to the code can be distributed
    - So the software can be shared by many users
    - Encourages groups of developers to contribute to open source projects
* Disadvantages
  + There is no guarantee that project development will continue
    - May be left with an application containing bugs, with no-one to fix them
  + There may be a lack of support
    - With commercial software, the vendor has an obligation to support the user, especially with serious / security bugs
    - With an open source application, you may not get support without paying for it

**HTML**

* Programming language
  + Controls the appearance of a web page / tells the browser how to display a web page
* Uses special tags
  + To specify the structure of the web page / header / body
  + To specify the content / multimedia elements / text / images / tables
  + To set attributes such as fonts / background colour
  + And hyperlinks / navigation buttons
* Hyper Text Mark-up Language
* A language / has a syntax
* A HTML file is created for each individual web page
* HTML commands take the forms of tags
* The head tag describes / identifies the website / page
* The body tag specifies the content of the web page / what will be displayed in the browser
* Text can be formatted – fonts, sizes, colours
* Multimedia content can be inserted – graphics / images / sounds / movies
* Links can be inserted – to other pages / multimedia objects
* The structure of a page can be controlled by templates / tables / CSS

**MP4 Technology**

* Designed for digital streaming over the internet
* Stores and plays multimedia – digital audio and video including subtitles
* Stores data
* Encompasses MP3 technology – audio and images
* Uses compression to reduce large video files
* Software is available for editing files
* Uses Mpeg format

**Rich Text Format (RTF)**

* RTF documents can be read by most word processors and operating systems
* Various text formatting properties
  + Such as bold characters and different typefaces
  + As well as document formatting / structures / tables
  + Are encoded in a standard way

**Reports**

* A wizard / macro could be used
* The manager would first create a query
  + By selecting the appropriate table
  + And entering the appropriate search criteria
* The manager would then create a report
  + Based on the query
  + Specifying the fields to be displayed
* The report can be formatted / a template can be used
  + E.g. header / footer can be specified

**Spreadsheet Functions**

* SUM() or Total() function
  + Calculates the sum of a range of cells
* The AVR() or AVERAGE()
  + This calculates the average of a range of cells
* The MAX() or maximum function
  + This calculates the maximum value of a range of cells
* The COUNT() function
  + This counts the number of (non-blank) cells in a range of cells

Hardware

**Interactive White Board**

* Output device – displays the output from the computer to which it is connected (via a data projector)
* An input device – the user can select GUI options using a special pen
* Handwritten notes can be written on screen
  + Saved for later use (image form)
  + Printed out for distribution to the class
* Handwritten notes can be converted to text using OCR

**Data Projector**

* Output device – displays the output from the computer to which it is connected
* Project the output onto a screen
* Projects a high quality image
* Can be controlled via a remote control
  + Focus / image size can be changed

**CD-R**

* Laser is used
  + Heats areas of an organic dye layer
  + Permanently change the reflectivity of those areas
* A lower powered laser reads the data
  + By detecting alternating regions of heated and unaltered dye

**CD-RW**

* A laser is used
  + To temporarily modify the phase change properties of a dye
  + Between crystal phase (erased) and amorphous phase (recorded)
* A laser detects the difference between resulting light and dark areas
* Can be rewritten to 1000 times or more
  + Allows users to keep the most up to date data on the disk
* Suitability for backups
  + CD-RW is portable
    - And can be removed to a safe location
  + The data can be copied onto the CD-RW as it is writable
    - So the backup data can be copied to it
  + A CD-RW can be reused for multiple backups
    - As the backup can be erased and new data written (rewritable)
  + CD-RW has enough capacity
    - For small / medium databases
  + May not have enough capacity
    - For large databases

**DVD – Read and Write**

* A laser beam is used to read the data
* On a read-only DVD, pits are pressed onto the surface
* These are detected by changes in the intensity of the reflected laser beam
* On a DVD-R or DVD+R, the laser burns / heats the dye on the surface of the DVD
  + Changing its reflectivity
* On a non-rewriteable DVD, the writing laser is more powerful than the reading laser

