INFORMATION PROCESSES AND TECHNOLOGY
PROJECT MANAGEMENT
<table>
<thead>
<tr>
<th>SYLLABUS</th>
<th>INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Techniques for</td>
<td>● understand the communication skills required to manage a system development project such as</td>
</tr>
<tr>
<td>managing a project</td>
<td>○ active listening</td>
</tr>
<tr>
<td></td>
<td>It is the main source of info and provides better understanding of the speaker’s message. Includes mirroring, paraphrasing, summarising, clarifying Q (open/close ended) and motivation responses.</td>
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<tr>
<td></td>
<td>○ conflict resolution</td>
</tr>
<tr>
<td></td>
<td>Conflicts are inevitable and should be solved in the best interest of the project. The aim is for all parties to accept the final outcome. Includes attacking the problem not person, brainstorming, mediation and group solving.</td>
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<tr>
<td></td>
<td>○ negotiation skills</td>
</tr>
<tr>
<td></td>
<td>Negotiation involves reaching a compromised situation that suits both parties. Includes knowing info in advance, considering acceptable arrangements, approaching other party directly, lowering expectations during a meeting, being confident and assertive, and establishing trust and credibility.</td>
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<td></td>
<td>○ interview techniques</td>
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<tr>
<td></td>
<td>Interviews are used to identify problems in existing systems, obtain feedback during development and recruit and assess staff performance. Questions (pairs) should be planned ahead. The interview should be relaxed, professional and private.</td>
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<tr>
<td></td>
<td>● Interviewee – They should understand the subject of the interview, have time to prepare and be put to ease when meeting.</td>
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<tr>
<td></td>
<td>● Interviewer – They should be polite, focus on topic, use a conversational tone, active listening and adjust the speed of the interview to the interviewee.</td>
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</table>
team building

A team is two or more people with complementary skills and personalities, committed to a common goal. Members should feel their efforts are valued and communication should be honest and open.

- Tuckman – Forming, storming, norming and performing
- Groups that function – Increase productivity, enhanced job satisfaction and develop quality systems.
- Groups that fail to function – Financial lose, employment losses, missed opportunities, bad system

understand the need to apply project management tools to develop a system using a team approach

Gantt Chart

Gantt charts are horizontal bar charts to graphically schedule tasks in a project. The horizontal axis is the total time taken, broken into time intervals. The vertical axis has the tasks. There are milestones to signify completion of task and progression of project.

Scheduling of Tasks

Journals and Diaries

Journals and diaries record the day-to-day progress and detail of completed tasks.

- Diaries – Arranged in chronological order with a page/section for each day’s events
- Journals – A more detailed analysis of what happened each meeting, how tasks have been allocated and when tasks are completed. It can also include issues encountered, ideas on possible future improvements.
○ Funding Management Plan

It ensures the project is developed within the budget. This includes allocation of funds, mechanisms for wise fund spending, accountability of budget and procedure of reallocating funds.

○ Communication Management Plan

It provides a structure that reinforces ongoing communication. This includes the communication medium used, lines of communication, method of monitoring progress of SDLC and changing/emerging requirements.

- assess the social and ethical implications of the solution throughout the project

○ Health and Safety

- Ergonomics – Ergonomics is the relationship between the person and working environment. It includes psychological, physical and emotional aspects.
  - Ergonomic design of furniture, appropriate lighting and noise levels, sound climate, varied work routines, procedures for reporting and resolving OHS problems
  - Or it can lead to eye strain, head/back aches, fatigue, muscle pain and RSI.
- Loss of social contact
- Little sense of accomplishment

○ Changing Nature of Work

- Retraining, redundancy or redeployment
- Human/machine-centred – Machine-centred simplify what computers do at the expense of humans. Human-centred allow people to work as effectively without machinery interfering (user friendly).
<table>
<thead>
<tr>
<th>Security of Data and Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Mechanisms to prevent data loss – offsite backup, physical barriers</td>
</tr>
<tr>
<td>- Accessibility and ownership of data</td>
</tr>
<tr>
<td>- Piracy, hacking and viruses</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Copyright Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Contracts</td>
</tr>
<tr>
<td>- Procedures for obtaining permission of copyrighted material – software used in development and software incorporated in the solution</td>
</tr>
<tr>
<td>- Retaining rights of new system</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rights/Needs of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Privacy of individuals – team members must respect confidentiality of data and not divulge content</td>
</tr>
<tr>
<td>- Flexibility of working hours</td>
</tr>
<tr>
<td>- Equity – equal access of all participants to the benefits of the info system</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Understanding the problem</th>
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<tbody>
<tr>
<td>• apply appropriate techniques in understanding the problem</td>
</tr>
<tr>
<td>- Interviews and Surveys</td>
</tr>
</tbody>
</table>

The collected data is organised into suitable form (Spreadsheets/DBs) for analysis to prioritize problems. A requirements report is created to summarise the info.

- Surveys – Constructed in advance to draw out relevant info. It usually addresses current problems and improvements than revealing new needs and ideas
- Interview – It is informal, time consuming and expensive. It finds new ideas and needs from users. It can be conducted in small groups.
○ Interviewing/surveying users of the information system

It is the primary tool to identify user needs, experiences and new ideas to improve the system. The larger the sample, the more accurate it is.

○ Interviewing/surveying participants of the information system

Participants in existing systems will have an understanding of the part of the system they work in. They can identify problems, ideas to solve it and provide details on the info processes occurring.

○ Analysing the existing system by determining

How it works, what it does and who uses it.

● requirements reports

- Requirement – A feature, behaviour or property a system must have. Satisfying the requirements satisfies the system’s purpose.
- Outlines aims and objectives of the new system and how it’ll help the organisation.
- Doesn’t attempt to solve the problem
- Two versions to be understood by the client and system developers (communication interface).
- Structure – Purpose of the system (purpose, needs of users/participants, system scope), analysis of the existing system (system context, major system requirements, participants characteristics) and definition of extra requirements (physical, performance, security, data/info and system operations).
- Requirements analysis – Process of preparing a requirements report.
- Usage in SDLC
  - Planning – Helps determine possible solutions and their feasibility
  - Designing the solution – Each creation of the subsystem should meet a specific requirement.
  - Implementation – Describes what the system can do, when/which systems can be removed and areas of participant interaction that needs training.
  - Testing, evaluating and maintaining – Used to check each requirement has been met and accommodate emerging requirements.
- **requirements prototype** – a working model of an information system, built in order to understand the requirements of the system

  - A working model for an info system, built in order to understand the requirements of the system – It stimulates the look and behaviour of the final application and user interface. It includes screens, menus and screen elements with the ability for users to enter sample data and view sample reports.

  - Used when problem is not easily identified – Users can relate to the model to express what they want.

  - Repetitive process of prototype modification and participants’ feedback until the problem is understood – A sequence of prototypes are made, each one more refined, based on participants’ feedback of the system.

  - Clarify participants’ understanding of the problem

  - Can be the basis for further system development – The model can act as a guide to its development. Refinement continues until all requirements are fulfilled and ready as basis for development of real system.

  - Create a requirements prototype from applications package that provide – Screen and report generators

<table>
<thead>
<tr>
<th>Planning</th>
</tr>
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</table>
| - **conduct a feasibility study and report on the benefits, costs and risks of the project**  
  - **Technical**  
  Whether we currently possess the required technology, availability of it, ability to operate with other technology, technical expertise needed and IT trends that exist currently.  
  - **Operational**  
  It it will work in practice, if it is supported by users and participants, and concerns of retraining and changing nature of work. It is operationally feasible if it meets the user’s needs. |
- **Economic**

  It includes a cost-benefit analysis and calculation of all the costs involved during development and implementation of solution. It involves determining NPV, ROI and breakeven point. The development costs, ongoing operation costs, tangible benefits and intangible benefits.

- **Scheduling**

  This is concerned with whether the solution will be completed on time and if it'll meet the deadlines (and consequences if not met). It also includes how long it'll take to obtain the required info, hiring new employees and retraining. It shows the timeframe with the help of Gantt charts.

- **compare traditional, iterative and agile system development approaches**

  - **Traditional**

    Formal step-by-step stages, where each step must be completed for the next to occur (deliverables). This increases errors to feed through SDLC without detection, resulting in exponential costs. Requirements need to be determined in advance.

  - **Outsourcing**

    Another company develops the system. It can be more cost effective. All control is passed to the outsourcing, while time of completion is negotiated.

  - **Prototyping**

    Extends the use of the requirements prototype. It is used when requirements cannot be known in advance. Each iteration produces a more enhanced prototype. U&Ps are able to view the prototype and add modifications. Requirements are prioritised so when time/budget is low, it can still be implemented.
● Customisation

Existing systems are customised to suit specific needs of the new system. Includes alteration of ‘off the shelf’ hardware and software, in the underlying construction (source code).

● Participant Development

The same people who use the system develop the system. The users must have sufficient skills and documentation isn’t required. This is when professional solutions are unaffordable for small businesses and home users. ‘Off the shelf’ hardware and software are used.

● Agile Methods

Agile method places emphasis on a team developing system than following a predefined process. It is suited for web-based software and software apps. It is usually made with a team less than six. It is used when minute details can’t be determined in advance. When the budget and time has been exhausted, the current solution becomes the final solution.

- create Gantt charts to show the implementation time frame
Designing

- develop a solution to a problem from a prototype
  - Screen designs for input and output will be created.
  - Hardware and software specifications will be made before purchasing them.
  - The system is tested prior implementation
  - Documentation of the new system is required, including a written description of the development and operation of the info system. Backup and recovery will also be documented.
  - Documentation for users is made to provide directions to info processes. It can be on-screen help or a manual. It should be simple and user friendly.

- use a guided process in an application to create all or part of a solution
- Clarifying with Users the Benefits of the New Information System – So users feel comfortable and confident with using the hardware and see the software is user friendly.

- Designing the Information System for Ease of Maintenance – Whether upgrades will be considered, ease of implementation and availability of spare parts now and in the future should be considered.

- Clarifying Each of the Relevant Information Processes within the System

- Detailing the Role of the Participants, the Data and the Information Technology Used in the System

- Refining Existing Prototypes – Software apps that allow user interface and underlying processes to be modified, maintain versions of the solution and track changes. It should provide the provision for feedback.

- **detailing the role of the participants**

- Participant designed solutions – Ongoing feedback is critical for success.

- Tools for participant development such as guided processes in application packages – Software apps with wizards/assistants to guide users to perform tasks. They can create the whole or part of the solution.

- **tools used in designing**
  - context diagrams

Context diagrams represent the system as one process, identifying data entry and exit via sources and sinks. It indicates where the system interfaces with the environment. It is a top-level DFD. Description of data and info can be further specified in data dictionaries.

- Process > circle with label
- Data flow label > labelled data flow arrows to show direction of data flow
- External entities > Squares – Present in system’s environment and doesn’t perform any processes.

It includes sinks and sources. Participants are only external entities if they provide/receive info

○ data flow diagrams

DFDs show the movement of data between processes. It represents systems by describing the changes in data as it passes through processes.

- Process > circle with label
- Data flow arrows > describes data and direction of arrow describes the movement
- Data stores > Open rectangle with label – Where data is maintained prior to and after it has been processed. It is usually a file or DB stored on a secondary storage device.
○ decision trees

Diagrammatic way of representing all possible combinations of decisions (branches) and their resulting actions. The actions are listed right of the branches.
○ decision tables

2D table that represents all possible conditions and actions. It indicates the alternatives for different conditions and actions based on rules. Rules are represented vertically, and conditions and actions horizontally. It is less user-friendly but lowers the number of rules column in decision trees.

<table>
<thead>
<tr>
<th>Printer troubleshooter</th>
<th>Rules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditions</td>
<td></td>
</tr>
<tr>
<td>Printer does not print</td>
<td>Y Y Y Y N N N N</td>
</tr>
<tr>
<td>A red light is flashing</td>
<td>Y Y N N Y N Y N</td>
</tr>
<tr>
<td>Printer is unrecognised</td>
<td>Y N Y N Y N Y N</td>
</tr>
<tr>
<td>Actions</td>
<td></td>
</tr>
<tr>
<td>Check the power cable</td>
<td>X</td>
</tr>
<tr>
<td>Check the printer-computer cable</td>
<td>X X</td>
</tr>
<tr>
<td>Ensure printer software is installed</td>
<td>X X X X</td>
</tr>
<tr>
<td>Check/replace ink</td>
<td>X X X X</td>
</tr>
<tr>
<td>Check for paper jam</td>
<td>X X</td>
</tr>
</tbody>
</table>

○ data dictionaries

It details each of the data item used by the system. It usually describes field name, data type, field size, description and example. It is used in conjunction with other design tools.
Storyboards are tools for designing user interface in software. It documents the layout of elements on each screen and navigational links through software or hand drawn. There are linear, hierarchical (more common for webpages), non-linear and composite storyboards.

