Year 13 Knowledge organiser DESIGN METHODS & PROCESSES

Iterative Design

Iterative design is a repetitive process, that cycles through designing, modelling and testing constantly until the designed product has been made. Designers by themselves, or in teams, have to constantly evaluate their work in order to improve.

User Centred Design

UCD aims to improve user experience of products. The international usability standard (ISO 13407) makes this likely, and products that comply with this standard should:

- Take full account of users and their environment
- Involve users in design and development
- Result from a repetitive (iterative) process
- Consider the whole user experience
- Be developed by a multi-skilled team (engineers, designers, ergonomists, etc)

Iterative Design

Advantages	Disadvantages
• Consistent testing helps solve problems earlier • Constant feedback • Easy evidence of progress	• Designers can loose sight of "the big picture" • Time consuming

User-Centred

Advantages	Disadvantages
• User feels listened to • Makes sure the product meets their needs	• Requires extra time to get customer feedback • If focused on just one person it can limit appeal to others

Designing to Wants and Needs

Designers have to be aware of the needs, wants and values of consumers, and can do this through research methods.
For example:

- Physical needs of age groups (babies, teens, adults and elderly) and those with disabilities
- Emotional needs – likes, dislikes, aspirations, etc
- Intellectual needs of age groups (babies, teens, adults, etc) as well as those with mental disabilities
- Sociological needs and values – social pressures, culture, etc

Research Methods

Primary Research	Secondary Research
• Questionnaires and Surveys • Interviews • Designers going through user experiences • Focus groups • Product Analysis • Anthropometric Data • Observing users using a product for ergonomic data	• Online • Books • Using existing research • Using others anthropometric data

Ergonomics

Ergonomics are a key consideration when investigating how a product can be developed , focusing on safety, efficiency and

Anthropometrics

Anthropometric data is an important area to research in order to ensure prototypes are the correct size for people to use.

Year 13 Knowledge organiser NEW TECHNOLOGY PT1

Microelectronics

Impact on Products	Advancements in manufacturing technology for electronic components e.g. integrated circuits resulted in increasingly powerful and miniaturised range of products • E.g. 1940s transistor used for portable radios • LCD displays • Lithium batteries used for rechargeable power and longer battery life
Impact on Design and Manufacture	Technology developments have impacted how designers and manufacturers work • E.g. use of internet searches in research • Sketching used along side graphics tablets and CAD • Manufacturing using CNC and automatic machinery

Internet of Things (IoT)

The networking of multiple microelectronic devices using Wi-Fi and the internet

- E.g. Smart fridges using scanners to identify most used products and automatically ordering them
- Automatic JIT manufacturing that organises its own flow of parts, etc

Advancements in CAD/CAM

Examples include:

- Standardised file formats to connect a range of software to hardware
- Use of 3D printing
- Use of FEA and CFD in CAD simulations
- Cloud-bases packages
- Virtual reality systems

New Materials

New materials are ones that have recently been developed and over improvements over traditional materials.

- E.g. Glulam us a layered timber and glue used in buildings and structures
- Kevlar is woven fibres used in bulletproof vests
- Graphene is a nanomaterials, made from carbon particles with a honey-comb structure that is used from medical treatments to battery manufacture
- Precious metal clay is precious metal particles in pliable clay and used to make jewellery and decorative items

New Methods of Manufacture

Examples include:

- Electrohydraulic Forming – car parts
- 3D printing of metals – one-off prototyping
- Fibre injection moulding – lightweight parts for aerospace, medical equipment, etc
- Laser beam welding – shipbuilding and construction
- Physical labour deposition – food packaging, machinery and decorative products

Fair Trade

The FAIRTRADE Mark is the symbol of the international Fairtrade system – and the most globally recognized ethical label. When you buy products with any of the FAIRTRADE Marks, you support farmers and workers as they improve their lives and their communities

