Industrial Practices, Systems and Control at Key Stage 4

Abstract
This article discusses the relationship between designing and making processes followed in design and technology and industrial and commercial practices commonly used in industry. It identifies a range of industrial and commercial practices and gives examples of how these can be translated into classroom practice in different focus material areas. A unit of work for Key Stage 4 textiles technology demonstrates how industrial practices can be integrated into textiles work, using simple industry-related activities. The unit of work includes learning objectives, possible teaching activities, opportunities for building an understanding of industrial practices and further activities/homework ideas.

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The relationship between the designing and making processes followed in design and technology and industrial and commercial practices commonly used in industry

In design and technology we follow a design and manufacturing process that is based on an industrial model. At Key Stage 4 the National Curriculum document refers to these activities as 'industrial practices'.

In industry these designing and manufacturing processes enable manufacturers to make high quality, cost-effective products at a profit. Many industrial design practices and manufacturing systems make use of Computer Aided Design and Computer Aided Manufacture (CAD/CAM) and Information and Communications Technology (ICT). These have revolutionised the way the industry works, enabling companies to communicate information quickly and to design and manufacture on a global scale.

Thus it is that these practices are part of the requirements of the National Curriculum for design and technology and they are also practices used by UK industry to achieve the successful manufacture of innovative products that provide valuable exports. Industrial practices used in this way enable and encourage creativity.

We need to use them in the same way, as *processes* that enable students to design and make innovative products. We also need to provide a curriculum that is relevant and forward looking. Using up-to-date industrial practices will enable us to do this, as long as we use them as *processes* for encouraging creativity, innovation and enjoyment of design and technology. Bringing industrial practices into the classroom will also give students:

- a wider understanding of the importance of industry and what it has to offer
- an understanding of how ICT has revolutionised industry, enabling manufacturing on a global scale
- the opportunity for improved motivation and higher levels of achievement
- an understanding of the need for change.

A stork printer.

Figure 1: Summary of commonly used industrial and commercial practices and how they can be translated into classroom activities for different focus materials areas.

Industrial and commercial practices	Examples	
Research and development Investigating and analysing: • market research • product analysis • researching British and international standards legal requirements • researching scientific and technical information • investigating safety requirements and identifying risks • considering values issues (aesthetic, cultural, economic, environmental, ethical, political, social, technical) • costing products • developing design specifications.	**Resistant materials** Use market research to establish the profile of the target market group, identifying the buying behaviour, age group, lifestyle and brand loyalty of potential customers. **Graphic products** Use a shop report to analyse product types, new ideas and technologies and the competition from other manufacturers.	**Textiles** Monitor the life cycle of a textile product from cradle to grave, to assess its effect on people or the environment. Investigate the raw materials, the design, manufacture, distribution, use and disposal of the product. **Food** Investigate food products already on the market. Use disassembly activities to identify ingredients, taste characteristics, manufacturing processes and value for money. Use the results of the investigation to draw up design specification for a new food product.
Designing for manufacture • Developing ideas. • Modelling and prototyping. • Testing before production. • Designing for different levels of production. • Designing for ease of manufacture, maintenance and product life. • Designing for quality and safety. • Designing for cost-effective manufacture. • Developing manufacturing specifications.	**Food** Generate and model ideas for a variety of food products using a knowledge of materials, texture, composition and flavour. **Graphic Products** Use 2D and 3D modelling techniques, including CAD software to prototype products and test before manufacture.	**Systems and control** Design and use test procedures to check the quality and safety of design, so the system meets needs of the user and the environment. **Textiles** Produce a manufacturing specification, to ensure that the product is manufactured as the designer intends. Provide information about styling and construction details, dimensions, materials and components.
Production planning • Producing a production plan. • Identifying and planning materials, components and equipment. • Identifying the method of assembly and the stages of manufacture. • Planning and safety requirements. • Planning time and cost constraints.	**Textiles** Draw up a production plan which includes specifications, details of materials and components, a costing sheet, lay plan, cutting instructions and the work order. **Resistant materials** Use ICT to help plan the ordering of materials and components, so they arrive just in time for production.	**Food** Produce a detailed time plan to set deadlines for the different stages of manufacture. **Systems and control** Use a systems approach to find the most appropriate components and assembly process. Identify critical control points where quality can be checked.
Product manufacture • Using the most appropriate method of production. • Product assembly. • Using finishing processes.	**Graphic products** Identify how the method of production could be simplified so the product meets budget requirements. **Systems and control** Use ICT appropriately for controlling and manufacturing components and systems.	**Resistant materials** Explore a range of materials, components and processes to improve the method of production. **Textiles** Use finishing processes to ensure that the product is fault-free and matches the manufacturing specification.
Quality • Using quality assurance and control. • Testing and monitoring production. • Testing against British and international standards. • Testing against specifications.	**Resistant materials** Use a quality assurance system to ensure that products meet the required specifications. **Food** Use qualitative testing against specified quality standards to monitor the quality of food products.	**Graphic products** Use CAD systems to customise and control colour quality to enable the manufacture of identical products. **Systems and control** Use quality assurance tests to ensure that product specifications and tolerance levels are met.