- **User Interface** – when designing user interface, it is important to consider who the users are, consistency with known software, legibility of data entry screens (colours and graphics), showing all possible function, having a reaction for every action and a way out of potentially dangerous actions.
- **Use system design tools to** – better understand the system, assist in explaining the operation of the new system and document the new system.
| Implementing |● determine training needs arising from the creation of a new system  
  ○ Participant training  
  
  It is most effective with motivational learners. They are likely open to change, understand how the new system meets their needs, provided input during development and understand how their task assists in achieving the purpose.  
  
  - Traditional group – Trainer (member of SD or outsourced specialist) performs on/offsite session.  
  - Peer training – Users undergo training on how to operate the system and teach others. The trained  
  - Online training such as tutorials and help systems – Learn new skills at user’s own pace and when users train their peers (one-on-one). It allows users to learn new skills when required. needed. It is common in larger systems and to provide sample file and DBs.  
  
  ● compare and contrast conversion methods  
  ○ Parallel  
  
  The old and new system operate simultaneously for some time. For systems with critical info to avoid data loss. Users familiarise themselves but have double the workload.  
  
  ○ Direct  
  
  The old system is dropped and new system is implemented at one point. The system must be is error-free with all possible faults anticipated. Participants are trained in advance.  
  
  ○ Phased  
  
  The new system is gradually introduced, while old system is discarded. It is used when the system is still being developed (e.g. agile method). This method is more manageable. |
<table>
<thead>
<tr>
<th>Testing, Evaluating and Maintaining</th>
</tr>
</thead>
<tbody>
<tr>
<td>● compare the new system to the old and evaluate whether the requirements have been met</td>
</tr>
</tbody>
</table>

Acceptance testing is a formal testing of an operational system to ensure all requirements are met. The results determine if the system is successful. When successful, payment is made. An outside specialist or the client can perform the testing.

- Pilot

The new system is installed for a number of users. Users learn, use and evaluate the new system. If deemed satisfactory, it is implemented completely. Developers and customers are ensured the requirements are met in an operational environment. Form of acceptance testing.

  - how the system will be tested

The new system must be tested in its info tech (using diagnostic software) and info processes.
  - Onsite test data is used to cover all possible issues to encounter.
  - Info processes are continually tested.

  - need for an operational manual

It is similar to tutorials and help systems, providing an overview of the system, non-technical explanations of the processes, tutorials for each of the tasks and instructions to use each aspect of the system.

  - convert from the old system to the new

Issues of whether there will be an automated process to simplify the conversion, how long the conversion will be and accuracy of converted data should be considered.
testing and evaluating the solution with test data such as

- volume data
  
  Volume data is test data designed to ensure the system still operates while dealing with large volumes of data. Data can be from the system or generated. It measures the response time.

- simulated data

  Simulated data tests the performance of the system under certain operational conditions. Software is used to generate the simulation. It evaluates the performance of the system.

- live data

  Live data is actual data used in the system. It ensures it will operate under real conditions and meets all the requirements. This is usually the last step prior to client accepting the system.

checking to see that the original system requirements have been achieved

Ongoing evaluation is monitored through a technical and financial perspective. It determines the extent the system is meeting expectations. If the system isn't performing, changes are needed and thus a new SDLC.

Technical performance monitoring – This evaluates the continuing achievements of meeting the requirements. It also requires any changes that may require modification.

Financial performance monitoring – It evaluates the accuracy of the real economic situation to the predicted economic situation. Environmental factors should be considered (e.g. new competitors).
trialling and using the operation manual

Operation manual – The operation manual describes the procedures participants follow as they use the new system. It is used when the new system is operational. It can be written or electronic, user friendly and contain screenshots. It should be structured in terms of processes/tasks.

- What the task is, why it’s required and how it relates to other tasks.
- Who is responsible for the task and who performs it
- When the task needs to be completed by
- How to complete the task
- Trial period – During the trial period, modifications will be made to reflect the system’s policies of organisation and realities of the system’s operations.

reviewing the effect on users of the information system, participants and people within the environment

Surveys and interviews can be conducted for participants and users.

- Decreased privacy – Due to the Privacy Act 1988, organisations holding personal information must:
  - Explain why personal info is collected and how it will be used and managed
  - Provide individuals access to their personal records (to correct incorrect info)
  - Divulge details of other organisations that may be provided the info from the system
- Changing nature of employment – New systems will alter the work perform by participants and users who are affected by the system. It can be positive or negative. It may result in deskillling, faster completion of work and/or working hours decreased due to new technology.
  - Ergonomics
- Little or no sense of accomplishment, deskillling, loss of social contact
modifying parts of the system where problems are identified

When problems are identified, modifications are made for the new requirements emerging. For each modification, a new SDLC is commenced. All documentation should be updated to reflect the current operational system.

- Regular maintenance is conducted including regular maintenance and repairs when fault occurs
- Maintenance during operation of system
  - Maintaining info technology inventory
  - Perform backups and protect against viruses
  - Ensure no illegal software and all software licenced correctly
  - Maintain hardware (cleaning) and ensure consumables are stocked
  - Purchase, replace, install and configure new hardware and software
  - Monitor peripheral devices
  - Ensure all participants are trained
  - Set up network access for new users
INFORMATION SYSTEMS AND DATABASES
### Information Systems

- **the characteristics of an information system, namely:**
  - the organisation of data into information
  - the analysing of information to give knowledge

  Data must be organised (sorted, summarised, classified) prior to analysis. If not done carefully, the data will become meaningless, so use data dictionaries.

- **the different types of and purposes for information systems, including systems used to:**
  - process transactions
  - provide users with information about an organisation
  - help decision-making

  Transaction processing systems collect, store, modify and retrieve the daily transactions of an organisation. It also provides data for other systems.

  Management info systems provide info on the organisation’s performance. It takes data from TPS and organises it into info reports.

  Decision support systems assist people to make decisions by providing info, models and analysis tools. It takes data (from TPS, MIS and other external sources) to make decisions.
Office automation systems manage vast amounts of data. It provides ways to complete administrative tasks efficiently and effectively in an organisation.

### Database Information Systems
- **identify participants, data/information and information technology for the given examples of database information systems**
- **describe the relationships between participants, data/information and information technology for the given examples of database information systems**
  - school databases holding information on teachers, subjects, classrooms and students
  - the Roads and Traffic Authority holding information on automobiles and holders of driver’s licences
  - video stores holding information on borrowers and videos

### Organisation
- **the advantages and disadvantages of computer based and non-computer based organisation methods**
  - non-computer based

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convenience in acquiring info (no info tech)</td>
<td>Difficult to update</td>
</tr>
<tr>
<td>Easily and inexpensively organised data</td>
<td>Takes up more physical spaces</td>
</tr>
<tr>
<td>No computer skills needed</td>
<td>Takes more time when searching and only available to one person at one time</td>
</tr>
<tr>
<td>Easier to secure and private</td>
<td>Not many display options and only contains one view</td>
</tr>
<tr>
<td>Advantages</td>
<td>Disadvantages</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Greater display options such as tables, forms and reports-printable reports.</td>
<td>More easily prone to hackers, theft of confidential information due to its greater availability over a network.</td>
</tr>
<tr>
<td>Large amounts of virtual storage space on disk</td>
<td>Data can be wiped out if not backed up by a virus, etc</td>
</tr>
<tr>
<td>Fast retrievals using searches and sorts</td>
<td>Requires electricity.</td>
</tr>
<tr>
<td>Easily edited, updated electronically</td>
<td>More expensive to set up and operate the I.T &amp; training</td>
</tr>
<tr>
<td>Data can be backed up</td>
<td>Training for participants may be required</td>
</tr>
<tr>
<td>Data can be accessed by several people at the same time</td>
<td></td>
</tr>
<tr>
<td>Confidential information can be restricted</td>
<td></td>
</tr>
<tr>
<td>Arithmetic manipulation of data is possible</td>
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</tbody>
</table>

- the logical organisation of flat-file databases, including:
  - file
    - A block of data
      - record/tuple
  All the data about a single entry
○ attribute
A specific category of data in a database.

○ field
A particular attribute of a particular record.

○ character
Smallest unit of data. This includes letters, numbers and special symbols

○ key field
Used to uniquely identify a record in a file by using an item that only applies to one item.

- Candidate key – Any single/combination of field(s) that uniquely identifies each record
- Primary key – A new integer field, created specifically for this purpose, and can’t be null.
- Composite key – More than one field is used as primary key.

● the logical organisation of relational databases, including:
A collection of 2D tables that (with RDBMS) organises data through relationships to provide flexibility in manipulating data. It allows you to manage multiple DBs and manipulate data by searching and sorting.

○ schemas as consisting of:
(entity relationship diagram) – Illustrate the entire DB showing entities and attributes, PK & FK and relationships (in relational DBs). It underlines the primary and foreign keys and labels the relationship.
○ relationships

- one to one
  - Seldom used and possible to combine the attributes of both tables to one.
- one to many
  - Most commonly used
- many to many
  - Join table, with two FKs, to create two 1:M relationships to the two other tables.

○ linking tables using primary and foreign keys

A primary key uniquely identifies a record. It is the same as the foreign key (primary key of another table). The join between the keys connects the entities.

○ user views for different purposes

A form designer is a standard tool in DBMS. It gives you control over the layout and appearance of a database form.

- Table view – All records displayed in tables without any images. Overall view of the data.
- Report view – Used as a summary format and output of data for printing
  - Design elements – White space, legibility of text (serif & san serif), colour & graphics, consistency, grouping of info and justification.
- Form view – Each record is displayed separately and is used to enter, view and edit data

● data modelling tools for organising databases, including:

Data modelling is the process of identifying entities, the relationships and the attributes of those entities. It is critical to creating an efficient database.
○ data dictionaries to describe the characteristics of data including:

### client

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Data Type</th>
<th>Field Length</th>
<th>Constraint</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client_id</td>
<td>Number</td>
<td>10</td>
<td>Primary key</td>
<td>Client id, Auto generated</td>
</tr>
<tr>
<td>Client_name</td>
<td>Varchar</td>
<td>20</td>
<td>Not null</td>
<td>Name of client</td>
</tr>
<tr>
<td>Password</td>
<td>Varchar</td>
<td>30</td>
<td>Not null</td>
<td>Login Password for client</td>
</tr>
<tr>
<td>Client_Company</td>
<td>Varchar</td>
<td>20</td>
<td></td>
<td>Name of client company</td>
</tr>
<tr>
<td>Activation_date</td>
<td>Date</td>
<td></td>
<td>Not null</td>
<td>Starting date</td>
</tr>
<tr>
<td>Contact_no</td>
<td>Number</td>
<td>15</td>
<td>Not null</td>
<td>Landline or mobile number</td>
</tr>
<tr>
<td>Email_id</td>
<td>Varchar</td>
<td>30</td>
<td>Not null</td>
<td>Any email id</td>
</tr>
<tr>
<td>Max_Users</td>
<td>Number</td>
<td>10</td>
<td>Not null</td>
<td>Maximum number of users</td>
</tr>
<tr>
<td>Current_users</td>
<td>Number</td>
<td>10</td>
<td>Not null</td>
<td>Currently present user</td>
</tr>
</tbody>
</table>

○ schematic diagrams that show the relationships between entities
normalising data to reduce data redundancy

Reducing data redundancy (wastes storage space and increases maintenance problems). It involves designing an efficient schema and by splitting data into tables, linked by relationships and splitting fields into smaller fields. Data is reorganised and repeated fields are removed.

- **the logical organisation of hypermedia, including:**

  Hypermedia is the extension of hypertext that supports graphics, audio and video. The most well-known application of hypermedia is the WWW. Each document is retrieved electronically using hypertext.

  - **nodes and links**

    Nodes are a block info. Users follow links embedded in a node and is taken to other nodes.

  - **uniform resource locators**

    Unique address of a file or resource on the Web, which can be retrieved by entering the URL into an address bar. A URL is made up of a protocol, domain name and file path.

    - Protocol – The transfer method used to access the resource. Can be http, https or ftp.
    - Domain name – Name of the website, which can be replaced with its IP address. It is used to locate the computer/webserver that hosts the domain’s website. After the final full stop is the top level domain name – gTLDs and ccTLDs.
    - File path – The full path for the file to be retrieved.

  - **metadata such as HTML tags**

    HTML is the method of organising hypertext/media. HTML documents give instructions (formatting, hyperlinks + other functions) with HTML tags. Includes META tags and anchor tags.
### Tools for Organising Hypermedia

- **Storyboards to represent data organised using hyperlinks**

  Storyboards are tools for designing user interface in software. They document the layout of elements on each screen and navigational links through software or hand drawn. There are linear, hierarchical (more common for webpages), non-linear and composite storyboards.

  Each screen shows the title, headings, content and navigational elements. This includes linear, hierarchical, non-linear and composite. The type of storyboard is dependent on the nature of information. There is also a navigation map.

- **Software that allows text, graphics and sounds to be hyperlinked**

  Simple text editors to Web creation software. HTML tags are automatically inserted. These software editors remove the need to understand technical knowledge and use a WYSIWYG environment (artistic layout).

### Storage and Retrieval

- **Database Management Systems (DBMS) including:**

  A software app that allows the entry, manipulation (search/sort) and S&R of data in a DB. Data can be organised into tables, viewed in forms, retrieved using queries and displayed in reports. It uses data dictionaries and schemas. DBMS have data validation and backup and recovery.

