3. Processes

4. Industrial & commercial practices

INDUSTRIAL PROCESSES

MASS PRODUCTION

This is where hundreds of identical products are made on a production line. This process could involve the assembly of components or parts that are bought in eg. Cars are manufactured using many different components that are assembled on automated [Robotic] assembly lines. The use of robots would mean that a smaller work force would be required to carry out the work.

Car manufacturing

CONTINUOUS PRODUCTION

As the name implies, continuous production means manufacturing in large quantities usually 24 hours a day 7 days a week to maximise productivity without the need of stopping or starting the manufacturing process. This type of production is geared to making large quantities of identical products such as drink cans, disposable razors, oil refinery, steel production, popular biscuits, tights, light bulbs, disposable nappies etc.

This process would be highly automated with very little human involvement required.

FEATURES of the type of products that make them suitable for CONTINUOUS PRODUCTION are:-

that the product will have to be fairly simplistic to ensure speed of production.

The products are usually in **HIGH DEMAND.**

Not many components used so less work to assemble together.

Continuous Production
Oil Refinery, Steel Production,
Disposable Razors, Light Bulbs

3. PROCESSES 4. INDUSTRIAL & COMMERCIAL PRACTICE

Advantages of continuous production

- End product can be very cheap to the customer.
- Labour costs are very cheap, not many skilled workers will be required—saving costs for employer and customers.

Disadvantages

- Initial setting up of equipment very expensive—automated production line.
- Quality control issues have to be in place to ensure a quality product at the end.

These products would be suitable for continuous production

BATCH PRODUCTION

Products that are batch produced are made in specific quantities e.g. a batch of 13 bread loaves (a baker's dozen) or a batch of 1000 bricks. Products are sometimes made in one production run or batches may be repeated at particular times, e.g. a baker will make repeated batches of loaves between 5 a.m. and 12 noon.

Furniture

A batch can be a very small number of products - only 2 or 3 - or a very large number - for example 100,000 cans of Heinz beans. Large products like aeroplanes are produced in small batches as are food products like special cakes. Garments, furniture items, vehicles and agricultural machinery are often made in large batches of thousands.

This type of production is usually very labour intensive with the use of jigs and formers to ensure quality control.

Agricultural equipment

Advantages

- A good method if the item goes out of fashion or sells poorly, then production can stop. Product can be altered or changed to suit market demands.
- Machinery, Jigs or formers can be altered to adapt to market demand.

Aeroplanes are usually made in batches

Disadvantages

- Company needs to be flexible to adapt to different types of product batches.
- Initially expensive to set up production lines and equipment.

Roof Trusses

3. PROCESSES 4. INDUSTRIAL & COMMERCIAL PRACTICE

FEATURES OF BATCH PRODUCED PRODUCT

This type of product can be fashionable for a relatively short period of time—clothing or seasonal products. Usually they will be more expensive than mass produced products to buy. This will be due to the complexity of the product, more processes involved to produce, complexity of assembly, and higher labour costs.

UNIT OR ONE OFF

These type of products are usually 'One Off' products—one made at a time.

Every product could be different so would be very labour intensive. Products could be made by hand or combination of hand, machine and automated processes.

These products would usually be a one-off, only one made, for example a joiner making a table, your project at school, a cruise ship, an oil rig or a bridge.

Cruise ship

Advantages

- It would usually be a unique product.
- Would have to answers exact customer requirements or brief.

Bridge

Disadvantage

- Highly skilled workers required to carry out the work.
- Individually designed and produced—so more expensive.
- The manufacturing company needs to be very flexible to adapt to different customer requirements.
- Usually very expensive as far as labour costs. Cost is at a premium due to the originality factor.

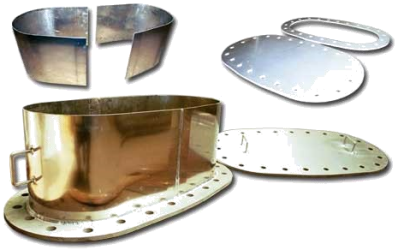
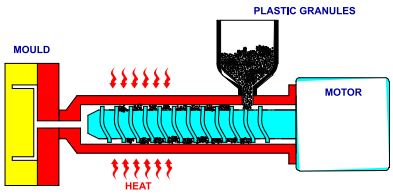
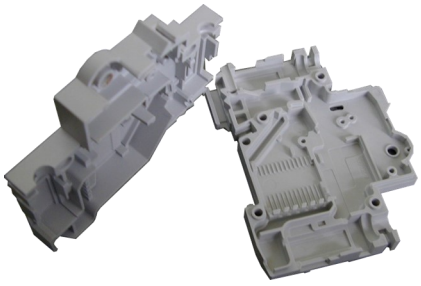
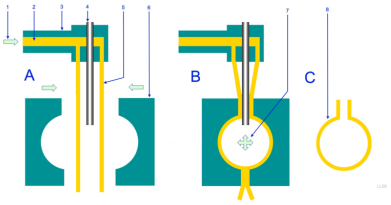
Made to order furniture

Oil rig

MANUFACTURING METHODS USED IN PROCESSING MATERIAL

Materials can be processed or formed in various ways.

