

A LEVEL NOTES

APPLICATIONS AND IMPLICATIONS

COMPUTER APPLICATIONS

There are a variety of applications that should be studied or that you should be aware of. There are two compulsory case to be studied each year.

Other applications should include:

Communications and information systems: teletext; viewdata; e-mail; information retrieval systems; database systems; office automation and library systems.

Commercial and general data processing: banking systems; hospital administration; systems for personnel records; stock control and order processing.

Industrial, technical and scientific uses: weather forecasting; CAD; CAM; image processing and industrial inspection systems.

Monitoring and control systems: hospital patients; chemical process control; nuclear power station operation and traffic survey and control.

Automation, embedded systems and robotics: domestic equipment; automatic navigation systems; automatic fuel injection systems and industrial robots.

Expert systems and artificial intelligence: mineral prospecting; medical diagnosis and speech recognition.

Education, training and entertainment: CBL; CAI; applications in music, computer graphics and animation for television and film; arcade and adventure games.

For every applications that you should study you need to know about each of the following aspects:

- 1 the purpose of the application;
- 2 the required outcome;
- 3 the overall system design ,including both the computerised and the non-computerised parts of the application;
- 4 the necessary inputs to the system and the means by which data is captured;
- 5 the overall organisation and processing of the data within the system;
- 6 the use and organisation of the major software and hardware components of the system;
- 7 the need for recovery in the event of a system failure;
- 8 the interface between the system and the user;
- 9 the effectiveness of the system in practice;
- 10 the effects of the application on individuals and organisations.

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The purpose of the application

This is a brief summary of what the application does

The required outcome

What is achieved and what are the outputs

The overall system design

How the system is designed: what are the inputs; what are the processes; what are outputs; what is stored.

The necessary inputs

What are the inputs

The organisation and processing of the data

How is the data organised, ie data structures, data types and file structures.

The software and hardware components of the system

Types of software used. Languages or application packages
Hardware needed.

The means of recovery

What happens if the system crashes or worse still if a jumbo jet hits the computer.

The design of the interface

What interface is there: command driven; menu driven; forms driven; WIMP or other.

The effectiveness of the system in practice

Does the application deliver what is promised?

The effects of the application on individuals and organisations

How does this application effect people - in terms of redundancy; retraining; de-skilling; job satisfaction.

CASE STUDIES

The ICI Personnel Database System (PDS)

1 The purpose of the application

ICI recognises that its employees are a major asset to the Company and the purpose of the application is to facilitate employee administration, including looking after the well being of the employees, and the provision of management information.

2 The required outcome

The objective of the system was to streamline administration by cutting out duplication, shortening paper flows and automating wherever practicable. The Company set out to create better and more satisfying administrative jobs by providing on-line completion of tasks and the removal of repetitive calculation. A further aim was to provide a better administrative service to employees and management.

3 The overall system design

The data for the system is notified to the Personnel Department from the other departments by means of appropriate forms. For example, change of address, notification of children and next of kin, and for payment purposes, overtime, sickness etc. These are then submitted by the Personnel Clerk through Visual Display Units (VDUs) into the computer database. Certain applications run periodically, such as weekly or monthly payment, and in other cases programs are run on request, whilst specific enquiries may be made at any time by authorised personnel.

4 The necessary inputs

-already covered in 3 above.

5&6 The organisation and processing of the data, and the software/hardware components of the system.

PDS is an on-line real time database held on a single IBM 3084Q Computer installation. The database is implemented on the ADABAS database management system using the IBM product CICS as the teleprocessing monitor. Programs are written in PL1 or NATURAL, and no fewer than 40 separate sites are linked by a network, using multi-system network facility and network job entry to the central computer. Large scale printing and batch entry are handled by a number of remote centres, whilst on-line screen entry and information display, together with small scale on-line printing is provided by 500 widely distributed VDUs and 100 associated matrix printers. The choice of the IBM hardware and the ADABAS software was determined as the standard by the Company for all its commercial applications, therefore this application is using exactly the same environment as all the other applications.

7 The means of recovery

This depends very much on the type of system failure. In the event of the computer being unavailable, which is highly unlikely since there are actually 2 computers in the same room linked together for back-up purposes, then a message is sent to all terminals informing them that the system is unavailable. The operating staff at the computer centre have standard procedures to go through to restore the system to operational status. This includes the establishment of which transactions have been completed at the time of the failure and the Users are asked to re-submit any subsequent input. Copies of the database are taken every night and kept in store which is remote from the computer room. In the event of a major failure, the database is restored to the position as at the last copy and a logging system automatically applies all the transactions since that time. Most of this is done automatically by the database management software under the control of the computer operators.