  SQL statements are on DBMS, permissions checked, then process is performed and items are sent to DBMS.

  - **The role of a DBMS in handling access to a database**

    It allows users to access a database so they can enter, maintain and view the data. It restricts access to maintain and establish data security.
○ the independence of data from the DBMS

Separation of data and its management from the software app. The DBMS doesn’t hold any data, but organises it for viewing. Data organisation can be changed without affecting the software, which just needs to adapt accordingly.

● direct and sequential access of data
  ○ sequential

Data must be accessed in a linear sequence. So it is much slower and impractical.

  ○ direct

Data is accessed without accessing other data. It only requires its location and an index.

● on-line and off-line storage
  ○ online

The peripheral device is under the control of the user. E.g. hard disk of computer or internet.

  ○ offline

Accessed when storage media is mounted into a drive. Suited for backup. E.g. USB, centralised DB.

● centralised and distributed databases
  ○ Centralised

One DB under the control of a DBMS. All users and client app connect to the DBMS. Problems may occur when there is an increase in users and remote access. Communication lines must operate without failure or loss of response times.
○ Distributed

Multiple DBs in multiple locations and controlled by a DDBMS. It has a central DB and other DBs that regularly sync to the central server. It reduces data transmission costs that would arise with centralised DB. Includes fragmentation (horizontal/vertical), downloading and replication.

○ Advantages & Disadvantages

<table>
<thead>
<tr>
<th></th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralised</td>
<td>• Security (only need to look after one place)</td>
<td>• Dependent on Network connection</td>
</tr>
<tr>
<td></td>
<td>• Easy to back up (on one server to deal with)</td>
<td>• Slow, unreliable for some users</td>
</tr>
<tr>
<td></td>
<td>• Single DBMS</td>
<td></td>
</tr>
<tr>
<td>Distributed</td>
<td>• Generally faster</td>
<td>• Poorer security</td>
</tr>
<tr>
<td></td>
<td>• Independent of network connection</td>
<td>• Prone to fragmentation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Redundancy</td>
</tr>
</tbody>
</table>

- storage media including:

○ Magnetic storage

Large storage with direct access at high speeds. Digital data is written on the surface of a magnetic medium. The strength of the magnetic force determines a 0 (low) and 1 (high).

○ hard discs
Metal or glass platters covered with magnetic material. Data is arranged in tracks and sectors, and read and written by read/write heads. It is direct access.

- **CD-ROMs**

Plastic disk with a reflective layer of metal covering the surface. Data is read and written with lasers on a spiral track made of pits and lands. The reflection of light detected by sensors determines whether it is a 0 (constant) and 1 (transition). It allows direct access and holds approximately 650 MB.

- **cartridge and tape**

Long strip of plastic coated with a layer of magnetic material, wound inside a cartridge. It can store large amounts of data (back up) for a cheap price, outweighing sequential access.

- **encryption and decryption**
  - Encryption is the process of encoding data, making it unreadable, while decryption is the process of using a key to make the data readable. It is most effective for transmission of critical data.
    - Single key (symmetrical) – Requires the same key to encrypt and decrypt.
    - Two key (asymmetrical) – Requires a public key to encrypt and private key to decrypt.

- **backup and security procedures**

Security is to prevent data loss and unauthorised access to data. Techniques are used in combinations. The techniques chosen are based on sensitivity of data, how critical the data is to the organisation's continuation of operations and repercussions of data loss.

<table>
<thead>
<tr>
<th>Data loss (DL)</th>
<th>Unauthorised access (UA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backup and recovery</td>
<td>Y</td>
</tr>
<tr>
<td>Physical security measures</td>
<td>Y</td>
</tr>
<tr>
<td>Restricting access using DBMS views</td>
<td>N</td>
</tr>
<tr>
<td>Record locks in DBMSs</td>
<td>Y</td>
</tr>
</tbody>
</table>
- **Back up** – A copy of data is stored at another location, to be retrieved for recovery in case loss of data. Backups are made regularly with full weekly and partial daily. It includes incremental and differential.

- **Physical security measures** – Climate controlled rooms + access controls (locks) to stop unauthorised entry.

- **Usernames and passwords** – Secure files, directories, DBs by identifying user and their assigned permission.

- **Restricting access using DBMS views** – Restrictions are made through assigning permissions. Permissions give users access to a view, which is as a result of SQL statements in DBMSs, specifying organisation of data.

- **Record locks in DBMS**
  - **Pessimistic lock** – Involves locking a record once editing, by a user, has started
  - **Optimistic lock** – Based on assumption that conflict rarely occurs. If there are changes, a warning message is shown to either overwrite the stored record or discard the user’s current changes.

- **tools for database storage and retrieval, including:**

  - **Indexes** – Describes particular records without actually ordering the records. It enables the ability to search through data quickly. It should only be specified for key fields or fields that are commonly searched.
    - extracting relevant information through searching and sorting a database

- **Searching** – Examining DB to retrieve data that fit the search criteria

- **Sorting** – Arranging data in an order (alphabetical/numerical or asc/desc) for higher efficiency.
  - selecting data from a relational database using Query by Example (QBE) and Structured Query Languages (SQL) commands, including:
Visual method of specifying a query without SQL knowledge. Search criteria are entered into an "empty record". A query engine creates a SQL statement, performs search & displays results.

Relational Operators

<table>
<thead>
<tr>
<th>CONTAINS</th>
<th>LIKE</th>
<th>GREATER THAN</th>
<th>&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOES NOT CONTAIN</td>
<td>NOT LIKE</td>
<td>GREATER THAN OR EQUAL TO</td>
<td>&gt;=</td>
</tr>
<tr>
<td>EQUALS</td>
<td>=</td>
<td>LESS THAN</td>
<td>&lt;</td>
</tr>
<tr>
<td>NOT EQUAL TO</td>
<td>&lt;&gt;</td>
<td>LESS THAN OR EQUAL TO</td>
<td>&lt;=</td>
</tr>
</tbody>
</table>

Logical Operators

<table>
<thead>
<tr>
<th>True when both expressions are true</th>
<th>AND</th>
<th>True when at least one expression is true</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opposite</td>
<td>NOT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SQL is a specialised language for searching a (relational) DB and manipulating data display. Searching and sorting is done by a SELECT statement. Also includes INSERT, UPDATE.

- **SELECT**: list of attributes. Using * will bring all attributes. E.g. Borrowers.LastName
- **FROM**: Tables data will be retrieved from. E.g. Borrowers
WHERE: Search criteria + what the PK and FK are. All records are returned if there is no WHERE clause. Wildcards include ? and *. E.g. Borrowers.BorrowersID=Book.BorrowersID, LastName="Shayshay"

ORDER BY: How the results will be ordered. It is automatically set alphabetically ascending.
  E.g. LastName DESC

- tools for hypermedia search and retrieval, including:
  - free text searching

Searching a computer-based document or DB for characters or words. Search engines search all the words and try to match search words supplied by the user.
  - operation of a search engine

It is a DB of websites. Specific info is found based on user’s search criteria.

- Crawling the web to locate and retrieve web pages
- Indexing and ranking each web page found
- Analysing search criteria entered by users
- Retrieving suitably ranked web pages.
- Indexing and search robot – An index is a table containing info about the location of data. It is made through search robots crawling the WWW. URLs found are sent to indexing software, which finds the page summary and stores it in a DB. Locations of specific words are also stored alongside the word in the index database.
- Metadata – Search engines search for metadata

Users enter search criteria into a search engine. The criteria are transmitted to its web server, then a query engine. The query engine analyses the search criteria and transforms it into a logical expression. It performs the search, retrieves page references (containing the webpage summary) and ranks it for the user.

- reporting on data found in hypermedia systems

This includes web browsers, stand along apps and media players.
| Other Information Processes for Database Information Systems | • displaying  
  ○ reporting on relevant information held in a database  
  It is the formatted and organised presentation of data. A DBMS controls the design of a report. E.g. invoices and sales summaries  
  - The purpose of the report determines its content, format and style. A typical report produced by a DBMS includes a report header, page header, the details, page footer and report footer.  
  ○ constructing different views of a database for different purposes  
  A form designer is a standard tool in DBMS. It gives you control over the layout and appearance of a database form.  
    - Table view – All records displayed in tables without any images. Overall view of the data.  
    - Report view – Used as a summary format and output of data for printing  
      - Design elements – White space, legibility of text (serif & san serif), colour & graphics, consistency, grouping of info and justification.  
    - Form view – Each record is displayed separately and is used to enter, view and edit data |

| Issues related to information systems and databases | • acknowledgment of data sources  
  Permission is needed from the source to use their data before publication. It is concerned with the work and expense used in gathering the data. People should acknowledge work for credibility, justifying data, mechanism for tracking data and as a requirement by the source organisation.  
    - Copyright Act 1968 |
- the Freedom of Information Act

Only governments and not to commercial organisations. It enforces access to info, ability to correct wrong info and appeal against decision to deny access. It is the right to access data that relates to the individual and does not invade another’s privacy.

- Freedom of Information Act 1982 (Cth)
- NSW Freedom of Information Act 1989

- privacy principles

This protects an individual’s personal info from unauthorised access and corruption. It enforces organisations to state why personal info is collected, how it will be managed, provide individuals access to it (to correct wrong info) and divulge organisations that may have access to the data.

- Privacy Act 1988 (Cth)
- Privacy and Personal Information Protection Act 1998
- Health Records and Information Privacy Act 2002
- National Privacy principals – collection, use and disclosure, data quality and data security, openness, access and correction, identifiers, anonymity, transborder data flow and sensitive info.

- quality of data

Data integrity is the reliability and accuracy of data. This can be improved by data verification and data validation. Data validation can be done by range check, list check and type check. Self-validation includes radio buttons and list boxes. This also includes effective prompts.

- accuracy of data and the reliability of data sources
Systems must be able to resist user mistakes, system malfunctions and intentional alterations. Errors may arise from mistakes during gathering, entering data, or simply out-dated. Info from internet should be checked with accuracy, authority, objectivity, currency and coverage. Also, compare the data with other sources.

- **access to data, ownership and control of data**

Access of data is concerned with the privacy and FOI act. Ownership should be defined in policy statements or terms and conditions. Control is implemented to restrict data access for only authorised persons.

- **data matching to cross link data across multiple databases**

- **current and emerging trends in the organisation, processing, storage and retrieval of data**
  - **Data warehouse** – A database that contains all the data from all the organisation’s databases. It is analysed to assist in making decisions. The content of the data is usually historical and read only. Therefore, it acts like a backup. Processes are performed on it to find techniques to improve performance.
  - **Data mining** – It is the process of looking for trends in the data stored in databases. It discovers patterns that predict future behaviour based on past trends. Patterns may be coincidental or have no real world significance. This is able to occur as a result of improvement in technology.
  - **Online Analytical Processing (OLAP)** – OLAP is a technique to provide business decision makers with statistical evidence visually, online and quickly. It optimises organisation of large data stores and combines DBs into multidimensional structures – data cubes.
  - **Online transaction processing (OLTP)** – OLTP systems are databases that allow transactions of remote users to be processed immediately (in real time). Completing a transaction online is an example of a transaction performed by an OLTP system. A transaction is a sequence of operations that must be completed successfully or it will fault. E.g. ATMs, online banking.
COMMUNICATION SYSTEMS
<table>
<thead>
<tr>
<th>SYLLABUS</th>
<th>INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics of communication systems</td>
<td>● communication systems as being those systems which enable users to send and receive data and information</td>
</tr>
<tr>
<td>Communication occurs between T&amp;R I.T. over a network between nodes.</td>
<td></td>
</tr>
<tr>
<td>• the framework in which communication systems function</td>
<td></td>
</tr>
<tr>
<td>- Security and management – Many protocols restrict through usernames &amp; passwords, and encryption. Encode Decode</td>
<td></td>
</tr>
<tr>
<td>- The data source produces the message. The transmitter encodes it into a suitable signal and sends it along a transmission media. The transmission media is the channel or the means by which the data is sent. The receiver (hardware) decodes the message into the original state as it arrives to the destination (recipient).</td>
<td></td>
</tr>
<tr>
<td>- Application level – Creates and organises the data in a format understood by the receiving app. It then reorganises it to be suitable for transmission. [HTTP, DNS, FTP, SMTP, POP, IMAP and SSL]</td>
<td></td>
</tr>
<tr>
<td>- Communication control and addressing level – Establishes and maintains communication with network, directs data to destination, and ensures correct transmission of data. [IP addresses and routers]</td>
<td></td>
</tr>
</tbody>
</table>
- Transmission level – Defines how the transmission media is shared and performs the actual physical transfer, converting bits into signals to be transmitted. [Hardware (transmission media)]

- the functions performed within the communication systems in passing messages between source and destination, including:
  - message creation
    
The message is compiled at the source, in preparation to be sent, by a software app
    
    - organisation of packets at the interface between source and transmitter
      
      As the message descends the layers of protocols, it is wrapped with a header and trailer, which contains data relevant to the protocol (address and error checking). There will be multiple independent headers and trailers.

