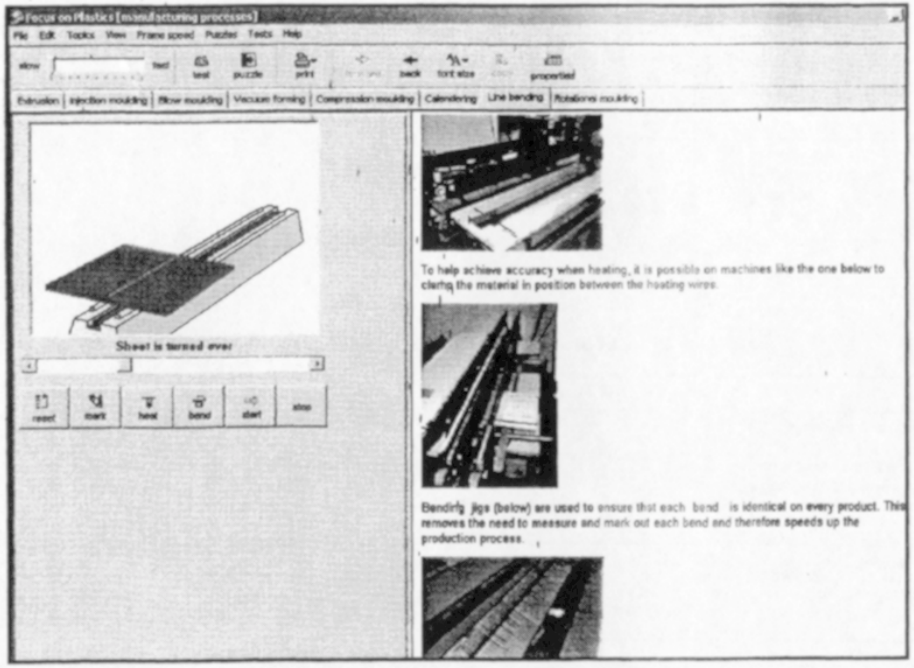
GCSE in Manufacturing (Double Award).

Unit 2: Manufactured Products

Proposed marks for Unit 2—Resistant Materials

			Allocated mark	Location of evidence
a1 describe a simple manufacturing process, using ICT as appropriate. 0 1 2 3	a2 produce a production plan that identifies the manufacturing processes and quality control. 4 5 6	a3 evaluate their production plan, in relation to manufacturing processes and quality control. 7 8 9	6	A manufacturing process (page 1) and production plan (page 2 and 3) are identified. Quality control checks are referred to (page 2 and 5) but not in any great depth specific to the project.
b1 describe the importance of accurate production planning and of meeting the product specification. 0 1 2 3	b2 identify in their production plan the schedule for manufacture and allocate roles to team members. 4 5	b3 evaluate their production plan in terms of how the schedule of manufacture could be improved and why particular roles were allocated to particular team members. 6 7	5	The importance of production plans is given on page 3, although this could be developed in more depth. Roles in the stages of manufacturing are identified and allocated to team members (page 6). Reasons for allocating the tasks is also detailed. A brief description of how the schedule could be improved is given on page 8.
c1 identify key control points during manufacture and describe the importance of health and safety. 0 1 2 3 4	c2 use quality control tests and carry out work with due regard to health and safety, including reference to appropriate safety systems. 5 6 7	c3 explain and justify how the production planning and scheduling could be improved to encompass total quality management and appropriate safety systems. 8 9	8	A basic list of key control points along with health and safety issues are given on page 9. Quality control checks are carried out on page 10. How the production plan can be improved is shown on page 11. More detail could have been included regarding safety systems.
d1 describe the features of good teamwork in the manufacture of a product. 0 1 2 3 4 5	d2 identify effective teamwork for different aspects of manufacture, identify key roles during the preparation of materials, components, equipment and machinery in the manufacture of their product 6 7 8	d3 explain methods of improving the production of their product by more effective use of the manufacturing team and through improvements that could be made as a result of buying in ingredients or components. 9 10	9	Page 14 organises the team and shows the key roles that they are to undertake page 15 outlines features that make a good team. Methods of improving the production are identified on page 16, the buying in of components to make improvements is also considered.
e1 describe how they produced their product using appropriate tools and equipment. 0 1 2 3 4 5 6 7	e2 explain why the tools and equipment used were appropriate to the task and identify any changes they have made to their production plan. 8 9 10 11	e3 evaluate their product in terms of the tools, equipment and processes they have used and comment on how these would be modified in "real world" manufacturing. 12 13 14 15	11	A plan of making with process sheet (page 17) is given along with work progress sheet/diary of making (page 18) of one part of the unit, these do describe how the product was made identifying tools and equipment but little explanation is given as to why these were appropriate. Only minor changes to the production are outlined on page 18, however the evaluation on page 19 does suggest further improvements. Pages 20 and 21 do outline industrial situations for making the project in quantity but more direct comparisons to the product and manufacturing it in industry should be made.
		Total mark	39	



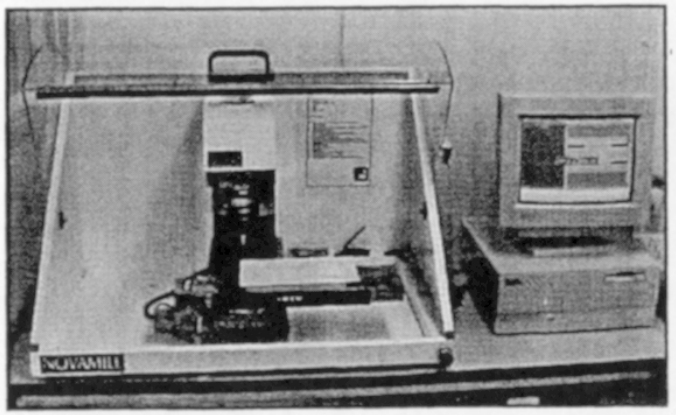
Manufacturing Processes

In lesson time I investigated a range of Manufacturing processes that could be used to shape plastic. These processes were all shown on a CD Rom - Focus on Design and Technology Plastics.
The CD Rom showed seven different processes - Extrusion, Injection Moulding, Blow Moulding, Vacuum Forming, Compression Moulding, Calendering, Line Bending and Rotational Moulding.
The programme goes through the process in a series of stages and in addition to this it has a written explanation down the side of the screen explaining the process in more detail and gives examples of where these processes are used in industry.

The process that is shown above is line bending and this is an operation that I can carry out at school on projects that I make. We have two machines in school that can be used for bending angles on plastics a strip heater and a line bender.

Computer Aided Manufacturing

In school we have a Denford Novamill that allows materials to be cut out to shapes that have first of all been designed using a Denford Computer Aided Design package. I intend to design the shape for my project on computer and then cut the blanks out on the Novamill machine shown below. By doing this I will make sure that every piece produced will be exactly the same.