8 The design of the interface

The main interface between the system and its Users is the VDU screen. This was designed in consultations with the actual Users, who had experience of other applications before this one. In general, the initial screen is in the form of a 'menu' giving the User choice of the activity that they wish to perform. Having chosen the activity, they are usually presented with the equivalent of a form on the screen and they fill it in in accordance with the rules. Extensive training of the Users is given in advance of implementation of the system.

9 The effectiveness of the system in practice

The system has proved to be extremely effective within the Personnel function. The ability to update the database and to enquire of it on-line, giving instant access has eliminated many problems that were present previously. The quality of data has been improved and the reliance on it has increased substantially. The administrative staff enjoy using the system and would not wish to go back to the old systems. The system calculates the employees pay and transmits the data to the 'BACS' computer which automatically credits the money into the 'employees' bank account. The system has enabled organisational change to take place and has provided much needed information for the administration of the employees. A powerful enquiry system allows data to be extracted and down-loaded to Personal Computers for further manipulation including graphical representation. The intention is to make the database available to a much wider range of managers and staff in departments other than the Personnel Department. However, this must be combined with privacy considerations in accordance with the Data Protection Act.

10 The effects of the application on individuals and organisations

From the outset, the system was intended to eliminate the boring, repetitive type of work and create more interesting jobs. The individuals using the system appear to be very happy with this change. The effect on individuals who are actually subjects in the database is at the moment indirect, but the service from Personnel Officers to the individuals and to their management has been improved considerably and should be of benefit to the individuals. As regards the effect on the organisation, the rationalisation of the inputs to the system to eliminate duplication etc. has meant that certain groups of people originally in different departments have now been grouped together in one department. Also their way of working has been altered considerably, although the area in which they are working is still the same. In such a large Company as ICI, there are continual changes of organisation and this system has helped staff to cope with them fairly easily, whereas in the past it was a mammoth task. For instance, 4 separate divisions have recently been combined into a single group employing 30,000 people. In the past, this would have given tremendous administrative problems, but with the new system the change was managed relatively easily. In addition, Parliament and the EEC continue to pass legislation which has far reaching implications for companies such as ICI. Where this concerns employees, PDS helps to ensure compliance with the new regulations.

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Courtaulds - Group Treasurer's System

1 The purpose of the application

Courtaulds is an international manufacturing company based in the UK. Different sections of the company at various times need to acquire foreign exchange to finance work abroad. This is done through the group treasurer who buys and sells foreign currency in the Futures market. The buying and selling is done centrally to co-ordinate these exchanges to get the best deal.

2 The required outcome

- a) To have the foreign funds available to finance work abroad at the correct time and at the least cost.
- b) The production of contracts.
- c) Management reports.
- d) Insurance cover for these deals in case of a big change in the interest rates.

3 The overall system design

The data, as detailed below, is collected from the various sections and then entered via VDUs. This information is incorporated into a letter which is sent to an appropriate Bank and confirmation of the deal is sent to the group treasurer.

4 The necessary inputs

The information needed is

- a) Which section wants the money,
- b) How much they want,
- c) What currency,
- d) When it is required.

This information is typed in via a terminal.

5 The organisation and processing of data

The above information is used together with a file of Banks and their addresses to send a letter to the Bank. This letter forms the contract. Confirmation of this is sent to the group treasurer. The bank sends an invoice to the group treasurer who settles up with the Bank.

6 Software and Hardware

The operating system is PICK, which is a Virtual Memory operating system with a built in database. Pick can handle variable length data, and accesses this data using hashing algorithms that are microcoded. The languages used are DATABASIC a mixture of PASCAL and BASIC, and a 4GL (4th

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generation language) called ALL (Application Language Liberator). PICK has a built in query language. Fixed point arithmetic is used to accurately hold numbers such as interest rates which may be expressed to 4 decimal places. The hardware is located in Coventry. It consists of a super-mini, the MICRO-DATA M9000, which has 1 megabyte of internal memory and a 250 megabyte hard disc. There are 40 terminals, which are fairly dumb; 25 are for users and the remaining 15 are used for development work, which also takes place at this site.

7 System failure

Towards the end of each day the whole of the contents of the hard disc is dumped to tape, this is done in the background. In the event of a failure late in the day something may be lost. This is one reason for the production of many reports so that the system can be restored. If a failure occurs during the day, the previous days state can be restored from yesterdays backup tape. The days input must then be retyped. The system clock may have to be reset for the correct date to appear on the contracts.