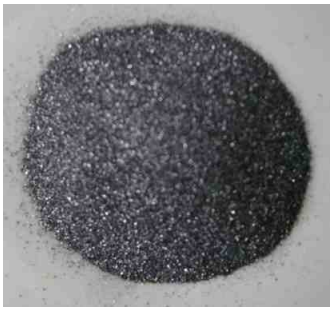
These included methods of cutting, wasting, forming and combining materials to improve or enhance properties.

Fabrication Components are joined together by nuts and bolts, welding, riveting.	  
Moulding Plastics can be moulded into different forms. Casings can be injection moulded. PET Bottles can be blow moulded. Molten Aluminium can be injection moulded to create toys.	    

3. PROCESSES 4. INDUSTRIAL & COMMERCIAL PRACTICE

Sintering

Sintering is a method for making objects from powder, by heating the material (below its melting point) until its particles adhere to each other. Sintering is traditionally used for manufacturing ceramic objects, and has also found uses in such fields as powder metallurgy.



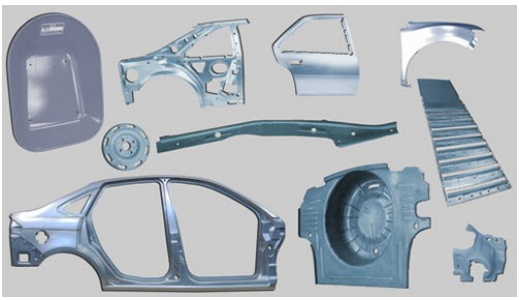
Steel powder compressed under high pressure and heat to create gear wheels

Laminating

This is the process of bonding different layers of materials with a bonding agent to form intricate shapes and forms that usually is much stronger than the original material. Can be used with wood veneers or fibreglass resin.

Stamping

This is a process of pressing or stamping shapes under high pressure into a former from sheet metal.



Milling

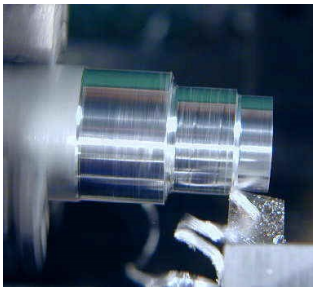
Process of shaping a product from a solid block of material. This means that the material that is not required is removed—can be a an uneconomical process because the excess material will be waste.

3. PROCESSES 4. INDUSTRIAL & COMMERCIAL PRACTICE

Turning

Process of rotating materials in a lathe to achieve cylindrical shapes.

Metals and woods can be turned or formed.



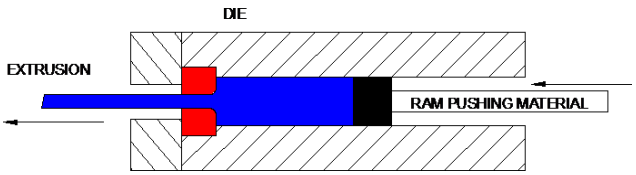
Injection moulding

Process of injecting molten material under high pressure into a mould or die to achieve a certain form.

Materials such as metals or plastics can be used such as Die cast aluminium components or ABS Mobile phone casings.

Extrusion

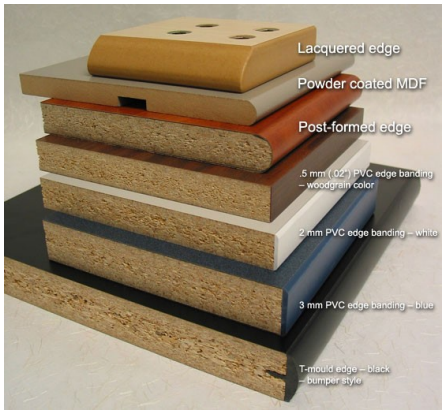
A process of pulling or pushing softened material through a specially shaped die to achieve different material profiles. Materials such as polymers or metals can be extruded —UPVC Guttering.