    - signal generation by the transmitter
      
      The transmitter represents individual bits as a wave (which is determined by the rule of the TL protocol). Usually transmitters and receivers are held in same hardware. [NICs, switches, routers, ADSL, cable modems, mobile phones and Bluetooth devices]

    - Transmission
      
      Transmission occurs as the signal (as a waveform) travels through the medium. The transmitter creates each wave form and maintains it on the medium for a small period of time. Data is split into packets and aren’t sent continuously. [Flow control]

    - synchronising the exchange
      
      Common clocks are used to sync the exchange to ensure that each waveform (data packet) is detected by the receiver. The receiver is able to decode the signals whilst the transmitter keeps sending it. Two preambles are used to help sync the clocks.

    - addressing and routing
Data packets (forming a single file) pass through many different links. For each communication link, each packet will ascend its protocol level until it reaches the addressing and routing of protocol and then descend the level as it is prepared for transmission down the next path.

- error detection and correction

As messages descend the levels prior transmission; many protocols calculate checksums or CRC values and include them in the headers and trailers. The receiver recalculates the value for data detection.

- security and management

Many protocols restrict through usernames & passwords and encryption

- the roles of protocols in communication
  - handshaking and its importance in a communications link
    - Protocol – A formal set of rules that must be agreed to ensure successful and efficient data transfer.
    - Handshaking – It occurs when two or more devices agree on protocols to ensure successful communication. It commences when one device desires to communicate with another and is successful when a connection is made.

- functions performed by protocols at different levels
  - Protocols define how a link is established, data is transmitted and error is detected.
  - Application level – Http, SMTP, SSL
  - Communication control and addressing level – TCP, IP, TCP/IP
  - Transmission level – Ethernet, token ring,
- E.g. When transferring a webpage, HTTP, TCP, IP and Ethernet are involved.

- the client–server model
  - the role of the client and the server

This is a form of distributed processing. Processes occur sequentially.

- **Servers** – They don’t understand the client’s processes but still provides resources and services. [File server, printer server, mail server, web server]

- **Clients** – Clients request a service, and wait for a response, while the server is processing the request. It provides the user interface, making users unaware of the server’s role. A client can be a server to another. [Web browsers, mail clients]

- **Advantages** – Manage resources, access and data security easily; share I.T and network across the network; can access remotely

- **Disadvantages** – Become high congested and overload servers; dependability; greater measure of security; expensive to purchase, setup and maintain
  - thin clients and fat clients

- Thin client – “Dumb” computers that don’t carry out processes or store files. Data input is transmitted to a centralised server. It is a network computer without a hard disk.

- Fat client – Performs the bulk of the processing in client/server apps. It can handle higher bandwidth and OS, and has its own memory capabilities.
  - examples of clients such as web browsers and mail clients
○ examples of servers such as print servers, mail servers and web servers
<table>
<thead>
<tr>
<th>Examples of communication systems</th>
<th>public switched telephone network (PSTN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSTN (aka POTS) carries the old telephone system and is designed for synchronous communication. It is connection-based/circuit switched, meaning an individual circuit is maintained during each conversation.</td>
<td></td>
</tr>
</tbody>
</table>

- **teleconferencing systems**

A multi-location, multi-person, synchronous meeting where audio, video and/or other is communicated in real time to all participants.

- Need/purpose – To exchange info among several people in multiple locations using I.T. (internet).
- Participants – Business people, educators, students
- Data/Information – Video, text (numeric), audio and
- Information technology – Computer, video camera, microphone (headset), speakers, Internet connection, large monitors/data projectors, web conference software, teleconferencing server
- Transmitting and receiving data – Raw video is collected and fed, in real time, through a software-based codec. The video is compressed, transmitted to Chat and Video server (determines transmission speed, frame rate and resolution). Video is transmitted as data packets, which is then decompressed and displayed.
- Advantages – Reduces costs; no additional I.T; simple to set up; regular communication.
- Disadvantages – Loss of facial and body language and close relationships; difficult to maintain long calls; low internet speed = lower quality.
- **messaging systems**

  - Telephones – Real time voice communication between users in different locations. It uses electronic switching to maintain a direct connection during each conversation. Apart from the connection between telephones and their local exchange, it is digital (bit compressions & having many convos simultaneously).

  - Fax – A fax machine scans the document and stores it as a bitmapped image. It is compressed and sent via telephone lines. The other fax machine receives the image, decompresses it and prints it out.
    - Advantages – Doesn’t require the other person to be present
    - Disadvantages – Reduces confidence that the other people will receive the message

  - Email – System where electronic messages are sent and received (with different media types attached).
    - Envelope – Data used by SMTP servers to relay email to other SMTP servers and then destination.
    - Contents – Contains the actual message and headers specifying sender, receiver, data/time, subject
      - Destination address field, originator field, identification field, informational fields and resent, trace and optional fields.

  - T&R – An SMTP client establishes a connection to the SMTP server and sends the email over. A DNS and relationships with other messages lookup is used to determine the IP address of their domain. The message is sent to the machine. The recipient’s SMTP server passes it on to the POP and IMAP server. The server puts the message into the mailbox. The user logs into the server and retrieves the email.
    - Advantages – Fast transmission, capable of T&R all media types and free (except ISP fee).
    - Disadvantages – Only available to users with a computer, internet and email address; viruses.

  - Multipurpose Internet Mail Extensions (MIME) – Used to send non-textual data and attachments as ASCII so it can be transmitted. Following encoding the bits with 64base, SMTP sends the text as ASCII. The receiver reads the MIME headers and formats the message accordingly.
- Voice mail – The voice mail system (provided by a telephone service provider) answers the call, plays an OGM and digitally
tools and retrieves the messages. It is designed as a hierarchical storyboard with each audio section as a screen.
- Information technology – telephone, voicemail account, voice mail system
- Advantages – Sends and receives brief messages; has security features; no extra hardware
- Disadvantages – Impersonal; only available to users with voice mail account.

- Voice over internet protocol (VoIP) – VoIP transfers voice calls via the internet with IP. It allows for interfacing to PTSN. After
data is digitalised, it passes through protocols (RTP, UDP & IP).
  - Processes
    - RTP & UDP – Real Time Protocol and User Datagram Protocol is similar to TCP/IP
    - Gateways – The VoIP provider maintains servers to translate telephone numbers into IP addresses, and
      analogue calls to IP packets (vice versa). Gateways are shared and installed globally. VoIP providers enter in
      a contract with local PSTN, allowing a circuit to be created for the duration of the call. The VoIP gateway
      server manages the packet switched side of the connection and the conversion of data between the Internet
      and local PSTN.
    - Users signing up – They commonly connect using their existing broadband modem (built-in support) and
      internet connection. Soft phones, where a VoIP software application operates on an existing Internet
      connected computer, can also be used.
  - Need/purpose – To allow voice calls to be made via broadband internet connection
  - Participants – Individuals, business people
  - Data/Information – Audio
  - Information technology – Computer microphone, speakers, sound card, Internet, VoIP software, modem
  - Processes – Soundwaves, recorded by microphone, is compressed and sent to destination. An address is put into
    each data packet. Received computer decodes the transmission for sound waves.
  - Advantages – cheaper costs from anywhere in the world; no added info tech
  - Disadvantages – Distortion due to internet congestion; no power = no calls, worse QoS
other systems dependent on communication technology such as:
  - **E-commerce** –

It is financial transactions that occur over an electronic network.
  - Advantages – more easily compare prices and products; less
  - Disadvantages – Preference to not reveal financial and

- **Automatic Teller Machine (ATM)**

It is essentially a computer with specialised peripheral devices. ATM networks are all connected.
  - Collection devices – Magnetic stripe reader, keypad or touchscreens.
  - Display devices – Screen (usually CRT), receipt printer, speaker and cash dispenser.
  - Transactions – To approve transactions, all ATMs are connected to a network that is connected to labour/paper and reduced waiting time personal info; fraud, hacking, identity theft the customer’s bank.
    - Banks (Ethernet cord); Shopping malls (phone line); service stations (dial-up modem).
    - Different to EFTPOS, the host verifies the pin prior transaction amount and account type entered, allowing for multiple transactions without needing to re-enter pin.
  - Advantages – easier than manually transfer funds from bank branch; secure and efficient
  - Disadvantages – Not practical for smaller items; fees charged to use; some prefer to use cash.

  - **EFTPOS (Electronic Funds Transfers at Point of Sale)**

EFTPOS is a standard equipment to electronically pay for goods with debit or credit cards. Both customers and merchants are charged each transaction. Merchants are in charge of filling ATMs with cash.
  - Collection devices – Keypad and magnetic stripe reader
  - Display devices – monochrome LCD screen and small thermal printer
  - Transactions – EFTPOS terminals t&r data on PSTN via built in modem. Wireless communicates via mobile phone networks and Ethernet versions via internet. Two key encryption is used.
○ Internet Banking

Internet Banking – Allow customers to pay bills, transfer money and other functions from the comforts of home. It is accessed via a computer connected to internet, with user ID and password as identification.

- SSL/Transport layer security (TLS) – It is in CC&AL with public key encryption. HTTPS is used when connecting to server. A padlock icon is present when SSL is used.
- Server-side – .shtml refers to HTML documents with embedded SSI. The server executes programming codes, to query the bank DB, and the output is sent to the client.
- Advantages – available 24/7; reduction of time and cost
- Disadvantages – Not available for computer illiterate people or without computers; phishing, malicious software to record keystroke; identity theft

○ Trading over the internet

This allows small businesses to sell worldwide and buyers to compare products and prices easily. E.g. Ebay and use of Paypal.

- Virtual businesses – Organisation/business whose members are geographically separated. It works through electronic communication and removes the need for shop fronts.
  - Issues – Establishing truth and loyalty of customers; security of purchasing transactions.
  - Paypal – It is the world’s most popular payment service. The buyer deposits funds into a Paypal account, which is transferred to seller’s Paypal, then bank account. It maintains links to banking systems and clearing houses. SSL is used.
    - Advantage – Sellers don’t need to create a certified payment service; accepts almost all currency and operates in almost all countries.
transmitting and receiving in communication systems

- **Transmission of data**
  - LAN (local area network) – Network that exists in an organisation, building, etc.
  - WAN (wide area network) – Communication between computers from different LANs
  - MAC (address) (media access control) – Every piece of communication device is given a unique MAC address during manufacturing. It is a unique identifier.
  - Simplex – Transmission of data in one direction only. E.g. radio
  - Half Duplex – Allows transmission from both directions, but not simultaneously. E.g. walkie talkie
  - (Full) Duplex – Transmission of data in both directions and simultaneously. E.g. telephones, VoIP
  - Synchronous – Sends data all at same time as a constant flow. It requires clocks in sync.
  - Asynchronous – Send data by identifying each byte with start and stop bits. E.g. internet
  - Parallel – Transmission of data simultaneously using separate channels, causing data to arrive out of order
  - Serial – Transmission of data one after another
- **Transmission of media**
  - **Wired transmission**

This restricts the signal so that it is contained in the cable.

  - **Twisted pair** – It is composed of pairs of copper wire twisted together, held in plastic insulation and an outer sheath. It is twisted to lessen EM interference. [telephone, LAN]
    - **UTP** – It is the most common and economical of copper cable for both LAN and telephone connections. There is no physical shield. It is composed of four pairs of twisted cable
      - **UTP** is classified into categories, where higher category cables support higher frequencies (high data transfer speeds). Most common is Cat-5e, with 125MHz.
      - **STP or ScTP** – It includes a metal shield or screen and a drain wire. As it is expensive, it is limited to apps with high levels of EM interference.
    - **Advantages** – Inexpensive; readily available
    - **Disadvantages** – Susceptible to EMI; lower bandwidth; bad over long distances (100m)

  - **Coaxial cable** – Steel>copper>nylon insulator surrounding core>aluminium foil>braided copper/aluminium>plastic black sheath [Broadband apps, cable TV]
    - **Advantages** – Less susceptible to EMI, more durable and faster data rates than TP, available
    - **Disadvantages** – More expensive, bulkier and less flexible than UTP; slower data rates.

  - **Optic fibre** – It is composed of one or more optical fibres, where each fibre forms a waveguide for containing (infrared) light waves. The light reflects off the inside of the cladding that surrounds the core, where both are made of glass. The cladding has lower refraction index than the core, making light reflected to mostly stay in the core. [submarine cables, LAN backbones, international lines]
    - **Advantages** – Higher data rates over greater distances; immune to EMI; lightweight; secure
    - **Disadvantages** – Expensive in cost & service; specialised installation
    - **LAN apps** – Each optical fibre is held in protective plastic coating like coaxial cables. The final cable is then enclosed in a plastic sheath.
Wireless transmission

It uses the atmosphere as the medium to carry EM waves (RF) between nodes. It allows nodes to move freely within the coverage area. As it is unbound, it is susceptible to interference and unsuitable for critical high speed connections.