A tape is produced for every day of the week. These are kept for the week. A tape is produced at the end of each week. These are kept for each period of four weeks and are stored off site. A tape is produced at the end of each month. These are kept for a year.

8 The interface

The input system is via a VDU. Input to the prompts is restricted in length and is validated there and then. A '?' will give a help screen.

10 Effects on individuals and organisations

The system makes it much easier to enter data and acquire foreign exchange.

Security

Access to the centre is via a door fitted with a keypad. Two failures are allowed then a security alarm is triggered. Each terminal requires a user id. and a password and some programs require sub-passwords.

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BR British Rail

British rail uses computers for a large range of applications.

1 TOPS Total Operations Processing System

This is a large real-time system which constantly records the location of over 40,000 freight wagons, 2300 diesel locomotives and 240 electric locomotives on British rail. It uses 820 intelligent terminals at freight marshalling yards throughout Britain on-line to an IBM 3084 in London.

2 Timetable Production

An on-line database containing the entire British Rail train timetable uses computer-aided typesetting methods to produce timetable publications including the Public Timetable book, Red Star Timetable public booklets, Pocket Timetable booklets, and the Station Departure posters which are displayed at all major stations. It also provides the information for the BR timetable section of PRESTEL. Data from the database also feeds other systems, one of which automatically sets some of the train destination boards on many station platforms. It is also used to provide managers with locomotive and train crew schedules.

3 Stock Control

Two big systems serve BR and BREL (BR Engineering Ltd.) for stock control, ordering, accounting and invoice certification. On-line terminals provide interactive interrogation and direct input facilities. Regional depots have micros connected to mainframes by dial-up over railway telephone lines.

4 Ticket Issuing and Passenger Accounts

BR is currently in the process of installing approximately 2500 computer controlled ticket issuing machines at stations as well as introducing new portable machines to be used by Conductor Guards on pay trains. Each of these machines is connected directly or indirectly to a central computer which retrieves information every night about tickets sold and revenue collected so that up-to-date sales and revenue data can be made available for managers on which to base their decision making processes.

5 Reservations

Two large systems run currently on IBM mainframes for reserving seats and sleepers on trains and for reserving passenger and car space on ferry services. A third system is under development for linking continental reservation systems for the reservation of space for continental travel. Access to this system is provided by 800 terminals based mainly in UK railway stations and Travel Centres but also from a small number in Southern Ireland and the European Continent. In

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addition over 1500 travel agents in Britain, Ireland and in the near future Germany, will also be able to access the system using PRESTEL television type terminals. The system uses fully duplexed IBM type processors on a 24 hour, 7 day week basis, with application software running under the ACP (Airline Control Program) operating system. This has been modified to let a NOVA processor control a 1000 terminal network based on 40 Videcom TDUs (Terminal Drive Units), each of which can manage up to 100 terminals in the UK and Europe. Over 10 gigabytes of mass storage allows on-line access to over 350,000 ship and train movements per year. System security is maintained by message and file update logging to fast tapes. The network handles interactive and bulk data flows, file transfers between mainframes and between mainframes and micros, plus remote job entry working.

The most important DBMS (Data Base Management System) for BR is ADABAS, which runs on IBM mainframes. It embodies much of the relational database philosophy, and with NATURAL, its high level interactive query and report generation languages, it gives users easy and efficient access to their data, which they see as only the data items they want to see, organised suitably for their particular application. Applications using this database include Timetabling, Train Scheduling, Track Information Systems, Rolling Stock Maintenance and other financial systems.

ROBOTS

A robot is "a reprogrammable multi-functional manipulator designed to move material, parts, tools or specialised devices through variable programmed motion for the performance of a variety of tasks".

The main reason for using robots is the reduced production costs. Robots work about 98% of the time while humans have time off for lunch, sleep and illness. Robots can produce goods that meet quality control tests better than those produced by humans.

A robot welder can weld 30" per minute as against 10" per minute for a human.

A robot paint sprayer can spray a car in 3 minutes whilst a human needs 15-30 minutes.

Robots can be used in hazardous places, eg. steel rolling mills, forging presses where white hot metal is handled, radio active environments, deep sea, space.

Typical robot applicationsLoading and unloading

Here it is the job of the robot to present a work piece to some industrial machine which processes it in some way then for the robot to unload it and perhaps place it on a conveyor to be carried to another machine.

Such machines include forges, presses, moulding machines, milling machines and lathes.

Material handling

This is closely related, covering such tasks as transporting work pieces directly between machines, stacking completed parts, and packing material to separate and protect the goods.