**Blue-Ray**

* Advantages
  + The format was developed for high-definition video (HD) and for storing large amounts of data
    - Permitting high definition audio and video
    - Providing clearer pictures with improved colour and vividness
* Disadvantages
  + Blue-ray is a new / emerging technology
    - Players and discs are still relatively expensive
    - Range of films is restricted

**Touch Screen**

* Input and output device
* Screen is covered by a membrane
  + Which is sensitive to pressure
* Alternatively, a line of infrared sensors / lights
  + Along the edges of the screen
* The pressure of the user’s finger is detected / the finger cuts the beams
* The x and y positions / coordinates are calculated

**Speech Input**

* A microphone
  + Attached to a soundcard
    - Used to capture speech
* The signal is converted from analogue to digital
  + Using sampling
* The digital signal is compared to a database of sounds
  + For a matching pattern
    - Of frequencies / wavelengths

**Speech Input compared to a Touch Screen**

* Advantages
  + No special ICT skills required, just spoken commands
  + The user can control the system from a distance
  + Can be designed only to respond to certain people’s voices
  + Can be adapted for remote activation e.g. by phone
  + More suitable for people with disabilities
* Disadvantages
  + Can be complicated / time consuming to calibrate / set up
  + Could be activated by extraneous sounds e.g. background noise
  + May fail to respond to the user if they have a cold for example
  + May respond to a word not intended as a command

**Sensor**

* Sensor readings monitored at intervals
  + Heat sensor continuously monitors temperature
  + Microphone records sounds

**Actuator**

* Attached to a pump for example
* Computer sends a signal to switch it on or off
  + Computer controlled motor

**Digital Television: Benefits**

* Improved picture quality / sound quality
  + Programs can be broadcast in much higher resolution than analogue television
* Increase in number of TV channels
  + Compression technique enable the broadcast of high definition signals / multiple streams with stereo sound
  + Improved accessibility for the visually and hearing impaired
  + Sign language / audio description / subtitling can be made available
* Access to interactive services

**Robots**

* Can be used in hazardous environments
  + E.g. paint spraying a car
* Used to assemble goods from components
  + E.g. building a car
* Moving components from store to the assembly line
* Welding components together
* Testing of safety of goods
  + E.g. car crashes / dummies

**Optical Mark Recognition (OMR)**

* A special document / form is used to collect the data
* This has specific areas / boxes representing the user’s choices / answers / selections
  + Which the user shades in
* Document is scanned using light
* Reflected light is analysed
  + Positions of the user’s answers / choices determined
  + Against a template
* Benefits
  + Human error is eliminated
  + Answers can be read at electronic speeds reducing the processing time

**Optical Character Recognition (OCR)**

* Light (a laser) is passed over the document
  + Converting light and dark areas into binary / digital data
* OCR software can distinguish between types of content
  + Text, tables, photographs
* OCR program matches any text elements
  + With an internal library of characters, letters, numbers, spaces etc
  + This produces editable text
* Images are stored as bitmaps / JPG

Feasibility

**Technical Feasibility**

* Is the technology commercially available?
* Is the hardware and software available to meet the requirements?
* Will the technology cope effectively with proposed workloads?
* Will the required technology be compatible with existing technology?

**Legal Feasibility**

* Will the proposed system comply with all relevant legislation such as the Data Protection Act?

**Social Feasibility**

* What will the effect be on employees and customers / redundancies, retraining, relocation / effect on customer service
  + - E.g. they might have to apply online

**Economic Feasibility**

* Will the benefits outweigh the cost?
* Is the system affordable?

**Operational Feasibility**

* Will the system be practical to use / what changes to procedures will be required?
* Will the impact of the system on peoples working lives be manageable?
  + Retraining / redundancy?