- Microwave – Point-to-point ground based (terrestrial) microwave is used to relay wireless signals across large distances. Each transponder receives the signal, amplifies and transmits it to the next transponder. Transponders must be physically located high above the local ground. [local TV]
  - Advantages – Accurate; fast
  - Disadvantages – Expensive; line of sight

- Satellite – It uses microwaves to carry digital signals to and from both ground based stations and satellites. Satellites contain (100s – 1000s) transponders that receive, amplify and transmit microwaves on a different frequency. Communication satellites are usually geostationary. [Satellite TV/internet, broadband internet, GPS, LEOS]
  - Advantages – Fast speeds; long distance
  - Disadvantages – Expensive; complex to setup and maintain

- Radio – It is used in Mobile phones, wireless LAN and Bluetooth.
  - Advantages – Inexpensive for receivers; portability; readily available
  - Disadvantages – Security; costly for transmitters; interference; low speed transfer

- Infrared – Infrared waves occur above microwaves and below visible light. A direct line of sight is required. [TV remote, mobile phone data link]
  - Advantages – Wireless features in devices; cheap; readily available
  - Disadvantages – Short range; limited bandwidth; line of sight limitation.
## Characteristics of media in terms of

- **Speed**
  - Bits per second – It is the rate binary is transferred
  - Baud rate – Number of signal events (change in transmission signal used to represent the data) occurring each second. This is equivalent to the number of symbols/sec.
  - Bandwidth – Range of frequencies (difference of highest and lowest) used by a transmission channel. Frequency is measured in Hz (cycles/sec). [broadband, baseband, narrow band]

- **Capacity**
  
  Maximum rate that data can be transmitted over a communication path and how much is stored

- **Cost**
  
  Cost to set up and maintain

- **Security**
  
  Protection against interference and tapping. E.g. optic fibre – no EMI, no tapping.

## Communication protocols

- **Application level protocols**
  - HTTP (Hypertext Transfer Protocol - AL) – Used by web browsers to communicate and retrieve files from webservers. The three HTTP commands are HTTP GET, HEAD, POST
  - SMTP (Simple mail transfer protocol) – It is used to send email
  - SSL (secure sockets layer) – Encrypting data (two keys) for secure data transmission via internet.
○ Communication control and addressing level protocols

- TCP (Transmission Control Protocol) – TCP/IP are responsible with correct transfer of data via internet. TCP requires IP, but not vice versa. When errors are encountered, the packet is discarded. Each segment (576 B) includes a header with checksum (20 for TCP & IP each)
  - Sliding window – Control data flow and ensure data is acknowledged once it’s received.

- IP (Internet Protocol) – IP (4 bytes) sends data packets from sender to receiver. It doesn’t guarantee its arrival nor acknowledge it. It is designed to work on all networks and hardware. A router is used to determine the next path (avoiding problem areas).
  - IP address – Every device on the internet must have one or more IP addresses – one IP for every network. Routers examine the destination IP address in the header of packets to determine which network connection to retransmit it to. It can be static or dynamic. Composed of Network ID (path to arrive) and Host ID. (destination device)
  - Fragmentation – Splits packets to suit the protocol of the hardware it has hopped on. They are combined upon the destination and preferably avoided.

○ Transmission level protocols

- Ethernet – Controls the T&Ring of data in any transmission medium. Ethernet packets are frames.
  - Carrier Sense Multiple Access & Collision Detection (CSMA/CD) – Makes nodes ‘listen’ when they require a transmission. It is made to counter collusions.
Preamble (8 bytes) | Destination MAC Address (6 bytes) | Source MAC Address (6 bytes) | Type (2 bytes) | Data (46-1500 bytes) | CRC (4 bytes)
---|---|---|---|---|---
- Preamble – Syncs the clocks. The alternating 1s and 0s physically represent transitions from H-L and L-T, respectively.
- Destination/Source Mac Address – Every node on Ethernet network has a 6B MAC address. Every node examines the MAC address and accepts if it’s their own.
- Type – Indicates the higher-layer protocol used.
- Data – Includes data packet of CCAL level.
- CRC – For error checking. The sender calculates the CRC based on the contents of the frame. If the recalculated CRC matches, the frame is accepted, or the data is resent.

- **Token Ring** - It is used to send/receive data in a physical ring. As the token circulates, nodes attach packets to the token and the token continues passing until the recipient receives the message. A confirmation is then attached to the token ring and sent back.

- **Network topologies**
  - **Star**
    All nodes connect to a hub (usually a switch) via their own cable. For wireless LANs, a WAP (Wireless Access Point) is used.
    - Advantages – Nodes dis/connected without affecting other
    - Disadvantages – More cabling required; if a fault occurs at the hub, the network is down. nodes; Issues more easily identified
  - **Bus**
    All nodes are connected to a backbone (cable that carries data to each node) via T-connector. Terminators prevent reflection of data signal back down the cable.
    - Advantages – Less cabling; easy to implement
<table>
<thead>
<tr>
<th>Disadvantages – Can’t accommodate lots of nodes; Break in the backbone disables the whole network; Collusions can occur when data is sent simultaneously.</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ <strong>Ring</strong></td>
</tr>
</tbody>
</table>

Each node is connected to another two nodes. Thus, data packets circulate the ring in one direction using a token ring.

- Advantages – No data collusion; cheaper without needing a hub.
- Disadvantages – If a cable is broken, a node is off or added/removed, the network is disabled.

| ○ **Hybrid** |

One transmission between any two nodes with bus as backbone for stars (usually).

- Networks – When two or more networks are connected, a bridge or gateway may be created.
- Advantages – Used when different types of networks are required.
- Disadvantages – Expensive; Errors are more difficult to detect.

| ○ **Wireless networks** |

Data packets are converted into RF and travel through air to the receiving node. Each device has a wireless card/adapter which contacts the backbone via the router.

- Advantages – Cables aren’t required; allowing use of portable
- Disadvantages – Disconnections are more common; quality of transmission is not as high; devices not Wi-Fi-enabled can’t connect; be intercepted by hackers.
The functions performed by the following hardware components used in communication systems

- **Hubs and Switches**
  Hubs – Multi-port ‘dumb’ device that provides a central connection point to all nodes. It transmits the received data to all nodes, slowing down the network. However, it is cheaper. It is half-duplex, making it inefficient under high network traffic.

  Switches – ‘Intelligent’ device which sets up a direct connection between a sender and receiver. It identifies the destination of the data and sends it. They can simultaneously send and receive data to multiple pairs of nodes. This reduces network traffic, making it have faster data transfer speeds. Additionally, it has better security and reduces data collusions.

- **Routers**
  Directs data between networks with similar protocols. A router looks at the data’s destination and determines the quickest path, rerouting around problem areas. It can translate one protocol into another. This overcomes I.T compatibility issues. It connects networks as it reduces data collision.

- **Modems**
  Modems are used to connect a computer to their local ISP to provide internet access to a household or network. It connects through USB, Ethernet or wireless connections to the computer.

  - Modulation – Digital signal  analogue signal for the telephone line
  - Demodulation – Analogue signal  digital signal for computer use.
  - Asymmetrical digital subscriber line (ADSL) – Copper telephone lines to transmit high-speed data.

- **Network interface card**
It is a small chip on the motherboard that allows for wireless/wired network. It breaks down communication into binary and reassembles binary into more complex data.

- mobile/cell phones

It uses radio waves to T&R data to and from the base station in each cell. They provide portable access to text and video messaging, e-commerce and social networking sites.

- Cell – Each base station in each cell is connected to the PSTN either wire/wireless. As users roam from one cell to another, the current base station will pass onto the next

- Cables

Transmission medium made of copper or fibre optic glass. They use EM or light pulses, respectively to transmit 1s and 0s from a transmitter to a receiver.

- Wireless access points

A central node (hub) to connect wireless nodes to a wireless LAN. It sends and receives data to all wireless nodes and requires encryption for security. The WAP must be physically connected to the LAN to allow wireless nodes to access wired nodes on the network.

- Advantages – Devices can be added without cabling
- Disadvantages – Small range for wireless signal; suffers interference from bad weather.

- Bluetooth devices

For short-range transmission, replacing cables that connect portable devices. It is available in mobile phones, PDAs, computers, etc. The physical distance between Bluetooth devices depend on the power of the transmitter in each device. Error checking is present in each data packet.
**Similarities and differences between**

- **Internet**
  A worldwide packet switched public network based on IP where all data moves between nodes in packets. It is “connectionless” and asynchronous, making data packets arrive out of sequence.

- **Intranet**
  A private network maintained by a company or Gov. organisation and based on IP. Lines are leased to allow the amount of data transfer to be controlled by the intranet owners.

- **Extranet**
  The extension of intranets to allow access to other users outside the organisation. It allows companies to share their services. The interface between the extranet and intranet must be secure.
  - Both – Virtual private networks (VPNs) use the internet infrastructure to provide secure and private connections to a company’s internal network.

<table>
<thead>
<tr>
<th>Features</th>
<th>Internet</th>
<th>Intranet</th>
<th>Extranet</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose</strong></td>
<td>Share information</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ownership</strong></td>
<td>Not owned by one particular body</td>
<td>Privately owned</td>
<td>Privately owned but can be hosted externally</td>
</tr>
<tr>
<td><strong>Network</strong></td>
<td>A worldwide network of computers, servers and LANs</td>
<td>Designate one computer as a server to client computers on a LAN</td>
<td></td>
</tr>
<tr>
<td><strong>Accessibility</strong></td>
<td>Can be accessed by public via an ISP</td>
<td>Can only be accessed by specific users</td>
<td>Like an intranet, but external access also available to specified bodies</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------</td>
<td>----------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td><strong>Protection</strong></td>
<td>Little protection from viruses</td>
<td>Can be protected from intruders and viruses by security software</td>
<td></td>
</tr>
</tbody>
</table>

**other information processes in communication systems**

- Collecting and displaying
  - The phone as the collection device with voice mail
  - EFTPOS terminal as a collection device for electronic banking

A keypad/board is used to collect data from the user. The EFTPOS terminal then collects data from the main bank server and displays it.
• Processing
  ○ Encoding and decoding analog and digital signals

For successful communication to occur, T&R must be successful. In transmitting, the message is encoded and transmitted over the medium. In receiving, based on the protocols agreed on in handshaking, the message organisation is understood and decoded. Encoding and decoding are essentially organising processes, utilizing ADC and DAC.

- Encoding – Organises data into form suitable for transmission along the communication medium
- Decoding – Changes organisation of received data into form suitable for subsequent info processes.
- Digital data – Data that is represented using whole distinct numbers
  - Digital signal – digital data is encoded onto an analogue wave
- Analogue data – Continuous data that usually originates from the real world
  - Analogue signal – analogue data is encoded onto an analogue wave.
- Analogue data to analogue signal – E.g. telephone conversations – the system encodes speech and transmits it from sender to receiver.
- Digital data to analogue signal – A series of 1s and 0s is converted into a series of waves. E.g. amodem modulates digital data into an analogue wave and when transmission is received, another modem demodulates it to be suitable for computer use.
- Digital data to digital signal – A series of 1s and 0s is transmitted by sending it through a channel of on and off EM pulses. Nodes in a network can communicate. E.g. Digital data is encoded by a computer and decoded by another computer in a LAN.
- Analogue data to digital signal – The analogue wave is encoded to a series of 0s and 1s through sampling with ADCs (sound cards, TV cards, scanners, cameras).
  ○ Formation of data packets

A packet is the unit of data that is routed on a network. The structure depends on the type of packet it is and the protocol used. It has a header (Pg. 7 CS) payload and a trailer.
Routing

Selecting paths in a network along which network traffic is sent. It is performed for many kinds of networks and maintains no permanent link. This improves security and is more efficient.

- Encryption and decryption
- Error checking

Parity bit check < checksum < CRC

<table>
<thead>
<tr>
<th>Protocols</th>
<th>Error Check Method</th>
<th>Response to Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP</td>
<td>Checksum (in header of segment)</td>
<td>Only acknowledges the right packets</td>
</tr>
<tr>
<td>IP</td>
<td>Checksum (in header fields)</td>
<td>Drop the entire data packet</td>
</tr>
<tr>
<td>Ethernet</td>
<td>32-bit CRC (in frames)</td>
<td>Request for packet to be resent</td>
</tr>
</tbody>
</table>

Parity bits are single bits added after the data so the total number of 1s is either even or odd. During handshaking, even or odd is decided. It is used for asynchronous transmission.

- Errors with corruption of even number of 1s are undetectable.
- Checksum is the count of the number of bits in a data packet that is included at the end of the packet to allow the receiver to determine whether the packet is erroneous or not. The accuracy depends on the length of the data packet and length of checksum. It can't detect area of the error
  - If the data sent is all 0s, then the checksum is 0 as well. Errors causing empty packets will be undetectable. To resolve, the checksum is reversed to all 1s.
  - Corrupt packets counted as valid are undetectable.
  - Reversal of an even number of bits causes undetectable errors.