One such example used by IBM is a system which takes blank discs, inserts them in a writer, presents them to a labeller and then puts them in boxes for delivery.

Manufacturing

In this category, either the robot holds a tool which it applies to the work piece, or holds the work piece and presents it to the tool, with the robot ensuring it is held in the correct position and orientation.

Such applications include:

Casting: a master is dipped into a ceramic slurry to form a cast. The object is dipped several times at controlled intervals.

Grinding: involves the robot holding a tool to remove burrs and sharp edges from objects or even to

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obtain a surface finish as close as 1/1000".
Deburring: is a similar job, but a file is used rather than a grinding wheel.

In shoe manufacture robots have been used to hold water jet cutters to cut leather to shape.

In the car industry robots are used to apply glue and sealants to panels and windscreens.

Paint spraying

One method of paint spraying used with robots involves a large voltage difference between the car and the paint sprayer, so that the paint is electrostatically attractive to the car. This is an advantage for awkwardly shaped parts. High voltages are dangerous to human workers.

If humans are used, goggles get covered in paint, fresh air is needed, and the paint shop must be kept at a humanly acceptable temperature- all of these add to the costs.

Robots used for painting are often special purpose ones. They usually use hydraulic rather than electric motors to prevent sparks igniting the paint/air vapour mixture.

Welding

Spot welding joins pieces of metal at a point. Arc welding, joins two pieces of metal along a seam.

In the first case a pair of pincers held by the robot forces the items together with a large force to ensure good electrical contact, and passes current through the pincers.

Often vision systems are used to follow the seam, in arc welding, or use is made of touch sensors.

Robot assembly

This is probably used most in electronics manufacturing. Tasks include: placing components on circuit boards; keys in keyboards; assembly of floppy disc drives; and even complete assembly of telephones.

Inspection

Robots are used to inspect finished products either by running a measuring probe over them at selected points or in another case perhaps picking things like car bumpers and holding them up in a vision system.

BL (British Leyland) have developed a system for testing for leaks in windscreens, by filing up the car with a helium mixture and then moving a sniffer sensor around mounted on the end of a robot arm. It tracked areas where leaks were most likely and the gas analyser connected to the sniffer, and then draws a picture of the car with the leaks marked.

EXPERT SYSTEMS

"An expert system is regarded as the embodiment within a computer of a knowledge-based component, from an expert skill, in such a form that the system can offer intelligent advice or take an intelligent decision about a processing function. A desirable additional characteristic, which many would consider fundamental, is the capability of the system, on demand, to justify its own line of reasoning in a manner directly intelligible to the enquirer. The style adopted to attain these characteristics is ruled-based programming".

An expert system is a computer system that holds specialist knowledge about a particular area of expertise and is capable of making intelligent decisions. Areas successfully tackled so far include:

- * medical diagnosis;
- * geological exploration;
- * organic chemistry;
- * fault finding in electronic equipment.

MYCIN

MYCIN is a computer system which diagnoses bacterial infections of the blood, and prescribes suitable drug therapy. MYCIN introduced several new features which have become the hallmarks of the expert system.

Firstly, its "knowledge" consists of hundreds of rules, such as the following:

IF (1) the infection is primary-bacteremia, and
 (2) the site of the culture is a sterile site, and
 (3) the suspected portal of entry of the organism
 is the gastro-intestinal tract
THEN there is suggestive evidence (0.7) that the
 identity of the organism is bacteroides.

Secondly, these rules are probabilistic. MYCIN can reach a conclusion even when some of the evidence is incorrect or missing.

Thirdly, MYCIN can explain its own reasoning processes. The user (a doctor not a patient) can ask why it asked a particular question or why it reached a conclusion. MYCIN is "user-friendly".

Fourthly, MYCIN actually works. It does a job that takes a human years of training.

PROSPECTOR

Prospector a "geological expert" found a previously unknown deposit of Molybdenum.

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Components of an Expert System

There are four essential components of an expert system:

- * the knowledge base
- * the inference engine
- * the knowledge-acquisition module
- * the explanatory interface.

The knowledge base

A knowledge base contains facts and rules. Facts are short-term information that could change in the course of a consultation. Rules are the longer-term information about how to generate new facts or hypotheses from what is presently known.

The inference engine

This part searches through the rules and facts in an attempt to prove or disprove a goal.

The knowledge-acquisition module

Knowledge is a scarce and costly resource. Experts (human ones) are notorious for not being able to explain how they reached a decision. This module attempts to capture knowledge and convert it into rules.

