Introduction

The new syllabuses in 14 – 16 Design and Technology present two main challenges for teachers. The first is to ensure that the needs of the whole year group are met. The second is to meet the requirement that pupils must consider the relevance of their designs to industrial production.

Inside Industry

At GCSE and Standard Grade, it is no longer enough for pupils simply to make what they have designed. To achieve a good grade they will need to be able to explain how their product could be manufactured in quantity. The **Design and Make It!** television programmes aim to support teachers in this new challenge. By taking pupils 'inside industry' they present a stimulating view of Design and Technology. Professional designers and technologists describe how their product design is influenced by the constraints of the manufacturing process. The application of computer-aided design and computer-aided manufacture (CAD-CAM) is given particular emphasis as various products are followed through their stages of creation.

This Teachers' Guide is intended to help in the process of enabling pupils to learn about industrial production methods and to apply them to their own project work. A special feature is the inclusion of a number of simulations which can be used as focused practical tasks. The programme notes will also help pupils to put the programme content in the context of their own experience and their coursework.

For each programme there is a general introduction, followed by a summary of the three sequences which make up each programme. Learning objectives and the key vocabulary and concepts covered are then listed. In the 'While watching' sections, each of the three television sequences is presented separately, with questions which can be posed to pupils to help them engage with the content. A further set of highly focused questions are also provided: pupils can be told to listen out for the answers to them while watching. The 'After watching' sections invite pupils to answer the questions previously posed and to consider how the content and issues raised in the sequence might apply to their current on-going coursework projects. At this point pupils might also be directed to undertake in groups the short, focused simulation tasks which follow. Teachers should suggest that pupils identify similar issues in the mass-production of their own products. Finally, suggestions are made for a number of design and make assignments which pupils might undertake as final coursework projects.

Pages 22–3 contain guidance on how the television programmes and Teachers' Guide can be linked with the *DESIGN & MAKE IT!* textbooks (published by Stanley Thornes).

CONTENTS

Food Technology

Not that long ago most of the food we ate was produced locally. There wasn't a lot of choice: many items were only available at certain times of the year, and didn't keep fresh for very long. Modern food technology has changed all of this.

Introduction

Today we can buy produce from around the world, all year round, and, thanks to packaging, preservatives and refrigeration, keep it for months. Food technologists are not just good cooks. They need to be able to identify exactly what food products people want, where and when they want to be able to buy, prepare and eat them, whether they can be produced and sold at a price the customer might be willing to pay, and how many to produce over what period of time.

Programme outline

The programme has three main sections:

- Designs Behind Bars (chocolate manufacture)
- Designer Meat
- The Big Chill (cook-chill products)

The first sequence takes us into the Cadbury's chocolate factory, where we see chocolate being piped, poured, moulded and mixed with other ingredients to make a considerable quantity of a range of familiar products. The design of the Wispa bar is followed in detail, with reference to production line control and automation.

We don't usually think of meat as being 'designed', but somehow meat producers need to be able to provide a range of products that are lean, fresh, hygienically prepared, last a reasonable time and are competitively priced: these product qualities don't just happen by chance, but by careful decision-making and production-planning. We see meat in carcass form being hung, weighed and analysed for consistency of structure and colour **(N.B. some pupils may find these shots upsetting)**. Testing procedures involve cooking and eating, and computer analysis of the data.

Finally, in the supermarket the consumer is able to choose the cut, amount of further preparation, the method of cooking, and the price that suits their lifestyle. Not everyone has the time or ability to prepare and cook a complicated dish, and a growing range of 'cook-chill' meals are being produced. In the final sequence we discover how the Somerfields supermarket chain develops a new vegetable lasagne. In their test kitchen they analyse rival products for taste, appearance and texture, and from this develop their own specification. In terms of production, achieving the correct portion size, quantity of ingredients and accurate temperature control are all essential.

Learning outcomes

Pupils should gain an understanding of:

- how a basic food product can be produced in a variety of forms
- the complexity and sophistication of automated food production
- how meat is 'designed'
- sensory testing
- food product disassembly
- the importance of health and safety requirements in food production, including temperature control

Key vocabulary & concepts

- Microbiological contamination
- Quality control
- Automation
- Shelf-life
- Constituent parts
- Protein
- Cook-chill
- Pasteurisation
- Conveyor cauldron
- Protein control
- High-risk assembly

While watching

Initially the programme should be watched straight through as a general introduction to the subject. Specific sections should then be shown again during the course, as and when they become appropriate to on-going project work.

Pages 22–3 show how this programme links with the *DESIGN & MAKE IT! Food Technology* textbook.

Here are some questions for students to think about in conjunction with the programme.

'Designs Behind Bars'

Before watching, think for a moment about your favourite chocolate bar. What words would you use to describe its texture? How do you think it is made in the chocolate factory?

While watching:

- What are the basic ingredients of chocolate?
- How do the properties of chocolate affect its design and production?
- What are the main stages of production of a Wispa bar?

'Designer Meat'

Before watching, think how 'natural' the meat, fruit and vegetables are that we buy. In what ways do you think they might have been 'designed', for example selected, treated, prepared, etc?

While watching:

- What are the constituent parts of meat?
- What quality control tests can you apply to meat products?
- Why and how are meat products tested and analysed?

'The Big Chill'

Before watching, recall a ready-prepared pre-chilled meal you have had recently. How many different types of this sort of meal can you think of? Why do you think temperature control is so important during production?

While watching:

- How would you define a 'cook-chill' meal?
- Why is portion control important in food production?
- What precautions need to be taken to help avoid food contamination?

After watching

1. Where possible, produce a series of labelled, coloured diagrams to illustrate your answers to the questions posed above.
2. Apply the following questions to your current coursework project:
   - What are the basic ingredients of your food product? In what other ways could they be processed by the manufacturer to produce a wider range of products?
   - What methods of sensory evaluation could you use to evaluate your recipe?
   - What precautions do you need to take to minimise the risk of contamination?
3. Undertake the production and quality control simulation exercise on the next page.

Design and make projects

Healthy breakfasts

A national chain of hotels wishes to offer and promote an appetising 'healthy breakfast' menu option. Prepare a suitable and imaginative menu. Discuss the implications of providing a higher proportion of fresh foods on a daily basis. Produce costings to show that the healthy breakfast will not always be more expensive to prepare than a traditional cooked English breakfast.

Make a sample 'healthy breakfast'.

Special occasion picnics

A local business produces unusual picnics to order for special events and occasions. They are considering developing a menu based on traditional ingredients and dishes from non-UK countries. Develop ideas for such a picnic box suitable for four people to share. As well as the food items, think about the way in which they will be presented (for example, the garnish or decoration).

The food items must be easy for the company to prepare the day and/or morning before, and must not deteriorate in the box. Suggest some suitable ways to package your picnic ideas. Provide costings of the ingredients for each box based on orders of one, ten and 50 boxes at a time.

Make a sample picnic box for four.

Sports refreshments

Devise a refreshments menu for a visiting sports team to your school. Conduct a survey to discover the range of items offered at other schools in your area, and what people like best. You will also need to consider the size of portions and the numbers required.

Produce a presentation to an outside caterer to show the viability of supplying local schools with ready-made refreshments. You will need to include details of demand, food items, facilities in schools, and costs.

Make a sample of the refreshments that could be served at a specific sporting event.

Production process simulation

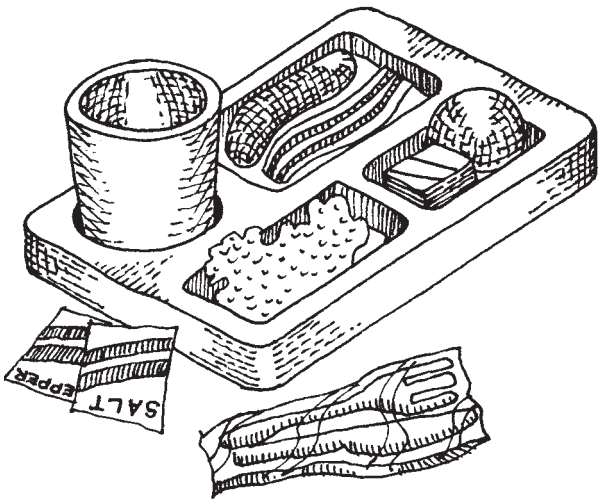
A local food manufacturer needs to produce portions of coleslaw for pre-packed airline meals. Your have been asked to recommend the most efficient way of organising the production. You should work in groups of four.

