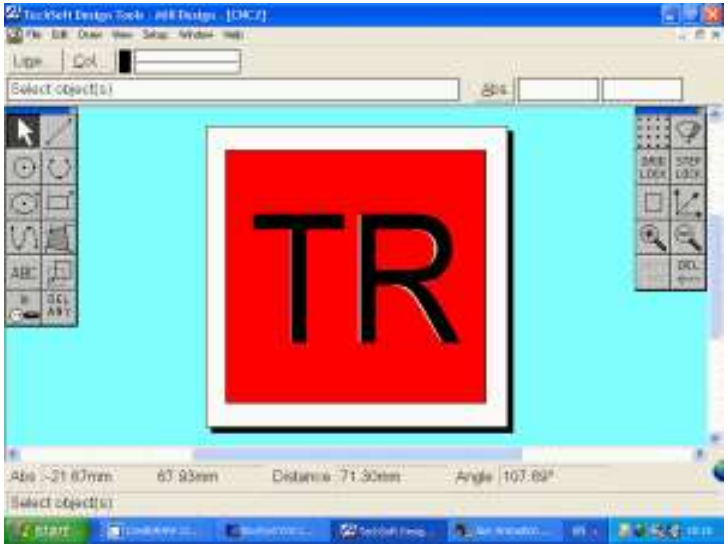
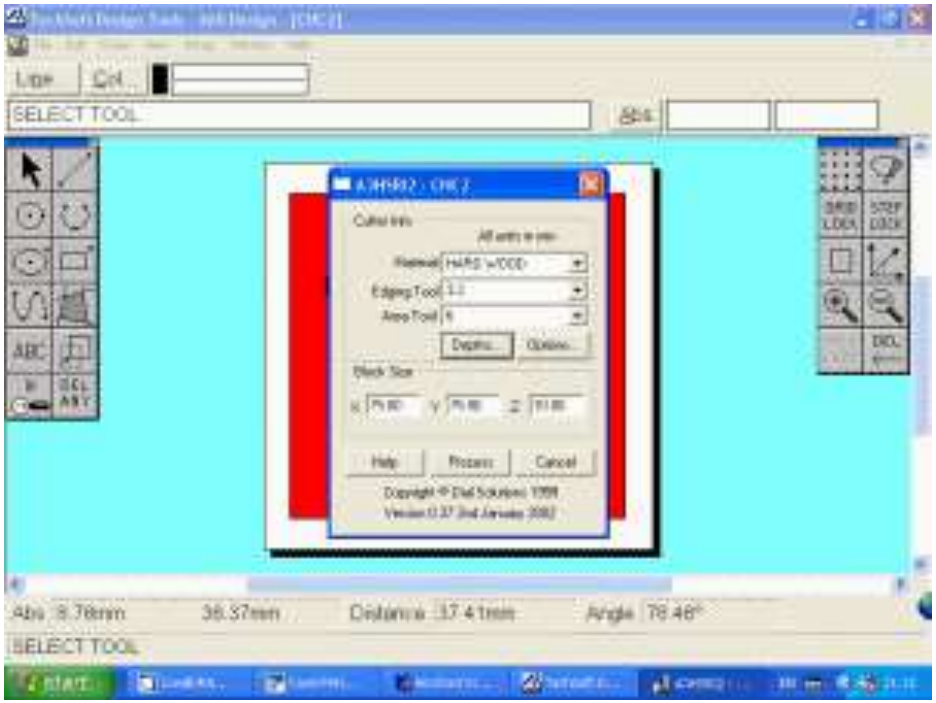
Computer Aided Design and Manufacture

There are two types of computer aided design software, two dimensional and three dimensional modellers. Both can be used in manufacturing to drive computer aided machinery, such as CNC lathes , CNC milling machines, Laser cutters and rapid prototype machines.