The explanatory interface

One of the best things about the classic expert systems like MYCIN is the care exercised over the user interface. At any time the enquirer can ask the system why it made a given deduction or asked a particular question.

ON-LINE BOOKING SYSTEMS

ST DAVID'S HALL

St David's hall is a modern purpose built concert hall opened in the early 1980s. The actual Concert Hall is very large, catering for up to 2000 people. The stage is carefully constructed so that it can be altered for different events such as wrestling, snooker, orchestras and rock groups. There are seven different seating arrangements possible because of the different stage layouts.

1) Purpose of the application.

If you want to buy a ticket at St David's Hall you can go there, 'phone in or call at the New Theatre which has a link with St David's Hall. The computer takes bookings for the New Theatre as well as St David's.

2) The required outcome

To sell as many tickets as possible without double booking seats and to have quick access to the accounts for each show.

3) The overall system design

4) The inputs

The operations manager uses a menu-driven program to allow her to set up details for a new performance.

The ticket clerks key in the seat numbers that have been sold or booked.

5) The organisation and processing of data

The main file is the SETUP file, which enables them to:
add new shows;
add subscriptions;
add agents;
change ticket formats.

The PERFORMANCE file contains:

name of the concert;
date;
capacity available;
target value for sales;
sales value;
number of tickets paid for;
number of free seats;
seats available.

There are two other files the TILL REPORT file and the ADVANCE REPORT file.

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Updating occurs after every sale, ie pseudo real time.

6) Software and Hardware

The applications programs are written in FORTRAN. Every program is designed to be user friendly and the Ticket Clerks need to know very little about computing.

The operating system is multi-access.

The computers used are a PDP 11/44 and a smaller PDP 11/24. These are both minicomputers.

There are nine VDUs and nine ticket printers at St David's Hall and four of each at the New Theatre. There is also a report printer to produce accounts of each show for the manager.

There are two modems and some multiplexors to connect St David's Hall to the New Theatre.

7) Recovery in the event of failure

There is one systems disk and seven data disks. There are three copies of everything. Once a week the systems disk is copied to make the three copies. One of these copies is then kept on the premises in an unknown location, another is kept in Cardiff and the third at St David's Hall.

On any one day all the day's transactions are on the systems disk. These transactions are copied across to a database several times a day. There is a database for each day of the week.

If the system fails all the lost information can be retrieved from three copies of the database and the systems disk in about 15 minutes.

Every transaction is also printed on the line printer. So all the information could be retyped.

8) User interface

Each terminal shows a layout of the Concert Hall. Each seat has a special marker:

a block	indicates	a sold seat
a %		a reserved seat
a H		a House seat
a C		a complimentary seat.

The customer indicates the seat(s) and a ticket is printed.

9) Effectiveness

The advantages are:

More than one point of sale
No need for advance ticket printing
No wastage on ticket printing
Instant accountability on each show
Box office fraud eliminated

The disadvantages are:

Expensive to install. 140,000 in 1981
Ticket printing slow. On a busy night tickets are some times sold manually for the last half hour before the show.

10) Effects on individuals and organisations

It is much easier to book a seat. Over the phone you have to pay by credit card, but if you go to the booking office you can pay by credit card, cheque or cash.

EXERCISE

- 1 In the next few years there are likely to be major developments in the capacity and capabilities of communication systems and in the sophistication and performance of expert systems, largely through the exploitation of parallel processing hardware and techniques. (Expert systems make use of artificial intelligence, and are sometimes known as intelligent knowledge based systems.)

Discuss the nature of these developments and possible applications for which they would be suitable.

[20]

- 2 A worthwhile computerised control system must be secure, reliable and resilient. Nevertheless, failures in a system can occur. By considering an example such as an air traffic control system, show how the effects of failures in the system can be minimised.

[8]

[WJEC 1989 A2 Q4]

- 3 (a) Outline the reasons that have led to the widespread use of electronic mail in business, industry and education. [4]
- (b) Discuss the security problems that have arisen with electronic mail systems and indicate what steps can be taken to overcome them. [4]
- (c) Describe the user interface that is provided by a system such as Telecom Gold. [6]
- (d) Discuss developments to electronic mail systems which might occur in the future. [6]

[WJEC 1989 A1 Q9]

- 4 (a) A current area of industrial research work is concerned with the developments of an automatic or robotic vehicle. The vehicle is intended to move along a number of predetermined routes or paths within a factory. The vehicle is required to carry a number of stackable objects from one loading bay to another, where it will deposit them. A computer will be used to control the movements of the robotic vehicle.

