Noel-Baker Academy
A L.E.A.D. Academy

# KNOWLEDGE ORGANISER KS4

# R105: OCR Engineering Design: Examination subject knowledge

## Lo1 The Design Cycle

The design cycle is a recognised way to create an Engineered Product. It enables checking at every stage of the process

### IDENTIFY

Checking what has been asked of you, what the client has asked for and researching around the problem to better understand the situation

Brief / Research / Process planning

### DESIGN

The design phase involves creating a set of design rules based on the IDENTIFY section then creating designs (drawing or cad, 2d or 3d) and planning how it would be made

Specification / Design / Manufacturing Plans

### OPTIMISE

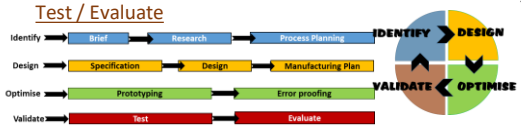
The optimise stage is making models to ensure the plans and designs will work in making. Usually this involves prototyping a one off model and testing the making process you have come up with

Prototype / Error Proofing

### VALIDATE

The validate phase is your evaluation stage, you have to test the product then comment on how effective it was

Test / Evaluate




## Clients & Customers

### NEEDS OF THE CLIENT

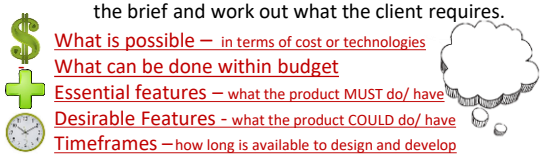
There will be some non-negotiables that the client needs to see involved in the design

Corporate Branding – e.g. what colours or logos do they use

Target Audience – who are the company focused on already

### DISCUSSION BETWEEN CLIENT AND DESIGNER

The discussion meeting is the engineers chance to explore the brief and work out what the client requires.



What is possible – in terms of cost or technologies

What can be done within budget

Essential features – what the product MUST do/ have

Desirable Features - what the product COULD do/ have

Timeframes – how long is available to design and develop

## Investigating the design context

There are areas that can be researched to find out more about the product requirements:

-Focus groups – talking to the likely customer

-Surveys – getting general information from the pubic

- Needs of target market – a product that fills a gap

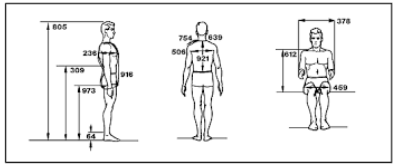
-Changing consumer trends – a "must have" item

## Lo2 Specification Requirements


– aesthetics – how they might require it to look

– ergonomics – suitability for human sizes e.g. hand size, height, weight, finger length

– anthropometrics – Physical sizes/ measurements recorded and used to deign ergonomic products



-Function – the purpose of a product e.g. a television displays programmes

-Features – the additions that make the product unique e.g. remote, controls,etc.

## Lo2 Sustainability

### SUSTAINABLE DESIGN

Environmental considerations about the products effect on the environment. There is also pressure to be ethical and socially responsible

Renewable energy sources – made products cost resources, energy and pollution

Materials that are replaceable – materials that are plentiful/materials that regrow or replenish

Recycled- Using materials from reclaimed sources

Recyclable – Enabling a product to be recyclable – through material choice or disassembly

FSC

### LIFE CYCLE ANALYSIS

Product life cycle affects how well a product is designed and how long it is required to work.

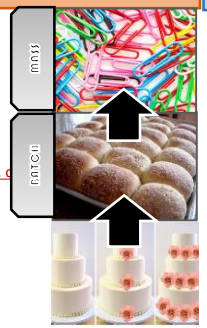
Lifespan – how long a product is intended to be used

Lifecycle – including what happens to it afterwards

Planned Obsolescence – A product designed on purpose to become outdated or unusable after time

## Lo1 Manufacturing

### REQUIREMENTS




- Materials availability/supply chain -

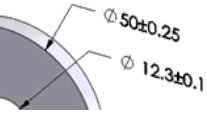
– Ease of manufacture – Processes that are easy to do and quickly produce accurate repeatable results in a very few stages e.g. Injection moulding, c

– scale of production,:

Mass: expensive set up, cheap in high volume

Batch: Allows regular changes in features, colour etc.