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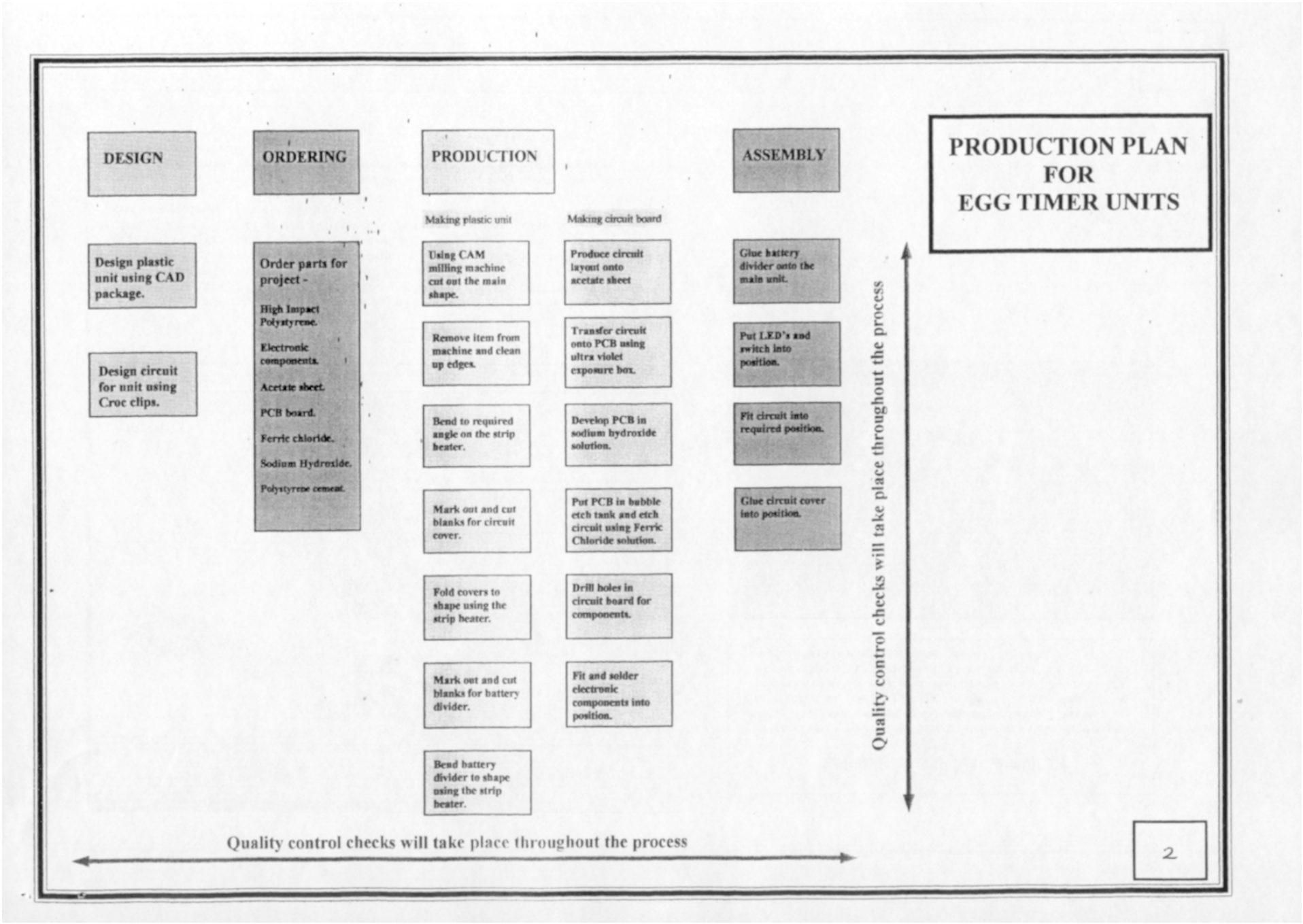


PRODUCTION PLANS

Accurate planning is needed in order to analyse stages of production in such a way that the product is made and assembled as efficiently, accurately and as quickly as possible.

PLAN FOR MAKING - EGG TIMER.

Manufacturing Operations to be followed when producing the Egg Timer.

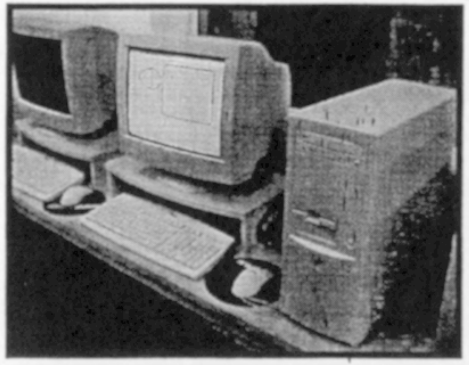
STAGE	OPERATION	MATERIALS/PARTS/ COMPONENTS	TOOLS & EQUIPMENT	RISK ASSESSMENT	High Medium Low	TIME TAKEN Est.	Actual.
	Making plastic units. Cut shape of unit on milling machine.	High Impact polystyrene sheet 225 x 125 x 2 mms.	Denford milling machine. 2 mm cutter.	Cutting fingers on edge on milling tool.	M	10 mins.	
	Bend milled shape to correct angle.	Main unit.	Strip heater.	Burn fingers on heater.	M	5 mins.	
	Mark out and cut shapes for circuit cover.	High Impact Polystyrene sheet 225 x 75 x 2 mms.	Steel rule, try square, scriber, Hegner saw.	Cutting hand or fingers on Hegner saw.	M	8 mins.	
	Make four right angle bends on circuit cover.	Prepared blanks.	Strip heater, engineers square.	Burn fingers on heater.	M	8 mins.	
	Mark out and cut shapes for battery divider.	High Impact Polystyrene sheet 75 x 40 x 2 mms.	Steel rule, try square, scriber, Hegner saw.	Cutting hand or fingers on the Hegner saw.	M	5 mins.	
	Make a right angle bend on the battery divider.	Prepared blank.	Strip heater, engineers square.	Burn fingers on heater.	M	2 mins.	
	Making circuit boards. Transfer circuit layout onto PCB.	PCB 100 x 50 mms.	Acetate sheet, UV box, developing tank, plastic tweezers, sodium hydroxide solution.	Chemical burns from splashes, fumes.	M	15 mins.	
	Etch circuit onto PCB.	Prepared PCB from previous stage.	Bubble Etch tank. Ferric Chloride solution, plastic tongs.	Chemical fumes and burns.	H	8 mins.	
	Drill holes in PCB for Components.	Prepared PCB from previous stage.	PCB drill, 1.5 mm drill.	Cutting fingers on drill.	M	10 mins	
	Fit and solder components into position.	PCB, push switch, red LED, green LED, 100uF capacitor, battery snap, 2x330 ohms resistors, 10K resistor, 500K resistor, 1M variable resistor, 555 Timer IC, 8 pin IC holder, solder.	Soldering iron, soldering stand, sponge.	Fumes from solder, burn fingers while soldering.	M	45 mins.	
	Assembling the unit. Fit circuit into position	Main plastic unit and circuit board.	Pliers.	Nip fingers with pliers.	L	5 mins.	
	Glue battery divider and circuit cover into position.	Assembled unit and remaining shaped plastic pieces.	Polystyrene cement.	Glue fingers together.	L	5 mins.	