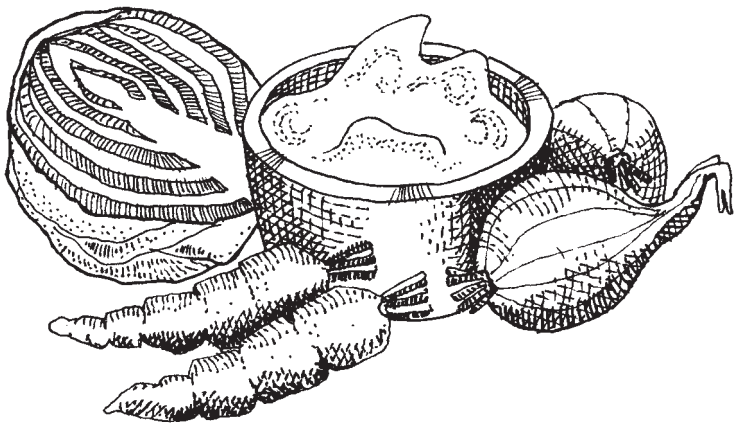
Product specification

- Each batch of coleslaw is to made from 300g cabbage, 150g carrots, 90g onions and 150ml of mayonnaise.
- The batch is to be divided into 50 portions which each weigh exactly 20g.

The aim of the task is to identify the quickest way of making 50 portions of the correct weight, within a tolerance of plus or minus 5g.

The team which achieves the best results will be awarded the contract!





Developing the production sequence

Work through the following stages:

1 Devise a flow-process chart (for symbols, see page 5) which identifies the various main stages in:

- organising the work space (i.e. where food and cutting and weighing utensils will be placed for easy access)
- preparing the food (for example, making sure there is a steady supply of washed and cut ingredients ready to use when required)
- mixing the ingredients into one large container
- dividing the mixture into 50 portions
- checking the accuracy of the portions

2 To begin with, just one of you should go through the whole process from start to finish, with the other members of the team timing how long each stage takes and thinking about how it might be possible to organise the production line more effectively.

3 Next, focus on each separate stage of production and consider how the work might be divided up between two or more people. Some possibilities are:

- each person works in line, passing on a partly completed ingredient to the next person
- on some stages, two people work together
- some people may have more than one job at different stages of the production process
- Draw a production line flow-diagram.

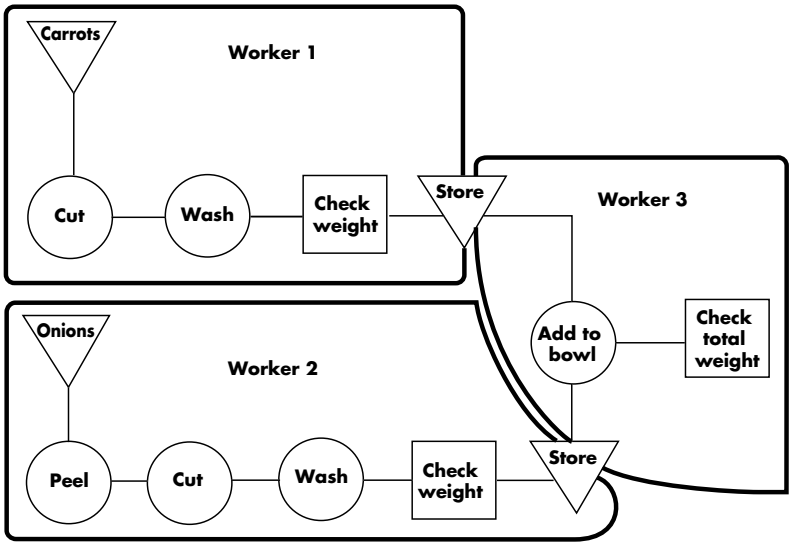
4 You will need to keep a check on the accuracy of portion size – dropping below 15g will result in hungry passengers, giving them more than 25g will increase the costs for the airline!

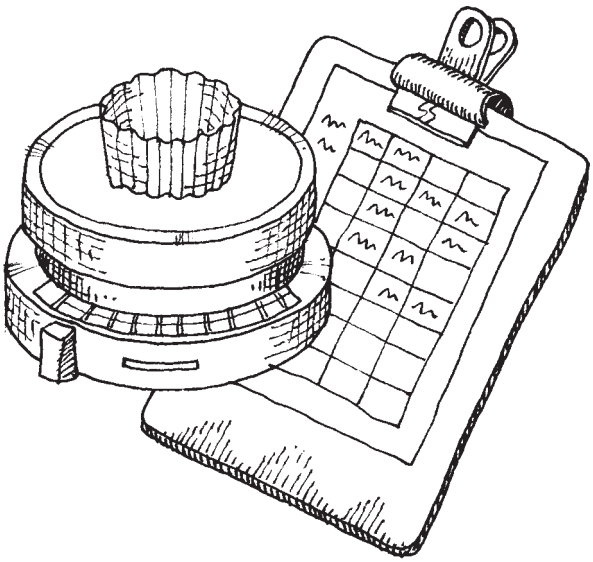
- How many of the portions will you check for weight?
- When will you check them?
- How will you check them?
- If they are outside the tolerance limits, what will you do?

5 It is also important to design the most efficient organisation of the workspace – i.e. where ingredients and workers will be best placed to minimise delays in moving partly completed products around. Additionally, storage space and location must be considered.

6 Experiment with a variety of production layouts and scheduling until the most effective arrangement is identified. To achieve this, you will need to work closely together and co-operate well. Group discussion and decision-making meetings are essential. At these sessions you might like to consider taking on specific roles of responsibility for various aspects of the process, for example stock control, quality control, work-flow, etc.

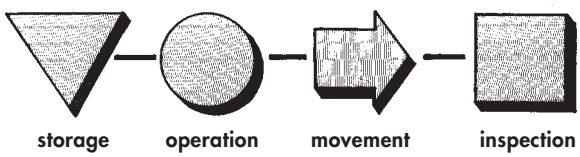
▶ Agree and organise the final layout and obtain the necessary stock of food ingredients to prepare for the final test simulation run.





The design and development of the production process to this point should not be included in the timing of the final simulation.

7 Run your production process simulation. Time how long it takes. Measure each final portion to identify how many have fallen outside the tolerance limit, i.e. are less than 15g or more than 25g.



Design and make it better!

Whether your production design turns out to be the most efficient at the end of the production run is not the end of the exercise, however. The next question is how can it be improved, either to build on your initial success, or to catch up with your competitors in the airline meals market?

- How could you improve the accuracy of the portion size?
- Would adding extra members to the team make a worthwhile difference to the production-rate?
- If a much longer production-run (for example, batches of 500) was planned, how would the schedule and layout need to be developed?
- What parts of the process could be automated most effectively?
- How could the basic recipe be changed to make a more appetising coleslaw?
- How would including more ingredients affect the production schedule and the cost of each coleslaw portion?
- Write up a report of the project, including graphs, charts and diagrams to illustrate the different production layouts and schedules used.

Resistant Materials

Resistant Materials technology is concerned with the world of 3D product design, from jewellery to jumbo jets and hair-dryers to high-chairs. The role of the product designer is to create objects that not only do the job for which they are intended, but also give a sense of pleasure and satisfaction to the people who use them. To achieve this, designers need to know why people need and want the things they do, and how material and manufacturing technologies might be able to provide them.

Programme outline

The programme has three main sections:

- The Good Body Guide (car-body design and manufacture)
- The Tree, the Computer and the Wardrobe (flat-pack furniture)
- Heavy Metal (musical instruments made from metals)

In the first section, we visit the TVR car-production factory in Blackpool. Unlike the major manufacturers, TVR produce around 22 hand-made, high-performance sports cars a week. Designer, Damian MacTaggart explains how he designs car bodies with simple hand tools and polystyrene foam. The process of building up layers of glass-fibre and liquid resin in a series of moulds to make the body shell is demonstrated. The need for health and safety at work is emphasised.

Christies are a luxury fitted furniture company. They specialise in producing one-off, made-to-measure bedrooms, bathrooms, home offices and kitchens. By using a sophisticated CAD-CAM system they are able to design, make and deliver furniture and fittings individually for each customer within two weeks. In the programme we see high-density fibreboard (HDF) being made, and then follow the story from a client placing an order, through design, manufacture, and finally to installation in the home.

The third section looks at the making of brass musical instruments. Boosey and Hawkes were formed in the 1930s with the merger of two companies: Boosey & Co and Hawkes & Son. As well as the brass instruments they make in their Edgware factory, they make woodwind and stringed instruments. The sequence reflects the company's aim to fuse traditional methods of manufacture with the innovations of modern technology. It shows how they use a variety of hand and computer-controlled production processes and quality control systems to produce products which sound and look right.

Learning outcomes

Pupils should gain an understanding of the use of:

- composite materials
- moulding processes
- the working properties of woods, metals and plastics
- various methods used in the mass-production of products made from woods, metals and plastics
- CAD-CAM alongside traditional manufacturing processes

Key vocabulary & concepts

- Composite materials
- Glass-fibre mat
- Medium- and high-density fibreboard (MDF and HDF)
- Customised automation
- Computer numerical control (CNC)
- Optical templates
- Fine tolerances
- Crimping

While watching

Initially the programme should be watched straight through as a general introduction to the subject. Specific sections should then be shown again during the course, as and when they become appropriate to on-going project work.