One off: Costly, allows total cutomisation




– Tolerances – how accurate it must be:

High: can be innacurate, less wasted products, less accurate mchines

Low: Lot of wasted products, expensive machinery, very accurate

– maintenance – how easy it is to maintain/repair

### EASE OF MANUFACTURE

Specification points covering how easy it needs to be to make and assemble:

Standard components – using pre made components e.g. screws

pre-manufactured components- using premade parts e.g. speakers

design for manufacturing assembly (DFMA) – Less stages, less parts, standard components

design for disassembly –to repair or if it must be recycled or reused

manufacturing processes – If a certain process must be used; injection moulding is a popular choice as it is repeatable, accurate, fast and produces less waste

## Regulations

### REGULATIONS

© TM

- Copyright – Protecting a piece of creative work, eg a drawing by LAW

– patents – a protected design IDEA by LAW

– registered designs &

– trademarks – images/logos associated with the company protected BY LAW

### SAFEGUARDS

– British Standards – Are guides to ensure QUALITY

– European Conformity (EC) – are guides to ensure SAFETY

Vs CE

## New Technologies

Market Pull – a need or gap needs filling – the customer wants something new e.g. longer battery life on mobile phones

Technological Push – new technologies allow new ways of doing something – e.g. facial recognition or AR

## Iconic Products

### INSPIRATIONAL / ICONIC PRODUCTS

me products are so popular they set an expectation. E.g. the inimalist design and easy use of e Ipod influenced the design of nany other electronic gadgets.


### IMPROVEMENTS IN MATERIALS

Engineering often creates new materials that create opportunities for better products. E.g. Recently carbon fibre has offered better products in some areas.

### NEW PRODUCTION PROCESSES

Engineering often creates new ways of making that allow a product to be better or made cheaper. E.g. Recently 3D printing has created new opportunities.

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## Ergonomics

The word "**ergonomics**" can be broken down into:

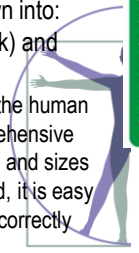
- "ergon" (meaning "work" in Greek)
- Work- on the patterns of economics

**Ergonomics** is the process of designing or arranging workplaces, products and systems so that they fit the people who use them.

## Anthropometrics

The word "**anthropometrics**" can be broken down into:

- "anthropos" (meaning "human" in Greek) and
- "metron" (meaning "measure").



This is the Measurement of the physical properties of the human body. Anthropometric data are obtained from a comprehensive anthropometric survey to understand the body shapes and sizes in a certain population. Once analysed and understood, it is easy to develop a sizing system that enables production of correctly sized clothing for the population under consideration.

## ACCESS FM

Questions to consider when analysing a product

**Aesthetics**
Does the product look good?
Does it make good use of colour and texture?
What has inspired it's appearance? (E.g. is it organic? Is it industrial?)

**Cost**
What is the estimated cost of the product?
What is the retail price?
What is the relationship between the two?
Is the product affordable?
Does it offer value for money?
What is the product's cost in relation to the income of potential buyers/users?

**Safety**
How has the designer considered safety issues in the products design?
Think about the ways it is being used and how different parts have been joined together.
Are there any risk assessment issues in relation to the use of the product?

**Size**
Are the product's proportions appropriate for its use?
If you increased or decreased the products size, would it look or function better?

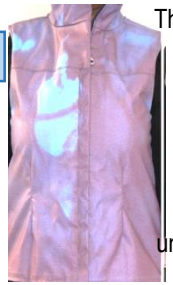
**Customer**
Who is the product designed for?
How and where would they use it?
What effect will it have on their lives and relationships?
Will it add value?
How is the product promoted to attract customers?
Has the designer considered how people will interact with the product?
Does the product target a particular age group or sector of people?
What assumptions have been made about the potential buyers/users?

**Environment**
What is the product's impact on the environment?
What happens to the product after use?
How long will it last?
What factors limit/lengthen its life span?
Can it be repaired? Can parts be replaced?
How easily can it be recycled?
Who would pay for the cost of recycling?

**Function**
Does the product do the job it was intended to do?
How does it work?
How easy is it to use?
What effects will using it have, including those beyond intended use and user?

**Material**
What materials are used to make the product and why?
Would another type of material work better?
What impact could the designers choice of material have on the environment?
Where do the materials and other resources needed for production come from?
Are they likely to run out?

## Smart Materials



**Smart Materials** react to changes in their environment. They can be grouped by how they react to their environment.

They respond to:

- Heat
- Light
- Moisture
- Electric/ magnetic

An example of a smart material can be seen in military uniforms- Photochromic dyes are used in the uniforms which sense and react to light by changing colour, increasing the camouflage

## Iconic Products

**What makes a design iconic?**

- A design that sets a bench mark for others to follow.
- A ground breaking design, in terms of its technology or manufacturing techniques used during its production.
- A design that improves on the past.
- A design that sets new standards in terms of quality, functions/features or style.

- A design that stands the test of time, remaining popular despite the passing of years.
- A design that stays in the memory of those who see/use it.
- A design that is often recognised immediately by consumers.
- A design that inspires other designers.
- Sets a trend.
- A design that is innovative.
- A design that is aesthetically pleasing.
- A design that is often emulated/copied by other designers.
- A design that has its place in history, or even helps change history.

## DFD

**DFD (Design for Disassembly). Disassemble means to take something apart/ to pieces.**

DFD **is** the process of **designing products** so that they **can** be easily, cost-effectively and rapidly taken apart at the end of the **product's** life so that components **can** be reused and/or recycled.