- (i) Explain carefully how the robotic vehicle could be designed and tested. Indicate any assumptions that you make.
- (ii) What are the possible benefits and drawbacks of using such a robotic vehicle rather than conventional manned vehicles in a factory? [14]

- (b) Describe one other distinct use of computers in industry with which you are familiar. [6]

[WJEC 1988 A2 Q10]

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- 4 Describe a computer assisted learning package with which you are familiar. Your answer should indicate the purpose of the package, and the benefits and possible drawbacks that come from using such a package.

[9]
[WJEC 1988 A1 Q1]

- 5 In recent years computers have become commonly used in sales/stock control. For example, although customers may not necessarily be aware of it, computers are increasingly being used in supermarkets.

Discuss this use of computers and describe the technological developments that have made it possible. Illustrate your answer by considering a particular application you have studied. Comment on the benefits to the customer and the organisation.

[10]
[WJEC 1988 A1 Q2]

- 6 The term 'office automation' has been widely used during the last few years to cover the use of computers in the office. Describe recent advances in computer hardware and software including communications and networks which have made possible this transformation of working practice within some offices. By choosing examples from various fields, such as medicine, journalism or police work, discuss how the advent of office automation has:

- (i) affected the nature of the work carried out;
- (ii) affected the tasks performed by the office worker in such offices.

Comment on how society has responded to the use of computers in the office.

[20]
[WJEC 1988 A1 Q10]

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Social effects

The way computers are used affects our lives in many ways. It is difficult to avoid the computer, which intrudes more and more into our lives.

As soon as we are born, details of our birth, parents, weight etc. are entered into the NHS computer system. When we start school possibly our names, addresses, data of birth and other information is entered into the schools computer system. When we do exams more details are entered into the WJEC computer system. On reaching the age of 16 everyone is given an NI Numbercard. A visit to the doctors, supermarket, bank, building society, library all involve computers.

At home we may use computers to play games, or use videos containing microchips as well as cameras, washing machines and calculators.

Leisure

Computers are having a larger effect on our leisure time. Some of the areas where computers are used for leisure are:

Computers are used for playing games, such as arcade games, adventure games and traditional games like chess.

Cameras have already been developed that can automatically set the shutter speed, wind the film, adjust the focus and use the flash.

Videotex systems such as CEEFAX and ORACLE can be used in the home to view pages of information on hundreds of different topics. Software can be downloaded and then used in a home computer. Other systems like PRESTEL can be used for tele-shopping.

Economic reasons for the use of computers

The main reason for using computers is to increase the productivity of the workforce and hence maximise profits. This can be achieved by making the tasks much easier to perform and also much quicker to carry out. The consequences for the workforce will be:

- * deskilling
- * retraining
- * redundancy

Changes to existing methods, products and services

A computerised banking system illustrates the enormous changes that have been made to the way banks operate and the services that they can provide.

With a small work force they can process million of cheques each day, provide an on-line cash withdrawal system using ATMs, and produce bank statements within a day or two for

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each of its millions of customers.

Development of new products and services

Some example of new products and services brought about by computers are:

- * teleshopping
- * telebanking
- * data communications
- * E-mail
- * interactive video
- * robot built cars; circuit boards; cut glass

Changes in working environment

Many industries have undergone a tremendous change in the last few years partly because of the introduction of new technology. For example, Fleet Street, which once produced all the countries main daily newspapers, has now closed down and the old mechanical typesetting machines have been replaced by computer terminals.

Changes in employment and retraining

Occupation -----	Cause of loss of job -----
Printers and Typesetters	Desk top publishers Computerised press control
Welders and Paintsprayers	Robots
Technical draughtsmen	CAD
Technicians and Engineers	CAD/CAM
Secretaries and Typists	Word processors
Metalworkers	CNC (Computer numerically controlled) machines
Shopworkers	POS and computerised stock control
Telephone workers	Automated exchanges
Postal staff	Electronic mail
Bank workers	ATM (Automatic telling machines)

The table above is a list of some jobs that have been affected by the introduction of computer technology. Although unemployment is very high in all the main industrial countries this is not because of the introduction of computers and computer controlled devices like robots into the work place.

The introduction of computers into industry has taken place because they can greatly increase the productivity of a worker. Consequently not so many workers are required to produce the same amount of output.

Some employees jobs will disappear almost completely, for

example paint sprayers, assembly workers and welders especially in the larger more modern factories.

Some employees will be retrained to do other jobs which may be created because of the introduction of computers, for example printers.

Other employees such as secretarial staff may continue to do their old job but use word processors instead and be given extra work as well.

Of course the making, operating, programming and repairing of computers, robots and devices controlled by computers and microprocessors have created new jobs.