2D Computer Aided Design and Manufacture



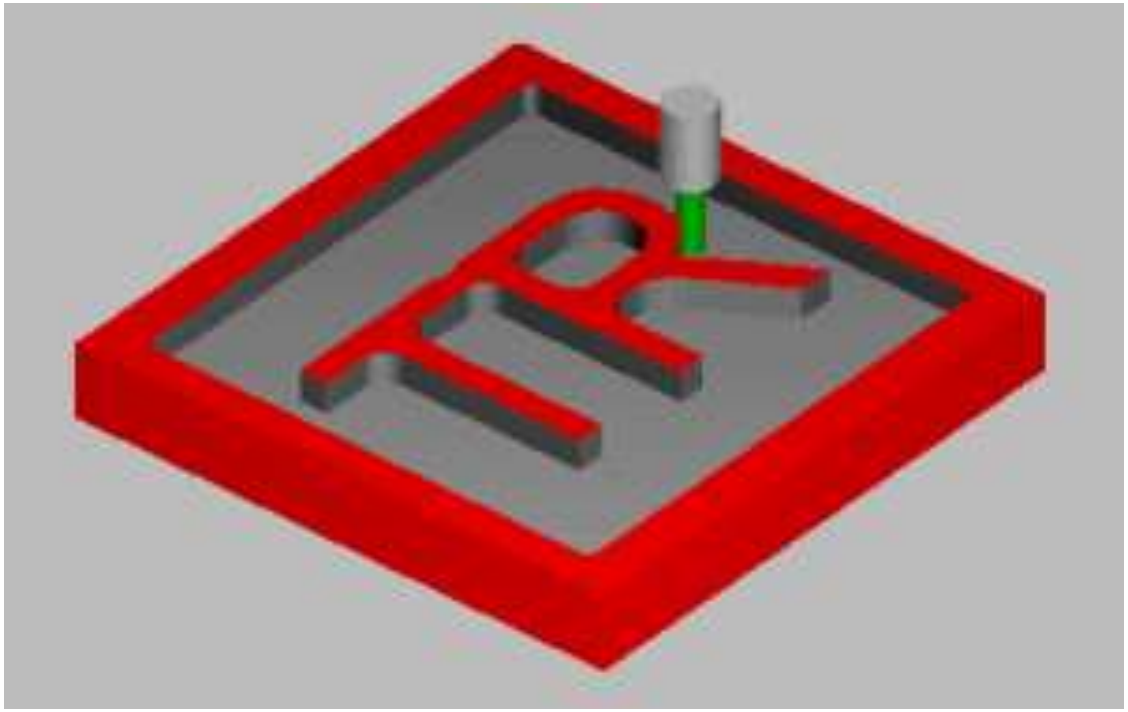
The design is drawn using software such as TechSoft 2D Design. At first appearance this software looks basic but, depending on the skill of the designer, quite complex designs can be produced.
The example shown is a simple block of material with initials.



When the design is complete the drawing is processed. This converts the drawing into a detailed series of X, Y and Z coordinates. Processing must take place before the CNC machine can cut the design from material.

When the CNC machine shapes the material the cutter follows the coordinates, in sequence, until the shape has been manufactured.

Most CAD/CAM software allows the designer to test the manufacture of his/her design on a computer rather than actually making it. This saves time and materials. Testing designs is carried out using 'simulation' software (Boxford use 'CAD/CAM Design Tools' software). When the design is run through simulation software the computer displays the manufacturing on the screen. It also checks whether or not the design can be manufactured successfully. Many designs have to be altered before they can be made by a CNC machine.



After all the testing and improvements to the design, it can finally be manufactured on a CNC machine.