**Schedule Feasibility**

* Can the system be developed within the required timeframe?

Jobs in ICT

**Programmer**

* Produces program code
  + Using a programming language such as VB, SQL
    - From module specifications
* Debugs the code
* Documents the code
* Maintains the code
* Carries out testing

**ICT Project Manager**

* To oversee / manage the development of the new system
* To plan / schedule the project / set time scales
* To manage the budget
* To allocate resources
  + Human, hardware, software
* To monitor progress
* To identify / respond to risk
* To report to management / client

**Technicians**

* Installs hardware
* Installs and configures software
* Maintains ICT systems
* Liaise with / support users
* Troubleshoot / monitor ICT system
* Perform backups

Software Development

**Fact Finding Methods**

* Observation
  + Benefits
    - The working of the system can be studied at first hand
  + Drawback
    - Users may ‘act up’ under observation
* Questionnaire
  + Benefits
    - Same set of questions can be given to a large cross section of users at the same time
    - Anonymous process may encourage honest answers
  + Drawbacks
    - The questions are set beforehand and a question cannot be changed in the light of the user’s response
* Interviews
  + Benefits
    - Can be fine tuned for the particular user / follow up questions can be asked
  + Drawbacks
    - Users may ‘act up’ under the pressure of an interview
    - May be difficult to select the users to interview

**Design Stage**

* Detailed design of user interface / switchboard / menus / screens
  + Output / reports
  + Database structure / model / DFDs
  + Test plan
* Design of data capture forms
* Process design
  + E.g. queries
* Specification of manual / clerical procedures

**Implementation Stage**

* System is developed
  + From the technical specification
* Software / code produced
* Installation of the new system
* Testing of the overall system
* Staff training
* Changeover
  + Data conversion

**Testing**

* System is operated under controlled conditions and the results evaluated
  + To ensure it meets its objectives / requirements / identify errors / faults / bugs
* Test data is used / test plan is used
* Module / unit testing is carried out
  + And integration testing
  + And system testing
* Alpha / beta / acceptance / application testing is carried out
* Software is debugged

**Technical Documentation**

* Contains system objectives / specification / user requirements
* DFDs / ERDs / normalisation results / database structure / data dictionary
* Module architecture / specifications
* Interface design
* Queries and reports definitions / validation formulae
* Code Listings
* Test plan and results
* Needed during the development of the system
  + So that the system can be developed to meet the system requirements
  + So that programmers / testers / developers understand how the system will be developed
* Needed during the system maintenance
  + So that the system can be corrected / perfected / adapted to meet the user’s requirements
  + So that programmers / testers understand how the system was developers
  + Testers can refer to the test plan / the original testing can be replicated

**User Documentation**

* Overview of the system / introduction to the system
* HW & SW configuration
* Installation instructions
* User Guide
* Troubleshooting section / FAQ section
* Training materials

**DFD**

* Provide a visualisation / graphical presentation
  + Of a system at different levels
  + Of how a system interacts with external entities
* Identifies processes / data stores
* Includes:
  + External Entity
  + Process
  + Data Store
  + Data Flow

**Entity Relationship Diagrams**

* An ER diagram is a graphical model / representation
  + Of a system’s data requirements
* It identifies the entities about which data is stored
  + An the links between them / relationships
  + And the type of links
  + And the entities’ attributes / properties
  + Including the key attributes / fields

**Application Testing**

* Performed by the developer
* Software is tested against the system requirements
* Includes
  + Module testing
  + Integration testing
  + System testing
* Modules are tested against module specifications / module testing
* Modules are tested working together / integration testing
* Test schedules / test data will be used
* Test plans are followed / test data is used
  + Valid
  + Invalid
  + Extreme
* Black Box and White Box testing is used