Page 22 shows how this programme links with the *DESIGN & MAKE IT! Resistant Materials* textbook.

Here are some questions for students to think about in conjunction with the programme.

'The Good Body Guide'

Before watching, consider the process of making something in a mould. Have you ever made a jelly? What other products are made using moulds? Which materials lend themselves to being moulded? How many different moulding processes can you think of?

While watching:

- What are the advantages and disadvantages of using computer-aided design? Identify one of each.
- What is the main sequence of operation involved in making a glass-fibre car body?
- What health hazards are there when working with glass-fibre and spray finishes?
- What safety precautions do workers need to take?

'The Tree, the Computer and the Wardrobe'

Before watching, recall an occasion on which you helped assemble an item of flat-pack furniture. From what materials were the different parts made? What fittings and fixtures were used? How easy was it to put together?

While watching:

- What is the main sequence of manufacture of high-density fibreboard?
- What does 'customised automation' mean?
- How is a CNC routing machine used in modern furniture production?

'Heavy Metal'

Before watching, think whether you have you ever tried playing a brass musical instrument. Why are brass instruments coiled? How do you think a bell-shape is made?

While watching:

- What are the main raw materials used in the production of brass musical instruments?
- How is the long tube of an instrument bent in the factory?
- Why is red brass used for bell-making?

After watching

1 Where possible, produce a series of labelled, coloured sketches to illustrate your answers to the questions posed above.

2 Apply the following questions to your current coursework project:

- If your final design were going to be mass-produced, how might a moulding process be used to increase speed and reduce costs? Which one would be most appropriate?
- How difficult would it be to allow a customer to customise the design?
- Could your product be partly self-assembled by the end-user?
- How could you use computer-aided design?

3 Undertake the costing simulation exercise on the next page.

Design and make projects

On your bike

Study current bicycle accessories, for example mirrors, carrying devices, stands, etc. How might they be improved? Consider using different materials and/or production processes, replacing mechanical parts with electronic systems, adding extra features, improving fixings and fastenings, etc.

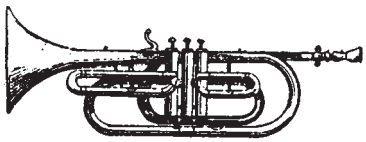
Develop design ideas for a new accessory which has strong visual appeal. Make a final product model and test it. How would you manufacture 10,000 units?

A chair for a child

A furniture manufacturer has identified a market for a high-quality multi-purpose chair for children between the ages of 4 and 7. To justify the selling price, the design must look distinctive and appeal to a child. Design and make a suitable chair, and test it out for its size, stability, versatility and visual appeal. If 100 were to be made, what jigs and templates would aid batch-production? What stages might be automated for accuracy and speed? Which stages would benefit from being hand-crafted for quality of finish?

Sound sculptures

An arts centre is planning an exhibition to interest children in music. They have commissioned you to make a sound sculpture for them. They want to include a number of 'sound sculptures' – original instruments which make interesting and unexpected noises and look big, bold and colourful. If the exhibition is successful they plan to make copies of the most popular sound sculptures available to primary schools across the country. Explain how 20 copies might be made, and approximately how much they would cost to produce.

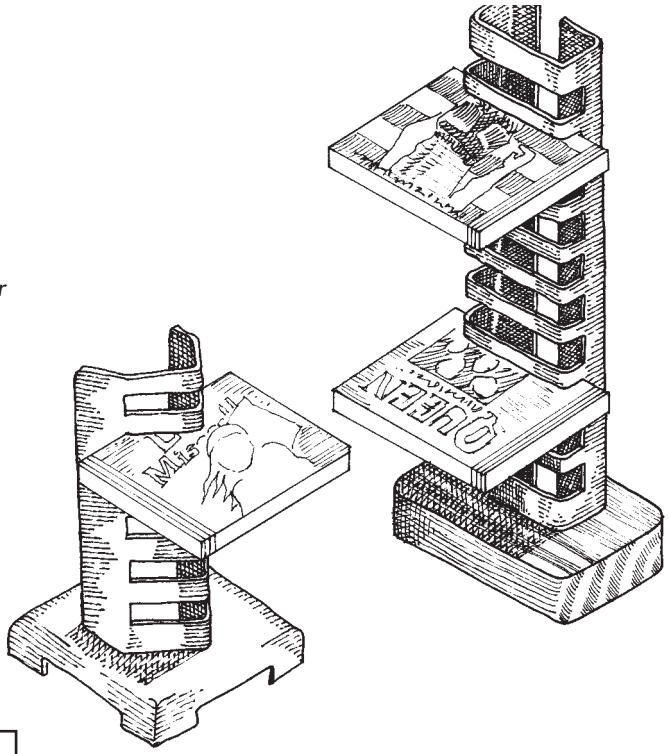


Costing simulation

'Make them cheap and stack them high'

A manufacturer is planning to produce a CD storage unit. To make the operation worthwhile they need to be confident of making at least £20,000 profit. How many should they make? What quality of materials should be used?

Work in a team of four to help advise the manufacturer on the best specification.



Production costs

The manufacturer has already asked a designer to produce a basic design for a CD rack. There are two main components: a base and a central column with slots in. Both components can be made in different materials.

The production costs are as follows:

Base	**10 units**	**1,000 units**	**100,000 units**
Wood or Metal	£100	£4,000	£250,000
Plastic	£20	£1,500	£30,000
Column			
30 slot height metal	£200	£8,000	£500,000
10 slot height plastic	£40	£3,000	£70,000

Using these figures, it is possible to calculate, for example, that making 100,000 units with plastic bases and columns would cost £100,000 (£30,000 plus £70,000). Therefore each unit would cost £1 to make (£100,000 divided by 100,000). Meanwhile making 10 units in non-plastic would cost £300 (£100 plus £200), so each unit would cost £30 to make.

Using the same method, it is also possible to calculate the production costs of combining the two components in different materials (for example, a wooden base with a plastic column) at different length production runs.

Calculating the selling price

By the time additional costs have been added on (for example, packaging, transport, retailer's mark-up, VAT, etc), the minimum selling price will need to be twice the production cost. A further 10% then needs to be added to this figure to provide the company with a profit margin. So the most expensive unit will sell for £66 (£30 + £30 + £6), and the cheapest for £2.20 (£1 + £1 + 20p).

The company are confident that people will be prepared to pay these prices. They anticipate that less people will want the very expensive CD racks (though they make more money on these), but also that most people will probably want something better than the cheapest unit.

However, the company is in competition with one other well-established major manufacturer of similar units. This means that:

- their low-cost products must be cheaper than those of their competitor, and
- their high-cost products must be of a significantly better quality than those of their competitor.

The bottom line

If the manufacturer fails to sell more than a certain number of products (known as the 'bottom line'), then production costs may not be covered, and a loss will be made.

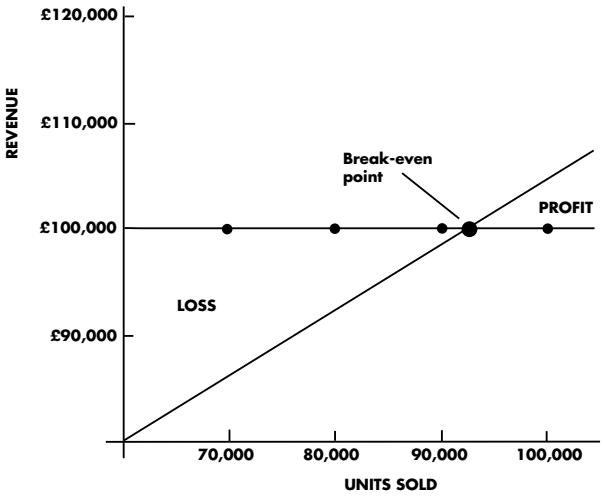
Write down:

- the total cost of production (i.e. do not include add-on costs or profit) of all units, (for example, £100,000 for 100,000 of the cheapest unit)
- the total amount received by the manufacturer for each item sold (i.e. the production cost, plus 10% profit), (for example, £1.10 for the cheapest unit)
- how many need to be sold to enable the production costs to be covered (for example, £100,000 divided by £1.10 = 90,909)

Do you think the manufacturer is likely to make a profit of at least £20,000? Or is there a high risk of making a loss, 'breaking even' or only making a very small profit? If so, you will need to consider advising one or more of the following alternatives:

- increase or decrease the number to be made – remember this will affect the cost of manufacture: the more that are made, the cheaper each will be
- increase the final selling price (and thus the profit) – this means that less need to be sold to break even, but the higher price may reduce sales
- decrease the selling price – this probably means more units will be sold, but more have to be sold to reach the break-even price
- reduce the cost of production by using cheaper materials, reducing quality checks and specifications, providing less options/features – but remember these will reduce the quality of your product, and fewer people may want to buy them unless you reduce the selling price as well
- increase the cost of production to provide a more desirable product – a smaller number of people will pay a great deal more for an unusual, high-quality product

Setting up a spreadsheet will help you explore more possibilities much more quickly.