Bonding

Process of gluing or joining different materials together under high pressure to produce sheet form materials.

Laminated surfaces can be bonded onto chipboard to be produce for worktops etc.

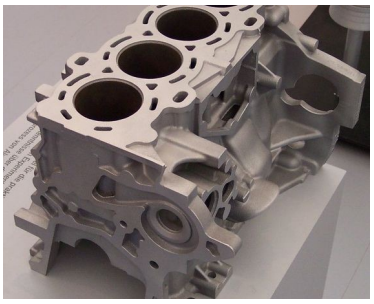


3. PROCESSES 4. INDUSTRIAL & COMMERCIAL PRACTICE

CASTING

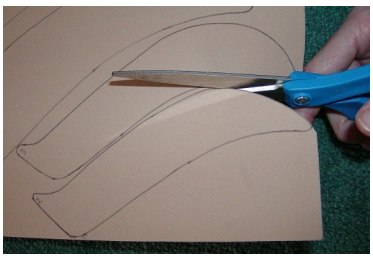
Material in liquid form [can be molten] poured into a prepared mould. No waste.

Materials like resins can be cast cold.




CUTTING/WASTING

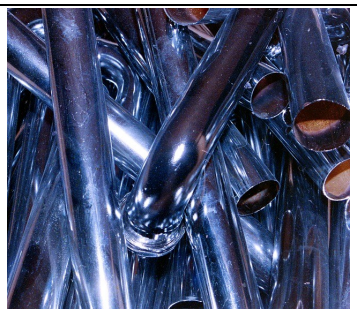
Material is removed to create the required shape or form. Can be cut, drilled, milled, stamped out.

SHAPING AND FORMING

Bending material or laminating wood to form a shape.

Can be fibreglass laminated to the shape of a car body or canoe




LABOUR ORGANISATION IN INDUSTRY

Industries set out their factories to produce their products using different methods depending on the type of product manufactured.

Two main methods are used:-

1. Assembly lines

2. Assembly Cell [Cell Production]

Assembly Line

ASSEMBLY LINE

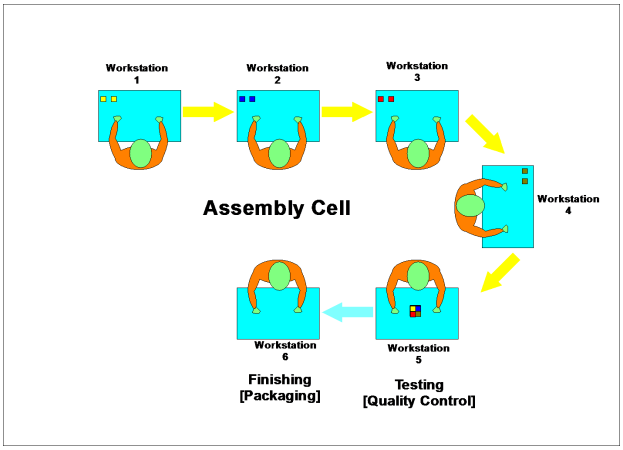
Products are assembled on production lines.

Disadvantages

1. Work tends to be boring and very repetitive.
2. No job satisfaction - rarely see the final product.

Advantages to company.

1. Low level training and skill required.



Assembly Cell

CELL PRODUCTION

Products assembled built and packaged within a small group of workers.

ADVANTAGES

Better quality products – the cell is responsible for the product and can see straight away if there is a problem with the product, and can usually rectify the situation.

Workers can move around and do different work – they don't get bored. Workers need to be more skilled because they carry out different tasks.

Workers feel more of an ownership of the product so resulting in a better quality product at the end. Job satisfaction.

Assembly Cell worker

JUST IN TIME MANUFACTURING

This method of manufacturing concept evolved in Japan during the 1960s and 1970s, especially developed in the Toyota car manufacturing plant.

Companies only buy enough stock or materials that are required for its immediate use.

This method is used by most manufacturing companies to save on manufacturing costs, so that companies can be more competitive.

Essentially this method ensures that there's very little waste or capital tied up in working area or materials. Materials and components arrive just before the product is manufactured.

For this to be effective precise planning and timing is required. Any delay in delivery times or difficulties in obtaining components would have severe consequences in being able to get the product to market.

When effective this method offers the following:-

ADVANTAGES

- No need for large warehouse to stock materials, and waste valuable floor area that could be used to manufacture products.
- Capital not tied up in materials and stock standing doing nothing in storage for weeks on end therefore not making any money.
- If there would be a slight incremental change to the product the company could change product manufacturing quickly - just a matter of re-ordering the new component for the next day manufacturing rather than having a storeroom of components that could go to waste.