**Acceptance Testing**

* Performed when the software is ready to be released / handed over to the client / users / after application testing
* Intended to give the end users the confidence that the software meets their requirements
* A group representing the end users tests the application
  + Using real world scenarios / data
* The users report back / provide feedback on any problems
* Eventually, the users sign off the software / complete the contract
* Alpha and beta testing may be used

**Parallel Changeover**

* Both systems are used at the same time
* The old system is discarded when the new system is satisfactory

**Pilot Changeover**

* The system is first introduced into one part of the organisation
* The new system is then introduced across the organisation

**Direct Changeover**

* The old system is discarded
* The new system replaces it immediately
* Benefit
  + Both the new system and old system have to be resourced during changeover
* Drawback
  + If the new system fails, the old system is not there as a backup

**Phased Changeover**

* The new system is gradually implemented
  + In stages or module by module

**Parallel Changeover compared to Direct Changeover**

* The original system is still fully operational
  + If the new system fails / is unsatisfactory using parallel changeover
* The results from the original system can be compared

**Evaluation of Software**

* The usability of the software
  + How fast can a user learn to use the user interface?
  + Is the interface intuitive?
  + Does the interface match the users level of ICT competence?
  + Is the interface familiar to the user?
  + How well can a user transfer previous skills?
* The effectiveness of the software
  + Is the system cost effective?
  + Does the system perform its tasks efficiently / meet benchmarks?
* The suitability of the software
  + Does the system meet all its objectives?
  + Does the system provide the required functionality?
  + Is it compatible with existing technology / hardware / software / data?
  + Is it robust?
* Has it delivered the promised improvements?
  + Such as reduced processing time / improved productivity?
  + Increased processing accuracy?
  + Better quality information?
  + Reduced business costs / operating costs / manpower costs?

Threats

**Worm**

* Replicates itself from system to system
  + Without the need for a host file
* Worms generally exist inside other files
* Example:
  + A worm will pass on a document infected with a malicious macro
* Effect
  + The replication will progressively slow down the computer

**Macro Virus**

* Usually attached to a document or spreadsheet
  + Uses the macro functions / language of the application
* It is typically designed to run automatically when the document / spreadsheet is opened
* It copies itself and spreads from one file / document / spreadsheet to another
  + By infecting the application’s start up file

**Logic Bomb**

* A logic bomb lies dormant
  + Until a specific piece of program code is activated / or an event occurs
* A typical activator for a logic bomb is a date
* The logic bomb checks the system data and does nothing until a pre-programmed data and time is reached
* May wait for a certain message from its programmer
  + Before executing its code

Security

**Firewall**

* Set of related programs / software / hardware
  + Which monitors / controls traffic entering and leaving the network
  + To protect the network from unauthorised access / intrusion / hackers / viruses
* Examines each network packet / message
  + To determine whether to forward it towards its destination
  + To comply with the network’s security policy

**Proxy Server**

* Intercepts all requests to the Internet
  + To see if it can meet the request
* If not, it forwards the request to the Internet
* It stores recently used pages in cache memory
  + Increasing access speeds
* Proxy server may be used to filter requests
  + Preventing employees from accessing specific web sites
* Hides the IP address from external access

**HTTPS**

* A protocol
* When a user connects to a website via HTTPS a secure session is created
* The website uses encryption
  + For sensitive data such as bank details
    - Using a digital certificate
    - Has a private key restricted to the owner
    - Public key given to the user
* The website must have a Secure Socket Layer (SSL) Certificate
  + Which must be verified / trusted
* Example:
  + PayPal
    - Safeguards the buyer’s and seller’s bank details
    - Buyer and seller must each have a PayPal account
    - PayPal transfers money from the buyers account to the sellers account
      * So that the buyers confidential details are withheld from the seller and vice versa

**Username & Password**

* Allocated to each authorised user
* Username is unique
* User is usually first given a default password
* The password can be created / changed / selected by the user
* Both are required to log on
* There may be a restriction on the number of attempts at the password