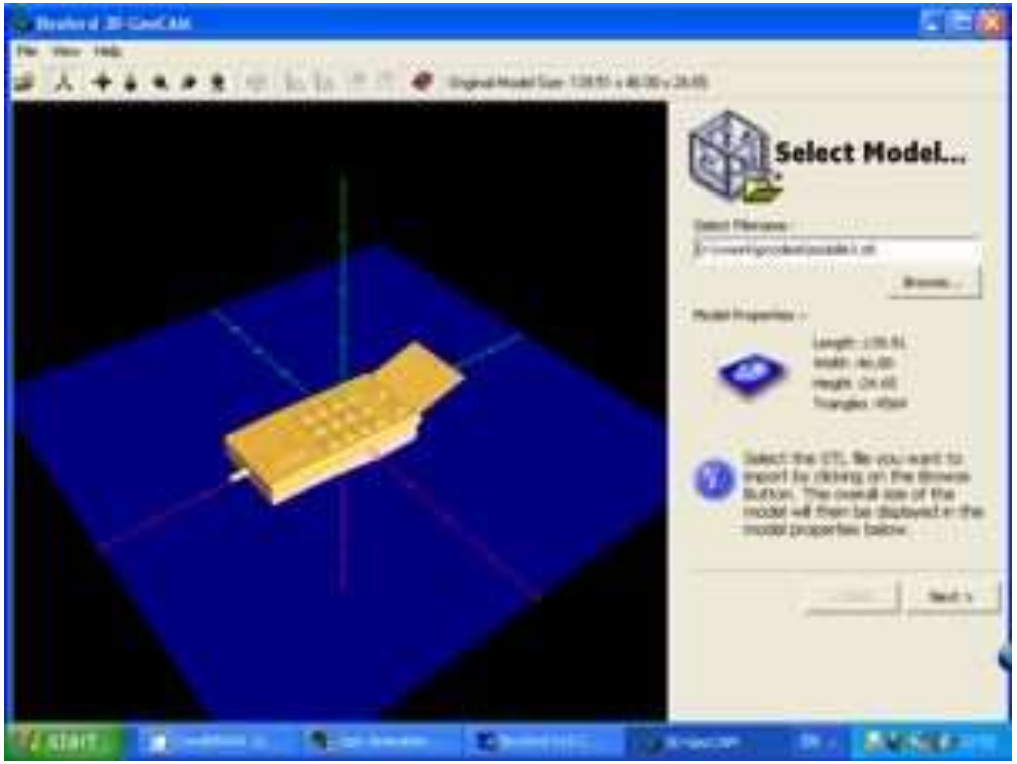
3D Computer Aided Design and Manufacture

3D Design software such as Pro/DESKTOP® allows the designer to produce three dimensional representations of his/her ideas. When completed the design can be viewed on the screen and it can even be revolved and examined at any angle.

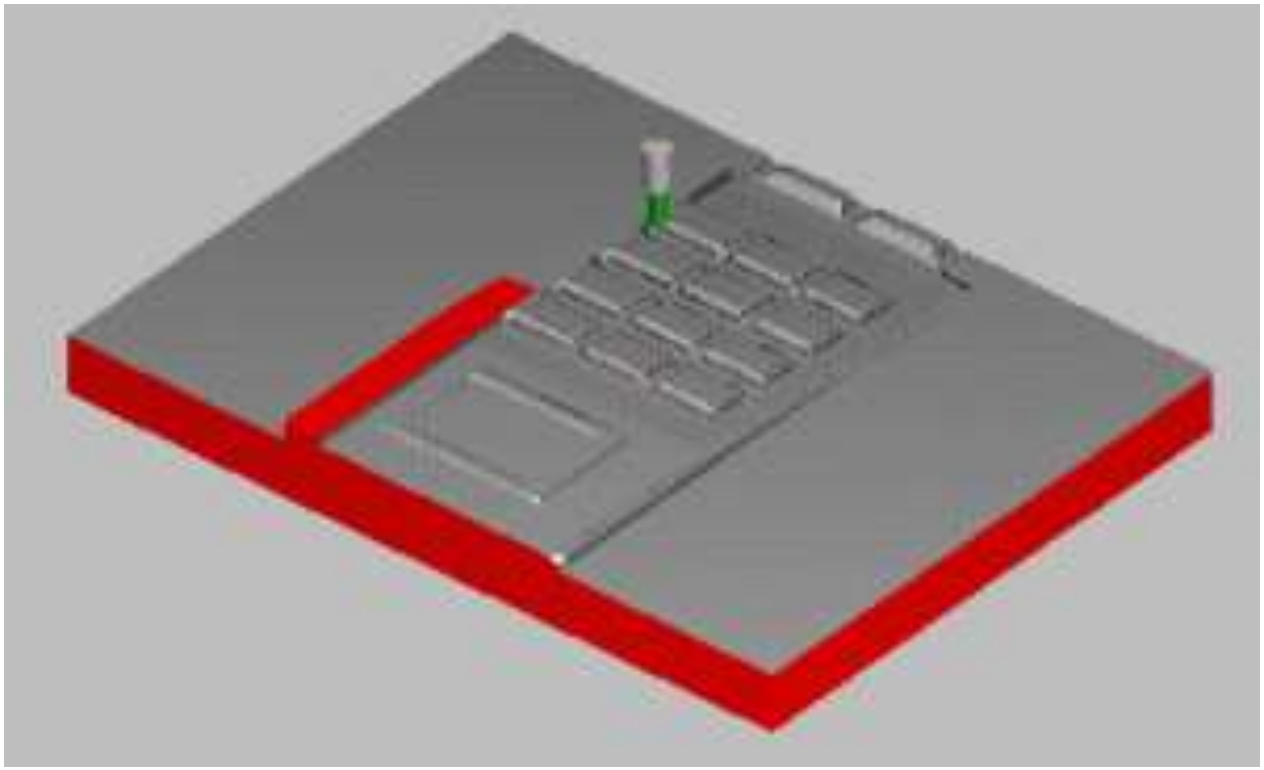
The designer draws up the design using the software.The design can be examined in detailed and if modifications are needed they can be made on the screen.