Fittings such as screws and brackets in stock for next day manufacturing

Components arrive at assembly points just before assembly

Enough stock of materials for next day production

3. PROCESSES 4. INDUSTRIAL & COMMERCIAL PRACTICE

USING STANDARDISED PARTS & COMPONENTS

To reduce costs, machinery companies do not manufacture all of their components for their products.

They buy standardised parts or part assembled components to be assembled on site to create the finished product.

These items can range from nuts and bolts, screws, springs or circuit boards.

They have to be sure that these components are of a high quality. They will ensure that the companies that manufacture these components have some quality control systems in place during manufacturing.

Electronic circuitry will have been tested and safe to use. Components will be within tolerance [Correct size, shape, weight etc] or they would not fit onto their product. Standard sizes such as metric, thread for nuts and bolts would be essential.

Nuts and Bolts would be standardised and bought in

Electronic circuits would be bought in ready assembled for using in electronic products such as computer systems or televisions

Car Gear boxes bought in ready to be assembled on to the car

ADVANTAGES to the COMPANY

- They do not have to specialise on creating this product.
- Concentrate their time on creating the product.
- No space required to manufacture these items.
- Save costs - no extra machinery or staff needed to produce the components.

DISADVANTAGES

- Quality cannot be guaranteed.
- Dependant on the other company for delivery.
- Dependant on the fact that the other company doesn't go on strike.

STAGES IN PRODUCTION

There are **FIVE** specific steps of production in Industry when products are manufactured, these are categorised into TWO areas **PRIMARY PROCESSING** and **SECONDARY PROCESSING**

PRIMARY PROCESSING

1. **Buying raw material, forward ordering**
2. **Processing of materials**

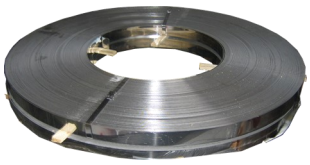
SECONDARY PROCESSING

3. **Assembly of components**
4. **Finishing**
5. **Packaging**

1. PRIMARY PROCESSING - Preparing material for processing

This is the process of preparing the material into a form that is suitable for manufacturing.

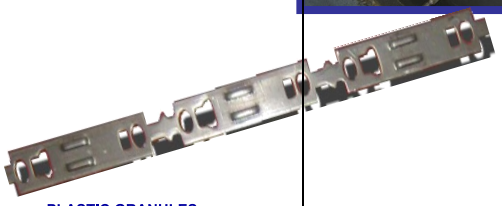
- Buying raw material
- Materials arrives at the factory in raw form
- Plastics come in granular or powder form
- Metal arrive in sheets or coils
- MDF or Chipboard in large sheets
- Wood in planks

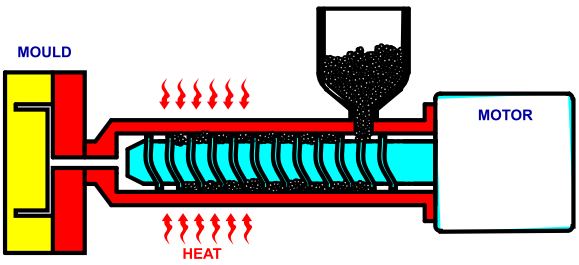


2. PRIMARY PROCESSING - Processing the material into components

Materials are processed to create the components

- Moulded into shapes
- Welded together
- Fabricated
- Cut
- Formed, bent, stamped





INJECTION MOULDING for CASINGS Etc

3. SECONDARY PROCESSING - Assembling the product

Parts are put together and the product is assembled

3. PROCESSES 4. INDUSTRIAL & COMMERCIAL PRACTICE

4. SECONDARY PROCESSING - Finishing

Product completed, tested, graphics applied.

HSE
Health & Safety Executive

5. SECONDARY PROCESSING - Packaging

- Product placed in box and ready for distribution.
- Box for protection purpose.
- Basic graphics for recognition.
- Instructions included with warranty details etc.

Packaging can be for marketing purposes with high quality graphics displayed to get customer attention.

