MANUFACTURING SYSTEMS

There are **three** main production systems:

Mass Production - is used where there is a continuous demand for large quantities of product e.g. tin cans for food, cars, etc. Sometimes called **flow production**, this system is organised so that specially designed machines carry out one operation on the product that is continuously passed from one different machine to the next, until at the end of the line it is complete and finished.

Advantages:

Low production costs, if sufficient products are made.

Disadvantages:

Models cannot be changed easily. If one machine breaks down the whole line is affected.

The machines cannot be easily reset to make other models. The machines cost a lot to purchase when the line is being set up.

Batch Production - is used where the need for a product is not continuous, or not enough are sold to make mass production worthwhile e.g. room heaters and one style of calculator. Batch production often looks like mass production, but it uses machines that can be altered to make another model, or something completely different e.g. the machines may be set up to make one model of heater for one month and then production is stopped while the machines are reset to make a different model for the next month.

Advantages:

Flow production methods lower the production costs. Model changes can be made regularly, upon change over.

Disadvantages:

No production occurs while machines are being reset, this adds to the cost. The products need to be stored until there is a demand for them.

One-off - Producing one product at a time. This method is often used by traditional craftsmen and artists, who work to order, e.g. high quality musical instruments and sculptures are made this way.

Advantages:

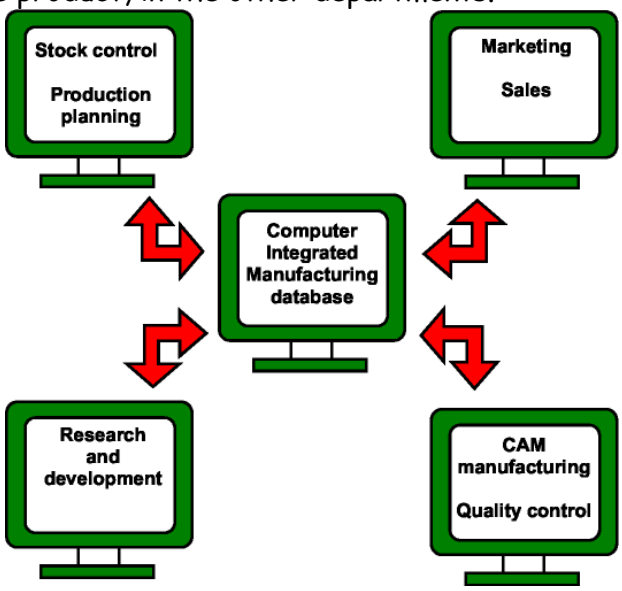
The customer gets a product that is designed exactly as they wanted it. Quality checks can be made at every stage of manufacture.

Disadvantages:

The production method is slow and very costly.

COMPUTER INTEGRATED MANUFACTURING (CIM)

Many people in different departments are involved in making even the most simple of products such as a ruler. Each department uses computers, the CIM system links all the computers, so that everyone involved can see what is happening, with regard to the product, in the other departments.



Because the computers are all linked, any changes such as a design alteration will automatically affect the ordering of materials, the production plan, and the quality control system and maybe even the packaging of the product. Everyone who needs to know will know immediately of any changes that affect their work.

KEY WORDS **Mass: Batch: One-off: CIM: Commercial Production**

1. Explain the term 'one-off' production.
2. List the advantages and disadvantages of one-off production.
3. Explain the term ' batch' production.
4. What are the advantages and disadvantages of batch production?
5. Explain the term 'mass' production.
6. What are the advantages and disadvantages of mass production?
7. What is meant by the initials 'CIM'?
8. Give **four** examples of the sort of links that can be made using CIM.
9. What is the main advantage of using a CIM system?
10. What manufacturing system would you use to make a fitted cupboard to go under the stairs?

A List **four** products found at home and state which manufacturing system you think were used to make them.

Worksheet 9a

QUALITY – Worksheet 9b

When a product is described as a high quality product it means that it is designed:

- to do what it is meant to do excellently
- to last a long time
- To need little maintenance.