**Why a user ID and password system may be ineffective**

* Users choose a common or obvious password which can be guessed
* Users to not keep passwords secure e.g. they write them down
* Users use the same password for multiple applications
* Users do not change default passwords
* Users share passwords
* Users forget to log off
* Unencrypted passwords can be hacked

**On-line Security**

* PayPal
  + Method sending and receiving money online / over the internet
  + It is a secure method
  + Acts as an intermediary between buyer and seller
    - So that the buyers details are withheld from the seller
  + It is set up using an email address and a password
  + Money is transferred through PayPal accounts, not ordinary bank accounts
  + Transaction fee may be charged
* HTTPS
  + Hypertext Transfer Protocol Secure
  + A protocol
    - Providing secure / safe internet transactions
      * Via a secure website
  + It is used when the information being communicated is sensitive / confidential
    - Such as credit / debit card details
  + Uses encryption
    - So that the information being transferred back and forth is encoded
  + And will be meaningless to any unauthorised parties

**Online Banking – Security Risks**

* Identity fraud
  + Personal / banking details keyed in during a transaction may be intercepted and used for unauthorised purchases / keystroke logging
* Phishing / fraudulent emails
  + User asked to supply personal / banking detail by a bogus email
* Viruses
  + May be downloaded while using on-line banking

**Minimising Internet Security Risks**

* Use antivirus software
  + That is updated regularly
* Do not open suspicious emails
* Do not visit dubious websites
* Use passwords on wireless network
* Block pop-ups
* Always log off interactive websites
* Delete internet cookies
* Set browser security levels

**Disaster Recovery Plan**

* Describes how critical operations will be restored
  + After a natural or human-induced disaster
  + Including plans for coping with the unexpected or sudden loss of communications
  + And key personnel
  + And back up and recovery procedures

**Minimising risk of Computer Viruses**

* Install antivirus software
* Install a firewall
* Use a proxy server
* Remove / disable / scan portable devices such as memory pens
* Introduce an acceptable use policy
* Train users to avoid opening suspicious emails etc

Virtual Reality

**Virtual Reality**

* Allows the user to interact with an environment that exits only inside a computer / an artificial environment is created
* Uses immersive technologies
  + Such as head-mounted displays / virtual reality helmets / special gloves
  + Or a special room whose walls consist of screens / simulators
* The computer creates a three-dimensional environment
  + From numerical data / sensors
  + Which sense the user’s reactions and motions
* The user can modify the synthetic environment
  + Creating the illusion of bing part of the real environment / receive feedback
* Real-time processing is required
* Benefits
  + Procedures can be repeated
    - At any time
    - Many times
  + Variations / emergencies can be programmed in
  + New techniques can be practiced
  + Feedback provided on the users performance
  + Minimises human risk from real life situations

**Simulator**

* Removal of physical risk
  + Users can be trained or testing without risking lives / expensive equipment
* Cost-effective (ignoring the high costs of simulators)
  + Compared to the cost of an air-craft for example
* Simulator can be programmed
  + To recreate specific situations e.g. flight conditions / emergencies / exceptional conditions / to repeat scenarios
* Data from training sessions can be recorded electronically
  + For future analysis / comparisons
* Training session can be repeated
  + So the user can improve / learn from mistakes
* Extreme / rare conditions can be created
  + Which the user may never actually experience / which would be impossible to guarantee in real life

**How ICT is used in a simulator**

* Computer software generates 3D images of what the user can see (weather, landscape etc.)
  + Projects them onto a special screen / dome
* Actuators move hydraulic / electromechanical legs
  + To recreate things such as pitch / acceleration / deceleration
* Sensors are used to detect use response
  + Such as response times / metabolic readings
* Virtual reality helmets / gloves with sensors may be used

Processing

**Real Time Processing**

* The processing of data as it is received / generated
  + Producing results without delay / immediate feedback
    - So the result is reflected / effective for the next processing activity
  + Example:
    - The system always has up-to-date data about temperatures at a house