SPECIFICATION

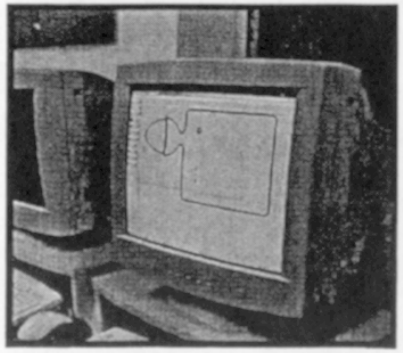
The final product should -

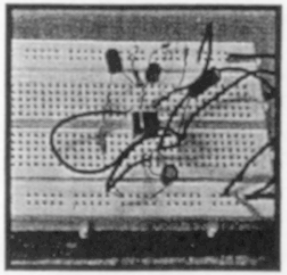
- **Be capable of being batch produced.**
- **Units produced should be exactly the same as they are a batch order and therefore the customers requirements will be that each one will function and look exactly the same.**
- **Units should be capable of being cut out using CAM in order to ensure that the shapes will be the same.**
- **The main part of the unit should be able of being shaped using the line bending machine as seen on the simulated manufacturing process at the beginning of the project.**
- **The egg timer should be able to be cleaned as it is going to be used in the kitchen area and hygiene is an important issue.**
- **The timer should be capable of timing for a period which will allow soft eggs to be cooked.**
- **The timer should be of a reasonable shape that it will fit in to the kitchen area, as people will not want to use it if it is an eyesore.**
- **The unit should be stable so that it will not fall over in use, and should not take up too much room as storage space is always needed in a kitchen area.**
- **Access should be allowed so that the user can easily change the battery if and when necessary.**

THE DESIGN PROCESS

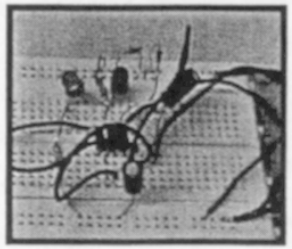


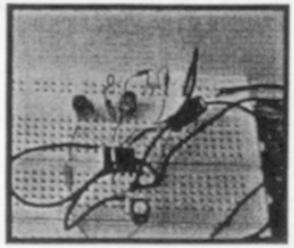
The main unit is designed on computer (CAD) using the Denford design programme. The design is then converted for machining using the G code option. It is then saved onto a disc and the disc is entered onto the milling machine ready for the shape to be cut out.

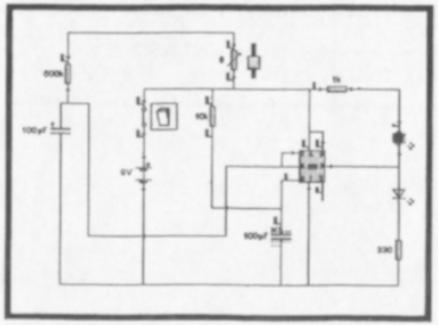




A possible timer circuit is modelled using breadboard. Two LED's are used in the circuit, the first to show that the timer is running until the fixed time is reached at which point the first LED goes out and the second LED glows (as shown in the two images below).







The circuit has been converted from the breadboard test to a screen simulation using a Crocodile Technology package. It now is ready to be converted into a circuit that can be manufactured through the use of PCB Wizard software.

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The process that I have observed of line bending can be used to produce a variety of projects using many different plastic materials. The plastics that are available for me to use in the school workshop are acrylic sheet and high density polystyrene.

Both of these materials can be cut out to shape in school using CAM.

I have decided that I will try to use the processes of line bending and cutting out using the Milling machine to make my product of an egg timer.

I will work with a group of other pupils to produce a batch of egg timers.

In carrying out the project we will have carry out quality control checks on the project as it progresses.

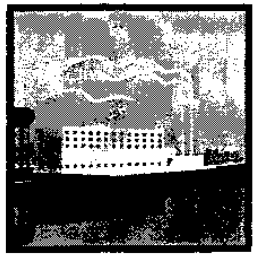
QUALITY ASSURANCE

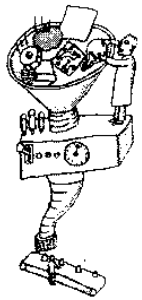
As the egg timer has to be produced as a batch it is important that checks are made at regular intervals in order to see that the last product made is exactly the same as the first. Also that all products meet the same design requirements and that they work to the same standard. The use of CAM ensures that the same product will be cut out time after time.

Quality Assurance is a very important part of the Manufacturing Process as if the customer knows that he/she is going to get a quality and reliable product then they will keep buying that companies products or keep returning to them to design new products. The company is expected to work to quality standards and over 50,000 British companies have been awarded The International Standard of Quality ISO 9000.

QUALITY CONTROL
Quality control is part of the quality assurance process. Production attitudes should follow an approach of all parts are right first time every time. The quality control unit should monitor the performance of products from the beginning of the manufacturing process through to the end. Quality control is applied in the manufacturing situation through inspection and testing.
Inspection is carried out to see if the product and the materials meet the specified design standards.
Testing is concerned with checking that the product works the way that it should and will continue to work over a period of time in different environments.

It is therefore important that when I make my product that I set up ways of checking that the egg timers do work the way that I intend.



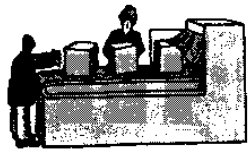


TYPES OF PRODUCTION

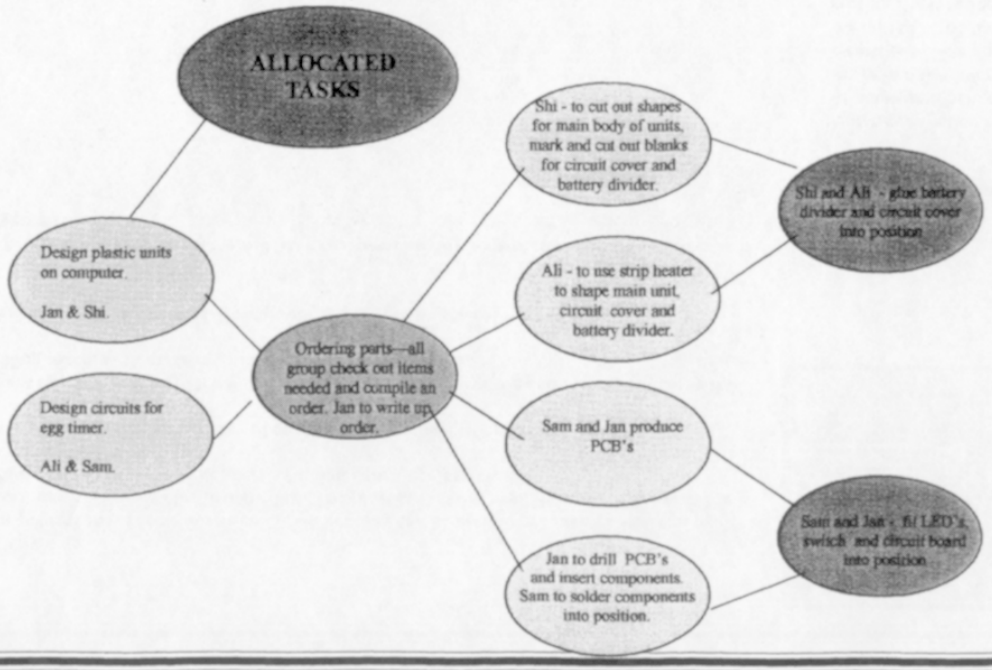
One off (job or custom) production is where a single item may be needed, such as a custom made item of furniture for a millionaires home. This method is suitable for producing individual items often to a particular customer's requirements but at a high cost.