As a group you will need to produce a series of recommendations. Specify:

- the range of types of unit the company should make
- the production cost of each type of unit
- the selling price of each type of unit
- how many of each type of unit to make
- the total profit if all the units made are sold
- the total profit or loss made if only half the number of units made are sold.
- the number of units which need to be sold to ensure the manufacturing costs are covered

Final presentation

- Should the manufacturer concentrate on selling a smaller number of a higher-quality product, and/or a larger number of a cheaper model?
- How much risk is the manufacturer taking?
- What potential profit might be made?
- Remember there are no right or wrong answers to all these questions! What's needed most is a convincing presentation.

Illustrate all your recommendations:

- verbally, either by preparing a short written report or by doing a short group presentation using a flip-chart
- visually using sketches, diagrams, graphs and charts

Compare your suggestions with those made by other groups.

Textiles Technology

The enormous range of clothes we wear and the extraordinary variety of furnishings and fittings from which we can choose for our homes and places of work have made the textiles industry one of the largest in the country.

Introduction

Textile technology is more than choosing colours, textures and patterns that work well together. Textile designers also need to take into account the production properties and characteristics of the materials and the manufacturing processes by which textile products are made in quantity. These days new composite materials and automated production technologies play a considerable role in textile design and manufacture.

Programme outline

The programme has three main sections:

- Virtual Fashion (summer dresses)
- Cover Story (fabrics for furniture)
- A Cast of Costumes (theatrical costumes)

The first section follows the progress of a range of summer dresses from the initial briefing with the designer through costing, the production of a sample garment, pattern making, and fabric cutting to machining. Emphasis is given to the use of CAD and automated production processes in speeding up the time from design to delivery to the high street store.

'Andrew Martin International' print fabrics for furniture. Fabric designer Amy Wells takes us through the process of developing a design with regard to how the fabric will be printed, fixed and finished, as this will affect its final appearance. The skill of the pattern cutter is essential to ensure the fabric is accurately prepared and fitted.

The theatrical costumiers 'Angels' are the subject of the final section. The use of dyes is an important part of their work – matching colours with fabrics to look authentic for a period costume is a demanding task. Most of their costumes are made in small batches from scratch, using traditional methods, so skilled tailors and pattern makers are needed.

Learning outcomes

Pupils should gain an understanding of:

- the use of CAD-CAM in the textile industry to save time
- the process of fabric printing and fixing
- the need for accurate colour reproduction
- methods of fabric cutting and dyeing

Key vocabulary & concepts

- Fashion trends in the mass market
- Computer-aided design
- Computerised pattern making
- Cutting in bulk
- Bleached fabric
- Continuous flat-bed screen printing
- Colourfast
- Colour consistency
- Weave and print faults
- Pre-dye solution

While watching

Initially the programme should be watched straight through as a general introduction to the subject. Specific sections should then be shown again during the course, as and when they become appropriate to on-going project work.

Page 22 shows how this programme links with the *DESIGN & MAKE IT! Textiles Technology* textbook.

Here are some questions for students to think about in conjunction with the programme.

'Virtual Fashion'

Before watching, think of an item of clothing you recently bought. How many variations of size and colour were available? Describe its colours, textures and patterns. How do you think these were created?

While watching:

- Why is speed of design and production important in the clothing industry?
- Identify two ways in which computer-aided design contributes to time saving.
- Identify two ways in which computer-aided and/or automated manufacture contributes to time-saving.

'Cover Story'

Before watching, identify which items of furniture you have at home which have printed, dyed or woven fabric covers. What other printed textile products do you have at home, such as curtains, carpets and cushions? How do you think they were made?

While watching:

- How are dyes made to be colourfast?
- What checks need to be made of the quality of fabric before pattern-cutting can start?
- Why does the firm undertake pattern-cutting by hand?

'A Cast of Costumes'

Before watching, recall a time you appeared in a school play. Can you remember what the costume you wore was like? What was it made from and how was it made?

While watching:

- How can old costumes be given a new lease of life?
- What needs to happen before a costume can be dyed?
- What are the two main considerations during a costume-fitting session?

After watching

1. Produce a series of labelled, coloured sketches or diagrams to illustrate your answers to the questions posed above.
2. Apply the following questions to your current coursework project:

- How could CAD-CAM be used to speed up the process of design and manufacture of your textile product?
- What will be the main sequence of batch or mass-production for your final design?
- What quality control checks could be made during production?
- Which stages of production might be automated effectively?

3. Undertake the costing and production simulation exercise on the next page.

Design and make projects

On the ward

The patterns, colours and textures of textile designs can be relaxing, re-assuring, fun, etc. In a hospital, attractive, co-ordinated furnishings and fabrics can help provide the important feeling of well-being.

Design and print a fabric which could be used as curtains, bed-spreads and cushions in a four-bed children's ward. If possible visit a local hospital and design the fabrics for a specific location. You will need to decide on the method of producing the fabric, keeping costs and the volume of production in mind.

Patchwork pieces

Patchwork quilts are currently very popular, but are time-consuming to make. With a number of friends set up a small business to design and make quilts to be used as bedspreads. Prepare a series of patchwork samples you could make up to order for customers.

List the various tasks involved in the production of the quilts. Produce a flow chart to show how you would divide the labour between four people, and estimate how long it would take you to make quilts of various different sizes.

Above and below average

Clothes are produced in a range of sizes to cater for the variation in size of people. The widest variety of colours and styles is produced for the large percentage of the population who fit the 'average' sizes. However, there is not so much choice for teenagers and adults who are particularly small or large.

Design and make a fashionable garment for a small or large-sized person. As the production cost will be relatively high, the item must be hard-wearing. You may wish to consider incorporating removable sections to increase the variety of situations in which it can be worn.

Costing cushions

A small family-run textile company plans to make a range of good quality hand-made cushions. To begin with they intend to make 1,000 cushions. They need to decide how many to make, what quality of materials to use, and how elaborate the cushions should be.

Work in a team of four to help advise the company on what they should make.

Manufacturing costs

The main decisions which the company needs to take are whether to:

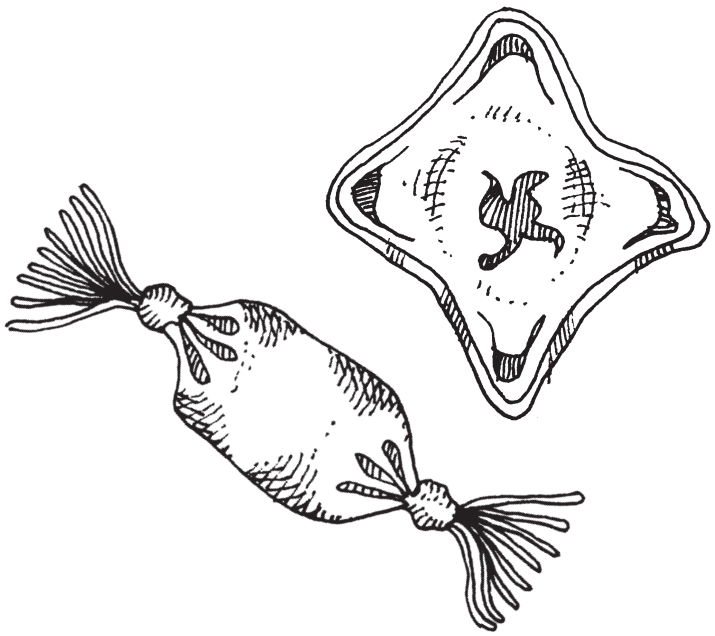
- use silk brocade, velvet, linen or cotton polyester
- use a foam or feather cushion pad
- add frills, braiding and/or tassels

As well as the different costs of the materials, there are also labour costs to consider, which vary according to the level of skill and care needed.

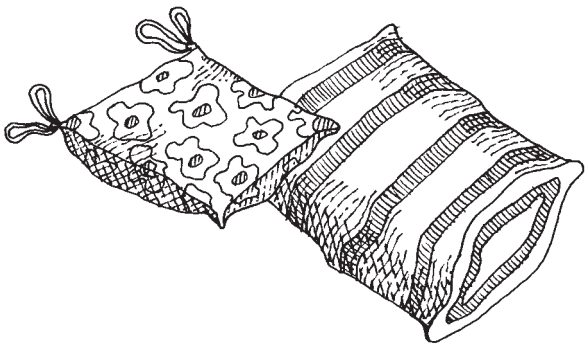
The manufacturing costs per cushion are shown on the right. Using these figures it is possible to calculate, for example, that:

- the most expensive cushion would cost £42 to make (silk £15, labour £6, feather filling £5, 4 tassels £12, labour £4)
- the cheapest possible cushion would cost £9 to make (cotton £5, labour £3, foam pad £1)

Using the same method, it is possible to calculate the manufacturing costs of combining different materials, fillings and decorative accessories.