Figure 1: Summary of commonly used industrial and commercial practices and how they can be translated into classroom activities for different focus materials areas (continued).

Industrial and commercial practices	Examples	
Health and safety • Following legal requirements and standards. • Using risk assessment and safe working practices.	**Products** Research the legal requirements related to safety standards in the workplace, for the consumer and for the environment. **Textiles** Investigate BSI and EU standards relating to textile manufacture, use and disposal.	**Systems and control** Research industry-standard hazard analysis and risk assessment techniques. Explain where hazards are likely to occur in food processing. Analyse the potential risk of that hazard. **Resistant materials** Demonstrate care, precision and attention to detail in the use of tools, equipment and processes, showing awareness of safety in the workshop and beyond.
Systems and control • A systems approach to design and manufacture. • Control systems. • Quality systems. • Manufacturing systems. • Computer systems. • ICT systems. • Marketing systems.	**Resistant materials** Plan a project using a systems approach, to improve planning, to enable the use of feedback and to monitor quality. **Graphic products** Investigate the use of control systems in high volume manufacturing. Compare high volume printing methods with hand block printing.	**Food** Research the use of computer systems in high volume manufacturing. Explain how a computer system can help in the design and manufacture of products. **Textiles** Explore how ICT enables feedback of product sales information to a garment manufacturer. Use a block diagram to explain this process.

A further reason for including industrial and commercial practices in design and technology is to enable an understanding of the need for change and how to manage it. In the future a job will not be for life. We will all have to be adaptable. The future for our students is life-long learning if they are to stay in the job market. Design and technology is one of the few subjects in the curriculum that will enable students to learn to be flexible and develop an understanding of change.

Designers and technologists are well placed to manage change because design and technology training encourages new thinking and new ideas.

Cutting machine.