## The 6 R's

| | |
|---|---|
| Reduce | Reuse |
| Recycle | Rethink |
| Refuse | Repair |

## Modern Materials

**Modern materials** have been developed through the invention of new or improved manufacturing and production processes.

They are designed to improve performance.

**Kevlar** is an example of a modern material- It was designed to be extremely strong, yet lightweight. It is flame and chemical resistant and five times stronger than steel of the same weight. Kevlar is used for bullet proof vests.

**Nomex** is a flame- resistant material and used by fire fighters. It was developed in the 1960's by DuPont.

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**Design cycle:** The **design cycle** is a series of tools used by designers to help them create and evaluate solutions in response to **design** problems. The **design cycle** can have many sections, but in its simplest form it is – Investigate, Plan, **Design**, Create & Evaluate

**User Needs:** They are the things people **need** from a product or service to do something

**Ergonomics and anthropometrics:** **Anthropometrics** is the study of body measurements and statistical data concerning the sizes and shapes of the population. **Ergonomics** is the relationship between a product and its users. ... User group, posture, clearance, reach and strength are all important factors in **anthropometrics** and **ergonomics**

**Product Safety:** **Product safety** is the ability of a **product** to be **safe** for intended use, as determined when evaluated against a set of established rules.

**Design briefs:** A design brief is a document for a design project developed by a person or team in consultation with the client/customer. They outline the deliverables and scope of the project including any products or works, timing and budget

Manufacturing: Manufacturing is the production of products for use or sale, using labor and machines, tools, and chemical or biological processing or formulation.

**Durability:** **Durability** is the ability of a physical product to remain functional, without requiring excessive maintenance or repair, when faced with the challenges of normal operation over its design lifetime.

**Tolerance:** Engineering tolerance is the permissible limit or limits of variation in: a physical dimension; a measured value or physical property of a material, manufactured object, system, or service

**Manufacturing considerations:** In engineering design, selection of materials and processing of materials into finished components are closely related to one another. The major objective of DFM is to ensure that the product and the **manufacturing** processes are designed together .

standard and pre manufactured components

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**Disassembly:** is to take something apart, like an old car motor

**Regulations :** On the other hand, **regulations** refer to the directives or statute enforced by law, in a particular country.

**Copyright:** The exclusive and assignable legal right, given to the originator for a fixed number of years, to print, publish, perform, film, or record literary, artistic, or musical material

**Trademark:**A trademark is a type of intellectual property consisting of a recognizable sign, design, or expression which identifies products or services of a particular source from those of others, although trademarks used to identify services are usually called service marks

**CE : European conformity:** CE marking is a certification mark that indicates **conformity** with health, safety, and environmental protection standards for products sold within the **European** Economic Area (EEA). ... The CE marking is the manufacturer's declaration that the product meets **EU** standards for health, safety, and environmental protection.

**BSI: British standard:** A **British standard** is a minimum **standard** that a product must be manufactured in accordance with before it is recognised by the relevant authorities as a quality product. Insurance companies will specify for example that all external wooden doors on domestic properties are fitted with a **British Standard** deadlock.

**Market pull and push:** **Push marketing** means you are trying to promote a specific product to an audience you find relevant. **Pull marketing** implies that you implement a strategy that will draw consumers towards your products – often creating loyal customers or followers.

**Cultural and fashion trends**

**Lion mark:** The Lion Mark is a British consumer symbol developed in 1988 by British Toy & Hobby Association and used to identify toys denoted as safe and of high quality. It represents a red and white lion face in a triangle with a yellow background and green borders

**Iconic Design:** **Iconic design** is something recognisable and memorable, and comes in many forms. Just like the DeLorean, **iconic design** is something recognisable and memorable. It comes in many forms such as architecture, branding, typography, automobiles, industrial **design**, and popular culture

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**Sustainability:** meeting our own needs without compromising the ability of future generations to meet their own needs. In addition to natural resources, we also need social and economic resources

**Renewable Energy:** Renewable energy is energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.

**non renewable energy:** A non-renewable resource is a natural resource that cannot be readily replaced by natural means at a quick enough pace to keep up with consumption. An example is carbon-based fossil fuel. The original organic matter, with the aid of heat and pressure, becomes a fuel such as oil or gas.

**End of life:** In the context of manufacturing and product lifecycles, is the final stages of a product's existence. The particular **concerns** of **end-of-life** depend on the product in question and whether the perspective is that of the manufacturer or the user

**Environmental pressures:** Indicators of **environmental pressure** reflect the impact of human activities on the **environment, environmental pressure**; **environmental** impact) that leads to the appearance of **environmental** problems.

**DFMA:** DFMA stands for Design for Manufacture and Assembly. DFMA is the combination of two methodologies; Design for Manufacture, which means the design for ease of manufacture of the parts that will form a product, and Design for Assembly, which means the design of the product for ease of assembly.