Material	Material cost	Labour cost
Silk	£15	£6
Velvet	£10	£5
Linen	£8	£4
Cotton	£5	£3
Luxury feather filling	£5	
Foam pad	£1	
Tassels (each)	£3	£1
Braiding	£1	£1.50
Frills	50p	£1



Calculating the selling price

By the time the additional costs have been included (for example, packaging, transport, retailer's mark up, VAT, etc), the minimum selling price will need to be twice the manufacturing cost. A further 10% then needs to be added to this figure to provide the company with a profit margin. So the most expensive cushion will sell for £92.40 (£84 + £8.40), and the cheapest for £19.80 (£18 + £1.80).

The company are confident that people will be prepared to pay these price levels for good quality products. They anticipate that less people will want the very expensive cushions (though they make more money on these), but also that most people will want something better than the cheapest cushion.

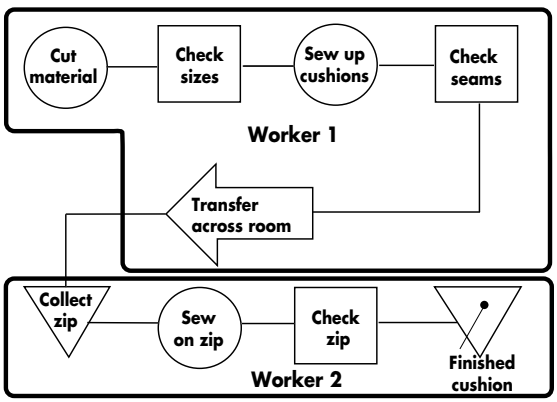
As a group you will need to produce a series of recommendations. Specify:

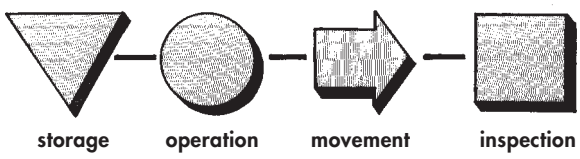
- the range of types of cushion they should make
- the manufacturing cost of each type of cushion
- the selling price of each type of cushion
- how many of each type of cushion to make
- the total profit made if all cushions are sold

Planning for production

Choose one of the cushions you have specified. Produce a detailed flow chart to show all the stages of manufacture. Include checks for quality of manufacture during and at the end of production.

How would you divide the manufacture and quality checks up between the four of you? Re-draw the flow chart to show how this could best be achieved.





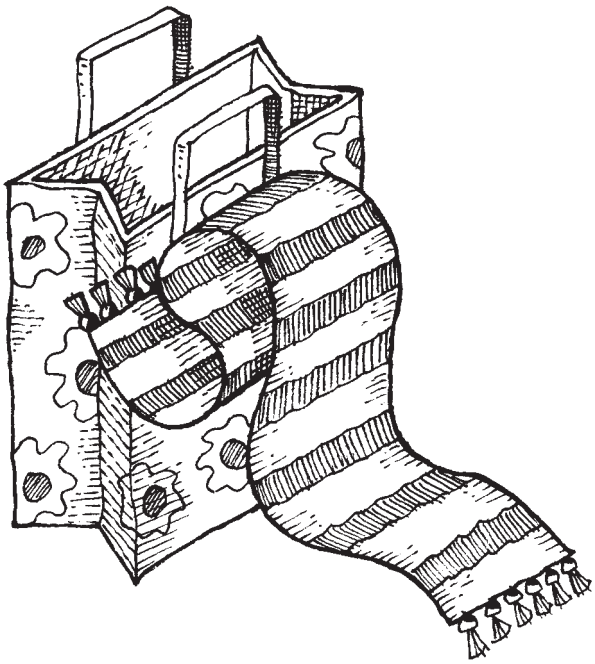
Planning for the future

The company hope that after they have established themselves as successful cushion manufacturers they will be able to increase the range of textile-based products they can make and sell. Suggest a range of other items they might consider producing.

One member of the company owns a personal computer. How could it be used to help the business? What software might they consider to help them with:

- accounting?
- developing designs?
- predicting costs?
- keeping records of customers and stock levels?

What items of computer hardware (if any) might you advise them to purchase at a later date which might help them with manufacturing?



Final presentation

Remember there are no right or wrong answers to all these questions! What's needed most is a convincing presentation.

Illustrate all your recommendations:

- verbally, either by preparing a short written report or by doing a short group presentation using a flip-chart
- visually, using sketches, diagrams, graphs and charts

Compare your suggestions with those made by other groups.

Electronic Products

Our lives have come to depend on electronic products. Amongst many other things, they monitor our health in hospital, protect us and our property from attack, control our financial, energy and transport systems, keep us in touch with each other, and entertain and inform us.

Introduction

Electronic products are more than just clever electronic circuits. They only work because they are contained in casings which have been designed for the specific environment in which they will be used, and because we are able to make them work the way we want using well-thought-out displays and controls.

Designing electronic products involves identifying ingenious and cost-effective ways in which new technology can be applied to meet everyday needs. This programme shows three ways in which designers and manufacturers have been successful in achieving this.

Programme outline

The programme has three main sections:

- Secret Circuits (a car-tracking device)
- Launching the Micro-chip (an electronic personal organiser)
- Wired Plants (an atmospheric control system)

The first section is about the 'Tracker', a new idea to help beat the car thief. As soon as a device fitted in a car is activated it starts transmitting a signal which can be picked up by specially equipped police patrols. The PCB (printed circuit board) was designed using a sophisticated CAD package, and thoroughly tested before going into production.

Electronic products continue to get smaller, and the Psion personal organiser is no exception. To make it pocket-sized, the electronics had to be designed with the size and shape of the final casing firmly in mind. While many operations on the assembly line are automated, fast and efficient, some of the more delicate stages of the production and some of the testing need to be done by hand. This sequence follows the production line sequence from PCB assembly to final quality control.

At Kew Gardens we learn about their sophisticated electronic atmosphere control system. Light levels, temperature, ventilation and humidity can be individually tailored to the needs of tropical plants in ten different climate zones. Electronic sensors detect minute changes in the conditions and report back to a central control computer every two minutes. This information is processed, and blinds, ventilators and sprayers are automatically turned on and off. As a result, visitors to Kew can enjoy seeing the exotic plants, without the need to travel to a real rainforest.

Learning outcomes

Pupils should gain an understanding of:

- the challenge of designing useful electronic products which utilise the latest components and production technologies
- the requirements for mass-production
- quality control tests used in the electronics industry
- the use of sensors to detect and monitor changes in the environment

Key vocabulary & concepts

- Printed Circuit Board (PCB)
- Application Specific Integrated Circuits (ASICs)
- Thermocouple
- Photoelectric cell
- Feedback control loop systems
- Electronic components
- Electronic sensors
- Quality control
- Hygroscopic

While watching

Initially the programme should be watched straight through as a general introduction to the subject. Specific sections should then be shown again during the course, as and when they become appropriate to on-going project work.

Page 22 shows links between this programme and *DESIGN & MAKE IT! Electronic Products* textbook.

Here are some questions for students to think about in conjunction with the programme.

'Secret Circuits'

Before watching, try to explain briefly how a pager or a mobile phone works: where the signal comes from, and how it is recognised by the receiver.

While watching:

- If the Tracker is not an alarm system, what is it?
- Why is colour particularly useful when using a CAD system to design PCBs?
- What does the signal of a prototype PCB need to be tested for?

'Launching the Micro-chip'

Before watching, consider a hand-held electronic product you own – a personal stereo, a pocket game, or a calculator, perhaps. If you were able to open it up, what sort of components would you expect to find inside?

While watching:

- What are the particular design features of the Psion Organiser?
- What is one of the main advantages of fast assembly?
- What methods are used to check the Psion's PCBs?

'Wired Plants'

Before watching, think about the ways in which the environment is controlled in your home or school. How are levels of light, heat and ventilation adjusted? Which can be controlled electronically as opposed to manually?

While watching:

- What does the Kew Gardens atmosphere control system do?
- What does a thermocouple do?
- What are photoelectric cells used for in the control system?

After watching

1. Where possible, produce a series of labelled, coloured sketches to illustrate your answers to the questions posed above.
2. Apply the following questions to your current coursework project:

- What exactly is the purpose of your design? What will it enable its users to achieve? What advantages does an electronic solution have over other methods?
- How might you use CAD in the development of your PCB? How might the computer data be used in the making of your electronic product?
- When your product is going to be manufactured, in what order would it be assembled?
- What special quality control checks would it need? What health and safety precautions would be required?
- How might sensors be used to control your product?