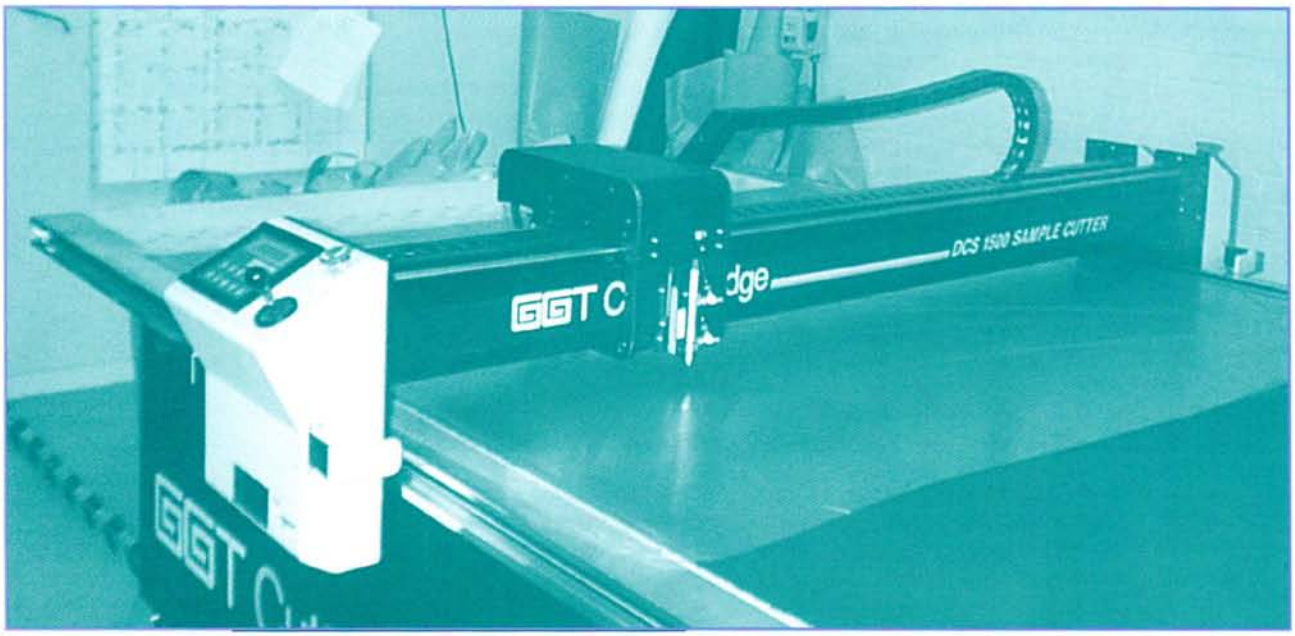

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Figure 2: This shows a typical Key Stage 4 textiles project. It demonstrates how a variety of industrial practices can easily be integrated into textiles work.

Unit Title: **Stylish Textiles**

About the unit

Through this unit students develop design and manufacturing skills by analysing, disassembling and evaluating commercial textiles products. They learn that the design of many textiles depends on image, style or fashion as well as on using appropriate materials and processes.

Learning Objectives	Possible Teaching Activities	Opportunities for Building an Understanding of Industrial Practices	Homework Ideas and Further A Activites
Develop design and manufacturing understanding and skills by analysing and evaluating commercial textile products.	**Design and make assignment** • Students are to design a simple decorative textile accessory for a chosen interior using the influence of a design style or a theme. • Identify the learning purposes of the DMA, analyse the task, set out the assessment criteria and help students plan a step-by-step approach to the project. **IDEA: Style analysis** In pairs choose an interior (could be living room, bedroom, restaurant etc.) from magazines or catalogues and draw up a chart to explain the style of the chosen room, explaining: • type of interior • types of patterns (checks, spots, floral etc.) • colour schemes (warm, cool, bright etc.) • mood of the room (modern, traditional, country etc.). Students could add sketches for colour and pattern/style information.	• Analysis of existing products (by hand or eye) is a process used by industrial designers to identify well-designed products and to gather information. It is an opportunity to discuss the design features of existing products and to use technical terminology. • The evaluation of products encourages the recognition of product. • High lighting topics such as image or lifestyle helps to raise awareness of the marketing of a range of manufactured products and the values issues that go with it.	**Homework** Market research – collect information about style and colour trends for interior accessories. Students can record information in a chart similar to the one used in class. **Further activities** Many manufacturers use image and branding to promote the sale of products. Explain how consumers are encouraged to buy products because of their image. Identify a particular product and evaluate its relationship with a way of life or lifestyle.
Understand how market research and disassembly are used to inspire design ideas. Recognise that social, moral, cultural, artistic or technological issues influence the development of style in textiles. Use a moodboard to communicate ideas about design, colour, themes, trends and styling.	**Focused practical task:** Market **research analysis** Choose one textile accessory from the market research and explain why it is suitable/not suitable for the chosen interior. Students could think about: • aesthetic appeal • fitness for purpose • maintenance/aftercare. Explain what may have influenced the style/colour of the textile. **IDEA: Investigating fabrics** In pairs students examine a range of different printed or decorative fabrics and record the pattern style, pattern repeat, fabric properties and possible end-use. Comparisons could be	• Textile designers regularly analyse fabrics, style and colour trends – they need to be up-to-date. They also disassemble fabrics to get ideas about pattern and properties, which they can use as starting points for designing. • This links to the use of contextual studies to inspire design work – using art, design and cultural influences. Moodboards are used widely by designers in the textiles industry to develop ideas and to present them to clients. Students can easily model this practice to help develop their own ideas. The use of themes to develop moods or 'stories' about textiles.	**Homework** Students work on moodboards for the chosen interior, using individual themes and the influences of style/colour trends from research. **Further activities** Students could report on the following: Textiles designers often use the influence of other cultures to develop their ideas. Do we exploit or promote these cultures by making use of their traditional design styles? Collect pictures of textile products and explain how they have been influenced by other cultures.