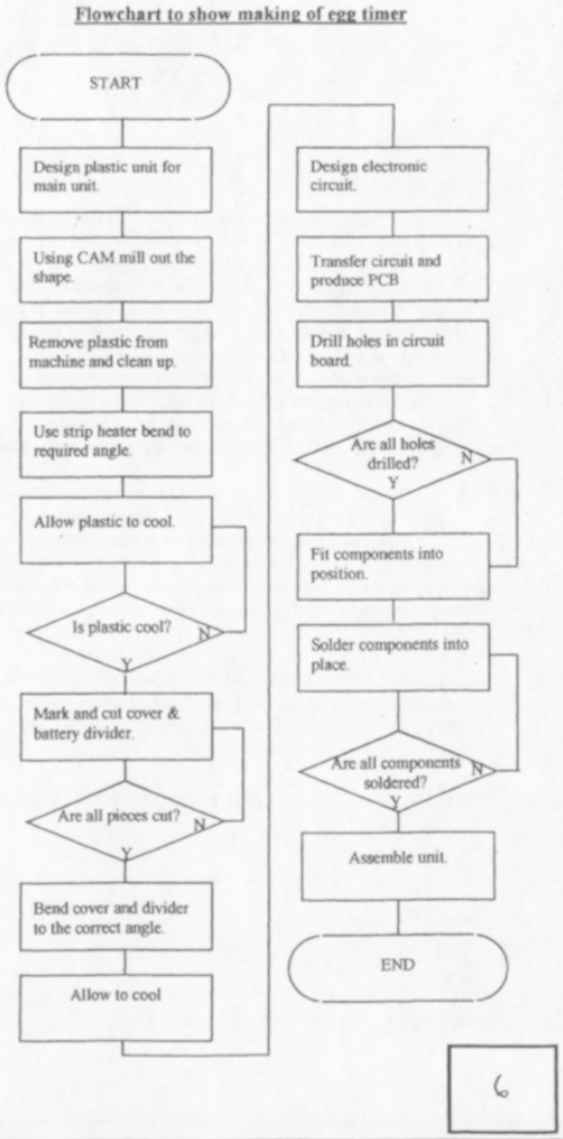
Batch production is where larger quantities of items are made. The method involves he same item being made repeatedly over a period of time such as 1000 loaves of bread made in a few hours daily in a bakery. The manufacturing system used can include elements of line and one off production . Batches produced can be increased or decreased according to demand. As this method produces a lot of items individual costing starts to reduce when compared to one off items.

Mass Production High Volume Production can be carried out in a number of ways -
Line production where the products move continuously along the assembly line with processes being carried out or parts added in sequence. This type of production is used when making cars. As many items are produced the individual cost of items is reduced a great deal compared to batch and one off methods.
Flow or continuous production is used when products are sold on an ongoing basis and production is continuous, maybe 24 hours a day, over a long period of time. Usually on these production lines a lot of money has been spent buying in specialised equipment which may involve automated control systems. Such machines keep production rates very high and therefore keep individual item costs very low. Nails and woodscrews can be produced using this method.



TEAM A	
Name	**Strengths**
Ali. B.	Ali is good at making things, he is quick and accurate. He enjoys practical work and has a good school attendance record.
Sam. L.	Sam enjoys practical work although he does not like design and written tasks. He made a good electronics project in year 9 and enjoys soldering and building up circuits.
Jan. W.	Jan was really good with design work when we were first told about CAD she takes I.T. as a GCSE and is also good at Art. She enjoys working in the practical area and making items out of wood and plastic.
Shi. R.	Shi is very good at most subjects and loves coming to school. He always has lots of ideas but sometimes they are too difficult to make in school. Shi enjoys sketching ideas and working on the computer best.





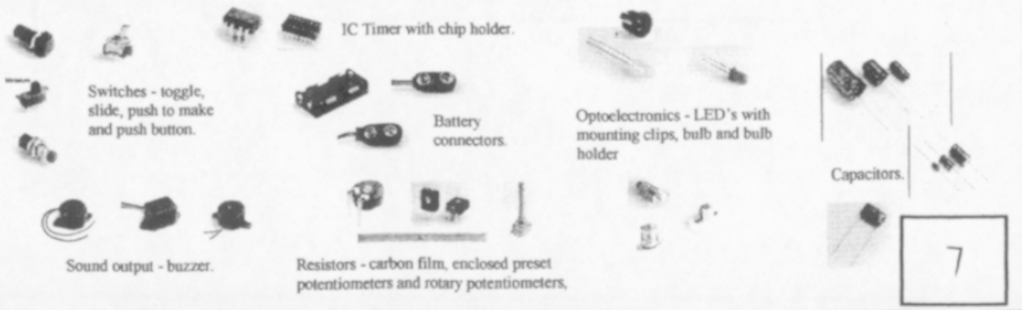
What materials would be suitable to use when making the egg timer?

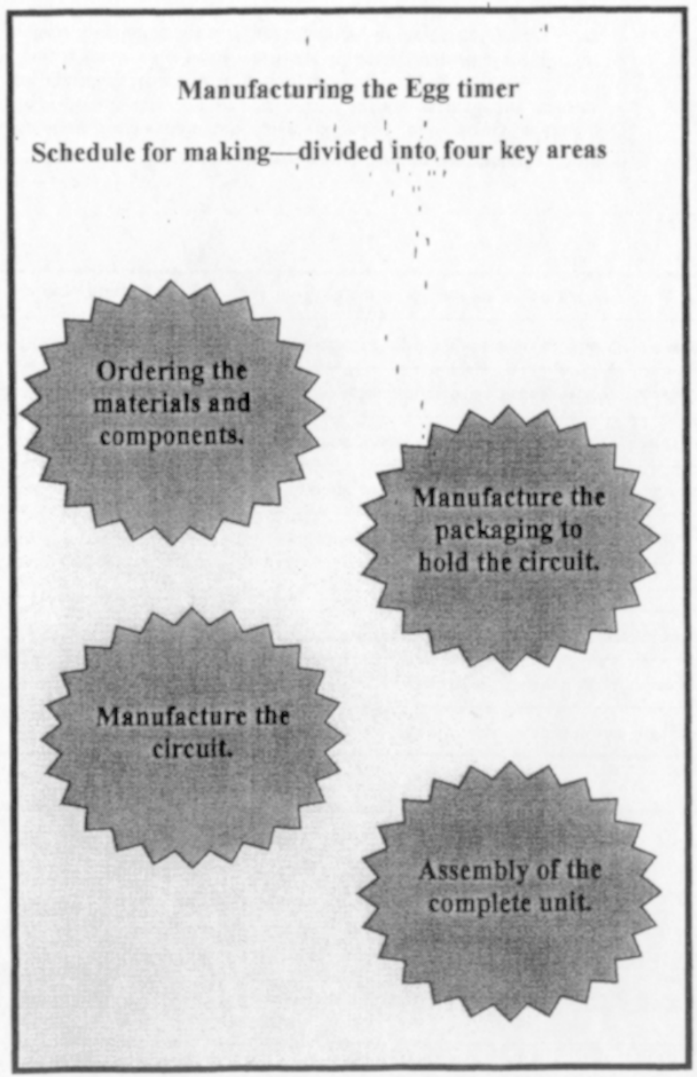
- **PLASTIC**
  - Acrylic Sheet.
  - High Impact Polystyrene (HIPS)
  - Polyester Resin
  - Nylon
- **WOOD**
  - Pine.
  - Plywood.
  - Medium Density Fibreboard (MDF)
- **METAL**
  - Aluminium Sheet.
  - Mild Steel Sheet.
  - Stainless Steel Sheet.

MATERIAL	ADVANTAGES/USE	DISADVANTAGES	SUITABILITY FOR PROJECT
Acrylic Sheet	Available in a range of colours, quite easy to bend to shape.	Tends to be expensive and can be brittle.	*****
High Impact Polystyrene	Available in many colours, machines well and easily bends to shape.	Can snap if not bent at correct temperature.	********
Polyester Resin	Can be cast into many shapes. Available in transparent and opaque.	More suitable for solid shapes rather than box structures.	*
Nylon	Can be moulded into a variety of shapes.	Can be expensive and is best when heat shaped, scratches.	*****
Pine	Light colour, readily available, quite cheap.	Easily breaks along the grain especially in small sizes.	***
Plywood	Available in a variety of thicknesses, can be cut to intricate shapes.	Surface tends to fray when cut, grain structure seen on edges.	*****
Medium Density Fibreboard	Available in many thicknesses, cuts well, takes a painted finish.	Needs surface finish, thin sections can easily break.	****
Aluminium sheet	Quite a light metal, can be cut, shaped and cleaned fairly easily.	Sharp edges, can be expensive when compared to other metals.	***
Mild Steel sheet	Reasonably cheap to buy and readily available. Good to work with.	Needs surface treatment to prevent rusting.	**
Stainless Steel sheet	Will not rust and available in a range of thicknesses.	Expensive and quite hard to shape.	*

Materials are the main items that will be used to construct the shell of the project, in this case the egg timer. They are normally the items or raw materials from which the project is manufactured from. Components are the items which are added to the shell of the unit to make it function as the designer intended. In the case of the egg timer components for it will be electronic components that are soldered together to form a circuit.