Software of this type allows the designer to model his/her idea on the screen rather than make/manufacture an expensive model. Good 3D software allows the designer to design almost any item.

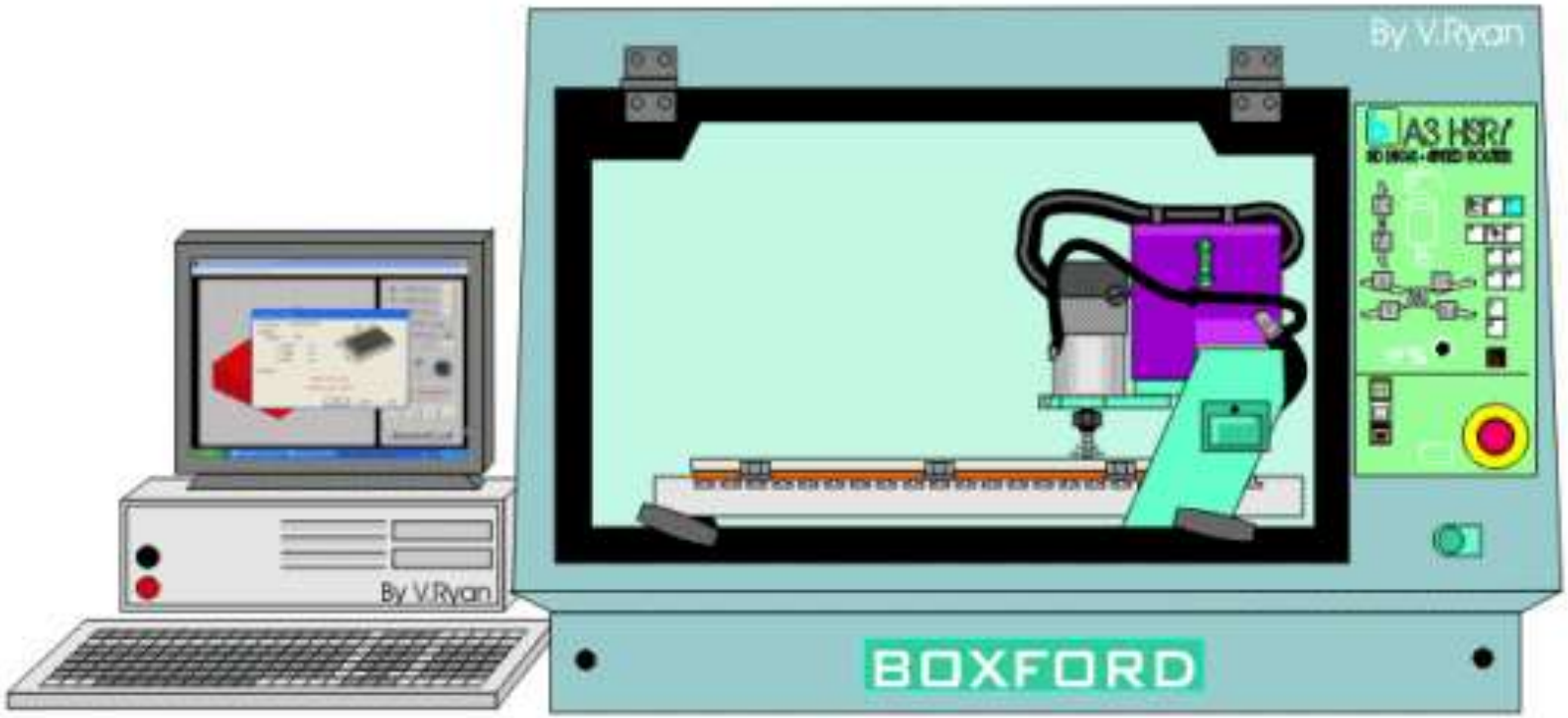
The design is processed. When the design has been completed it must be exported as a stereo lithography file. This type of file can be imported into processing software such as Boxford's 3D-GeoCAM which converts the drawing into a long list of coordinates. Each set of coordinates is called a GM code.