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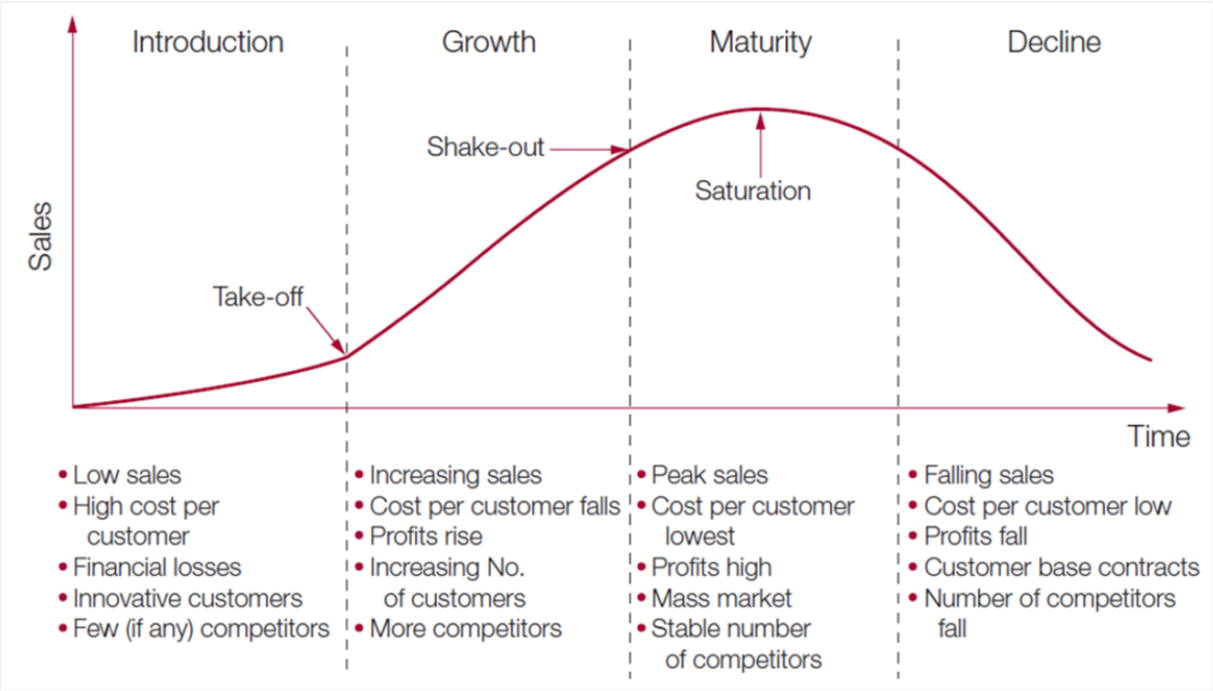
Product Life Cycle (PLC) Chart



The Product Life Cycle Chart helps companies track and predict product sales.

This is not to be confused with the life cycle assessment of products in regards to sustainability

Redefining and Redeveloping Products

Companies will often employ extension strategies to maintain their sales. Examples include:

Demand/Customer Pull	This is where designers respond to demand from consumers for desirable product features. E.g. colour choice and battery life in smart phones
Technology Push	Research and development costs lead to the technology push if new ideas. However, these then need to be 'sold' to consumers. E.g. Google Glass failed to be sold to consumers due to cost and privacy concerns
Planned Obsolescence	This is where products are designed to fail and be replaced. This can be for company profit or lack of compatibility with software or lack of parts being manufactured.
Evolution of Products	This is generally caused by new technologies, manufacturing methods, materials, etc. Research and Development departments (R&D) explore and develop new ideas for companies.

Year 13 Knowledge organiser 2.6 Selecting appropriate tools, equipment and resources

One-off Production

Also known as Bespoke or Prototype manufacture
Generally, specialist workers create, custom-made products and can uses specialist machines and materials. High Quality but expensive and involves individual client consultation and design work.

Advantages	Disadvantages
• Custom made • High Quality Materials • High Quality Craftsmanship	• Time consuming • Specialist training for workers • Expensive to buy

Batch Production

Uses a mix of workers and machinery with jigs, moulds and templates to help make identical products. Stations of workers e.g. cutting station, painting station, etc.
Can have some variation e.g. colour, finish, flavour.

Advantages	Disadvantages
• Lower cost than one-off • Jigs, moulds and templates help products look identical • Can have some variety	• High storage costs • Jugs, moulds and templates have to be checked • Workers can become bored on their station

Mass/Line Production

Workers carry out a single process in the production line, but generally manufacture is heavily automated. Production is linear with sub assembly lines working parallel to the main production line.

Advantages	Disadvantages
• Large amounts made at once • All products are identical and to same standard • Using automation reduced human error	• Initial starting costs are high • If production line stops, the product can't be made • Workers become bored monitoring machines and repetitive tasks

Quick Response Manufacturing (QRM) Production

This strategy is used to reduce time taken to respond to orders. Rapid completion of design and development processes to minimise delays. However, quality and customer needs are still a high priority

Advantages	Disadvantages
• High product turnover • Generally makes smaller batches, so lower storage costs • Efficient use of materials minimises waste	• If there is a large variation in demand, then can cause problems if the manufacturer can't react to meet it • Managing and planning can be difficult • Highly dependent on suppliers to react to demand changes

Unit Production Systems (UPS)

Used in textiles manufacturing. Computer controlled and incorporates hanging carriers to carry garments from station to station.