What components could be considered suitable for the egg timer?





Improvements to the production plan

The production plan given shows a process that could be carried out by an individual person making a single unit. In selecting the team to making the units individual workers have been selected according to their interests, capabilities and strengths. It will be therefore much better when manufacturing the units if group members were given individual tasks to perform according to their identified strengths and interests.
By allocating tasks to individual members the manufacturing will be speeded up due to individuals becoming aware of what is required and by repeating the sequence they will become quicker in carrying out the tasks. They will also become familiar with problems associated in carrying out that particular operation and will be more likely to solve or avoid the same problem when it cropped up, due to previous experiences.

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Quality Assurance of Egg Timer Product.

Stages for checking during manufacturing -

- Check that plastic blank is inserted into milling machine in correct position - cutting out takes place near edge and positioning is critical.
- Check that all plastic blanks for main unit are identical after they have been cleaned up - keep first one produced back as a template to lay over new pieces.
- Check bends on all plastic parts are at the same angle - use a former at the folding stage and a template to check angles.
- Circuit boards - check that circuit works.
- Circuit boards - check, alongside a stop watch, that circuit is set to correct time delay.

Health and Safety Issues.

Machining

- Using the Denford Milling machine - set correct cutting speeds.
  keep fingers away from cutter.
  keep safety guard clean & closed during machining.
- Use of drilling machine - wear safety goggles.
  keep fingers away from moving parts.

- Using strip heater - keep fingers away from heater element.
  use grips to hold small parts.
  take care when folding heated pieces.

Soldering

- When using the bubble etch tank - make sure that the unit is near to a sink in case of spillage.
  the area should be well ventilated to get rid of any fumes.
  on removing the PCB from the tank avoid touching with fingers before washing in water.
- When soldering - avoid breathing in the fumes from the solder, wear a mask.
  do not touch hot solder or components.

Completed product

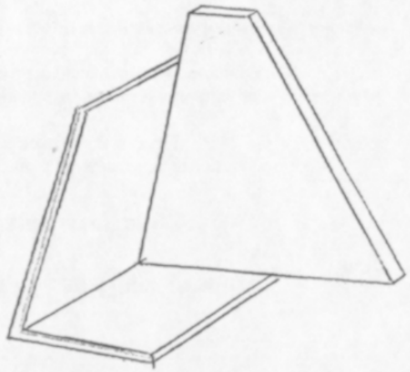
Avoid sharp corners and small loose parts.

Quality checks carried out in making the egg timer

Setting the cutter and positioning the material in the correct position on the bed of the milling machine.

Checking the circuit prior to fitting it into the unit

Using a template to check the angle that the plastic is bent to.



Health and Safety issues.

Checking safety systems available in the school workshop

Health and Safety check sheet. ROOM TECH 5.

Item	Location	Condition
Aprons	Hanging by door.	
Safety Goggles	Next to machines	Good
Dust Mask	Ask teacher.	
Ear protectors	Ask teacher.	
Water Supply	On wall next to storage room.	
Power cut off switch	Next to drill, next to wood store, entrance	
Fire Alarm	On wall next to drill.	
Emergency Exit	Push doors next to tool cupboard.	
First Aid Equipment	In teachers office.	
Ventilation Windows	Down machine wall	
Ventilation Extractors	—	
Lighting Electric	Ceiling only	Good
Light switches	Next to door	Good
Electric sockets	On wall alongside door to room.	Good

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Improving our production line

- **The production of the project could be improved by prioritising tasks a little better this can be done by scheduling which helps to organise the activities and ensures efficiency.**
- **Looking at the organisation of the work area will also help to speed up the process, preventing the team from wasting time by having to move too far when carrying out different tasks.**

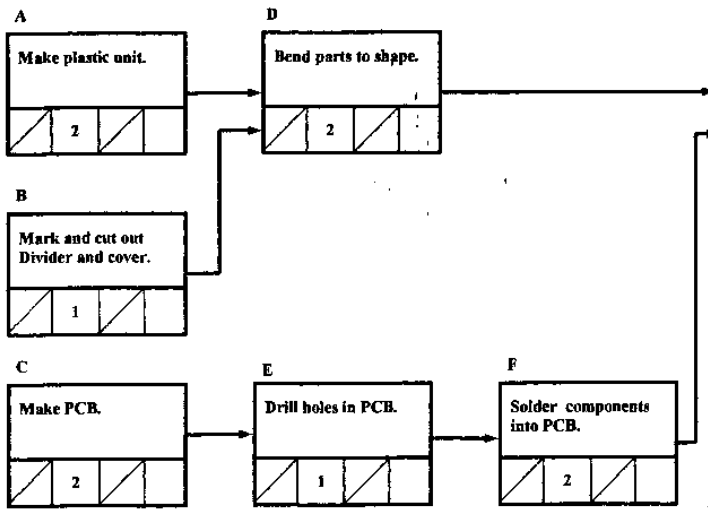
Organising the layout of the manufacturing process.

Making the plastic units - at present the CAM process is carried out in a room next to the workshop, the marking out, cutting and bending of the plastic takes place in the workshop. As the CAM machine room has a large worktable in the middle of it which is only used for storing items it would be better if the workshop tasks could be carried out on this table. This would save a lot of walking backwards and forwards and would speed up the operations.

Etching the PCB units - due to the situation of the 3 pin sockets in the workshop the bubble etch tank is located on a bench that is 8 metres away from the sink. The bench is also on a wall opposite all the windows that are down one side of the room. It would be much better for safety reasons if the bubble etch tank could be moved nearer to the sink to wash away immediately any splashes that may happen. Also by moving the tank nearer to the sink it is also closer to the windows and ventilation which will help to keep down the build up of any fumes.

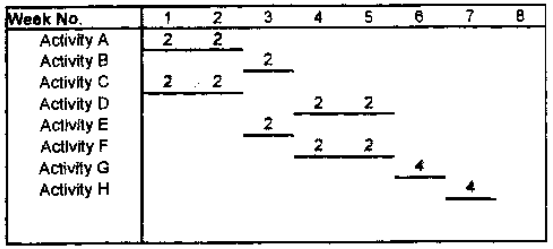
Scheduling

Time available - 5 lessons per week 50 minutes per lesson

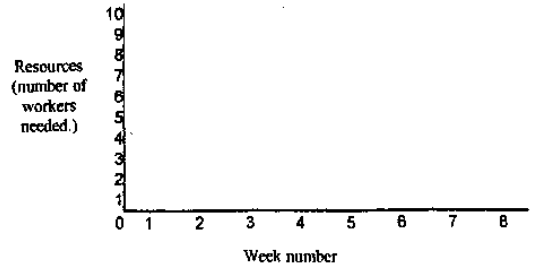


Summary of schedule

Time bar chart report - showing allocation of team - number of workers needed and when.



Total Resources



11

Overcome problems as they arise.

CORRECTIVE ACTION REQUEST Number: 1

Request raised by Shi To: Sam

Department: Cam machining Dept. or Supplier:

Date: Week 1 Copies to: Manufacturing Manager
Quality Assurance Manager
Others: Teacher

Signature: SR

What is wrong (e.g. give details of parts, batch details, not working to procedures etc.)