Most CAD/CAM software allows the designer to test the manufacture of his/her design.



When the CNC is in operation it will follow the path set out from the model information. It does this by dividing the solid into hundreds, sometimes thousands of separate thin layers. These can be a 0.1mm in depth. The CNC will continue to cut at the set depth until it has completed the model.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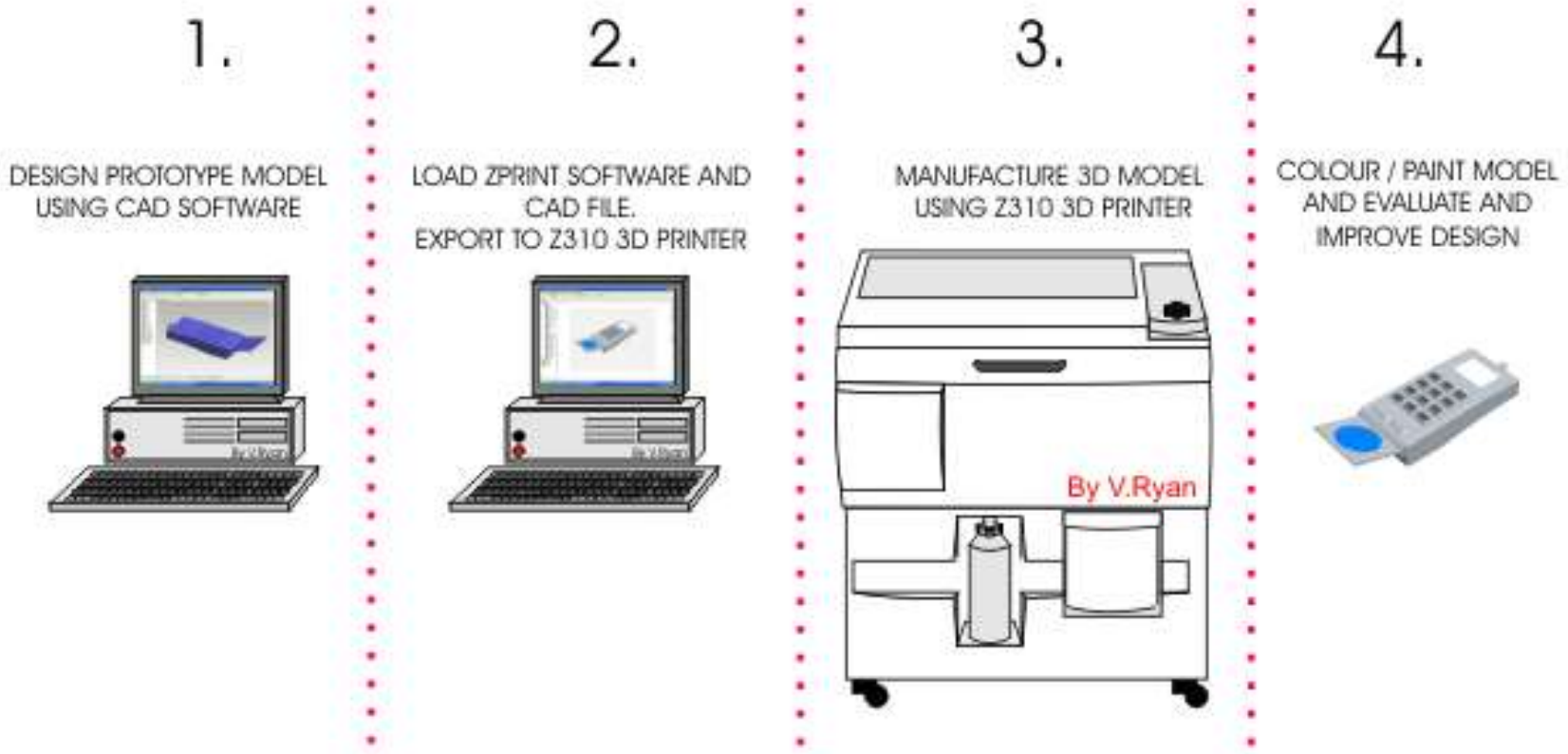
Rapid Prototyping –
The 3D printer - manufacturing sequence