If you look inside a microcomputer you will find that many of the chips are made in 'third world' low-wage countries such as the Philippines, Malaysia, Korea although some chips do come from Japan.

The introduction of IT has meant that many different types of jobs have disappeared or have been changed dramatically. For example, in BT one engineer can now do the repairs in telephone exchanges that a few years ago took 28 engineers. Mechanical telephone exchanges are being replaced by electronic System X exchanges.

Privacy and security of information

Data is being collected every day about individuals and stored in computer systems. Twenty years ago nearly all this information would have been written on paper and stored in filing cabinets or card indexes. It was a time consuming job to search through a file and a huge job to copy a file. Nowadays both tasks can be performed quickly and easily using a computer system.

You don't even have to be in the same building, or town as the information because it is possible to log-in to a computer system to retrieve information. Of course, its not as easy as that because you first have to have the right sort of equipment, (a terminal and a modem) know the telephone number and the passwords and codes require to gain access to the system. Once into the system more passwords may be needed to get at 'sensitive' information. Those people who do this illegally are called hackers.

Because information is now stored on disc or tape it can be copied very easily. Often companies who collect data for one reason sell it to someone else. The electoral register, which everyone over 18 has to fill in in order to vote is stored on a computer system. These registers containing the names of every adult in every house are sold to private companies.

The growth in computerised files has its dangers. Information may be wrong or out of date, or it may be mixed up with

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someone else. You may be refused a job, house, benefit or credit or even wrongly arrested because of this.

Data Protection Legislation

The DATA PROTECTION ACT gives everyone certain limited rights in regard to computerised information held about them.

Data Protection Principles

Computer users must:

- * obtain the information fairly and lawfully
- * register the purposes for which they hold it *
- * not use the
- * not use the information for other purposes
- * hold only information that is relevant to that purpose
- * hold only accurate information and keep it up to date
- * not hold information longer than necessary
- * take appropriate security measures

We all have the following rights to

- * check if any organisation keeps information about yourselves
- * see a copy of the information (this will cost upto 10)
- * complain to the Data Protection Registrar about the way your information has been collected or is being used
- * have inaccurate data corrected or deleted
- * claim compensation if you have been damaged because of inaccurate info or because of unauthorised disclosure or loss or destruction of personal information.

There are some exceptions, data which is held for the following purposes are exempt from the act: ..

- * preventing or detecting crime
- * assessing or collecting taxes

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National Databases

The following is a list of the main national databases holding personal information:

Organisation	Type	Records	Terminals
POLICE (PNC)	Computer	52m	1500
DVLC	Computer	37m	1000
INLAND REVENUE	Computer	28m	17000 planned
DHSS	Computer	54m	25000 planned
TVLRO	Computer	19m	174
BT	Computer	20m	60000
NHS	Computer/Manual	80m	-
CCN	Computer	43m	7000

The largest private on-line database is run by CCN. The system uses two Amdahl 5860 mainframe computers with 60 gigabytes (60,000,000,000 bytes) of on-line storage. Mailing lists can be made up easily. For example, a mailing list could be sent out to 17-21 year olds, who live in council houses, in Birmingham and have a subscription to a record magazine. CCN's system can supply to their customers a list of all neighbours of someone who has bought a certain type of product (of course the sale of the product must have been entered into a computer system).

So much information is being recorded on computer systems that is confidential that we should all be concerned that it is held only by those organisations that should have access to it. For example a doctor may enter details about a patient into her computer system. As long as this information stays there and is not passed onto to others like medical drug companies we should not be too concerned. The doctor should ensure that all information held about her patients is held securely.

Security, Reliability and resilience of systems

As computers are used often in society, particularly in the keeping of large data files containing personal information, then the security of any system must be checked to see that it is adequate.

There are two different methods of file security - PHYSICAL methods and SOFTWARE methods.

Physical Methods

1. Lock Files Away

Data files can be locked away to prevent illegal access. Some data files may be kept in another building if they are important, e.g. in a bank safe. Important files may also be locked away in fire/water proof safes. These copies can then be used to recover the data if the master files become

corrupted.

2. Security Passes and Locks

To protect data already in a computer centre, security passes and locks can be used. Each person who is allowed access to the data, must either own a magnetic card to obtain entry to the room, or use a passcode to get into the room.

A magnetic card, similar to that used with a cash dispenser at a bank, is inserted into a machine. The computer reads the code on the card and opens the door if access is permitted.

Another method is to type a code in at the door into a keypad. Different people may have different codes so that a list of people in the room at any time can be produced.