High quality products normally cost more, one reason for this is that more money is spent in inspecting every part as it is being made and put together. The purchaser is willing to pay more to be sure that the product will not fail early on in its life.

Consumer Confidence

To help a consumer be sure that what they are buying is of good quality, independent standards organisations publish lists of standards of quality that the product must meet. If a product fully meets the standards, then the manufacturer can apply to the organisation to be allowed to have the organisations logo (known as a **kite-mark**) displayed on the product. If a consumer sees the kite mark on the product then they can be sure that it is safe to use and should work for a reasonable length of time.

The two most common kite-marks found on products in Britain are those of:

The **British Standards Institute**

The **European Commission**

Quality Assurance

Many companies want to get a reputation for high quality and wish to keep it. To help do this, the company can organise itself so that every employee tries to work with quality in mind, including those not directly involved in the making of the product, such as managers and office staff. When a company has done this, they can apply to be inspected to see if they are good enough to be awarded the **ISO 9001**. This is given by the International Standards Organisation to companies with a high standard of **Total Quality Management (TQM)**. These companies often organise their employees into small groups called **Quality Circles**, who meet regularly to discuss how the quality of what they do can be improved.

Quality Control

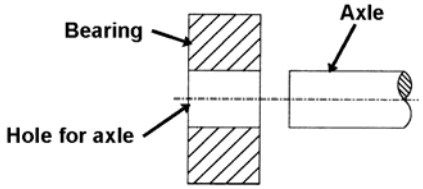
Even if every employee is working to a high quality standard, the machines making the product can go wrong and produce a poor quality output. To guard against this, computer controlled inspection equipment can inspect each part as it comes off the machine. This is called **Process Control**. The inspection equipment can warn the machine operator as soon as the quality of the parts begins to fall. Process control is costly; so many manufacturers rely upon inspecting the parts manually at regular intervals. For example, every 100th part can be removed for inspection.

Inspection

- A part needs to be inspected for:
- Accuracy of its dimensions
- Faults in the material (cracks, splits etc.)
- Its surface finish (e.g. rough instead of smooth)
- Its appearance (e.g. is the colour the correct shade?)

Dimensional Accuracy

Although Computer Aided Manufacture can produce parts very accurately, there will still be small variations in the dimensions. Problems arise when one part has to fit into another part. For example, the wheel of a shopping trolley has to fit onto an axle. If the axle diameter is too large, the wheel will stick and not turn easily; if it is too small then the wheel will lean over and the hole in the middle of the wheel, known as the 'bearing', will wear away quickly.



The dimensions do not have to be exact however, if the axle is just a little large or small, then the wheel bearing will still work perfectly. The amount that a dimension can vary without affecting performance is known as the **tolerance**. A dimension showing tolerances normally shows how much larger it can be by using a '+'sign and how much smaller it can be by using a '-'sign. If an axle should be 15mm diameter if perfect (this is known as the **nominal** size) but could be 0.1mm larger or 0.2mm smaller and still work well, then the dimension will be written in the following way.

Any axle that is too large or too small will be scrapped and hopefully recycled. Tolerances can also be given for:

- Lengths, widths and depths.
- Positions of holes and their diameters.
- Angle measurements (in degrees).
- Surface flatness and smoothness.

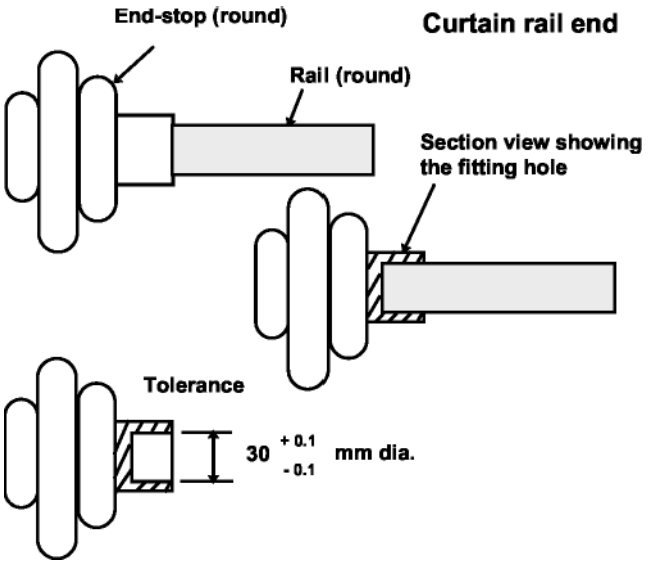
KEY WORDS **Kite-mark: Quality control: Nominal: Tolerance**

