WJEC A2 D&T In depth Knowledge & Understanding

2.3.6c Rapid Prototyping

Rapid prototyping

Rapid prototyping is the fast fabrication of a physical part, component, model or assembly using 3D CAD. The creation of the part, components, model or assembly is normally produced using an additive CAM process.

3D printing: this is the action of making a physical object from a 3D digital model by laying down thin layers in succession to 'build up' the outcome. Advantages of 3D printing include fast production, easily accessible, high quality complex shapes can be achieved, tangible design and product testing and it is a cost-effective method.

Selective Laser Sintering (SLS) uses a high-powered laser to 'sinter' or solidify powdered polymer. This process has been modified to work with glass, metals and ceramics, including direct metal laser sintering (DMLS) and selective laser melting (SLM).

Like 3D printing, SLS uses a 'slicing' concept to create layers for the digital outcome to be manufactured. It can be a time-consuming process, but there is very little waste.

Stereo Lithography (SLA): is a technique for creating 3D objects using a laser beam to build up layers or liquid polymer that hardens with laser light. SLA is a quick method, where complex shapes can be built quickly. Machinery is expensive and outcomes can be fragile due to the material and so mechanical testing is very limited.

Benefits of rapid prototyping in large scale production

- reduced design & development and lead-in time
- reduced overall product development cost
- elimination or reduction of risk / faults
- allows functionality testing
- improved and increased user involvement
- ability to evaluate human factors and ergonomics.

Before launching into full scale production in large volumes using mass or continuous flow production systems, the manufacturer must be totally convinced and sure that the final pre-production prototype is perfect.

It is very costly to install / configure the computer controlled automated machinery required for the large volume production process, and errors or oversights at the final decision stage can prove costly, time consuming and create delays in getting the product to market, which in turn delays sales, profits and can cause negative publicity for the company, loss of brand loyalty, and even product failure if a competitor product secures an increased market share due to the delays.

Disadvantages of rapid prototyping

- lack of accuracy
- added initial costs
- some rapid prototyping processes are expensive and not economical
- material properties like surface finish and strength cannot be effectively tested
- requires skilled labour
- materials are limited
- key features can be missed or overlooked because they cannot be prototyped
- end user confusion – mistaking prototype for end product
- developer misunderstanding user objectives.

Deciding on whether to rapid prototype during the manufacturing process depends on the business needs of the company. Some products lend themselves well, but others do not.

Rapid prototyping can limit options, and if the product is a complex one, rapid prototyping may not the best option. If the product is to be produced on a very small scale, for example, a one-off or bespoke item individually commissioned by the user might not be tested with rapid prototyping due to the single product required. Small batches of a product could also be produced as a trial final product rather than using rapid prototyping.