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Figure 2: This shows a typical Key Stage 4 textiles project. It demonstrates how a variety of industrial practices can easily be integrated into textiles work (continued).

	made with the textiles seen in market research, with students writing a simple design specification for one of the textiles that they have evaluated.		
Develop and use detailed design specifications when designing textile products. Use design specifications to generate design ideas.	**DMA** **Design specification** Each student draws up a design specification for their textile accessory using research information and moodboards to help them. **Generating ideas** Students generate design ideas that are guided by the design specification. They can base colour schemes on their moodboards. Encourage students to think about: • colourways, repeats and scale • developing co-ordinated fabrics for accessories • fitness-for-purpose. **FPT: Using CAD** Students watch video 'Talent and Technology' about the use of CAD in the textiles industry. Discuss the impact that computers have on design, modelling and prototyping and how ICT enables designers and clients to 'talk' to each other.	• Design specifications are developed through research information and used to generate and evaluate design ideas. • The homework asks students to develop design ideas and suggests working to a limited colour palate – an industrial practice. • The video enables students to understand the use of CAD and ICT in industry. If computers are available students can use CAD to develop design ideas and colourways.	**Homework** Students develop ideas and colourways for their accessory. You could limit the number of colours to be used in the design – often fabric designs have a maximum of three or four colours. **Further activities** Students can explain the benefits to the textiles industry of using CAD and ICT eg. • How CAD is used to develop and adapt designs and colourways etc. • How designers use ICT to work with clients • The impact of CAD/ICT on the development of prototype textile products.
Test and evaluate design ideas against the design specification. Understand the difference between quality of design and manufacture.	**DMA: Star diagrams** Students use star diagrams to evaluate their design ideas against the specification, justifying the chosen design. **FPT: Experimenting with techniques** Students can experiment with techniques to test the decoration of the accessory, using block printing, tie-dye, batik, fabric-painting, applique, embroidery etc, depending on students' prior knowledge and teacher expertise.	• Opportunities here for students to explore techniques – industrial designers have to be artistic and have an excellent technical knowledge so that they understand the limitations and possibilities of what they are designing. • The concept of practising textile techniques – practice makes perfect – can provide the opportunity to discuss the idea of quality of design and manufacturer.	**Homework** Students can mount samples, write up and evaluate the appropriateness of their experimental techniques for decorating their accessory. **Further activities** Students could investigate manufacturing issues such as the water pollution caused by dyeing and finishing of fabrics.
Produce and use a detailed production plan which identifies the stages of manufacture, the materials, components and equipment required to make a textiles product.	**DMA: Production planning** The production plan includes a manufacturing specification for the accessory, with detailed drawings, design details, dimensions, seam allowances, tolerance, materials and costs, fastenings and finishing details.	• Production planning is a key industrial practice. The manufacturing specification provides clear and detailed instructions about the product's styling, materials and construction. • Students can use a systems – a flow diagram with feedback loops to	**Homework** Produce a flow diagram to show where and how quality can be checked when making the accessory. **Further activities** Use a computer to produce a

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Figure 2: This shows a typical Key Stage 4 textiles project. It demonstrates how a variety of industrial practices can easily be integrated into textiles work (continued).

Provide quality checks and feedback to help solve problems.		show how and where quality checks are made to monitor quality.	work order, giving the assembly processes, equipment required process time and tolerances.
Understand that a textile's quality of manufacture can be judged by the appropriate use of suitable materials, how it meets manufacturing requirements and its fitness for purpose.	**DMA: Practical work** Practical work to produce decorative elements for the accessory. • Designs could be output from a computer and printed onto freezer paper, then ironed onto a fabric base e.g. for sampling a product as in the video 'Talent and Technology'. Practical work to produce the accessory. • Students use the production plan to monitor quality and the time available. • Students use computer-aided equipment where available to produce accurate/repeatable machine work.	• Textiles CAD/CAM equipment is relatively inexpensive and provides opportunities for computer control. • The information in the production plan will help students to monitor the quality of work, making checks at each stage of production.	**Homework** As required. **Further activities** Students can write a checklist to explain what changes would be needed if the accessory was to be made in quantity.
	DMA: Presentation of work and evaluation • Students display and discuss their work. • Individual evaluation of achievements. • Exam Board assessment sheet provided for student/teacher evaluation of success.	• Presenting ideas and finished work is an industrial practice to be encouraged. A display and/or oral session can improve design and evaluation skills and can be motivating for students.	**Homework** As required.