3. Undertake the production quality control simulation exercise on the next page.

Design and make projects

Secure sports

People using sports centres are naturally concerned about leaving their clothes and valuables while they enjoy themselves. Make a study of this problem, based on a sports centre you know, or your school sports facilities. Generate a list of different commonly used security systems (for example, alarms, locks, identification checks, etc). Think about how sensors might be used to detect whether property is being moved. Design and make an electronic product which will help provide greater security: state how it could be manufactured in quantity.

Educational toys

Young children enjoy toys which make unexpected sounds and flash lights when they give the correct answer. Study some existing non-electronic toys for children under six which help them learn letters, numbers or shapes. Consider how some of them could be developed to include electronically controlled lights and sounds. How will the circuit be activated? How will it be stopped? Design and make a working electronic learning aid and test it out. How could a batch of 1,000 units be made?

The envirobug

A small electronics-manufacturing company wants to make a range of electronic devices in the shapes of 'insects' which can sense and communicate changes in their environment.

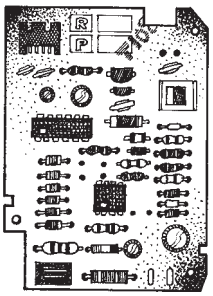
Make a study of all the different devices used to operate and control things in your home and/or school. Try to identify a number of things which could be turned on or off electronically – opening curtains when it gets light outside or sounding a warning when the bath is full, for example. Also look at some images of different insects for ideas for shapes, colours and markings.

Develop some design ideas, and make a prototype and then a final product model. You may find that a vacuum-formed casing is appropriate. Test your final design out at home, and get some opinions about how well it works.

A quality solution

Your class has been asked by a local electronics manufacturer to investigate the best way of packaging one of their products. You will need to work in groups to undertake this task. You should each take on one of the following roles:

- *Assembly worker*
- *Supervisor*
- *Quality controller*
- *Storekeeper*
- *Production engineer*



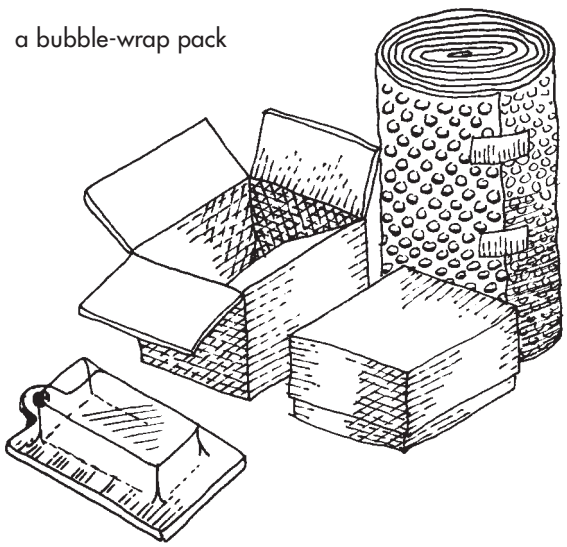
The problem

On the production line, assembly workers make and inspect the circuit shown above. They then pack them, 100 at a time, in cardboard boxes. These are then carried to the factory stores until ordered by a customer. They are inspected again before being despatched. The company are concerned that about 5% of the units are found to be faulty at this stage. Working units are then placed into individual cardboard boxes for despatch. Another 5% are returned by customers for being faulty.

Some solutions

One approach to the problem would be to improve the construction of the unit. This would increase the manufacturing cost and reduce the number that can be made per hour. Another solution would be to invest in better packaging such as:

- a large box and individual boxes for each unit
- a blister pack
- a bubble-wrap pack



Counting the cost

The company makes 50,000 units a year. Each unit costs £10 to make.

a Existing situation

A large cardboard box which costs £1 and holds 100 units. 500 of these are used at a total cost of £500.

An individual box which costs 10p. 50,000 of these are used at a cost of £5,000.

However, a total of 10% of the units are damaged, costing the company £50,000 per year.

Total cost: £55,500

b New solutions

Large box and individual boxes

These boxes cost £2 each and hold 10 units each. 5,000 of these would be needed at a total cost of £10,000. This would reduce the number of breakages in the factory to nil.

Individual boxes for final despatch would cost £5,000, but it is estimated that 5% of these would be returned as faulty at a replacement cost of £25,000.

Total cost: £40,000

Blister packs

These cost 20p each. They can only be opened once after packing. 50,000 would be needed at a total cost of £10,000. It is estimated that 2% would be returned as faulty, at a replacement cost of £10,000 per year.

Total cost: £20,000

Bubble-wrap packs

These cost 10p each, at a total cost of £5,000. Using these, breakages are estimated at 3% at a replacement cost of £15,000.

Total cost: £20,000

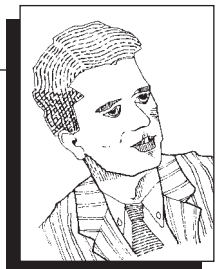
c Other information

- 40% of customers place orders for individual units
- 30% place orders for 20 units
- 20% place orders for 30 units
- 10% place orders for more than 30 units

Role play cards

The production engineer

My job is to see the product through from start to finish. I don't understand why the units keep getting broken – I suspect the assembly workers are rushing the job to earn their bonus. Maybe I can design some sort of special holder in which to place the units on their way to the stores.

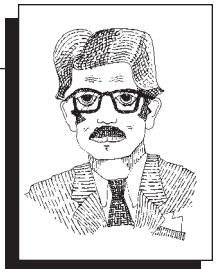


The quality controller

I've got some ideas for better checking methods to identify exactly which components are causing the problem. If we can sort the problem out earlier, we won't be wasting the whole unit. This will increase production time a little, but might remove the need for improved packaging.

The supervisor

I am keen to reduce the failure rate of the units produced by my section. The workers I supervise are well-motivated and want to produce good work, as well as earn their bonus for meeting daily production targets. My idea is to inspect and pack the boards ready for the customer directly after assembly.



The storekeeper

I think most people blame me for the failure of so many units. I do my job the best I can, but I have a lot of orders to deal with, and we can't afford to keep the customer waiting. Better packaging would be a good idea to protect the units on their way here from the factory floor, and in the post to customers.
It would slow me down though – I'd need an assistant.

The assembly worker

Achieving the production target for the unit is very important as it means we all get a bonus. We work hard together to achieve this, but it's very demanding.
The units all work fine when we pass them on to stores in the large cardboard boxes.

The discussion meeting

Read the costings and the role-play cards. Working in your specific role, discuss the advantages and disadvantages of each type of packaging. Think about:

- the cost of materials
- the production/packaging time
- how effective each packaging method is
- the purpose of packaging, and other possible methods
- alternative ideas

Remember that there are two aspects to the problem of packaging. One is how to pack the units after they have been made. The other is how to package them for the customer.

Make sure you discuss other possibilities. Investing in expensive packaging might not be the best solution

There is no single right or wrong answer to this situation. However, at the end of the session it is important that, as a group, you agree on a course of action. One of you should write this down. Compare your recommendations with those of other groups in your class.

Graphic Products

Every time someone picks up a book or magazine, watches a television programme, goes shopping, puts on a CD, visits a museum, or does one of countless other activities, the chance is that they are using a graphic product. Graphic products provide us with basic information about what's going on in the world, what's in a particular package and how it should be used, and how to find our way around our environment.

Introduction

Graphic product designers have to consider carefully the colours, textures, illustrations, typography and layout used in their designs. All these elements combine to deliver hidden messages about the nature and quality of a product or service, for whom it is intended, and how we should expect to think and feel about using it.

Programme outline

The programme has three main sections:

- Screen Test (movie posters)
- The Can Plan (packaging cosmetics)
- Monster Graphics (exhibition design)

In the first section, the opportunities and constraints involved in designing and printing a movie poster are explored. We see a range of different examples of the ways in which posters attract our attention, raise our interest, create a desire to see the film, and tell us where and when we can see it. A sophisticated computer-graphic system helps the designer to manipulate images and text to achieve the final layout. Finally, the poster is printed and checked for quality.

The requirements for the design of cosmetics packaging have some similarities to movie posters, but also many differences. The production process itself, printing on to metal sheet which is then formed into a can, places many restrictions on the colours and textures and shapes and sizes which can be specified. A packaging designer talks us through the way in which he tackled the creation of a hair-spray can which had to include specific safety warnings and instructions for use.

'Creepy Crawlies' is a recent permanent interactive exhibition at the Natural History Museum, aimed at young children. There are things to pull and push, and open and close, things which light up, and things which make weird noises. We look at the way in which the exhibition designers set about presenting the subject matter in an engaging and informative way, using colour, typography, and mechanical and electronic devices.

Learning outcomes

Pupils should gain an understanding of:

- the requirements for the design of successful advertisements, packages and displays
- how freehand sketching and IT can be used to develop and refine design ideas
- how graphic products are reproduced in quantity
- typographic design

Key vocabulary & concepts

- Image
- Typography
- Layout
- 2D CAD
- Constraints
- Marketing
- Lifestyle
- Production control
- Automation

While watching

Initially the programme should be watched straight through as a general introduction to the subject. Specific sections should then be shown again during the course as and when they become appropriate to on-going project work.