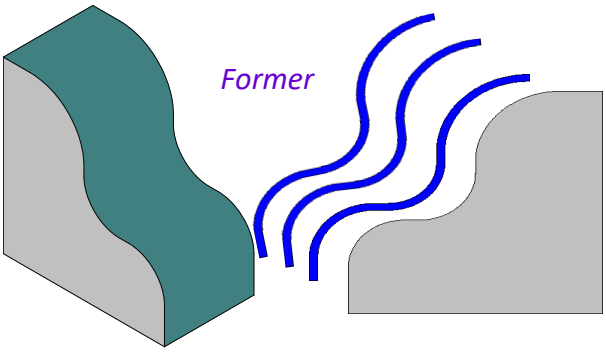
Batch production tools

When making several identical products or parts, jigs, formers, templates, patterns and moulds are used to ensure the parts are all the same.

Drilling Jig

A **jig** is used to make sure that parts are made exactly the same, without the need for marking out. For example, when drilling through a block of wood with two holes in, it will make sure that the holes are drilled in the same place in each component.

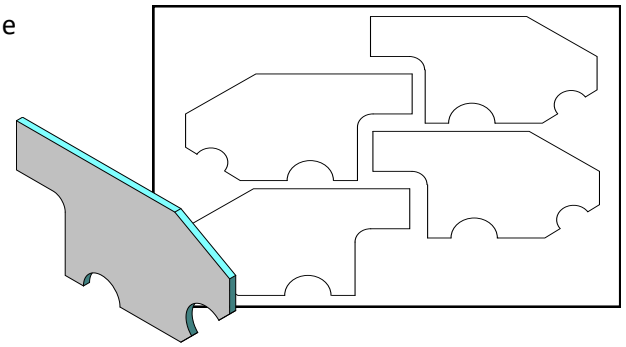
A **former** is used to make sure that parts are shaped or bent to exactly the same shape.



A **template** is something that you can draw around to mark an irregular shape onto material, so that it can be cut or shaped.

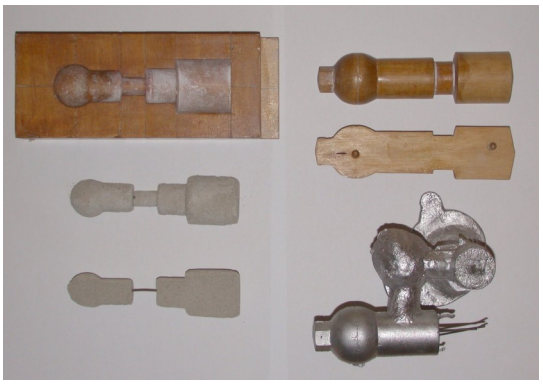
A **pattern** is used to make a mould when casting in metal or plastic resin. It is a replica of the finished object and may be made in wood or another soft material. Patterns are also used when shaping plastics in a vacuum-forming machine.

A **mould** is a hollow shape used when casting metal or plastic resin. Moulds for casting metal can be made in a special type of sand, in metal or in plaster. Moulds for casting resin can be made of plaster or rubber.



Templates arranged on Sheet Material to work out most economical way to cut sheet

Mould created to cast Pewter



Wooden patterns are made to cast Aluminium

PROJECT MANAGEMENT

Companies use project management systems during the manufacturing process so that their products are completed on time. You will have used time management systems with your school project.

