Computer-aided manufacture (CAM) and rapid prototyping

CAM:

- Automated machinery is controlled by software to manufacture physical parts
- CAM uses Computer numerical control (CNC) and CAD files to generate 3D tool paths for the machinery to follow
- CAM machines include laser cutters, embroidery machines, NC milling machines, routers and lathes

Advantages	Disadvantages
- Very accurate/eliminate human error - Repetitive accuracy - Save and reload drawings to suit demand - High speed/can run 24/7 - Reduced labour costs - Increased health and safety	- High set up costs - Training people to use it is difficult - Low worker morale - High skilled engineers need to be employed - Can't detect faults easily

CNC:

Advantages	Disadvantages
- Can run 24/7 - Designs can be manufactured many times - Less skilled employees needed - CNC can be improved through updates - Reduced labour costs - Repeatable accuracy	- High set up cost - Increased unemployment - Old skills lost

CNC lathes:

- Used to cut away material from objects in complex design

Advantages	Disadvantages
• Will cut range of materials • Repeatability of design • Easy to use/learn • Can run 24/7 • Can automatically change tools to complete different tasks	• Takes time to clamp down material • Tools need changing when blunt • Cutting fluid required • Swarf (of cutting) • Expensive to set up

Uses: Table legs door handles

CNC router:

- Used to cut sheet material that are too thick for the laser cutter

Advantages	Disadvantages
• Cuts a range of materials • Repeatability of design • Safer than traditional method • Less waste than traditional method • Able to run for softer materials such as foam	• Takes time to clamp material • Tools need changing as they become blunt • Requires cutting fluid • Swarf • Material can crack

Uses: To cut out foam (laser can't), cut materials too thick for laser

CNC milling:

- Similar to routers but for metal, cuts grooves/holes/angles into metal work

Advantages	Disadvantages
• Will cut range of materials • Repeatability of design • Easy to use/learn • Can run 24/7 • Can automatically change tools to complete different tasks	• Takes time to clamp down material • Tools need changing when blunt • Cutting fluid required • Swarf (of cutting) • Expensive to set up

Uses: Drilling, routing

CNC laser cutting:

- Cut complex shapes in a wide range of materials (paper, polymers, timber, metals, textile)

Advantages	Disadvantages
• Clean edge finish • Increased accuracy • No wear and tear on tools • Easy to set up • Can produce repeat designs	• Energy intensive • Expensive • Leave burn marks/some materials catch on fire • Does not work for all materials • Inconsistent production times

Uses: Engraving, cutting material size

CNC vinyl cutter:

- Image designed on CAD
- Peel of background
- Low tack film cut out
- Mark out surface

- Apply image to surface
- Remove low tack

Advantages	Disadvantages
• Good for low production • Resistant to moisture • Affordable/durable • Can produce bright colourful images	• Loss of jobs for skilled sign writers • Waste from weeding is not recyclable • Not completely flat

Uses: Posters, wallpapers

Rapid prototyping (3D printing):

- Models made using computer-based technology such as a 3D printer

Advantages	Disadvantages
• Fast process with minimal human input • Can be done cheaply/quickly • 3D models can be made to check for errors • Can be used for marketing pictures • Designers can evaluate design • Avoids high cost of errors in final production • Prototypes are made faster/work through the night/24/7 • Prototypes are made more accurately/higher quality/reduced errors • Prototypes can be more complex/intricate/finely detailed • Changes/edits are easier to produce • More modifications/variations can be considered • Better testing/analysis/ /decisions made	• Not as quick as some methods • Can only make small scale designs • Need specific polymer for specific 3D printing machine

• Improved outcomes are developed • Reduced development time/time to market/meet customer demand/satisfaction/increased competitiveness • Saves money (due to reduced labour/materials/energy/resources)	

Uses: Making prototypes of designs