**Batch Processing**

* Data to be processed is grouped / held in bundles
  + Until a suitable quantity / processing time is reached
* The entire patch is processed in one go
  + Usually at an off peak period / overnight
* All data undergoes the same processing
  + Without human intervention
* Validation by control / batch total is used

Memory

**Hard Disk**

* Used as semi-permanent storage
* Holds the system’s application software e.g. database software
* Holds the complete operating system
* Holds the data / files
  + Which has been saved
* Suitability for backups
  + Hard disk is connected to the computer system
    - Cannot easily be removed / stored in a safe or remote location

**ROM**

* To permanently store the boot up sequence / bootstrap / OS core / BIOS

**RAM**

* Temporary / volatile storage
* Holds programs while they are being executed
  + And data while it is being directly processed / upon input / prior to being stored in external memory
* To store data currently in use
* To store the current application

**Cache Memory**

* To allow the processor to operate at full speed
  + By storing data in faster memory (SRAM)
* Holds data that the processor is likely to use in the very near future
* Used by a proxy server
  + To store recently downloaded web pages
* To store the most recently / frequently accessed data
  + Speeds of retrieval of this data

Internet & Communications

**Internet – Search Engine**

* Use a search engine
  + By typing in key words about what is being searched for
    - Follow the links in the results
  + Will be listed in order of relevance
* Search could be widened / narrowed down
  + By including / excluding words
    - AND / OR

**Internet – Communicating**

* Could communicate by e-mail
  + Using an address book
  + Using saved contacts
  + Multiple recipients
  + Using attachments
* Using an Internet forum or message board
  + Users could register as members
    - Could submit / contribute to topics (threads)
    - Or communicated via messages visible to all members (posts)
* Videoconferencing
  + Each user needs a webcam
  + Each user needs a microphone

**Email**

* Attachments can be added to an email
  + Such as photos / videos
* Address book can be created / maintained
  + Containing email addresses of friends / family / customers
* The same email can be sent to a number of users at the same time
  + Relevant recipients can be selected and added to the “send” field
* The text of the email can be written in HTML
  + Allowing hyperlinks to be added

**Email – Group**

* Prepare email / any electronic documents / reports etc.
* Create a subject for the email
* Create a message for the email
* Attach any documents
* Select the recipients
  + From the address / contacts list / send a CC

**Email – Draft**

* Draft article is prepared in electronic form / using a word processor
* The text of the accompanying letter is composed
* Topic is inserted into the subject box
* Draft article is attached
* The users email addresses will be selected from a contact list
* The message can be sent to all members at the same time
  + Or selected members

**Email – Handwritten Draft**

* The student will use a scanner
  + To convert the draft into digital form
  + Such as a JPG file / BMP file
  + And save it
* The student will create an email for the tutor and add the file as an attachment

**Video Conferencing**

* Hardware
  + Web cam
  + Microphone
  + Loudspeaker
  + High resolution screen / data projector
  + High bandwidth cable / connection
* Software
  + Communication software enable the sending and receiving of data over telephone
  + Image compression / decompression software to reduce file sizes during transmission

Unions

**International Telecommunication Union (ITU)**

* World-wide organisation / United Nations agency
* Coordinates governments and private organisations
* Regulates the use of the radio spectrum throughout the world
* Assigns communication satellite orbits
* Establishes standards for a range of communication systems
* Organises meetings and exhibitions

**ISO**

* International Organisation for Standardisation
* It is a network of standardisation bodies from over 150 countries
* It establishes standards which control products and services
  + Such as quality, environmental friendliness, safety, reliability, efficiency interchange ability
* Most ISO standards refer to specific products
  + E.g. Disaster Recovery
* Some are generic
  + E.g. ISO 9001 (quality)
  + But apply to ICT