PURPOSE OF TIME MANAGEMENT

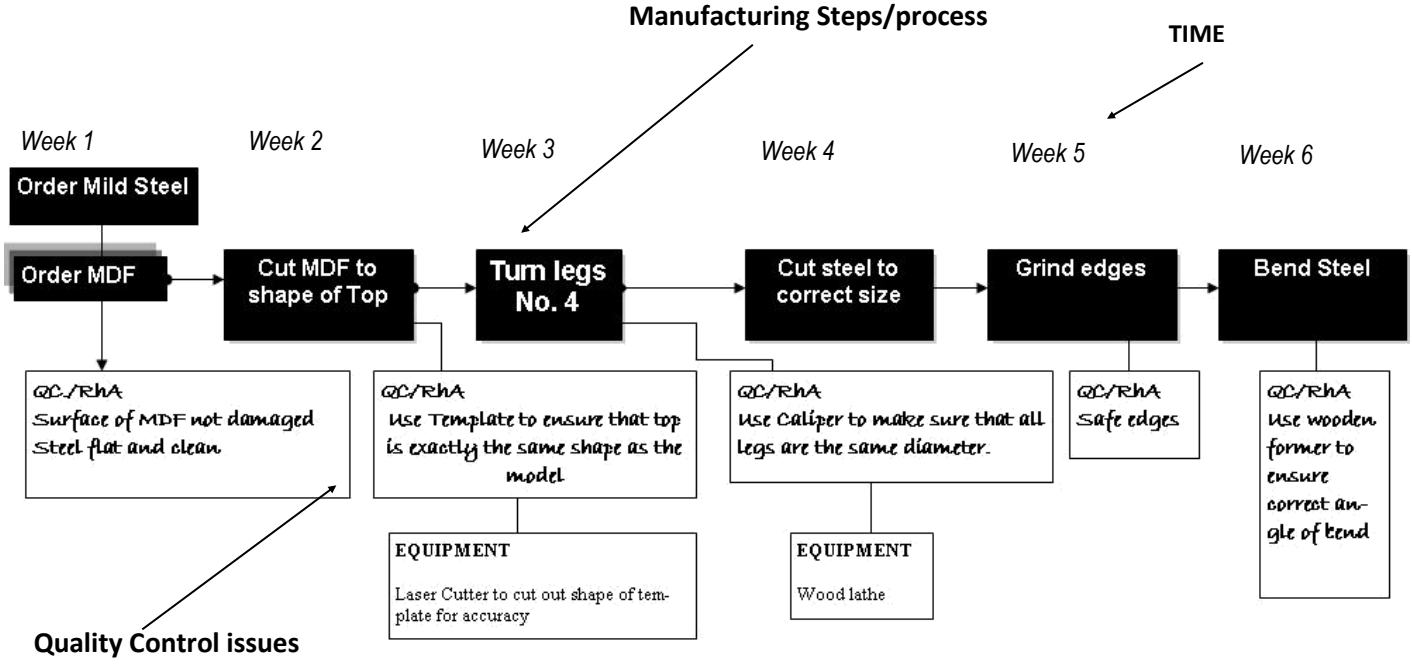
These are the **main features** of a good management system.

1. Plan ahead. What will be needed in two weeks, four weeks such as materials or extra staff.
2. Materials can be ordered beforehand - avoiding not being able to supply staff with work because materials haven't arrived.
3. Processes can be planned ahead - hiring equipment, buying equipment or machinery for a specific week.
4. No break in the manufacturing process.
5. Manufacturing should run smoothly.
6. Dates and times should always be noted.
7. Flagging up quality control issues during manufacturing

These are the main systems used for TIME MANAGEMENT in manufacturing.