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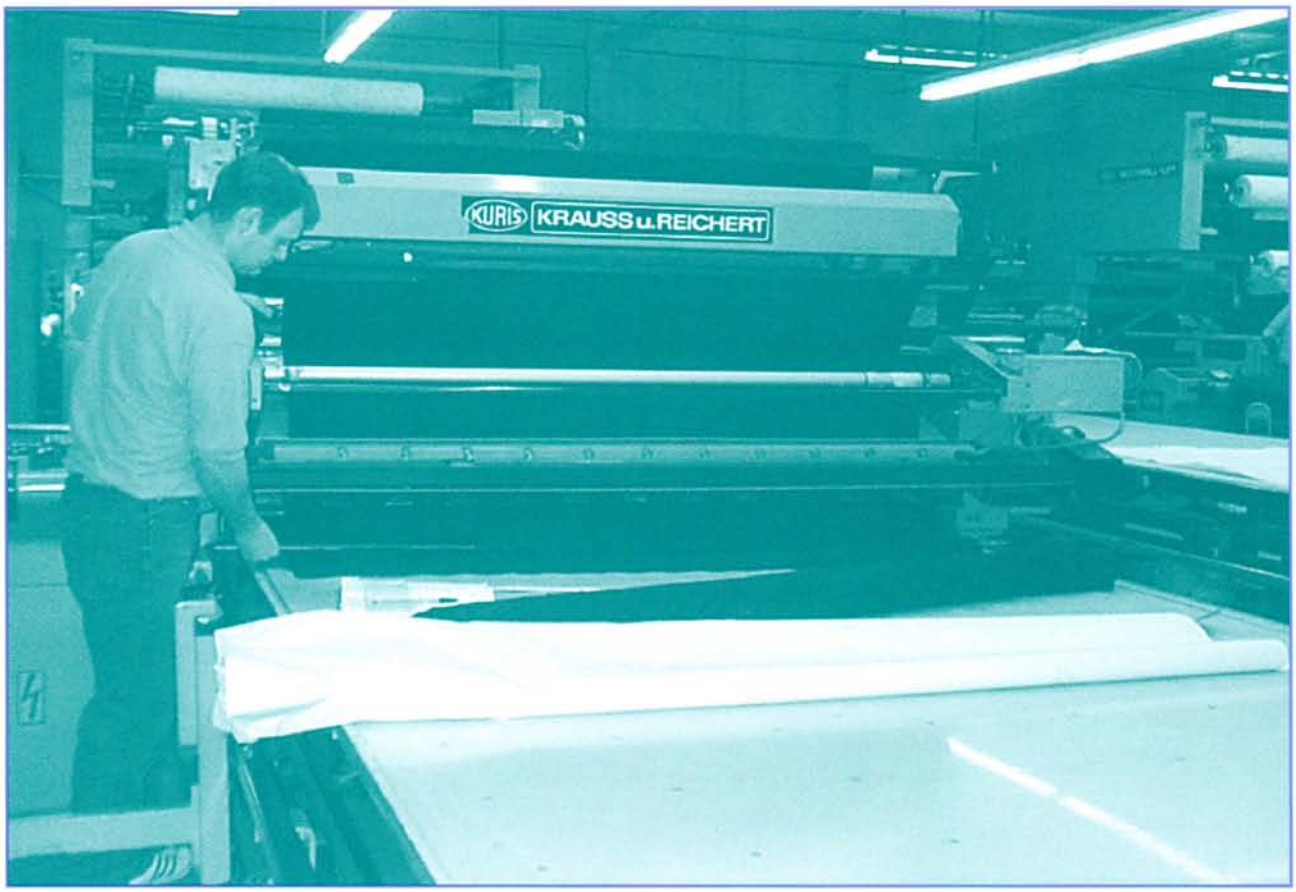
So what is the way forward?