STATISTICAL QUALITY CONTROL

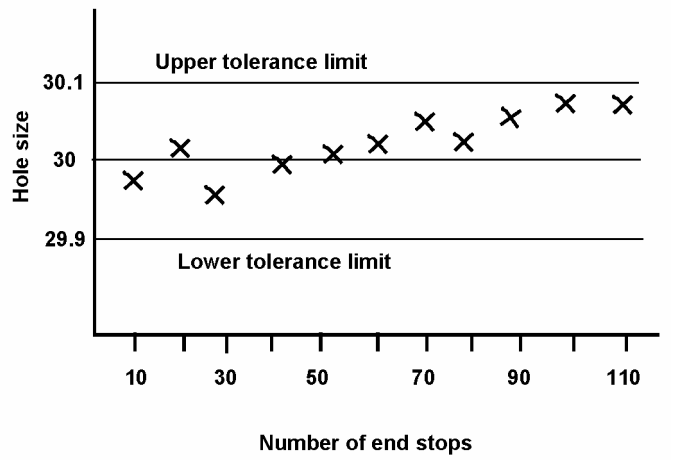
Checking each part of a product every time it is manufactured costs a lot of money. Normally it is only considered for the most expensive, top of the range products.

Usual practice is to test a selection of parts and the results are added to a graph to see if there is a trend showing that will eventually lead to the part being too large or too small.

The diagrams below show one end of a wooden curtain rail. The end-stop slides onto a round wooden rail. The hole that the rail fits into must be a tight fit and within diameter tolerances. The end-stop is turned on a computer controlled lathe.



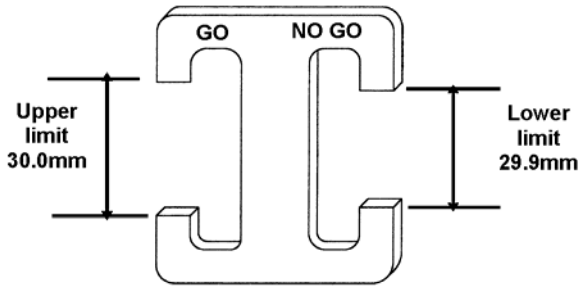
The production manager decides to check every tenth end-stop and plots the data on a graph.



It can be seen from the graph that there is a trend for the hole to get larger, so it would be a good idea to reset the machine before the hole gets too large and the end-stops have to be rejected.

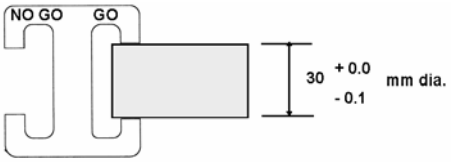
INSPECTION GAUGES

A quick and accurate method of checking to see if a component (part) is too large or too small is to use a 'GO - NO GO' Gauge

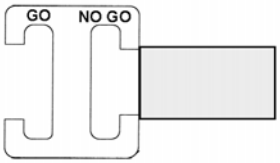


To use the gauge - On the rail

1. Check the the 'GO' side to see that it slides over the rail. If it doesn't, then the rail's diameter is too large.



2. Turn the gauge round and check that the 'NO GO' side will **not** slide over the rail. If it does, then the rail's diameter is too small.



For checking the hole in the end-stop, a **Plug Gauge** can be used in the same way.

1. What qualities must a high quality product have?
2. Sketch two examples of a quality kite-mark.
3. Explain the term 'Total Quality Management'. What will a successful company be awarded?
4. Why do manufacturers need quality control procedures?
5. Explain fully what is meant by the term 'tolerance' in manufacturing.
6. Name **four** things that tolerances can be applied to.
7. Why isn't every part of every product tested before it is assembled together?
8. How can statistics help reduce the number of reject parts?
9. Sketch a 'GO - NO GO' gauge and show how it is used.
10. Sketch a Plug gauge and show how it is used.