CRITICAL PATH ANALYSIS

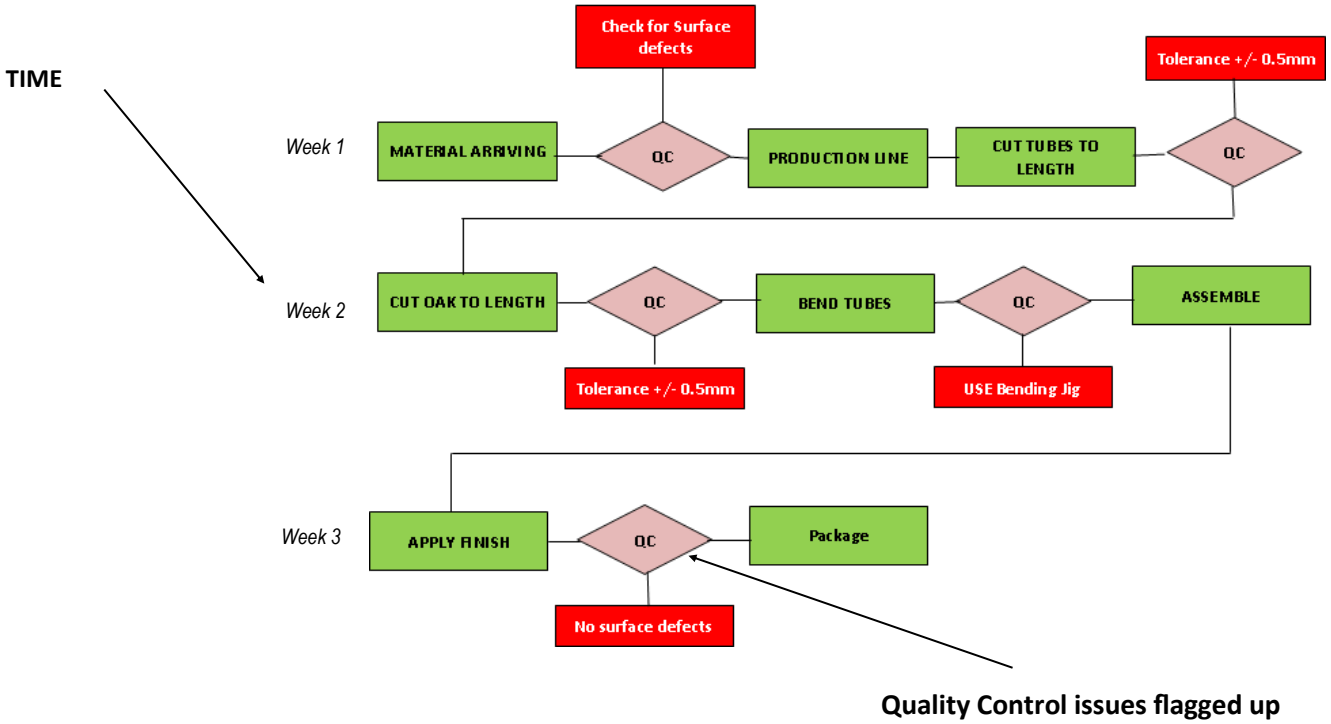
Similar to a Flow Chart



PROJECT MANAGMENT

FLOW CHART

MANUFACTURING FLOW CHART



GANTT CHART

DATES and TIMES

QUALITY CONTROL

STEPS

	TIME SCALE								
ACTIVITY	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	*Quality Control issues*
Source Materials									No surface defects
Cut MDF Sheet to required size									Tolerance of +/- 0.5mm
Cut Steel Tubes to correct length									Tolerance of +/- 0.5mm
Bend steel Tubes, Braze fillets									Use bending jig to ensure consistency
Clean & Plastic Coat Steel Tubes									Correct heat to ensure even coverage
Cut Housings in MDF									Use joint tenplate
Order Wall Brackets									Reputable make
Cut Acrylic spacers									Tolerance of +/- 0.5mm
Assemble Steel Tubes to MDF									Use assembly jig to ensure accurate location
Fix Acrylic spacers & Wall brackets									Align spacers with sides
Full assembly & testing									

QUALITY CONTROL

Products would be tested to make sure they work

Every company have Quality Control systems in place.

Quality Control is carried out throughout the manufacturing process.

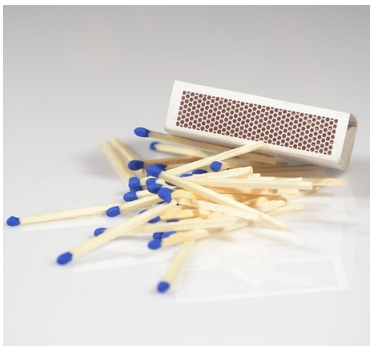
As the product is made it is tested to see if it works, if it is within tolerance [correct size] if it has been assembled correctly, if it has been assembled correctly.

No surface defects.

These steps are in place to make sure that the final product will be of a high quality and therefore ensures customer satisfaction with a product that will work well.

Some products will be tested at random, such as testing 1 in every 100 to see if it performs as expected. In some cases it will not be possible to test every single product like matches for example.

Every electrical product will have to be tested due to safety issues.



One every thousand from each batch would be tested

QUALITY ASSURANCE

Quality Assurance is more than the quality of the finished product that they manufacture. Quality Assurance involves the whole company and how the customers see the company, what have they done in producing the products they manufacture. To gain Quality Assurance companies would consider the following areas. They would use quality control systems to ensure that these are carried out.

Assurance about environmental issues

Assurance that the product has been made with consideration for the following areas:-

1. The work force are happy and encouraged to develop, which includes staff training (Investors in People Awards may be available). Staff paid a good wage/salary and treated well.

2. Product to be manufactured in a safe working environment. No waste products or harm done to the environment when product made

3. Use of recycled material.

4. Produced from materials that do not harm the environment.

5. Customer satisfaction - guarantee and warranty on products. Customers will have confidence in the company and the product so more likely to buy again.

Customer satisfaction

BUILD QUALITY

Every manufacturer needs to sell their products and so build quality is an important factor. These are some factors for consideration:-

- The product needs to sell, so the price must suit the target audience.
- How does the product compare with other similar products on the market—The competition. The build quality will have to be superior.
- How reliable is the product - will it work for a long time.
- What attributes or features should the product have? These will be based on market research, intelligence gained from the target audience, feedback reviews and questionnaires.
- Does the product meet the expectations/desires of the market segment?
- Is there product differentiation, is there a plan for diffusion of the product that meets the anticipated product life cycle.
- Is there an attempt to sustain brand loyalty?
- Will the product lasts for a long time - better for the environment - no need to buy another.

MP3 Player

iPod Nano

Which of these MP3 players have a good reputation of being well built?