CAD / CAM

**Computer Aided Design (CAD)**

* The use of computer technology / software in the drafting / design stage
  + Of object such as tools / machine parts / buildings / clothing / integrated circuits / food
* Benefits
  + Increase in productivity / accuracy – electronic v manual
  + Use of templates / tool box of specialist shapes increases productivity / quality
  + Designs can be edited electronically
  + Designs can be input directly into the CAM process
  + Manipulations such as 3D representations are possible
  + The design can be tested / evaluated before production

**Computer Aided Manufacture (CAM)**

* The use of computer technology / software to control
  + The production / manufacture of objects
  + Incorporating automatic tool changing
  + Such as drills, lathes, robots
  + Usually using the design / digital models created by CAD
* Benefits
  + Increase in productivity
    - Accuracy / precision
    - Consistency
  + Reduction in manpower levels / reduced wage costs
  + Can be reprogrammed – changes can be implemented by modifying the program

Operating System

**Multitasking Operating System**

* Enables the user to perform more than one task / program at a time
* Each task may have its own window
* Each task can be totally independent of each other
* The tasks may be dependent e.g. they may share data
* The OS must keep track of where the user is in these tasks
  + Enable them to go from one to the other without losing data
* The OS allocates storage and other resources accordingly
* In pre-emptive multitasking, the OS allocates CPU time slices to each program / task
* In co-operative multitasking, each program has use of the CPU for as long as it needs

**Multi-User OS**

* Enables many users to run programs simultaneously
  + From a few users up to thousands of users
* The OS must make sure that the resources allocated to the current users are balanced
  + So that each user has sufficient resources
  + Whilst the overall performance of the system is satisfactory
* Time slicing can be used

Errors

**Errors**

* Transposition error
  + The order of data / information has been switched
* Transmission error
  + The data has not been sent successfully / fully
* Omission error
  + Data has been omitted during transmission / data is missing

**Check Digit**

* Calculated from the other digits in the data item
  + Becomes part of the data item
* The check digit is recalculated when the data item is input
  + If it does not match, an error will have occurred
* E.g.
  + A transposition error will alter the place value of the digits
* In a transposition error, the places of two digits are interchanged
* The check digit is recalculated after transmission
* As each digit in the sequence is multiplied by its place weighting
  + And the positions of some digits have changed
  + The check digit will be incorrect

Photos / Images

**Photo File Formats**

* JPEG / JPG
  + Method of compressing full-colour or grey-scale images
  + Uses image compression
  + This reduces file size
  + Possible expense of image quality / lossy compression
    - Degree of ‘lossiness’ can be varied
    - Greater degree of compression, smaller the file size
      * Greater the reduction in quality
  + Can handle over 16 million colours
* BMP / Bitmap
  + Non-compression method
  + A bitmap file represents pixels in a grid
  + Each pixel in the photograph
    - Represented using 8 / 16 / 24 / 32 bits (colour depth)
    - For grayscale / coloured images
  + All detail in the image is stored / no compression
    - Resulting in large file sizes
  + The more bits, the greater the resolution
    - Larger the file size
* TIFF / Tagged Image File Format
  + Designed to transport colour or grey-scale images
  + Large and very high quality
  + Stored information about the image in a header
  + Supports multiple formats / different types of images available
    - Black and white / grey scale
    - Palette / RGB (i.e. true colour)
    - Each with a different range of colours
  + Virtually no compression
* PNG
  + Open-source format
  + Supports true colour (16 million colours)
  + Lossless / no compression
  + A lossless compression method
  + Supports indexed colours / grey-scale / RGB / millions of colours
  + Uses progressive rendering
    - The contents of a file become apparent earlier in the load process
  + Uses an alpha channel which enables multiple levels of opacity
  + Uses gamma correction to control how an image will appear on different types of display
  + Include file integrity checks to minimise problems while downloading or transferring PNG files
* GIF
  + This is a method of compressing colour or grey-scale images
  + Bitmap image format
  + It is an 8-bit format
    - Supports 256 colours
  + Uses compression for colour depth
  + Stores pixel data