Page 22 shows how this programme ties in with the *DESIGN & MAKE IT! Graphic Products* textbook.

Here are some questions for students to think about in conjunction with the programme.

'Screen Test'

Before watching, make a list of the some of the films you have seen in the last six months. How well can you describe their posters? Think about images of the main characters, the style and positioning of the main title and the use of colour. How much did it influence you to go and see the film?

While watching:

- To attract new audiences to films, movie posters need to do three things. What are they?
- The designer of a movie poster has to work to a tight specification in terms of what elements and information must be on the poster. What specific constraints are mentioned?
- How does the printer check that the reproduction quality of the poster is to a satisfactory standard?

'The Can Plan'

Before watching, think of some recent products you have bought – a CD, some sweets, clothes or cosmetics, perhaps. How were they packaged? Did you choose the product or the package? What information about the product was contained on the package?

While watching:

- What are the key stages in the development of the packaging design of a cosmetics spray, described by John Walworth?
- How is the final design printed on to the steel sheets?
- For what does the printer have to check the poster to ensure it meets the quality specification?

'Monster Graphics'

Before watching, recall a visit you have made to a museum or heritage centre. How many different examples of graphic product design can you remember using? Choose one, such as a guide-book, an information point, or an interactive display and say what you think the designer's brief might have been.

While watching:

- How do the different styles of lettering used to identify the different sections of 'Creepy Crawlies' reflect their subject-matter?
- How easily can the children work out how to operate the various interactive exhibits?

After watching

1. Where possible produce a series of labelled, coloured sketches to illustrate the answers to the questions posed above.
2. Apply the following questions to your current coursework project:

- What methods of graphic modelling (including CAD) could you use?
- What styles, sizes and colours of type-face will be most appropriate to your design?
- What materials and techniques could be used to create a high-quality product in school?
- What industrial materials and production processes could be used to print out your final idea?

3. Undertake the production process simulation exercise on the next page.

Design and make projects

Musical images

You have been asked to design an A3 colour poster for a forthcoming school production of either 'Miss Saigon' or some other musical of your choice. 30 copies will be needed. It will be produced on a black and white photocopier on white or coloured paper, and then hand-coloured. Design and make the poster, thinking carefully about images, typography, colour and layout.

Rainbow threads

A local manufacturer needs a package for four reels of different coloured cottons. The package must allow the cotton reels to be visible without opening, and be re-usable as a storage container after it has been opened. Design and make a suitable package which includes the name of the product, 'Rainbow Threads'. Develop a production flow-process diagram which shows the stages of preparation, construction and checking.

Living and learning

A local museum is preparing an exhibition called 'Living and Learning' about the history of schools in your area. Your school has been allocated three 1-metre-by-2-metre display stands, a table which has a surface area of 1 metre by 2 metres and a VCR and TV. It has been invited to submit exhibits which explain when it was founded and present information about interesting and significant events during the life of the school.

Devise a list of exhibits which could be included and allocate an appropriate amount of space for them in the display. Design and make a full-size main title display board and a series of final presentation drawings and a model which show your proposals.

Production process simulation

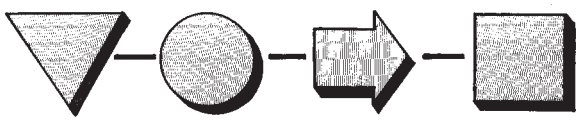
Your class has been asked to design and make a series of greetings cards and matching envelopes to be sold at a forthcoming school fete. Work in groups of four to discover the most efficient way of organising the task.

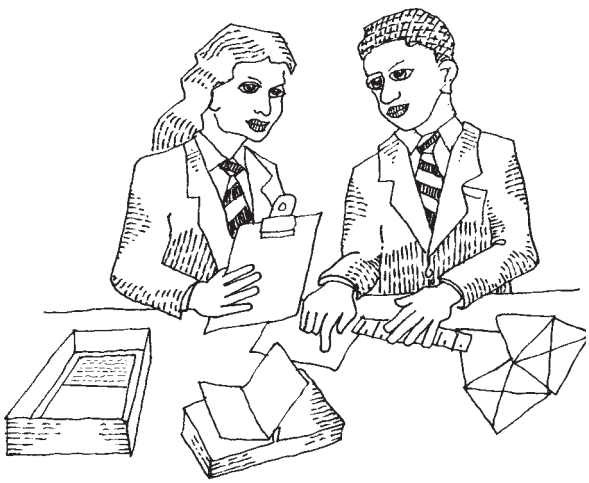
Design specification

- There are to be three different styles of card, though they can be printed in a range of colours and on different coloured paper or card.
- The front of the three cards will contain only the words 'Greetings', 'Congratulations' or 'Thank you', each in a distinctive and attractive lettering style. No other images or text are to be included.
- The card must include at least one fold.

The aim of the task is to identify the quickest way of making 50 copies of each design to the highest standard of quality. Keeping the cost of materials and labour down to a minimum is not essential in this exercise, but the card and method of printing used must not exceed 20p per card.

The team which achieves the best results will be awarded the contract!





Developing the design

Work through the following stages:

1. Produce and agree on a series of designs for the front of the cards which follow the given specification.
2. Decide how the image will be printed on the cards. A hand-coloured photocopy of a design produced on a laser printer using a CAD system is one possibility, or maybe a colour ink-jet copy if the cost is within the acceptable limits. Another good approach would be a silk-screen print.

The design work to this point should not be included in the timing of the production process simulation.

Developing the production sequence

1. Devise a flow-process chart which identifies the various main stages in:

- organising the work space (i.e. where tools and materials will be placed for easy access)
- preparing the materials (for example, making sure there is a steady supply of materials which are ready to use when required)
- making the cards (for example, printing and folding, placing in envelopes and packing sets into boxes)
- checking the quality (for example, accuracy of print, neatness of fold)

2. To begin with, just one of you should make a single card from start to finish, with the other members of the group timing how long it takes and thinking about how it might be possible to organise the production line more effectively.

3 Next, focus on each separate stage and consider how the work might be divided up. Some possibilities are:

- each person works in line, passing on a partly completed product to the next person
- on some stages, two people work together
- some people may have more than one job at different parts of the process

4 It is also important to design the most efficient organisation of the workspace – i.e. where materials and workers will be best placed to minimise delays in moving partly-completed products around. It is also important to consider storage space and location.

5 Another key consideration is how the three different designs will be produced, and how different colour variations will be organised. For example, would it be better to:

- print 10 copies of Design A in red, then 10 in blue, 10 in yellow, etc, followed by 10 copies of Design B in red, 10 in blue, and so on; or
- print 10 copies of Design A in red, then 10 copies of designs B and C in red, before switching to a different colour?

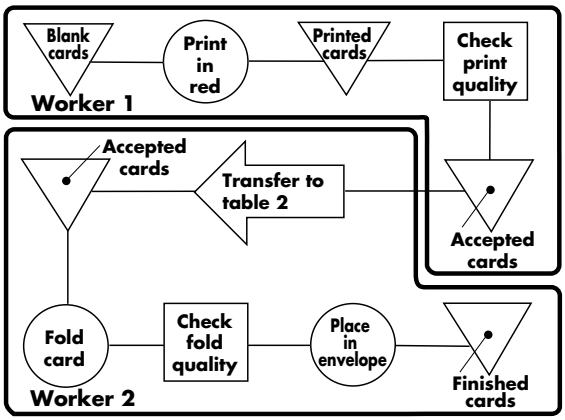
6 How might specially made jigs or templates help to speed things up?

Making teamwork count

Experiment with a variety of arrangements of production layout and scheduling until the most effective is identified. To achieve this you will need to work closely together and co-operate well. Group discussion and decision-making meetings are essential. At these sessions you might like to consider taking on specific roles of responsibility for various aspects of the process, for example stock control, quality control, work-flow.

Agree and organise the final layout and obtain the necessary stock of card etc, to prepare for the final test simulation run.

The design and development of the production process to this point should not be included in the timing of the final simulation run.



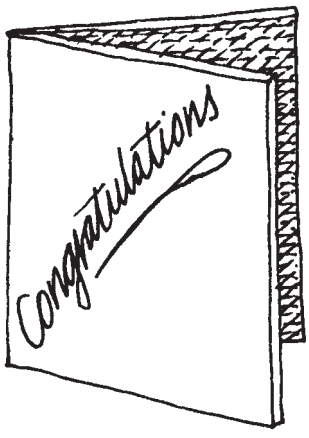
Design and make it better!

Whether your production design turns out to be the most efficient is not the end of the exercise. The next question is: how can it be improved further, either to build on your initial success, or to catch up on your competitors in the greeting card market?

From what you now know about production, go back to review the original design and manufacture of the cards.