Nike Running Shoe

Unbranded Running Shoe

Which of these fitness shoe has a good reputation of being well built?

CAM - Computer Aided Manufacture

These machines that are controlled by a computer to make or manufacture products. Probably the most common CNC [Computer Numerical Control] machine you have used is a Laser Cutter or a CNC Router.

Complex drawings can be created on computer drawing packages [CAD] and then downloaded to CNC machines so that the drawn components can be created from materials.

CNC Router

Features of CAM products.

- Difficult or Complex shapes can be cut out.
- Accuracy of shapes and interlocking fittings—this would only be possible using CNC machines.
- Repetition of shapes - able to cut the same shape over and over. Situations where batch or mass production required—number of exactly the same products.
- Much more accurate than man-made products with the added bonus of speed of production.
- Some machines are unsuitable for human use as they pose a danger.

Laser Cutter

3D Printer

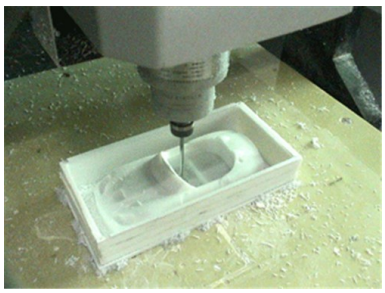
Types of CNC machines used in School

- Laser Cutter
- CNC Lathe
- CNC Router
- CNC Miller
- 3D printers

One disadvantage of equipment like this is that they are expensive to set up and maintain.

CNC Embroidery

Laser Cut Plywood



CNC 3D Milling machine cutting out a profile for a model car

3. PROCESSES 4. INDUSTRIAL & COMMERCIAL PRACTICE

Cutting Systems

Laser Cutter

Laser Cutting

A Laser Cutter uses a High Intensity Light beam that has been focused onto a specific point that produces extreme heat that is capable of burning through materials.

The laser beam can be so small that it will enable intricate shapes to be cut out. By adjusting the intensity and settings of the laser beam different thicknesses of materials can be cut. By increasing the speed of the laser head and reducing the intensity of the heat materials can be engraved.

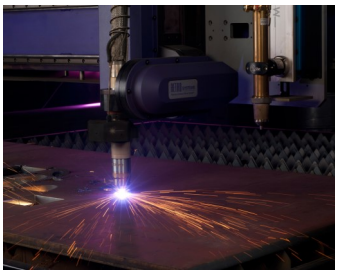
Acrylic Newspaper Stand

Plywood Lamp Shade

Engraving on Plywood

Plasma Cutting

Plasma involves the use of an electric arc to cut through metals. The electric arc produces heat at a specific point and a high powered air jet to blow away the molten metal at the cutting point. Detailed cutting can be produced depending on the width of the nozzle.



Plasma Cutting Steel

Water Jet Cutting

Water Jet cutting involves a jet of water that is injected through a small nozzle at a very high pressure. The water is mixed with an abrasive so that the water is able to cut through materials such as metals. Advantages of this method is that it does not involve any heat.

Water jet Cutting Steel

Milling Cutter

This involves a mechanical cutting process where a cutter rotates and removes materials by the cutting action. The disadvantage of this method is that it is difficult to cut out intricate shapes due to the size of the milling cutter. One advantage is that you can cut down to different levels or steps.

Milling Cutter

3D Prototyping

The development of CNC machines enables the designer to create high quality models or prototypes that could be used during the design process.

This is beneficial to the designer because the design process can be speeded up and therefore enable the product to be on market quicker or before competitors.

A 3D prototype would enable the designer to evaluate proposals so that changes can be made. Designer will be able to get answers on key features such as:-

- Feedback from clients on strengths and weaknesses of the product.
- Functionality
- Feedback on aesthetic qualities
- Mechanical performance—will it work
- Models can be tested

Products can be prototyped to extreme accuracy during the development stage

Feasibility Studies

Would this vegetable peeler be a successful product if it went to market?

Feasibility studies ensure your design and development investment will be worthwhile.

Essentially it is a method of working out if your idea is worth pursuing to the manufacturing and marketing stage.

Design feasibility studies are essential to reduce development time and costs. Taking time to check costs and the investment required to complete the project.

This reduces the risks involved by checking technical feasibility before any major investment is made.

If a project is commercially viable, it will also identify areas to reduce costs, work out efficient design development stages regarding research and investment.

Also the study will identify suitable materials and production processes that could be used to manufacture the product to the volume required.

A study will give confidence to a company that a thorough study has been made and the likelihood that they have invested in a product that will be financially successful.