CRC is added in the header or trailer. With polynomial division, the binary number (entire message) is divided by a predetermined number (generator polynomial). The remainder is the CRC value.
<table>
<thead>
<tr>
<th>Issues related to communication systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Issues related to communication systems</td>
</tr>
<tr>
<td>○ Security</td>
</tr>
<tr>
<td>Issue of the expanding internet</td>
</tr>
<tr>
<td>○ Globalisation</td>
</tr>
<tr>
<td>Large companies can take advantage, moving forward, while smaller companies may not be able to take advantage of this process.</td>
</tr>
<tr>
<td>○ Changing nature of work</td>
</tr>
<tr>
<td>May result in isolation, and need for new skills</td>
</tr>
<tr>
<td>○ Interpersonal relationships</td>
</tr>
<tr>
<td>Due to electronic communication, misunderstandings may arise.</td>
</tr>
<tr>
<td>○ E-crime</td>
</tr>
<tr>
<td>Identity theft, phishing and spam</td>
</tr>
<tr>
<td>managing communication systems</td>
</tr>
<tr>
<td>- It detects most undetectable errors of checksum and all error bursts less than or equal to the length of the generated CRC value.</td>
</tr>
<tr>
<td>- The type of errors detected is dependent on the generator polynomial used.</td>
</tr>
</tbody>
</table>
Legal

Copyright and ownership issues
  Virtual communities

E.g. online dating sites, where there are major negative aspects
  Issues associated with the use of communication systems
    Teleconferencing system

Although communication can occur more freely, this freedom can be abused. Work places must adapt to teleconferencing as others have. Interpersonal relationships may be affected.

  Messaging systems

Emails, without encryption, can be read by anyone with admin rights in mail servers. This raises issues of privacy.

  E-Commerce

Issues of identity theft and privacy, redeployment and redundancy.

  EFTPOS

The increase of EFTPOS has resulted in identity theft (via the cards) and changing in workplaces (EFTPOS terminals are expected and organisations without it may feel disempowered).

  Electronic banking
Due to electronic banking, there is changing nature of work (issues of redeployment, redundancy and retraining). There are issues of security and identity theft.

<table>
<thead>
<tr>
<th>TRANSACTION PROCESSING SYSTEMS</th>
<th></th>
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<tbody>
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</tbody>
</table>
### Characteristics of transaction processing systems

- **a transaction**
  - Series of events (a request, an acknowledgement, an action and an outcome) important to organisation
  - Either complete success or complete failure (leading to rollback)
  - Ensure events occur successfully – events send response to show success or failure to determine whether to commit or rollback. The events then send acknowledgement of performing request

- **the components of a transaction processing system**
  - **Purpose**
    - info system that collects, stores, modifies & retrieves transactions (info process) of organisations
    - Must have rapid response, reliability, inflexibility, controlled processing (e.g. TPM)
  - **Data**
    - Stored in DBs & transformed into info through info processes. Possible integrity issue resolved by transaction log. Additional data used to record details of each transaction
      - Older systems – Details of transaction recoded in transaction file. App controlled transaction file
      - Newer systems – Same but DBMS or TPM used instead of app
      - Transaction log – used to commit or rollback
- Added records or changes recorded in log. When committed, records in log replace/add to master file. If rolling back, records in log aren’t written.
- Record original data in log & change master file. If committed, nothing. If rolling back, original record pasted over master file. Also, entry made in log to specify to delete record.
- Most DBMS record before & after ver. of data in logs to allow
  - Backup with use of logs to commit until present &/or rollback incomplete transactions
  - Audits – shows when, what & who performed each transaction
    ○ information technology

- Hardware – Server machines (& redundant components), storage & communication devices, transmission media, backup devices, client workstations (client apps), collection devices
- Software – DBMS software (& log), client apps (interface for participants in client-server network), proprietary software apps, transaction processing monitors
  - TPM – Software apps to coordinate processing of large TPSs (may have many DB servers)
    - Connect to systems operated by other org.
    - Integrity of transactions using different servers/systems, committing, rolling back
    - Balance load of transactions sent to each server
  ○ Processes

Mainly Storage & retrieval, but also collecting, analysing, processing

  ○ participants

People, who operate TPS, enter data to initiates transactions, in enviro for online real time.

- **batch transaction and real time transaction processing**
  ○ Batch processing

- Collection & storage of data for processing at a scheduled time (system is quiet) or when sufficient data
- Separate from TP operations & user interactions
- Performed in parallel with other processes, thus ACID important (esp. isolation)
- Transactions stored (usually on magnetic tape/paper) until convenient or economical to process them
- Advantages – run on regular schedule with no operator need, cheaper than real time (esp. I.T. needed), no wait time as data usually not needed by other processes
- Disadvantages – If error occurs, whole system halted & restarted, exclusive access to data & no sharing,

  ○ Real time processing

- Complete transactions immediately after they've been initiated – feedback if needed
- Can’t control transmission speeds, only data access & processing speeds by hardware & software
- Online users – employees of org., customers entering details via web or other networks
- Advantages – reflects current situation, no time lapse
- Disadvantages – Expensive (compared to batch), requires human operator

  ○ Compare and contrast

<table>
<thead>
<tr>
<th>Real Time Processing</th>
<th>Batch Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collects, stores and modifies records of transaction</td>
<td></td>
</tr>
<tr>
<td>Has data integrity procedures (validation, verification, referential integrity and ACID properties)</td>
<td></td>
</tr>
<tr>
<td>Transactions are handled individually</td>
<td>Transactions are handled as a group</td>
</tr>
<tr>
<td>Processing and output is immediate</td>
<td>Processing and output is delayed</td>
</tr>
<tr>
<td>System failure critical as prevents processing taking place</td>
<td>System failure less critical as possible time to restore system before next batch</td>
</tr>
<tr>
<td>If event fails, opportunity to correct data immediately.</td>
<td>Errors stored on an error file &amp; corrected at a later time.</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>Fewer errors as data validation present</td>
<td>Data validation afterwards</td>
</tr>
</tbody>
</table>

- **the significance of data validation**

Data Integrity – A measure of how relevant, correct and accurately data reflects its source

- Data validation – At time of collection, data is reasonable or correct in terms of enterprise’s business rules. Performed by client app. 1 undetected data error can affect numerous transactions

- Data verification – Data collected matches & continues to match source. Simplified if unique identifier available across all systems, but raises privacy concerns

- Referential integrity – All FK match PK in linked table otherwise orphaned records. Data validation & verification issues can affect referential integrity.

- Resource manager – keeps track of all data in transaction & allows terminal access for different data

- ACID Properties – In real time TP, if ACID test is passed, then data integrity is achieved
  - Atomicity – Either completely successful (commit, permanent data changes) or none at all (roll back to original state)
  - Consistency – Transaction uses data from 1 consistent state & after, data left in a consistent state. All data accounted & each step of transaction carried in same way so data is correct.

  - Isolation – Process data without interfering with or influenced by other processes currently executing. As data is in inconsistent state during processing, record locking, logs & “two-phase commit” needed, or erroneous data may be processed.
- Record lock – Prevents other operations from accessing the data. Other processes are aware of record lock & will wait until released.
- Two-phase commit – 1st phase recorded in log & locks record. 2nd alters actual data permanently & releases lock.
- Durability – Ensures committed transactions permanent. In real systems, requires all changes written to permanent or secondary storage before transaction is truly committed.

- the historical significance
  - 1950s – clerks for manual processes in TPS replaced by computers
  - 1980s – TP apps developed (often in Cobol) for each individual organisation was replaced by DBMS
  - Today – most TPS are based on 1+ RDBMS with TPM & client apps to meet organisation’s specific needs
  - Vital to the development – Cobol (language) CICS (TPM) SQL RDBMS (oracle) Microsoft

<table>
<thead>
<tr>
<th>Types of transaction processing systems</th>
<th>Web-based</th>
<th>Non web-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservation system, internet banking</td>
<td></td>
<td>Point of Sale (POS) systems, Library loans system</td>
</tr>
<tr>
<td>On-line real time</td>
<td></td>
<td>Batch</td>
</tr>
<tr>
<td>Payroll, cheque clearance, bill generation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● Systems that appear real time responding as transactions occur, but really batch processing, such as credit card transactions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer, merchant, card issuer, acquirer</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Storing and retrieving in transaction processing systems

<table>
<thead>
<tr>
<th>● Storage of digital data in databases and files</th>
</tr>
</thead>
<tbody>
<tr>
<td>- TPS requires efficient method of storage &amp; retrieval of data</td>
</tr>
<tr>
<td>- Data normally stored in DB or data warehouse &amp; needs well designed backup &amp; recovery procedures.</td>
</tr>
<tr>
<td>● Retrieval of stored data to conduct further transaction processing such as printing invoices</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>● Systems to store paper records of transactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>document imaging (image file, searching/editing unavailable, save storage space), OCR (image file processed to have characters recognised saved in word doc file)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>● Data backup and recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Snapshot copy of data at point in time &amp; allow system to recover back to state it was backed up.</td>
</tr>
<tr>
<td>- Commonly hard disk failure (esp. read/write heads) – &lt;1 year (manufacturing fault) &amp; &gt;6 years</td>
</tr>
<tr>
<td>- Recovery is valuable – allow recovering from broadest range of possible problems.</td>
</tr>
<tr>
<td>- Frequency of backup &amp; length data is kept depends on value &amp; nature of data</td>
</tr>
</tbody>
</table>

  ○ Grandfather, father, son

- Daily (son, full/partial), weekly (father, full, onsite), monthly (grandfather, full, offsite)
- Usually final yearly backup archived permanently.
- Either replace tape regularly or promote son to father, etc.
- Detail of procedure determined by needs of organisations & can extend to great grandfather
  - Off-site storage
    - Storing backup separate from main system. E.g. magnetic disks at employee’s house.
  - Secure on-site storage
    - Backup location close to system – faster access but riskier & need extra precaution.
  - Full and partial backups
    - Full backup – Complete copy (OS, program files, configuration settings, data), data for TPS regularly. Impractical to perform regularly as takes long time & large amounts of storage. Archive bit to false.
    - Differential Backup – Backup all files changed since last full backup. Doesn't alter archive bit after backup, this size of backup grows until next full.
  - Recovery testing
    - Testing backup by restoring files into temporary directory to ensure backup works
      - Backward recovery – undoes unwanted changes
      - Forward recovery – Backup to recover as recently & logs to recreate loss data up until system failure
  - Suitable media
<table>
<thead>
<tr>
<th>backup system compress data prior writing to double capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Magnetic tape – Light, portable &amp; no complex electronics, long term &amp; off-site. Robotic system to automate tape libraries. Improves fault tolerance as drivers replaced without affecting system. Includes helical &amp; linear</td>
</tr>
<tr>
<td>- Hard disks – Externally connect via USB/firewire ports or Ethernet networks. Very expensive, with weight &amp; mechanical complexity significant when used for off-site storage</td>
</tr>
<tr>
<td>- Optical media – multiple DVD-RWs for full (with data compression), 1 for partial. Not viable for backup to tape in terms of capacity, quantity &amp; moving disks in &amp; out of drives.</td>
</tr>
<tr>
<td>- Recordable WORM – archive critical data in unalterable form for long periods of time</td>
</tr>
<tr>
<td>- Online – Automated backup process for individuals &amp; small businesses by managing secure storage at secure remote site. Large organisations maintain complete operational copies of entire system at remote locations via online communication lines to remote site.</td>
</tr>
<tr>
<td>- Specialised backup software</td>
</tr>
</tbody>
</table>

Configured to enforce backup procedure (+ verification). Backup of selected files (based on date/size/type), optimal compression, encrypt backup, schedule backup.

<table>
<thead>
<tr>
<th>- Transaction logs</th>
</tr>
</thead>
</table>

Historical details of transactions made. Restore TPS back to consistent state at anytime
- In recovery, recommit completed transaction or incomplete transactions rolled back

<table>
<thead>
<tr>
<th>- Documenting backup and recovery procedures</th>
</tr>
</thead>
</table>

Various backup media used to maintain many backup copies made at different times so system’s data can recover to different past states. Personnel responsible must document when, what & how of backup & storage media used, verification & storage location.

|  - Mirroring |
Writing data to two drives simultaneously (100% redundancy) & allows for fast recovery (hot swapping). Fault tolerance, but doesn’t protect from total system failure

- **Rollback**

Log used by system to automatically rollback incomplete transactions, returning data to most recent consistent state. Generally action aborted after certain period of time.
  - Server (initiating transaction) crashes – message to other involved systems to abort
  - Server (contributing to transaction) – inform initiating system who rolls back complete transaction
  - Roll forward – Recover (consistent data) & recommit transactions made since last update using log

- **Updating in batch systems**
  - **Historical significance**

First type of TP via punch cards manually punched & processed sequentially by operators. Real time not possible as hardware only performs 1 task at a time & output stored sequentially. Made max use & efficiency of limited resources.

  - **Limitations of batch processing**

Performed at evenings or weekends when OLAP requirements lowest – data not current (master file updated periodically). Time consuming due to sequential storage. Use interaction limited & error log generated after processing.