When I am machining the plastic on the milling machine lumps of plastic are sticking to the cutter and this is burning the surface.

CORRECTIVE ACTION REPLY

From: Teacher To: Shi

The problem is:

The cutter is burning the plastic and it is melting and sticking to it.

Immediate action to correct is:
Stop operation immeadiately.

Signature Sam Date Week 1 Tuesday

Action to prevent this happening again:
Increase the cutter speed and feedrate on the CAM programme.

Signature Sir Date Week 1 Tuesday

CORRECTIVE ACTION

Completed *

Not Completed

Signature Shi Date Week 1 Wednesday

WHEN COMPLETED SEND THIS FORM TO QUALITY ASSURANCE DEPARTMENT

QA DEPARTMENT ONLY

CHECK FOR EFFECTIVENESS Yes * By: Sir

No

Comments:

Plastic is being cut at a much more satisfactory speed - edges are cut to standard.

Signature Sir Date Week 1 Wednesday

12

Overcome problems as they arise.

CORRECTIVE ACTION REQUEST Number: 2

Request raised by Jan To: Shi

Department: Soldering Dept, or Supplier:

Date: Week 4 Copies to: Manufacturing Manager
Quality Assurance Manager
Others: Teacher

Signature: Jan W

What is wrong (e.g. give details of parts, batch details, not working to procedures etc.)

When checking the circuit the LED is not glowing, I have checked that all the components are in place but I cant see the problem.

CORRECTIVE ACTION REPLY

From: Shi To: Jan

The problem is:

The LED has been soldered into position the wrong way around e.g. the positive leg has been soldered into the negative position.

Immediate action to correct is:
Unsolder the LED and relocate in the correct position.

Signature Shi Date Week 4 Tuesday

Action to prevent this happening again:
Check the correct position of LED (+) and negative (-) legs.

Signature Sir Date Week 4 Tuesday

CORRECTIVE ACTION

Completed [*]

Not Completed [ ]

Signature JW Date Week 4 Tuesday

WHEN COMPLETED SEND THIS FORM TO QUALITY ASSURANCE DEPARTMENT

QA DEPARTMENT ONLY

CHECK FOR EFFECTIVENESS Yes [*] By: Sir

No [ ]

Comments:

LED's now in correct location - working fine.

Signature Sir Date Week 4 Tuesday

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Teamwork

Team Organisation

During the preparation, manufacturing and assembly of the project my team has to work together and it is important that people carry out a variety of different tasks in order for the egg timer to be produced efficiently.

TEAMWORK - Allocating tasks.

Team members - **1. Ali. B** **2. Sam L**

3. Jan W **4. Shi R**

5. **6.**

Preparation of Materials.
Ali and Shi will get out High Impact Polystyrene, mark it out and cut it to the required size. They will also look after the glue polystyrene cement, for the assembly process.
Jan and Sam will prepare the material for the PCB, they will down load copies of the circuit diagram and transfer it onto acetate sheet.

Preparation of Components.
Jan and Sam will identify what electronic components (including wire and solder) are needed for the circuit and will get the correct amount of these out of the electronics cupboard.

Equipment set up.
Ali and Shi will download the CAD work and set up the CAM. Checking with the teacher that the correct cutter is in place and that machine depths and cutting speeds have been set correctly. They will also set up the strip heater and have correct jigs, formers and templates available.
Jan and Sam will get out and set up the UV box, developing tray, and bubble etch tank, PCB drill and soldering equipment.

Tool organisation.
Ali and Shi will check the size of cutter needed for the CAM process.
Jan and Sam will need to load the 1 mm drill into the PCB, set up soldering station - soldering irons and stands, sponge, solder, wire cutters and strippers.

Quality Assurance.
When parts are made or circuits are built and assembled they should be checked by members from the opposite working group to try and identify faults. Therefore Ali and Shi will check all electronics work and Jan and Sam will check the quality of all the plastics work.

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Teamwork

What do I think is important in a good team ?

A good team needs to communicate with each other . They need to share ideas with each other and not be offended when others don't agree with or do not like their ideas.
The individual members need to be reliable and be good timekeepers, they should attend school regularly.
When carrying out tasks they should always try to produce their best. They should support each other and if one member is having a problem with a particular task or process then other members should support that person showing them ways to carry out the task or helping them with it. If one member of the team is behind with their work schedule and another is up to date it may be better if they pool their resources and work together to get everyone back on schedule and allow the work to progress as planned..

Review of Group

Key - A = Excellent F = Poor

NAME	Attendance	Punctuality	Contribution	STRENGTHS	WEAKNESSES
Ali B.	B	A	B.	Keeps everyone going N fun to be N the	Missed one or two lessons.
Sam. L.	A	A	D	Excellent with soldering tasks. Understands how the circuit works and is good at troubleshooting.	Didn't contribute to group meetings
Jan. W.	A	A	A	Understands how to make the unit and likes to help everyone.	Wants to lead the group and will not listen to others.

How does team communicate and overcome problems as they arise?

Meet at the beginning of each lesson to discuss ideas and give an update of progress.
For problems group uses prepared sheets - CORRECTIVE ACTION REQUEST.

How does team carry out quality control tasks?

Group is divided into two teams - TEAM A + TEAM B. Team A check work done by Team B and vice versa.

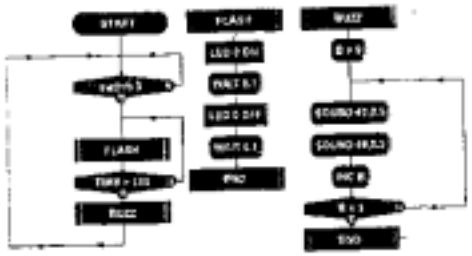
IMPROVING THE PRODUCTION SYSTEM

Organisation of the team.

It would be a far more efficient team if all members of the team were trained to carry out each others tasks. This would lead to a multi skilled workforce. Such a team would be able to cover for each other in times of absence from school or they would be able to assist team members if they got behind with their work schedule.

Buying in prepared components and parts.

Using a Programmed Integrated Circuit chip rather than building up complicated circuit boards would speed up the process and could improve the quality and reliability of the final product. A suitable programme that will time for 3 minutes, and built using PIC Logicator is shown below. This programme can be downloaded and burnt onto a chip very easily.



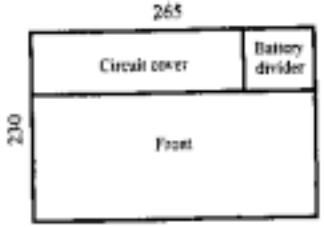
Buy in cover units that have been moulded to fit the back of the egg timer rather than fabricating and gluing extra pieces into position. Such units would enhance the appearance of the unit and protect the working parts of it much better.