A good example of a rapid prototyping machine is the Z310 3D printer from Z-Corporation. This uses data from computer software called ZPRINT to produce physical models. Machines such as 3D printers are essential for modern high - tech industry, in order that new ideas and concepts can be tested and evaluated before expensive manufacturing begins. Prototype modelling has been shown to reduce the time required to design and manufacture a new product.

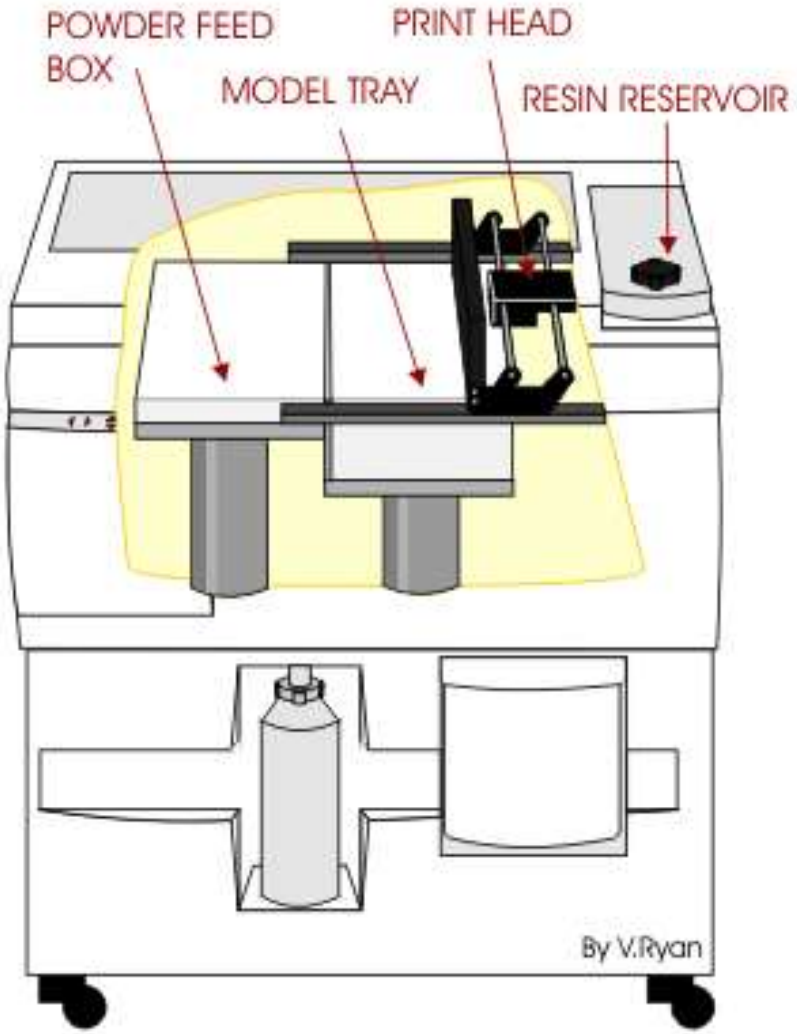
The basic design and manufacturing sequence for a prototype mobile phone is shown below.