- **Technology required**

large storage capacity (sequential – tape), simple software & user interface
Steps in a batch update

Collected transaction data added to transaction file. When convenient/ sufficient amount, file submitted for processing (similar to RT) & successful transactions written on master file

Suitable applications

Paper-based collection, off-line systems, bulk generation

Updating in on-line real time systems

Relevance and impact

Immediate update of data (current), record locking required, immediate feedback if error, multiple users simultaneously process transactions

Technology required

Fast communication links, fast processor, direct access storage devices, client-server system, user friendly interface, input hardware (barcode scanner, ATMs, EGTPOS terminals, PCs), software to enable simultaneous transactions, real time validation

Hardware requirements

Software requirements

Steps in on-line real time processing

Each transaction processed as it is initiated. Add transaction to transaction file. Read key field from file record. Locate same record in master file & update

Suitable applications

High demand for TP as hardware & software expensive, on-line & web-based apps
<table>
<thead>
<tr>
<th>Other information processes in transaction processing systems</th>
<th>Collecting in transaction processing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>● <strong>Collecting in transaction processing</strong></td>
</tr>
<tr>
<td></td>
<td>○ <strong>Hardware</strong></td>
</tr>
<tr>
<td></td>
<td>- Automatic Teller Machines (ATMs) – Card reader reads account info on magnetic card (identify user) via magnetic stripe readers (swiped or inserted (less error &amp; increase security). Keypad &amp; touchscreen to enter data, screen &amp; printer for output.</td>
</tr>
<tr>
<td></td>
<td>- ATM identifies user &amp; financial institution via card. If user has account with owner of ATM, amount debited. If not, amount moved into account of financial institution.</td>
</tr>
<tr>
<td></td>
<td>- Barcode readers – Decoder (no dedicated interface software) to organise data into character representation, then matched with index ID no. in DB.</td>
</tr>
<tr>
<td></td>
<td>- LED &amp; laser (star) – light reflected off barcode detected by a photocell, which state changes based on intensity level &amp; affects current flowing. Current changed into binary via ADC.</td>
</tr>
<tr>
<td></td>
<td>- CCD technologies – Row of LEDs &amp; photocells used. Light reflected off image to mirror, into lens to focus image onto CCD. The same as LED &amp; laser.</td>
</tr>
<tr>
<td></td>
<td>- Radio Frequency Identification (RFID) tags – RFID tags (96b) uniquely identify resources. RFID readers transmit frequency specific to antenna of passive RFID tags to power it. Tag responds by transmitting stored ID back to reader. Operates at 10 – 100m. ID used in conjunction with DB, to check movement of goods.</td>
</tr>
<tr>
<td></td>
<td>○ <strong>Collection from forms</strong></td>
</tr>
<tr>
<td></td>
<td>(user interface) collect data required for transactions: paper-based (indirect users manually complete, data entered, batch processed) or web-based (removes data entry operator)</td>
</tr>
<tr>
<td></td>
<td>- Web-based – screens part of front-end client apps that connect via LAN to backend DBMS or can be web-based clients where data travels over internet, then via web server to storage in DB</td>
</tr>
<tr>
<td></td>
<td>- General form design principles – know who users are; nature of data items collected; consistency; readability (fonts, capitalisation; graphics &amp; colours used sparingly); white spacing for grouping; preferably left justified (to lead users in desires input sequence)</td>
</tr>
</tbody>
</table>
- Principles for design of paper forms – Paper form & data entry screen structured to assist data entry & manual completion; clear instructions & positioning as unable to react to user input; design (colour, texture, fonts & paper itself) for majority users; appropriate space for answers.
  ○ Screen design for on-line data collection
  
  show available functions (dull not hidden); feedback; undo feature, warning messages; adhere to OS standards for user interface design
  ○ Web forms for transaction processing

validate data in DL page if possible (reduce data transferred. Feedback); design so transmission of data needed for validation occurs prior next form (“submit”); software tech works properly; security of personal info (encryption, SSL)

- Analysing data, in which output from transaction processing is input to different types of information systems
  ○ Decision support

Provides solutions & consequences to managers to assist decision making (e.g. OLAP)
  - Improve future performance via predictions based on historical data (data warehouse)
  - Data mining, querying data marts (improve efficiency of info extraction) are DS technique
  ○ Management information systems

Data in TPS into info to assist managing business operations
  - Statistical analysis of existing data – sales reports, profit & loss statements, sales trends
  - Small (info generated by manager, MIS in TPS) or large (1+ dep. For MIS, separate system(s))
  - Need computer skills & grasp of business processes to make data into relevant info
  ○ Data warehousing systems

- Old data purged from system – improve performance as less data to read when processing
- Centralise & store data in similar format even if changes – simplifies analysing in a place
- Snapshot of real data, so analysis proceed efficiently – no record locks, ACID, data integrity issues, effect on performance of operating system
  - Enterprise systems

Any system that performs processes central to overall operation of enterprise
- Hardware, software apps & data critical to its functioning

<table>
<thead>
<tr>
<th>Issues related to transaction processing systems</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Changing nature of work and the effect on participants</td>
<td></td>
</tr>
<tr>
<td>Early 1970s, thought new tech meant reduction in hours, but instead introduced new industries &amp; employment, longer, stressful hours</td>
<td></td>
</tr>
</tbody>
</table>
  - The automation of jobs once performed by clerks
    Automation is use of IT to do tasks once performed by humans. Either be retrained or taken over by younger, more skilled workers. E.g. less retail assistant or shop managers due to businesses web-based.
  - Shifting of workload from clerks to members of the public
    customers enter data for online banking, retailers enter data into EFTPOS terminal
  - Impact
    Either positive (right support given) or negative. New career opportunities & applications developed due to computer-based systems.

• The need for alternative procedures to deal with transactions when the TPS is not available
  - Large centralised systems maintain backup power generators & redundant communication lines
  - Staff trained, non-computer procedures trialled & tested at regular intervals to ensure operation to continue
- Paper-based forms to record transactions (e.g. EFTPOS)

- Bias in data collection
  - false emphasis or representation, leading to inaccurate info
    - When establishing the system and deciding what data to collect
      - Bias from incomplete data collected in aim to simplify system. Internet users not representative as higher tech skills, incomes & younger
    - When collecting data

- Identifying suitable source of data (cheapest/easiest data source than best choice)

- The importance of data in transaction processing
  - Data security
    - passwords, backup, physical barriers, anti-virus, firewalls, data encryption, audit trails
  - Data integrity
    - data validation & verification, referential integrity, ACID, minimising data redundancy
  - Data quality
    - How reliable & effective data is to organisation. Issues when survey not completed truthfully or trying to combine data from different systems. Effectiveness of info in data mining & OLAP reduced

- Data Quality Assurance (DQA) standardises definition of data & includes processes that “cleanse” existing data so it meets these data quality standards
<table>
<thead>
<tr>
<th>Control in transaction processing and the implications it has for participants in the system</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Monitoring employee’s work routine via recording which participants entered which data, how long workers away from desk. Management has right to monitor, but what level is reasonable? Excessive rules may lead to conflict &amp; loss of productivity.</td>
</tr>
<tr>
<td>- Current management theory – higher levels of productivity achieved when participants motivated by being given responsibility for tasks (less likely to deviate)</td>
</tr>
<tr>
<td>- Repetitive tasks motivation loss non-work activities authoritative control reduce motivation downward trend</td>
</tr>
</tbody>
</table>

MULTIMEDIA SYSTEMS
### Characteristics of multimedia systems

- **Multimedia systems -** information systems that include combinations of the following media
  - **Text and numbers**

  Text and number are displayed as images using fonts.
  - **Text** – Text is digitally represented by ASCII and EBCDIC with seven bit per character. Unicode, the extension of ASCII, is the standard for representing text.
  - **Fonts** – How a character is rendered for display. Includes outline font (TrueType) and raster font, and serif and sans serif. It is vital the font is available on the end-user’s computer.
  - **Numbers** – Numbers have magnitude and place value. This includes integer, real number, currency, Boolean and date & times. It is often represented as text when displayed.

  - **Audio**

  Audio is sound digitalised. Two main components of audio are frequency (Hz) and amplitude (db).
- **Sampling** – Converts analogue sounds to digital by taking samples of the sound at certain intervals. The points are joined to form an approximate shape. The quality is determined by no. of channels, bits per sample and sample rate. File formats include MP3, WAV and WMA.

- **Individual notes** – Digital audio is made with individual notes (pitch and duration). MIDI file format.
  - Images and/or animations

- **Images are used to represent data visually. They are all made of pixels (smallest part of a computer that can be controlled). The resolution is the total number of pixels of the image.**
  - **Bitmap images** – Bitmaps are a 2D array of pixels represented individually using binary to describe the colour. The total of number of colour present determines the size of binary representation. E.g. 256 colours = 8 bits.
    - JPEG, GIF, PNG and BMP
    - Bit depth – number of bits per pixel
    - Horizontal pixels x vertical pixels x bit depth = file size
  - **Vector images** – Each shape is represented with a mathematical description, allowing them to resize without loss of clarity/quality and increase of storage size. Each shape is a separate object. It requires less storage size but more processing than bitmaps.
    - SVG, WMF and EMF

- **Animation** – Animation is made of a sequence of image (cells). The cells are played quickly to perceive continuous movement.
  - Cell based – Sequence of images where each image is slightly different to the previous one.
  - Path based – The character follows a long line drawn across the screen. It can rotate, flip and transform. The character itself can be cell based.
  - Video

- **Video**
Video combines images and sound (optional) that are synced together. Each image is a frame (bitmap). Buffering prevents delays in the video.

- Calculate total frames – frames/sec x number of seconds
- Calculate size of each frame – horizontal pixels x vertical pixels x bit depth
- Calculate total file size – frames x size of each frame = ___ bits

Hyperlinks

Hyperlinks are a graphic or piece of text that connects users to another page or portion of the document. The organisation of hypertext and hypermedia is based on hyperlinks. It is based on HTML (tags).

<a href=www.google.com.au>Google</a>

- The differences between print and multimedia
  - Different modes of display

Prints have a higher resolution than multimedia (screen displays).

  - Interactivity and involvement of participants in multimedia systems

Prints are static. But, multimedia systems can be easily edited, while print can't be altered or requires money to change and reprint.

  - Ease of distribution

Print is harder and more expensive to distribute. Multimedia systems simply require the internet, hardware, software and basic skills. Print requires printers, ink, paper and publisher.

  - Authority of document

Professionally printed books are more readily trusted than multimedia.

- The demands placed on hardware by multimedia systems
- RAM – Temporarily holds data and instructions, is volatile and relies on power to maintain its content.
- ROM – Fixed in instructions that live when power is on.
- Cache – In between CPU and RAM, it speeds up access to commands.
- Secondary Storage – It is non-volatile and includes magnetic disk, USB, hard disk, CD/DVD and tape drives.

<table>
<thead>
<tr>
<th>Primary and secondary storage requirements as a result of</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Bit depth and the representation of colour data</td>
</tr>
</tbody>
</table>

Higher bit depth = larger RAM (frame buffer – section of memory that temporarily stores the current image displayed) and hard disk required.

- Sampling rates for audio data

Higher sample rate = larger RAM and hard disk required

<table>
<thead>
<tr>
<th>Processing as a result of</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Video data and frame rates</td>
</tr>
</tbody>
</table>

Videos are large files (thousands of frames and high quality audio). So a separate processor chip or video card is needed to reduce processing strain on CPU when viewing.

- Image processing, including morphing and distorting

Morphing (smoothly changing from one image to another) and distorting (changing original image by twisting, bending and stretching).

- Animation processing, including tweening

Tweening is the generation of intermediate scenes between key frames created by animators. For cell based, it requires a fast processor and large RAM
○ Display devices as a result of
  ▪ Pixels and resolution

High resolution = more pixels = higher resolution screens.

● The variety of fields of expertise required in the development of multimedia applications
  ○ Content providers
  
  Supply ready to use content by acting on behalf of copyright holders, to negotiate fees.

  ○ System designers and project managers
  - System designers – They identify the purpose, decide feasibility, choose and design the solution. Leadership skills are needed.
  - Project managers – They develop the project plan and ensure it is followed. They schedule and monitor each of the development tasks. Communication skills are needed.

  ○ Those skilled in the collection and editing of each of the media types
  - Text – Writers produce textual content and create storylines.
  - Image – Illustrators and animators draw figures and scenes with software (vector graphic software).
  - Audio – Audio production personnel record and edit audio (music, voice and special effects). They adjust levels and mix audio clips. This requires creativity, artistic and technical skills.
  - Video – Video production personnel includes a crew of at least a director, camera operator, sound engineer and perhaps actors and editors. Directors direct other personnel, and approve of set designs, costumes, camera angle, lighting and delivery of lines. They also over the final editing.

  ○ Those skilled in design and layout
### Graphic designers improve multimedia systems by enhancing visual appeal. They organise layout of screens, colour, typography and size, and develop consistent layouts.

- **Those with technical skills to support the use of the information technology being used**

Technical personnel ensure the system will operate on user’s machines. They need to consider hardware configuration and the typical communication speeds.

Multimedia delivered over the internet is reliant on the speed of the user’s internet connection – With different levels of compression, lower resolution and streaming, technicians ensure it will be delivered in timely fashion over slower internet.

