By the end of this spread, you should be able to:

- describe the advantages computers have over traditional drawing techniques
- describe how computers can be used to model and test ideas
- consider how computer models can be used for publicity

Computers are being used more and more by designers both in industry and in schools and colleges. At the beginning of the design process traditional sketching techniques are normally used because the speed of drawing must keep up with the flow of ideas. However, as soon as initial development has been completed the designer will use a computer to develop the idea. A computer has significant advantages over traditional drawing techniques.

**Computer versatility**

**CAD (Computer-aided design)** software allows the designer to draw any shape accurately and quickly. Standard shapes are usually scanned or stored in a library and can then be imported instantly into a drawing. Areas of the drawing can be repeated using the cut, copy and paste facilities. Components of the drawings can be moved, resized, spun or flipped into a new position. All these alterations can take place instantly and without any loss of quality. Intermediate design stages can be saved and reloaded as necessary as well as the final version. Storing the work safely is a great advantage. A floppy disc is much more convenient to transport than drawings and is much less prone to damage, or the work can be sent electronically.

Once the drawing has been completed the computer really starts to save vast amounts of time. The designer can try different colours, shades and textures. He can change a 2-dimensional image into 3-D and even display views around or through what he has drawn to see it from different angles. The final designs can be printed without any loss of quality. **Parts lists** can be generated by computer if needed. The design information is in a state which can be loaded onto other computers anywhere in the world. **Video conferencing** even allows designers sitting at different computers to develop the same design on screen. They can talk over the design and even take over the mouse control to illustrate their ideas. The design can then be sent to other computers which will control the actual manufacture of the artefact without any need for redrawing (see next spread).

**Computer modelling and testing**

As computers become more powerful they are able to test and trial ideas by simulating the environment in which they will be used. It is possible to design a mechanism, an electronic circuit or even an entire room interior and then see if it will function properly. Ergonomic information can be checked to ensure that the product is easy to use. It is possible to simulate loads and predict the stresses that different parts of the structure might be exposed to. This is a much more cost-effective way to test products — especially ones which are to be used in unusual or dangerous environments like space, for example.

**Marketing and publicity**

Some of the drawings and models, together with descriptive text and test reports, will be suitable for designing **data sheets** and **publicity material**. Graphics can be copied into desktop publishing packages and full use made of colour for a variety of brochures and advertising literature related to products you have designed.

1. Use a pencil and paper to draw the best CD storage system you can in three minutes. Now time how long it takes to do the same drawing using a computer. Explain which was the quickest method, and then which was the best.

2. List the advantages of using a computer to design a new light shade.

3. Think of a product which is likely to be used in an environment which would be difficult to recreate in any other way than on a computer. Explain what the product is and what tests you would ask the computer to perform.
### 7.6 COMPUTER-AIDED MANUFACTURE (CAM)

By the end of this spread, you should be able to:
- Suggest an appropriate use for CAM
- Identify the main advantages and disadvantages of using CAM during one of your projects
- Discuss the merits of CAM when compared against manual manufacturing techniques

In the previous spread we saw how computers could be used to help designers to develop and present their ideas. Computers can also be used to replace machine operators by carrying out a number of tasks more effectively. When a computer controls a machine to make something we call this computer-aided manufacture or CAM. The results of CAD can be fed straight into a CAM system.

**Using CAM at school or college**

In a school workshop you may find a computer-controlled router like the one pictured. This machine can cut most light materials very accurately and quickly. You use it to make a circle from a piece of acrylic. You draw the circle on the computer and then let the computer control the router to cut the shape. Providing you know how to use the software then the job could be completed very quickly. Without this machine the task would be a real test of craftsmanship. It would certainly take longer to make and be very difficult to produce a perfect circle.

**Using CAM in industry**

The jobs which make up the manufacturing process in industry are much more complex. A CAM system can be used to control many tasks simultaneously. In the picture you can see car parts being welded together using computer-controlled robot arms. Vast numbers of identical products are being made – this is called mass production. There are advantages and disadvantages that need to be considered when deciding whether to install such a system in a factory. The equipment is very expensive and complicated to set up so the installation costs will be very high. You may well need very skilled employees to set up this system. However, once the system is running the computer will control most or all of the machinery. The task will be completed very accurately, safely and quickly, and could continue for long periods without losing quality.

Furniture manufacturers can also benefit from using a CAM system even though they do not make vast numbers of identical products. They may have a product range from which people choose a particular style. They would use a computer which can store details of the various styles and allow them to make a small number of chairs in one style and then quickly switch to another style. CAM is therefore useful for this batch production as well. This is called flexible manufacturing.

CAM may even be advantageous for a company who has to produce single items, like a sign writer. This is called one-off production. The computer can have many typefaces stored in its memory which can be arranged easily on screen to suit the customer’s requirements. The computer can then control the machine which cuts out the letters to make the sign.

**Comparison between CAM and manual manufacturing processes**

<table>
<thead>
<tr>
<th>CAM</th>
<th>Manual manufacture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particularly accurate, producing items identical to each other, at high speed.</td>
<td>Can be accurate if person is highly trained; no two items would be identical; long production time.</td>
</tr>
<tr>
<td>Production system can go on for long periods without resting or getting bored.</td>
<td>Person has legal time limits within which to work; quality and safety may be compromised as they get tired.</td>
</tr>
<tr>
<td>Can work safely without risk of injury, no matter how heavy, delicate or dangerous the materials being used.</td>
<td>Health and safety regulations need to be followed to ensure safe working practices; it might not be possible to work with some very heavy, delicate or dangerous materials.</td>
</tr>
<tr>
<td>Risk of low utilisation or obsolescence.</td>
<td>Labour-intensive; high running costs.</td>
</tr>
<tr>
<td>Installation and initial programming very costly and highly skilled, but running costs and skill factors low once in production (except for maintenance).</td>
<td>Lower installation cost and quicker to get production started.</td>
</tr>
</tbody>
</table>

1. Why would we use CAM to make a large number of identical items?
2. Explain why you might make a product using hand tools rather than a CAM system.
3. Explain why there are fewer injuries when a CAM system is being used rather than a manual manufacturing process.