If our subject area is to expand we need to keep up with new ideas and new technology. We need to encourage familiar design and making skills but we also need to emphasise the importance of new ideas, creativity and innovation. We need to find a balance between 'design' and 'technology'. Recently there has been an emphasis on 'technology' and on 'manufacturing' aspects in design and technology, which may have stilted imaginative thinking but if we balance the technological side with creative aspects, our subject can move forward with confidence. Incorporating industrial practices that include 'designing' and 'manufacturing' and creativity will enable this.

In order to manage constant change and in order to keep our subject at the leading edge of the curriculum we need to have access to up-to-date materials, ICT and the Internet. Access to new materials and technology must be easy and new information needs to be relevant. We also need to enable the easy integration of industrial and commercial practices into design and technology work.

There are a number of questions related to design and technology that need to be answered. Design and manufacturing practices can involve designing and making for one-off, batch or high volume. Why do we need to know about this? Are we simply enabling students to have an informed choice or a greater understanding of the importance of designing for manufacture? Should we be encouraging more designers when we already produce many brilliant designers that our industry fails to employ? If we encourage an interest in manufacturing as well as design will we enable students interested in product design to become more employable? These are issues that also face higher education. There is no doubt that industry needs innovative designers, but ones that also have an understanding of designing cost-effective commercial products. Industry needs technologists who can source materials, have an understanding of them and develop



Laying fabric for cutting.

products to a price point. Industry doesn't need designers, it needs design technologists. This is one reason why design and technology is important. Check out higher education courses relating to design or technology - the content of many of these courses is now much more closely related to the design and technology curriculum.

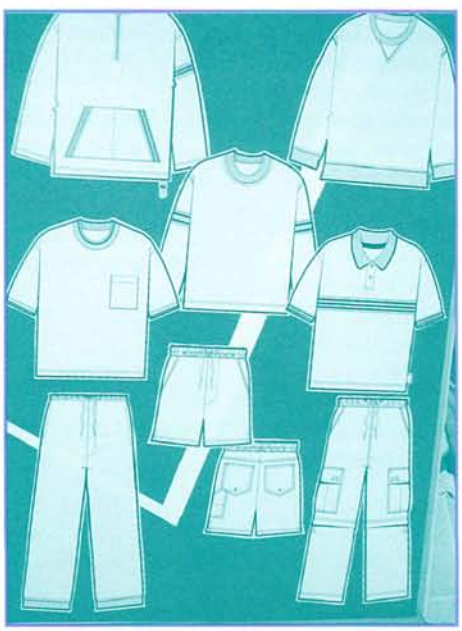
"Should we be encouraging more designers when we already produce many brilliant designers that our industry fails to employ?"

"If we encourage an interest in manufacturing as well as design will we enable students interested in product design to become more employable?"

Industrial and commercial practices commonly used in designing and manufacturing and how these can be translated into classroom practice in different focus material areas

Industrial and commercial practices are process-based activities that enable manufacturers to make cost-effective products at a profit. Industrial practices include manufacturing *and* designing activities, used to ensure the production of high quality products for specific market groups.

The industrial practices used by manufacturers depend on the type of products they make, the scale of production and the target market group. Many industrial practices are common to a range of manufacturing sectors, where the influence of style and



Images in outline CAD.

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Removing cut pieces of fabric.

'values' issues on design is increasing – in a global manufacturing environment successful products cannot compete on cost alone, but need the 'added value' that quality of design can bring. Design and technology encourages an understanding of quality of design and manufacture.

Translating industrial practices into classroom activities

The left-hand column of the chart (Figure 1) shows commonly used industrial and commercial practices. The examples in the right hand columns show how some of these industrial practices can be translated into classroom activities for different focus material areas.

A unit of work for Key Stage 4 textiles technology

Figure 2 shows a typical Key Stage 4 textiles project. It is written to demonstrate how a variety of industrial practices can easily be integrated into textiles work. It is not possible in the space of this article to include details of every possible activity related to industrial practices. Refer to Figure 1 for more ideas.

The unit of work includes:

- learning objectives
- possible teaching activities
- opportunities for building an understanding of industrial practices
- homework ideas/further activities.

References

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