Advantages	Disadvantages
• Quick and efficient transfer of garments • Product output is easily tracked and recorded • Multiple styles of garment can be used in the system	• High investment and set-up costs • High maintenance cost • Pre-production planning is essential

Vertical In-House Production

This is where the company owns its supply chain, which minuses dependency on external suppliers. Factories must then have the ability to manufacture all components required

Advantages	Disadvantages
• Reduced risk of component prices changing • Less impacted by suppliers going out of business • Protects the brand and improves security of intellectual property rights • QA is easier to implement	• Specialisation reduced, potentially diluting expertise • Increase in administration • Reduction is flexibility

Year 13 Knowledge organiser 2.6 Selecting appropriate tools, equipment and resources

What Employers Should Ensure

- Workplace is safe and free from risk
- First Aid is provided
- Dangerous substances, etc. are stored safely and correctly
- Training and supervision is provided, where needed
- PPE is provided
- Machines are maintained and has guards in place
- Signage is present and clear
- Accident reporting systems are in place

What Employees Should Ensure

- Take care of their health and safety, as well as those around them
- Use provided PPE
- Use machines correctly and after training
- Report any accidents or near-misses

Legislation

The Health and Safety at Work Act (1974) ensures that all employers must ensure that employees and visitors are protected in the workplace, in terms of health, safety and welfare

The Control of Substances Hazardous to Health Regulations (2002), otherwise known as COSHH is where employers need to prevent, reduce or control their workers exposure to substances that mat be hazardous or cause ill health. These substances will usually have symbols indicating their hazards

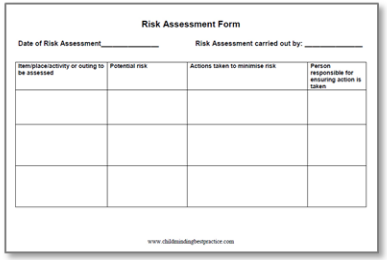
General Safety Symbols in Workshops, etc

Precautions and Risk Assessments

Safety precautions are actions that are carried out before an activity that could be a danger or cause an injury. E.g. wearing goggles and having extraction on before using a belt sander.

The use of signage is also a type of precaution, allowing employees and visitors to be aware of hazards with certain areas, equipment, etc.

Risk Assessments must be carried out by law, by employers and reviewed regularly – they are working documents. These consider what could harm people and if reasonable steps are being taken to prevent that harm. Not all risks can be eliminated but the can be minimised.


Risk Assessment Form

Date of Risk Assessment_____ Risk Assessment carried out by: _____

Item/place/activity or outing to be assessed	Potential risk	Actions taken to minimise risk	Person responsible for ensuring action is taken

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Stages of a 5 Step Risk Assessment

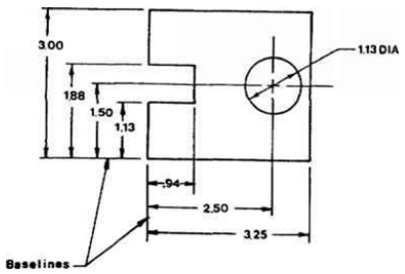
1	Identification of the hazards
2	Who could be harmed and how
3	Evaluate the risks and minimise them
4	Record and document findings
5	Review regularly

Year 13 Knowledge organiser 2.7 Accuracy in design manufacture

Importance of Accuracy

Accurately fitting parts to ensure the correction function of products. The acceptable range of accuracy is known as the tolerance.

The use of datum edges and surfaces, aw well as vertical and horizontal lines a generated by laser levels, provide reference points to facilitate improved accuracy



Testing Eliminating Errors

- Dials on machine controls allow precise movement on tools
- Digital test gauges are very accurate and are often computer linked
- Profile inspectors measure fine details
- CNC machines use computer codes to control their movement and ensure accuracy
- Laser micrometres, material thickness sensors and alignment systems are examples of non-contact testing devices

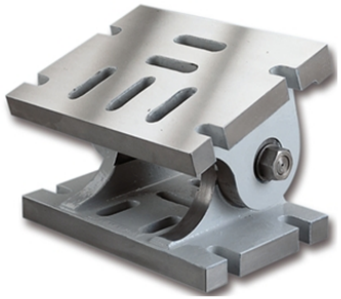
Measuring Aids

Jigs are guides for cutting tools. They help tools, such as drills, for repetitive machine operations without needing to mark out.

This helps reduce the need for skilled workers and reduces the chance from human error.

Fixtures hold work in place for processes such as welding. They maintain the accurate alignment of parts by providing framework into which they are securely clamped during manufacture.

They are often designed so that parts can only be fitted the right wat round, they ensure that every manufactured assembly is of high quality.



Templates ensure the consistent repetition of the same outline, by providing of a consistent, rigid, profile of a shape.

This helps create identical pieces and are incredibly common in batch production.