Costing sheet

Supplier	Item	Size	Quantity	Price each	Cost	Price each per 100	Cost per 100
Hindleys ltd.	Yellow High Impact Polystyrene	265x230x2	1	£ 1.75	£ 1.75	£ 0.45	£ 45.00
Hindleys Ltd.	Polystyrene Cement		1	£ 1.00	£ 1.00	£ 0.05	£ 5.00
JPR Electronics Ltd.	Photo resist coated boards	75x50	1	£ 1.70	£ 1.70	£ 0.35	£ 35.10
JPR Electronics Ltd.	Push switch		1	£ 0.28	£ 0.28	£ 0.19	£ 19.00
JPR Electronics Ltd.	Red LED		1	£ 0.07	£ 0.07	£ 0.05	£ 5.00
JPR Electronics Ltd.	Green LED		1	£ 0.08	£ 0.08	£ 0.05	£ 5.00
JPR Electronics Ltd.	100uF Electrolytic Capacitor		2	£ 0.07	£ 0.14	£ 0.04	£ 4.00
JPR Electronics Ltd.	330 ohms resistor		2	£ 0.01	£ 0.02	£ 0.01	£ 0.95
JPR Electronics Ltd.	10K ohms resistor		1	£ 0.01	£ 0.01	£ 0.01	£ 0.95
JPR Electronics Ltd.	500K ohms resistor		1	£ 0.01	£ 0.01	£ 0.01	£ 0.95
JPR Electronics Ltd.	1M variable resistor		1	£ 0.10	£ 0.10	£ 0.07	£ 7.00
JPR Electronics Ltd.	IC 555 Timer		1	£ 0.22	£ 0.22	£ 0.13	£ 13.00
JPR Electronics Ltd.	IC Holder 8 pin		1	£ 0.04	£ 0.04	£ 0.03	£ 3.00
JPR Electronics Ltd.	Battery Snap		1	£ 0.06	£ 0.06	£ 0.04	£ 4.00
JPR Electronics Ltd.	PP3 Battery		1	£ 0.44	£ 0.44	£ 0.29	£ 29.00
					Total	£ 3.92	Total	£176.95
							Cost per unit	£ 1.77

The individual price shown in the table for the purchase of polystyrene and photo resist boards is based upon the smallest sheet size available to produce the item. The price per 100 items is based upon the purchase of larger sized sheets in order to make the stated quantity.

Size of blank for plastic unit



Size of blank for circuit board

The costing sheet shows that it will cost £5.92 for each unit when they are manufactured individually. This price does not take into account any overheads that might need to be paid such as heating, lighting or power costs. The cost of setting up the production line and the buying of machines, tools and items to carry out the manufacture of the electronic circuit boards has also been ignored. However these items will all be divided out according to how many products are produced if one item is made then it will have all the costs added to it but if more items are made then the cost will be divided by the amount made.
The table above shows individual cost of units and how the cost will be reduced by purchasing items in amounts of 100 pieces. Even by manufacturing 100 egg timers it can be seen that individual unit costs are reduced to £1.77.

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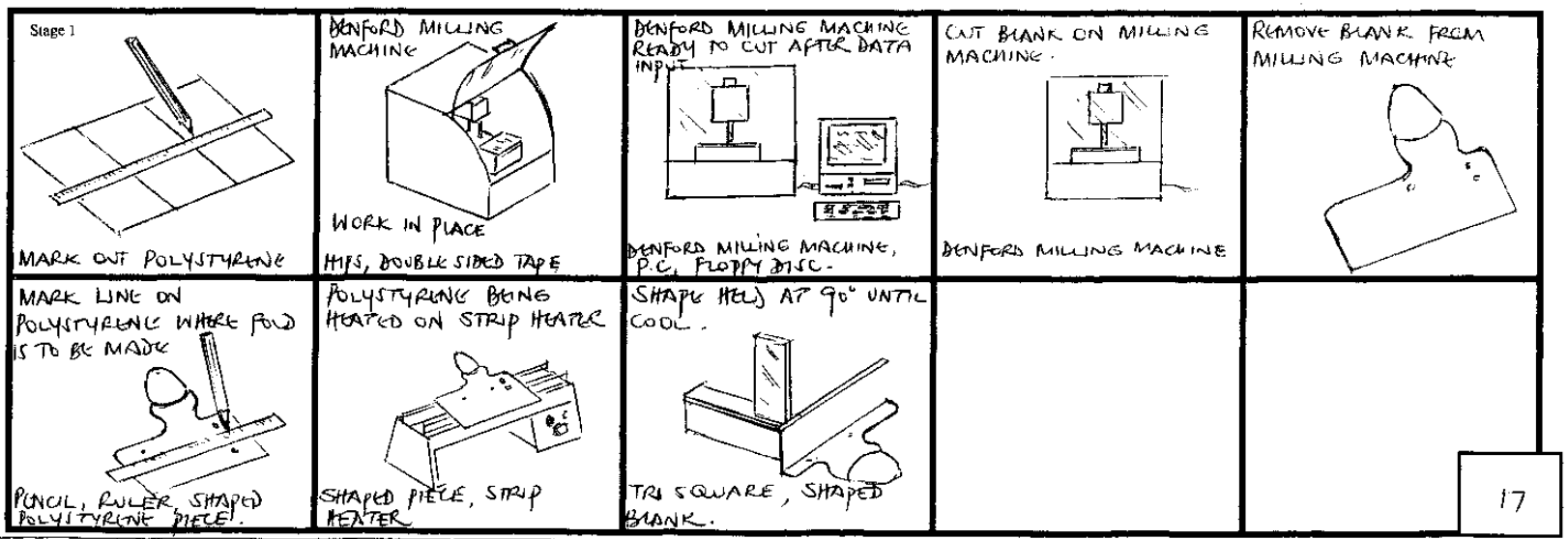
MAIN PROJECT - EGG TIMER

PLAN OF MAKING PART - a) Main plastic unit,

TASK	SUB TASK	HEALTH & SAFETY
Cut out blank	Take a sheet of High Impact Polystyrene from the store cupboard.	Care with lifting heavy items.
	Mark out the size required—225 x 115 mms.	Care using hand tools.
	Cut blank out to required size.	Care using hand tools.
Load material on Milling machine	Open up Denford Milling machine.	
	Put double sided tape onto plastic sheet.	Keep sharp edge of milling tool
	Put plastic sheet on bed of milling machine.	away from hand.
	Set tool data on machine.	
Cutting shape	Start machine.	Use of safety screen.
	Allow time to cut blank.	
	Remove blank from machine.	Beware sharp cutting tool.
Forming shape	Mark line where bend is to be on blank.	Care using hand tools.
	Switch strip heater on and fold material.	Keep fingers away from heater.
	Remove plastic from heat and hold in position until cool.	Hold well away from hot fold.

PROCESS SHEET to show stages to be carried out



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WORK PROGRESS — MAKING MAIN UNIT FOR EGG TIMER.

DATE	WORK CARRIED OUT	TOOLS, MACHINES, PROCESSES.	REPORT (changes, problems etc.)
Week 1.	CUT OUT BLANK, FOR EGG TIMER BODY	BANDSAW.	
	PUT BLANK ONTO BED OF MILLING MACHINE	MILLING MACHINE, DOUBLE SIDED TAPE.	
	CUT OUT BLANK.		
	REMOVE BLANK FROM MACHINE AND SMOOTH EDGES, AND AREA AROUND HOLES.	SCRAPER, GLASSPAPER. SANDING DISC.	CHECK SIZE OF HOLES - SEE IF COMPONENTS FIT IN CORRECTLY - ADJUST PRE DRILLED HOLES SO THAT THEY FIT.
Week 2.	MARK OUT LINE TO BE FOLDED ON BODY OF EGG TIMER.	PENCIL, RULER.	
	HOLD BLANK OVER STRIP HEATER.	STRIP HEATER.	
	HEAT TO REQUIRED TEMPERATURE.		
	FOLD TO REQUIRED ANGLE, HOLD UNTIL COOL.	TRI SQUARE.	
Week 3.	CUT OUT BLANK FOR BATTERY BOX COVER.	BANDSAW	
	MARK OUT FOLD LINES ON COVER.	RULER, TRI SQUARE	
	FOLD COVER ON STRIP HEATER - HEAT TO REQUIRED TEMPERATURE	STRIP HEATER	
	MAKE FIRST BEND - HOLD IN POSITION UNTIL COOL.	TRI SQUARE	
	REPEAT FOLDING PROCESS ON SECOND SIDE.	STRIP HEATER TRI SQUARE	SAND EDGES OF BATTERY COVER SO THAT THEY ARE FLAT AND SMOOTH. POSSIBLY ROUND EDGES FOR SAFETY.
Week 4.	ASSEMBLE UNIT - EGG TIMER BODY + CIRCUIT BOARD IN PLACE.		
	GLUE COVER IN POSITION.		CHECK FUNCTION OF TIMER.