CD-ROM – As the physical space limits the size of presentation, images, audio and video need to be compressed. Technicians ensure the required codecs are available at end user’s machine.

### Examples of multimedia systems

- **The major areas of multimedia use**
  - **Education and training**

This allows users to learn new skills, distribution of multimedia and training staff in OHS, customer support, communications, sales and computer skills. Users can learn at their own pace.

  - Participants – Infants, students (schools & universities), parents and training organisations
  - Data/info – Text (info), videos (online classes), icons and other menu path-based animations
  - Info tech – Adobe flash, mouse, keyboard, OS, speakers (any basic computer), touch screen, CD-ROM, sufficient RAM and fast processor.

- **Leisure and entertainment**

This includes action (3D games), role playing, and MMO, platform and simulation games. The high level of graphics, animations and audio increase interactivity. The introduction of more platforms (PC, consoles, Wii) has led the video gaming industry to grow in profit and audience.
- Participants – Anyone with technological skills (all ages and abilities)
- Data/info – text (dialogue/instructions), images, video (fighting scenes) and audio (sound effects)
- Info tech – keyboard, mouse, OS, graphic card, sufficient RAM and fast processor (good computer)
  - Information provision, such as: information kiosk

Different multimedia types are integrated to provide info to users, advertise products and promote services. This includes information kiosks, multimedia brochures, reports, and encyclopaedias.

- Participants – Anyone (not much skilled is required)
- Data/info – Text (instructions to route), images (maps/icons/keys) and audio (optional)
- Info tech – Touch screen (reducing technology literacy requirements and removing need for keyboards and mouses), secured personal computer, magnetic swipe card readers, printers and internet connection.
  - Virtual reality and simulations such as flight simulator

VR is a computer generated artificial reality that projects the user into a 3D space. It is used where training would normally be impractical. This includes flight simulators, medical schools (surgeons), military, virtual tours, architectural and overcoming phobias.

- Participants – Restricted to certain ages and professions [e.g. pilots (trainees)]
- Data/info – Text (instructions, info related to pilots), images/videos (scene created), audio
- Info tech – VR headset, microphones, speakers, VR program/software, PC
  - Combined areas such as educational games

Computer games can be created to have an educational twist. (Participants, data/info and info tech is similar to ‘education and training’ and ‘leisure and entertainment’)

- Advances in technology which are influencing multimedia development
  - Increased storage capacity allowing multimedia products to be stored at high resolutions
This allows for more realistic and high quality images (particularly in VR).

- Improved bandwidth allowing transmission of higher quality multimedia

These speeds allows larger and more detailed multimedia products to be distributed faster and more easily for users.

- Improved resolution of capturing devices

- Increases in processing power of CPUs

Large high quality videos and music can be handled. Simulations (games) requiring high resolution can be supported. Larger files can be processed.

- Improved resolution of displays

Displays can view higher resolution images (more detailed and realistic)

- New codecs for handling compression of media while improving quality

Highly interactive multimedia can be distributed on the web. For video, the most commonly used standard is MPEG.

<table>
<thead>
<tr>
<th>Displaying in multimedia systems</th>
<th>Hardware for creating and displaying multimedia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Screens including CRT displays, LCD displays, Plasma displays and touch screens</td>
</tr>
<tr>
<td></td>
<td>- VGA = Video graphics array and DVI = Digital visual interface</td>
</tr>
<tr>
<td></td>
<td>- CRT displays (Cathode-Ray tubes – VGA connector) – Electron guns are fired onto the inside of the phosphor-coated screen, causing it to glow. RGD beams are fired at different intensities at the pixels (three phosphor dots – RBG). Refresh rate is the no. of times/sec the beam traverses the screen.</td>
</tr>
</tbody>
</table>
CRTs are heavier, take up more desk space, use more power, emit EM radiation and require a DAC. But, they have larger viewing angles, multiple resolutions and unlimited colours.

- LCD displays (liquid crystal display – DVI connector) – An array of liquid crystals is placed between polarised glass panels, which direct light to display RGB. Transparent electrodes electrify the crystals to change its directions. Light shines through to the pixels (RGB). A separate transistor controls the light allowed to pass through for each colour of each pixel by varying the voltage.
  - LCDs are smaller, lighter, has unlimited colours, native resolution, uses less power, doesn’t emit EM radiation and accepts digital signal. However, it has a smaller viewing angle.

- Plasma displays (DVI connector) – Cells, between glass panels, are made of neon and xenon, and coated in RGB. Electric currents excite the gas, forming plasma. Plasma releases UV light, reacting to the phosphor colours. Varying the current alters the colour intensity.
  - Wide screened and thin with same colour intensity, good brightness and contrast. It allows for true black but needs more power, heavier and more fragile than LCD.
- Touch screens – It is made up of a sensor panel overlaying the screen. When the electric current flowing through is disrupted, the change is detected and determines the location of the touch. It includes resistive, surface wave and capacitive.
  - Eliminates keyboard and mouse. It’s less likely to damage and the interface is easier to use.
  ○ Digital projection devices
    It uses the data output info from the computer and projects it at a reflective surface. Light is directed through a small transparent image or reflected off a small image, and then at a small focusing lens onto a large screen. It uses LCD technology.
  ○ Speakers, sound systems

- Sound card – A sound card is either embedded on the motherboard or on a separate card that attaches to a PCI bus. It has an ADC and DAC, and contains their own RAM, which acts as a buffer. The DSP decompresses and smooths the sound samples, which is then sent to the DAC.
- Speakers/sound systems – Speakers are analogue devices that convert currents into sound waves. The electromagnet (a coil around a magnet) performs the conversion into soundwaves. The coil vibrates in time with the alternating current. The coil is attached to a diaphragm, which compresses and decompresses the air, forming the sound waves.
  - CD, DVD and Video Tape players

  A laser beam reads/write data on the spiral tracks. A sensor detects the pits and lands, translating it into binary. Quality is maintained after copying.

  - CD (Compact discs) – CDs store data on a single track, holding up to 680 MB.
  - DVD (Digital video disc) – Double sided and dual layered (17 GB). Ideal for distributing multimedia.
  - Video tape players – Stores data on long strip of magnetic tape. Quality reduces after copying.

- Head-up displays and head-sets

  - Head up displays – Information is superimposed on a transparent screen and won’t interfere with the user’s normal view. It is used in military and aircraft.
  - Headsets – It is an integration of microphone and speakers into a device worn on the head. It used by users who spend extended periods on the phone. Lower quality microphones can be used, while speakers are eliminated. It allows users to listen without distracting others.

  - Virtual Reality headsets – VR uses head-up displays, goggles, gloves or body suits. These devices contain sensors that monitor movement. This allows the displayed image to move with the user.

- Software for creating and displaying multimedia

  - Presentation software
<table>
<thead>
<tr>
<th>Other information processes in multimedia systems</th>
<th>Processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>It creates high quality multimedia presentations with graphics and date/info from other software tools. It also provides templates, themes and transitions to use. E.g. Powerpoint.</td>
<td>• The integration of text and/or number, audio, image and/or video</td>
</tr>
<tr>
<td>○ Software for video processing</td>
<td></td>
</tr>
<tr>
<td>This allows video to be captured, imported and edited (special effects, text overlays, transitions). It compresses the original video size to be more suitable.</td>
<td></td>
</tr>
</tbody>
</table>
- Compression and decompression of audio, video and images
  - Audio – high or low frequencies that are barely notices are removed. This results to fewer bits to store the remaining frequencies.
  - Video – Codecs are used to encode/decode files. MPEG is the most common standard. Repetitive data and data that the human eye can’t perceive are removed. E.g. block based encoding.
  - Images – lossless and lossy Pg. 6 MS

- Hypermedia as the linking of different media to another

- Existing content is imported into the app. A library/collection of media files is created by the app.
- Screens are created, content is added and formatted and hyperlinks created
- The file is then created (authoring packages – integrated package) for distribution and display

- Organising presentations using different storyboard layouts
  - Linear
  - Hierarchial
  - Non-linear
  - A combination of these

- Storing and retrieving
  - The different file formats used to store different types of data
<table>
<thead>
<tr>
<th>File Format</th>
<th>Compression</th>
<th>File Format</th>
<th>Compression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint Photographics Expert Group (JPEG)</td>
<td>Lossy</td>
<td>Motion Picture Experts Group (MPG)</td>
<td>Lossy</td>
</tr>
<tr>
<td>Graphics Interchange Format (GIF)</td>
<td>Lossless</td>
<td>Quicktime (MOV, QT)</td>
<td>Usually Lossy</td>
</tr>
<tr>
<td>Portable Network Graphics (PNG)</td>
<td>Lossless</td>
<td>Audio Video Interleave (AVI)</td>
<td>Usually Lossy</td>
</tr>
<tr>
<td>Windows Bitamp (BMP)</td>
<td>Lossless</td>
<td>Windows Media Video (WMV)</td>
<td>Lossy</td>
</tr>
<tr>
<td><strong>Audio</strong></td>
<td></td>
<td><strong>Animations</strong></td>
<td></td>
</tr>
<tr>
<td>Mpeg-1 Audio Layer 3 (MP3)</td>
<td>Lossy</td>
<td>Shockwave Format (SWF)</td>
<td>None</td>
</tr>
<tr>
<td>Waveform Audio Format (WAV)</td>
<td>Lossy, Lossless, None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windows Media Audio (WMA)</td>
<td>Lossy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Music Instrument Digital Interface (MIDI)</td>
<td>Lossless, None</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Compression and decompression**
  - Compression – It is the reduction of the size needed to store the file. The amount the file has been compressed is compression ratio.
    - Lossy – Permanently removes a number of data bytes from the file, leaving reduced quality and smaller file size. Usually the quality reduction is unnoticeable.
    - Lossless – Temporarily replaces repeated data with something that requires less space. It recovers the original data when opened.
    - There is no compression in vector images (PDF, SWF, WMF, etc).
  - Decompression – Reconversion of compressed data to its original form so it can be read, seen as normal.

- **Collecting**
○ Text and numbers in digital format

- Keyboard (in digital form)
- OCR scanner – Allows conversion of scanned images of printed text into machine-encoded text.

○ Audio, video and images in analog format

- Images
  - Flatbed scanner, handheld scanner, Overhead scanner (from analogue form) – Sensors the intensity of the light (raw analogue data) reflected off the image. In response to the amount of light detected, sensors will emit varying currents. The current is converted into binary.
  - TWAIN – Protocol that controls communication among software and digital imaging devices
  - Digital camera (also audio and in digital form) – It works similarly to scanners. They are either based on CCD or CMOS (complementary metal oxide semiconductors).

- Video
  - Video camera – It captures light and converts it into binary signals. There are two sensors. The front sensor collects light and transfers the electrical current to the lower sensor. The lower sensor reads it, while the upper lays is still collecting. Data passes through an ADC.

- Audio
  - Microphone (from analogue form) – Sound hits the diaphragm, which transfers the waves via the coil to an electromagnet. The electromagnet then converts the vibrations into audio.
  - Sound card – When the analogue sound reached the soundcard, it is fed into an ADC to the DSP (digital signal processor). The DSP filters and compresses sound samples to better represent the original sound. The samples then give to the CPU to be placed in storage.

○ Describe the process of analog to digital conversion
ADCS repeatedly sample the magnitude of the incoming electrical current and converts the samples into binary. DAC conversion is much simpler.

- Methods for digitising analog data

ADC are used (audio, video, images).

### Issues related to multimedia systems

- **copyright**: the acknowledgement of source data and the ease with which digital data can be modified

Infringement to copy/adapt someone else’s multimedia product without the author’s consent. Copyright encourages creativity by providing an incentive by limiting distribution. After receiving permission, the copyright owners should be acknowledged.

- Copyright Act 1668

- **Appropriate use of the Internet and the widespread application of new developments**

All software created must stay in line with today’s ethics. Introducing living streaming is effective, but raises privacy issues. There is also distribution of disturbing material, and misuse and abusing efficient online transactions.

- **The merging of radio, television, communications and the Internet with the increase and improvements in digitisation**

Advances and cost reduction in processing speeds, storage, codec and speed of electrical components have made the use of digital data more affordable.

- Digital convergence (store data as digital than analogue) has allowed multimedia types to be combined with computer technology. This includes VoIP, streaming of desktop digital internet radio and WEB-TV.

- **The integrity of the original source data in educational and other multimedia systems**
Data integrity is concerned with the data being accurate, consistent and up-to-date. The increase of info and unknown authors has made data integrity a bigger issue. Multimedia systems usually derive from various sources, thus making it important to reference sources. All source data should be cross referenced.

- **Current and emerging trends in multimedia systems**
  - **Virtual worlds**

  VWs are online simulated environments with another persona through an avatar. It is mostly for entertainment but others are emerging (e.g. business meetings). It allows users to overcome their disabilities or trial new products with creating a physical sample.

  - VW are now available on PC, laptop, iPhones and Android smart phones. Smartphones also have a large availability to different apps.
  - Ethical issues – anonymous people in VW can pose problems of privacy and identity theft.