Worksheet 9c

RECYCLING

Recycling is processing old material to make it good enough to be used as new, e.g. melting down used aluminium drinks cans so that new cans can be made without using fresh aluminium. Sometimes the old material is added to the new. Most 'new' steel contains up to 40% melted scrap steel.

Plastics - most thermoplastics can be recycled, e.g. 'PET' used for fizzy drinks bottles is recyclable. Thermoset plastics are not recyclable.

Metals- Pure metals can be recycled. Alloys can only be effectively recycled if all the scrap is the same alloy.

Wood & Ceramics- are not recyclable.

Products that are made of material that can be recycled will normally display the three arrow symbol on the label.

Recycling is part of the government's drive to reduce the amount of waste in this country. The aim is to reclaim and re-use as much material as possible. However, this is not always possible, some materials e.g. ceramics, cannot be recycled, but can be used for other purposes, e.g. old ceramic products are used as hard-core, a layer of broken ceramics and bricks, onto which concrete is poured to make pathways, etc.

The government's policy can be called the '4Rs' policy.

Reduction - Reduce the production of waste in the first place.

Re-use - Clean and re-use products, e.g. bottles.

Recover - Recycle paper, glass, cloth, steel and aluminium, etc.

Remove - Remove as little as possible and try and gain energy from burning the waste or collecting methane gas from a landfill site.

Life Cycle Analysis (LCA) This analysis process involves collecting data at each stage of the manufacture and use of a product, from the extraction of the raw materials, to the problems it produces when it is thrown away at the end of its life. The data is about:

1. The cost of getting the raw material e.g. digging metal ore from the ground.

2. The cost of converting the raw material into a usable material, especially how much energy was used (electricity, coal, gas or oil).

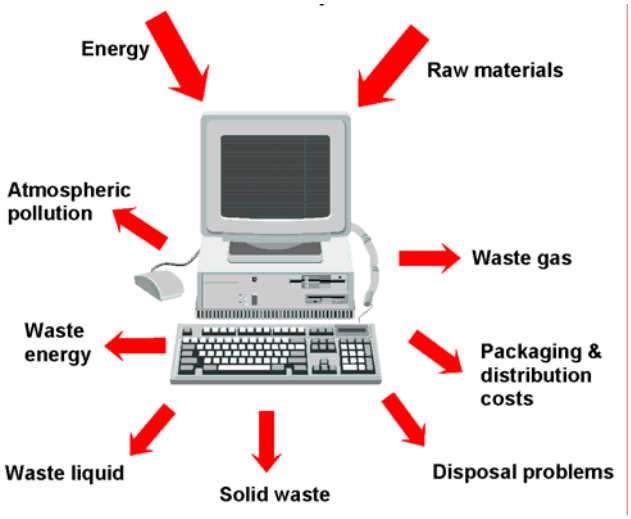
3. How much recycled material was used in making the product?

4. How much time, energy and waste were involved in each making process.

5. How much material, time and energy were used in packaging the product and distributing it to the shops.

6. How easily it can be disposed of safely, or used for recycling at the end of its useful life.

LCA can be applied to the manufacture and use of a computer.



The aims of responsible manufacturers are:

A) To reduce the amount of energy used in manufacturing the product.

B) To make a product that lasts a reasonably long time.

C) To make it as recyclable as possible when it is worn out, or out of date.

Recyclable packaging

1. What do you understand by the term 'Life Cycle Analysis'?
2. How would you identify a responsible manufacturer?
3. What is the difference between the terms 'recycled' and 're-used'?
4. A clear glass jam jar is to be recycled. What would you expect to happen to it?
5. What is the government's policy about reducing waste and energy use?

A. Identify **four** products that are used at home that could be recycled. Say what they are for and what material you think they are made from.

B. Identify **four** products that are used at home that could be re-used, either for their intended use or for an alternative use. State how they could be re-used.

Worksheet 9d