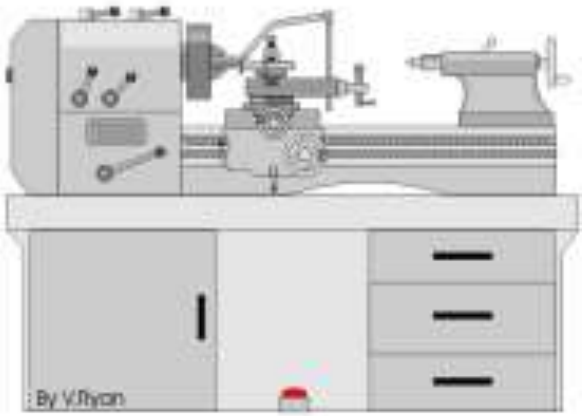
Before manufacturing the 3D model powder is added to the powder feed box and a water based binder/resin is poured into the resin reservoir. These are the essential ingredients to manufacture the model.

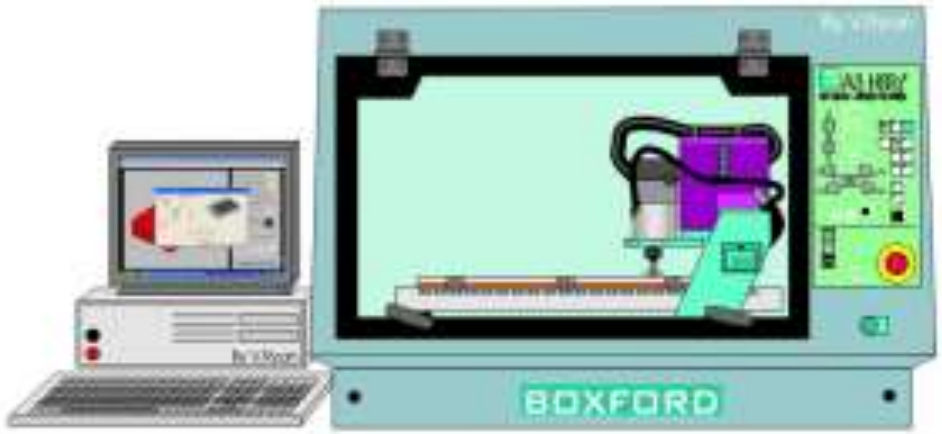
The CAD file is opened in ZPRINT software. The software then controls the printer building the model one layer at a time, gluing together the cross sections of the model being built.

A typical hand held model can be manufactured in less than an hour, at the fraction of the cost of manufacturing it by hand.



CNC Computer Numerical Control machines are widely used in manufacturing industry. Traditional machines such as vertical millers, centre lathes, shaping machines, routers etc.... operated by a trained engineer have, in many cases, been replaced by computer control machines.





ADVANTAGES

1. CAD/CAM machines can be used continuously 24 hours a day, 365 days a year and only need to be switched off for occasional maintenance.
2. CAD/CAM machines are programmed with a design which can then be manufactured hundreds or even thousands of times. Each manufactured product will be exactly the same.
3. Less skilled/trained people can operate CAD/CAM unlike manual lathes / milling machines etc.. which need skilled engineers.
4. CAD/CAM machines can be updated by improving the software used to drive the machines
5. Training in the use of CAD/CAM is available through the use of ‘virtual software’. This is software that allows the operator to practice using the CAD/CAM machine on the screen of a computer. The software is similar to a computer game.
6. CAD/CAM machines can be programmed by advanced design software such as Pro/DESKTOP®, enabling the manufacture of products that cannot be made by manual machines, even those used by skilled designers / engineers.
7. Modern design software allows the designer to simulate the manufacture of his/her idea. There is no need to make a prototype or a model. This saves time and money.
8. One person can supervise many CAD/CAM machines as once they are programmed they can usually be left to work by themselves. Sometimes only the cutting tools need replacing occasionally.
9. A skilled engineer can make the same component many times. However, if each component is carefully studied, each one will vary slightly. A CAD/CAM machine will manufacture each component as an exact match.

DISADVANTAGES

1. CAD/CAM machines are more expensive than manually operated machines, although costs are slowly coming down.
2. The CAD/CAM machine operator only needs basic training and skills, enough to supervise several machines. In years gone by, engineers needed years of training to operate centre lathes, milling machines and other manually operated machines. This means many of the old skills are been lost.
3. Less workers are required to operate CAD/CAM machines compared to manually operated machines. Investment in CAD/CAM machines can lead to unemployment.
4. Many countries no longer teach pupils / students how to use manually operated lathes / milling machines etc... Pupils / students no longer develop the detailed skills required by engineers of the past. These include mathematical and engineering skills.