3. Protection labels

Magnetic tapes have write protect rings which stop them being accidentally overwritten. Floppy discs have a write protect notch which if covered over makes the disc read-only. Cassettes have a similar notch.

Tapes and discs have labels on them which will show what information they hold and when they were created and when they can be destroyed.

Software Methods

1. Passwords

When a person logs on to a computer system, they are required to type in their personal login number or code and their password. The computer can then keep a record of each person who has used the computer, how long they've used it for and which files they used.

2. Back-up Copies

All data entered into a data file may be corrupted at some time by accident or due to a hardware or software fault. So that the data is not lost forever, a back-up of the disc or tape should be made every so often.

3. Grandfather Father Son Method

For example, on a payroll system using sequential files a new master file is created every week (the son) and the old master file from the previous week (the father) as well as the master file from a fortnight ago (the grandfather). The weekly transaction files are also kept for at least three generations back. If the current master file gets damaged it can be re-created from its father and matching transaction file.

4. Protection labels

On large computer systems files can be given different protection and access labels, like READ WRITE or EXECUTE. On the BBC microcomputer using DFS a file can be locked using L.

5. Encryption

Data that is particularly private can be encrypted or coded so that it can only be understood if you have the key to the code.

Reliability

All computer systems need to be reliable, by which is meant that it does what it is supposed to do. If the system is not reliable users will lose confidence in the system and will stop using it.

Resilience

A resilient computer system is one that can cope with varying work loads and process requests in differing orders without it crashing.

Consequences of system failure

If a computer system fails the results may be catastrophic in the case of a real time process control system. Damage to people and machinery may occur.

A failure in an on-line transaction system may cause great problems for the business concerned. For example, a airline or theatre seat booking/reservation system; or a checkout system in a supermarket; or a cash card banking system.

Computer Crime

Computer crime includes activities such as the cracking of ineffective security systems so as to gain unauthorised access to commercially sensitive or confidential personal files, and fraud through the improper transfer of funds from one account to another. Computer criminals may work within the organisation suffering the crime or may be outsiders. Measures taken to combat computer crime include physical security, development of more sophisticated security codes and systems, encryption of sensitive data, and monitoring of all attempts to access the system, whether successful or not.

Most computer crimes go unreported because the companies involved do not want to admit to their customers that their computer data banks are vulnerable. Computer crime might involve a computer programmer or operator altering details

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about themselves in their own file, for example paying themselves more. They could create a fictitious bank account and divert some of their companies profits into this secret account. Some programmers have left a 'software bomb' in their companies computer which is only activated if they get the sack. The bomb then might stop all the EPOS terminals from working.

Some programmers have invented computer viruses that spread from disk to disk and computer to computer. Some viruses can do the following:

- * just flash a message on the screen,
- * make the letters on the screen drop to the bottom of the screen
- * make files bigger and bigger each time they are used so that in the end they are too big to fit on the disk,
- * slowly 'eat up' all the files
- * slow the computer down
- * flash black boxes on the screen.

Hackers are people who 'break in' to computer systems that they are not authorised to use. They do this by finding out the passwords needed to gain access to the computer. They can then look at confidential information, or destroy or alter information.

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EXERCISE

- 1 Describe the nature of the various form of computer crime. Discuss reasons why the incidence of computer crime might have increased and explain why its total extent is hard to estimate. What types of people are involved in computer crime and what steps have been taken to attempt to curb its increase? At what point does society become aware of the effects of computer crime? [10]
[WJEC 1988 A2 Q3]

- 2 (a) Outline the methods that major clearing banks are adopting to ensure that their customers are able to increase their access to their accounts whilst ensuring the security of the accounts. [10]

- (b) Discuss the effects that the increasing computer storage of information is having on society and the effect this is having on the lives of certain groups of people, both at home and at work. Explain with reasons, whether you consider that the increase in computerisation is beneficial to the individual or not. [10]
[WJEC 1987 A2 Q10]

- 3 Explain how conflicts may occur between accessibility and security when data is stored in a computer. What effects could this have on ordinary people's lives?
Discuss some of the measures that have been introduced in order to attempt to overcome those conflicts? [8]
[WJEC 1986 A2 Q8]

- 4 In the past ten years the use of computers has become widespread. The ordinary person is likely to become aware of the use of computers in many different fields. Give one example taken from each of three distinct fields, of such a use of a computer. Describe clearly the role of the computer in each case.
Indicate the probable effects on employment of the increasing use of the microcomputer. The effects on employment in both the developed and underdeveloped countries should be considered. [10]
[WJEC 1981 A2 Q4]