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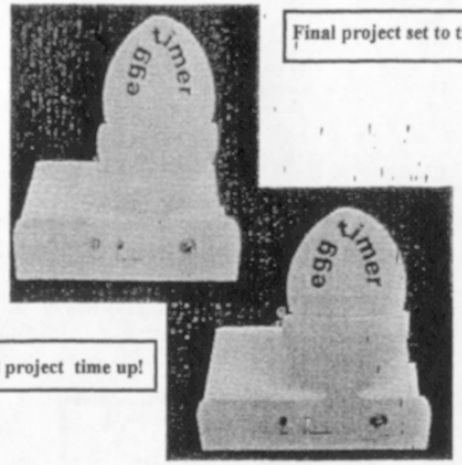
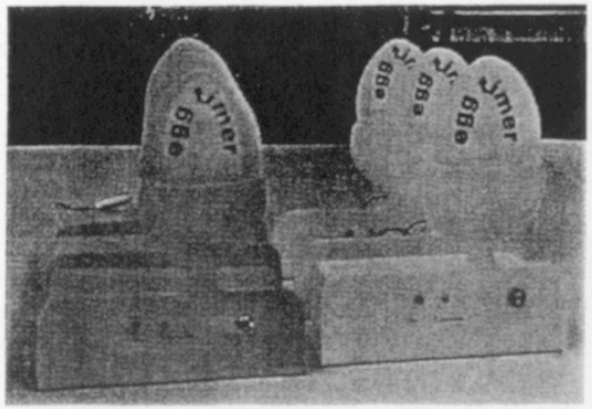


Final project set to time.

Final project time up!



A batch of egg timers.

EVALUATION OF MANUFACTURED PRODUCT

I am pleased with the way that the egg timer has turned out. My group worked well together and we managed to produce a batch of egg timers as we had identified at the beginning of the project. I think that the egg timers will be popular with people.

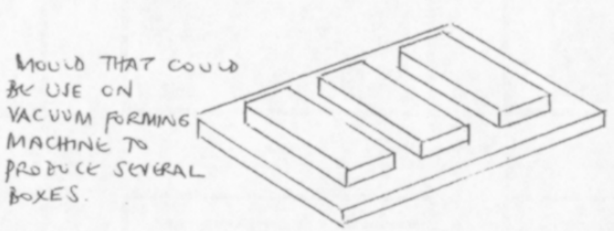
We have checked that the timers function as expected as we have switched they on and tested how long they take to switch from one LED to another. The red LED glows when the timer is switched on and after timing them against a watch it was seen that the red LED went out and green LED came on after 3 minutes. This was the target time and the units did work as planned.

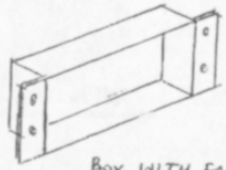
I like the image that is used on the front of the timer as the egg and egg cup design fit in well with the theme of the project.

The LED's are in a good position at the front of the unit as it is easy to see that the unit is in operation and when the time is up. Likewise the switch is easy to see and use.

I think that the unit could be improved in a number of ways -

- Rather than constructing separate units to divide the battery from the main circuit and then to add a cover over the top of these pieces it may be beneficial to use a former a mould a complete cover. The reason for this is that with the separate items used on my project you can still see the circuit board and can touch the pieces which could damage them and stop the unit from working correctly.





BOX WITH FLAPS FOR LOCATING ONTO BACK OF UNIT.

- A potentiometer could be positioned on the front of the unit so that it could be adjusted and used to set the unit to different times in order to produce soft boiled eggs and hard boiled eggs.
- A PIC could be used instead of the designed circuit. In doing so there would be a reduction in the amount and cost of components used. The PIC could be programmed for a variety of different times and this would increase the use of the timer.
- A different method should be used for the labels that are glued onto the front of the unit as they are coming off far too easily, it may be necessary to use sticky backed plastic with the information printed onto it.

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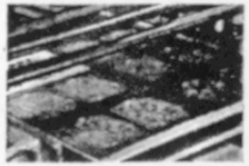
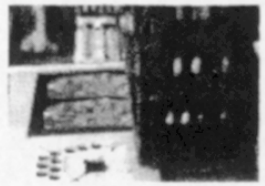
Manufacturing the electronic circuits in Industry.

PCB's being produced as a group.



PCB's showing location for components.

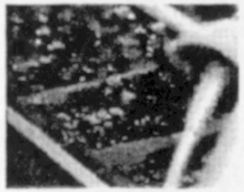


Holes drilled into the board.

Fitting the components in position.

Fitting the components in position.

Fitting the components in position.



Soldering the components in position.

Assembly systems used in Industry.

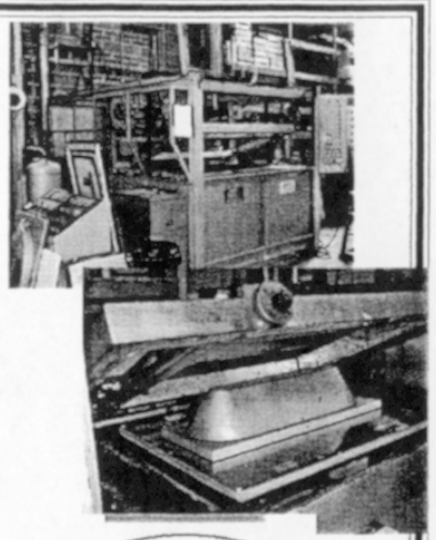
The parts produced that make up the egg timer would be assembled in industry using an assembly line, where different people carry out a variety of different tasks adding parts to the unit as it passes from one person to the next until it is complete and ready to be distributed to the shops.

Assembling the product

Manufacturing the Egg Timer in a "Real world" situation

It would be more likely that if the Egg Timers were produced commercially they would be produced in much greater numbers either as batch production or even mass produced in order to make them more cost efficient.
There is also a possibility that the basic design of the packaging would be changed to make the product much more robust and capable to withstand the various situations that it would be placed in.
Similarly the circuit would be reviewed and some components would be replaced with the introduction of IC's and maybe sound outputs rather than using the LED's. Such changes would increase efficiency of the circuit as they are less components to solder and to check or fail in use. It would also bring down the component costs and may reduce the selling price of the artefact.

Manufacturing the plastic packaging in Industry.

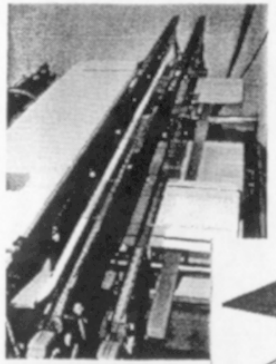


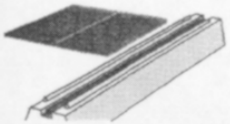
Depending upon the final selected design of the packaging a variety of forming processes could be used in industry to manufacture the main area.
Including:
Vacuum forming

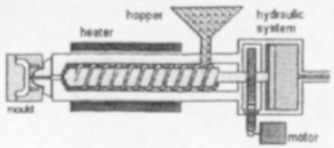
Injection moulding

Line bending

However not all of the package could be made this way as some form of fabrication would be needed as extra pieces would have to be added including a cover that can be removed to replace the power source, possibly a battery.







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