- Did you choose the best method of printing?
- Would it be significantly more efficient to print just one design and/or just one colour?
- Would extending the range of designs and/or colours to increase eventual sales be easy to achieve?
- Would adding extra members into the team make a worthwhile difference to the production-rate?
- If a much longer production-run were planned, how would the schedule and layout need to be developed?
- What parts of the process could be most effectively automated?

Write up a report of the project, including graphs and charts and diagrams to illustrate the different layouts and schedules used.



Design & Make It! links with textbooks

The *DESIGN & MAKE IT!* textbooks have been prepared by a team of authors and NEAB examiners to give a clear indication of the appropriate project work and coverage of knowledge and understanding needed for success with coursework and written papers.

Within each book, tasks, activities and key revision points are embedded in a number of extended projects. There are a range of specific opportunities to view the television programmes during the undertaking of these projects.

All programmes provide an effective introduction to the whole course, giving pupils a general idea of the design and production issues they an expect to encounter as they progress towards their final GCSE/Standard Grade coursework submission and written examination.

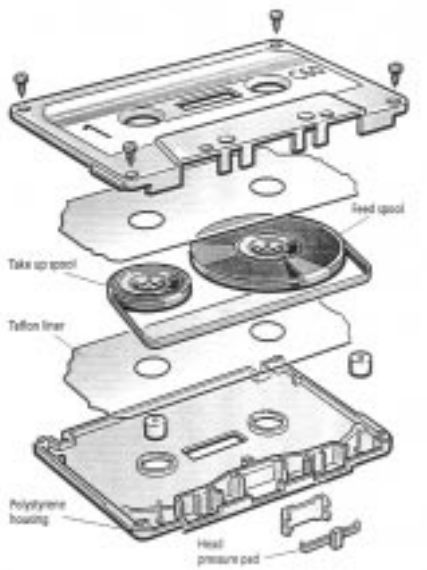
Food Technology

The programme is particularly recommended as a support for establishing the issues involved in creating food products for industrial production. The 'Design Behind Bars' programme sequence will support the material on chocolate products. Meanwhile the 'Designer Meat' sequence should accompany the pages on meat products. Finally 'The Big Chill' will provide an excellent introduction to the series of pages which form the Cook-chill Products section of the book.

The production process and quality control simulation (pages 4 and 5 of this guide) could be undertaken alongside the 'Production Process Systems' pages of the book.

Resistant Materials

All three programme sequences should be shown as part of the final 'Flat Pack Furniture' project. The fibre-glass mouldings of 'The Good Body Guide' are referred to in Manufacturing in Plastics on page 124.



The making of musical instruments at Boosey and Hawkes is included as part of Manufacturing in Metal on page 122. In Manufacturing in Wood there is an extended case-study of Christies which ties in closely with the material featured in 'The Tree, the Computer and the Wardrobe'.

The production costing task on pages 8 & 9 of these notes could easily be integrated into the suggested development of a CD rack as a solution to the 'Flat Pack Furniture' project.

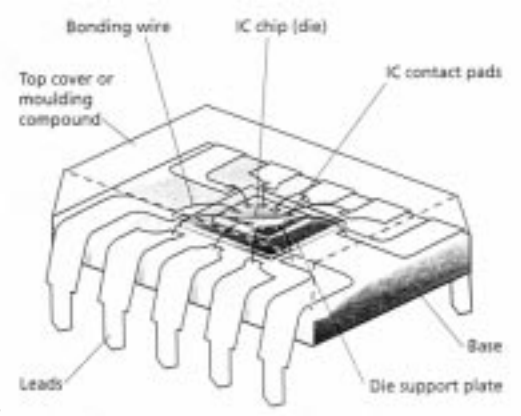
Textiles Technology

The 'Virtual Fashion' programme sequence could be shown to pupils designing and making uniforms during the Sea Cruise project, while the 'Cover Story' section could be shown to pupils printing furnishing fabrics for the same project. Meanwhile 'A Cast of Costumes' will support the introduction of the initial 'On Stage' project.

The costing and production process simulation on pages 12 & 13 of these notes would fit most appropriately into the pages dealing with manufacturing within the Sea Cruise project.

Electronic Products

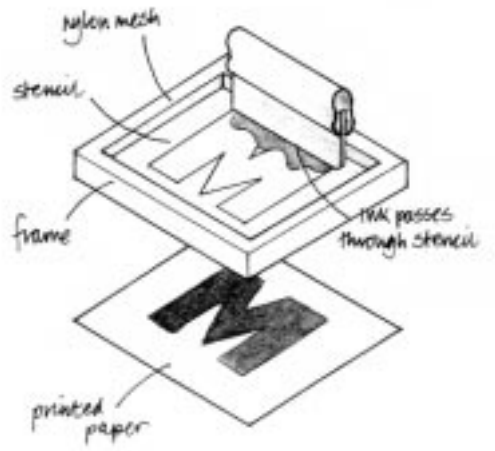
The programme is particularly recommended as a support for the Introductory pages of the book where issues of the design and manufacture of electronic products are presented. The production issues presented could then be reviewed during the final Just For Fun project where pupils need to consider the implications of manufacturing (pages 118–33), with particular reference to CAD-CAM (pages 120–3) and Hazards and Risks (pages 130–1).



The quality control production process simulation on pages 16–7 of these notes could be effectively run alongside coverage of pages 127–9 (Quality Counts).

Graphic Products

The programme sequence 'Screen Test' could be shown very effectively at the start of the movie marketing project; 'The Can Plan' ties in with design development of the Mix and Match packaging projects. The Creepy-Crawlies exhibition featured in the 'Monster Graphics' sequence could be shown early on during the Product Launch project to encourage pupils to tackle issues of spatial design, typography and interactive exhibits.



The production process simulation on pages 20–1 of these notes would fit well into the manufacturing pages of Mix and Match.

Useful resources

Books and magazines

'KS4/GCSE Design and Technology: Design and Make It!', Food Technology, Resistant Materials Technology, Electronic Products, Graphic Products, published by Stanley Thornes (Publishers) Ltd. (*Tel*: 01242 228888)

'Design and Technology Interactions: Starting Points and Support Packs – Let's Celebrate, Hotels, Early Years, Our Built Environment', published by Stanley Thornes. Each pack contains a number of structured design and make assignments, many of which could be used in various KS4 D&T courses.

'GCSE Craft Design and Technology', R Kimbell, Thames/Hutchinson (1987). Suggested coursework projects for Graphic Products, Resistant Materials Technology, Electronic Products and Systems and Control.

'The Colour Eye', Robert Cumming & Tom Porter, BBC Books, 1990. Particularly recommended for Graphic Products and Textiles.

'Green Design', Dorothy Mackenzie, Laurence King, 1991. Particularly recommended for Graphic Products, Resistant Materials Technology and Textiles.

'Mastering Manufacturing', Gordon Mair, Macmillan, 1993. Good coverage of manufacturing processes for Resistant Materials Technology and Electronic Products

'About Packaging', Hobsons Publishing, 1993. Recommended for Graphic Products and Food Technology

'Developing for Quality', produced by Tesco, concerned with developing new food products. Tesco Stores Ltd PO Box 18, Cheshunt, Hertfordshire EN8 9SL

'Manufacturing By Design', CAD software and curriculum materials, CBI, available from NCET (*Tel:* 01203 416994)

Television resources

Real Life Design – 4 Learning

Techno – BBC Schools

Opening Up Technology – BBC Schools

Organisations

The Design And Technology Association (DATA)
16 Wellesbourne House
Walton Road
Wellesbourne
Warwickshire CV35 9JB
(*Tel*: 01789 470007)

Film Education
41 – 42 Berners Street
London W1P 3AA
(*Tel*: 0171 637 9932)

British Standards Institute
Marylands Avenue
Hemel Hempstead HP2 4SQ
(*Tel:* 0144 2230442)

Intermediate Technology
Myson House
Railway Terrace
Rugby CV21 3HT
(*Tel:* 01788 560631)

The Crafts Council
44a Pentonville Road
Islington
London N1 9BY
(*Tel:* 0171 278 7700)

Chilled Food Association Ltd
6 Catherine Street
London WC2B 5JJ
(*Tel:* 0171 836 2460)

National Council for Educational Technology (NCET)
Milburn Hill Road
Science Park
Coventry CV4 7JJ
(*Tel:* 01203 416994)

Technology Enhancement Programme (TEP)
Middlesex University
Trent Park
London N14 4XS
(*Tel:* 0181 447 0342)

Credits

Production Company Science Pictures Limited

Producer **Madeleine Spears**

Directed and edited by **Derek Hall**

Script **Tracy Gow**

Researcher **Sajjad Bhatti**

Teachers' Guide written by **Tristram Shepard**

Edited by **Liz Meenan**

Acknowledgements

The author would like to thank Hazel King and Alex McArthur for their suggestions. The 'Electronic Products: A Quality Solution' simulation was based on The Quality Circle Project, published by the Engineering Careers Information Service in 1983.