**Joint Photographic Experts Group (JPEG)**

* Standard image compression format
  + Designed for compressing either a full-colour or grey-scale image
    - So that its file size is reduced
* JPEG is ‘lossy’
  + Resultant image does not contain the same detail as the original
  + But it exploits the limitations of the human eye in detecting small colour changes
* Degree of ‘lossiness’ can be varied by adjusting compression parameters
  + So that file size can be traded against image quality

**Transferring a Photo**

* Camera could be connected directly to the computer
  + Using USB cable / connection
* Camera’s memory card could be removed
  + Placed in a media card reader connected / built in to the computer
* Photograph could be sent wirelessly to the computer
  + Using a Bluetooth connection

**Image Enhancement using a Computer**

* Digital imaging / graphics software is used
* This can alter the lightness / darkness of the photograph
  + And the contrast
  + And the colour saturation / hue / balance
    - Automatically / as defined by the user
* Parts of the image can be copied / moved / deleted
* Image can be cropped / re-sized
* Filters / effects can be applied
  + Image can be sharpened for example
* Blemishes / dirt marks can be removed / blurred / cloned out

TCP / IP

**TCP / IP**

* TCP layer
  + Supports the transfer of files between computer systems
  + Controls security / permission issues
  + Can handle file transfer between different computers (different character sets, end of line conventions)
  + Splits data into packets
  + Allocates an address to each packer
* IP layer
  + Responsible for transferring packets of data from node to node
  + Forwards each packet using its address
  + Responsible for verifying the correct delivery of data
  + Detects errors or lost data

**TCP / IP**

* TCP layer
  + Enables two hosts to establish a connection and exchange data
  + It is responsible for reliability and correct delivery
  + It converts a message into data packets
    - Containing a header / sequence number / destination address
    - That are transmitted over the network to the destination computer
    - And then reassembled so that the message can be read by the recipient
* IP layer
  + Responsible for routing data packets from node to node
  + It forwards each packet using its destination address (the IP number)
  + Packets of the same message may be sent by different routes

By routers / switches

Barcode / RFID

**Barcode**

* Increased accuracy / speed over manual systems
  + Barcode is read electronically / it is a direct data capture method
    - There are no transcription errors
* More up to date prices
  + Once a price is changed in the database it will be immediately used when / if the barcode on the corresponding product is scanned

**RFID**

* Radio Frequency IDentification
* Data relating to a product is stored on a RFID tag attached to the product
* An RFID tag carries data programmed into a small computer chip
* The tag is activated by radio waves emitted from an RFID reader / wirelessly
* The tag sends the data stored in its memory back to the reader
* RFID uses radio waves / wireless technology
  + To transmit the identity of an object / its unique serial number
* An antenna / reader emits radio signal to activate the RFID tag / chip
  + And decode it
  + And to read and write data to the tag
* A tag can hold kilobytes of data
* The range can be anything from centimetres to metres
* In active systems
  + The chip has its own power supply
* In passive systems
  + The chip is activated by the reader’s power
* RFID chips are generally very small / approximately 1cm by 2mm
* RFID technology does not require direct contact
* RFID can track moving objects

**RFID over Barcodes**

* There is no line of sight requirement
  + A barcode must be clean and the reader and label must be properly oriented with respect to each other
  + RFID tags can be read from a greater distance, even in harsh environments
* The information stored in a barcode is fixed and cannot be changed
  + RFID tags can be dynamically changed
* Human intervention is usually required in order to scan a barcode
  + Whereas data from an RFID tag can be read without the need for someone to properly align the tag with the equipment that reads the data
* Barcodes must be visible on the outside of a product’s packaging
  + Whereas RFID tags can be placed inside either the packaging or the product itself
* More data can be stored in an RFID tag than on a barcode
  + And RFID tags have both read / write capability, whereas barcodes are read-only and cannot be reused