

SGDM:5008 Automated Technology Examination

- ① a) STAGE 1: CAD Solid Model: To do this on existing solid model or closed surface must be available to scan the part therefore reverse engineering it. It can also be made through a CAD/CAM package.

STAGE 2: Convert to .STL File: File generates X, Y, Z coordinates of the 3 vertices of each surface triangle, index to describe build orientation. The support pillars/structure is generated during this stage and is a result of the build orientation. This support structure is used to separate the part from the build platform and to support floating geometries.

STAGE 3: Slice the File: A series of 0.15mm horizontal planes is mathematically passed through the .STL file to generate a series of 2D planes of the build layer thickness.

STAGE 4: Build model: Parameters are set e.g. layer thickness and scan speed. The file is also sent to the machine and the build commences. The elevator lowers the base by the thickness amount programmed.

STAGE 5: Clean and Finish: Part is removed from base/platform. The support structure is removed. The part is finished by curing, sanding or polishing and is then cleaned by wiping or rinsing.

- b) The 3 classifications: Solid based, liquid based, powder based.

Solid based: 3D Printing: Layers are formed by expelling drops. Part material is a thermoplastic and support structure is a wax compound.

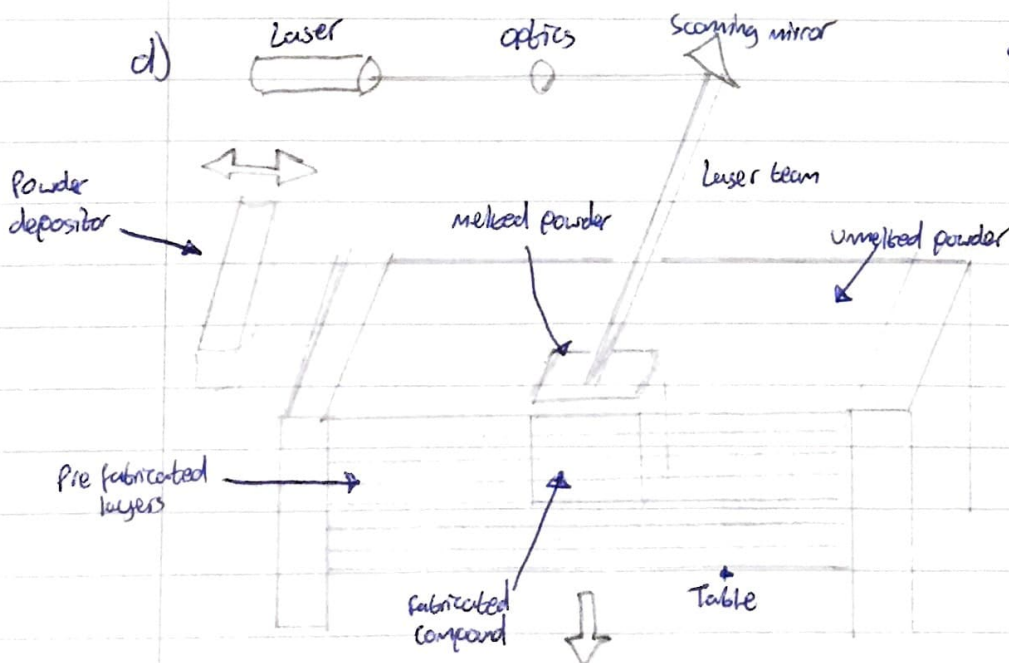
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- ① 6) Material is expelled through jetting heads / dual print head (head for each material). Head moves on X + Y axes and elevator drops by layer thickness.

Liquid based: Stereolithography: Uses a UV laser to scan ashice in a resin tank. Elevator lowers platform.

Powder based: Selective laser Sintering: A CO₂ laser bonds a preheated layer of heat-fusible powder to form a model slice. New powder is then put on top for next slice and material required is fused to that. No support structure required due to strength of bonds. Work table lowers by slice thickness, excess powder simply brushed off and reused. Process can produce end-parts.

- c) Support structure is used to support the part whilst being built during solid + liquid processes. Powder based processes don't require support structure due to the strength of the bonding processes that take place.



Selective laser Melting

Laser bonds powder together by melting it. Similar to SLS however due to different bonding process results in much stronger, denser and more dimensionally accurate parts than SLS.

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- ① a) Robot: A programmable device used to manipulate and transport parts through programmable motions to perform a specific task.

Advantages: Large work envelope and increased repeatability and accuracy over humans.

Disadvantages: Takes time to program and can't do intricate tasks

Cobot: An easy to install robot designed to work safely along side humans.

Advantages: Easy to install, "self taught" and can learn by a technician recording the function and literally guiding the cobot to carry out a task e.g. paint spraying.

Disadvantages: Small working envelope and can't complete tasks where dexterity is required.

- b) Positive impact on manufacturing: ~~Supreme repeatability and time efficiency over humans resulting in quicker turnarounds and a higher standard of work compared to humans.~~

Able to produce industrial scale parts due to brackets / gimbals that couldn't be made before robotics existed.

5 reasons why a company should get a robot: 1. Reduced operating costs due to reduced overheads and improved competitiveness.

2. Improved quality: Robots don't fatigue or get distracted, high quality finish.

3. Increased production rates: 24 hour production available.

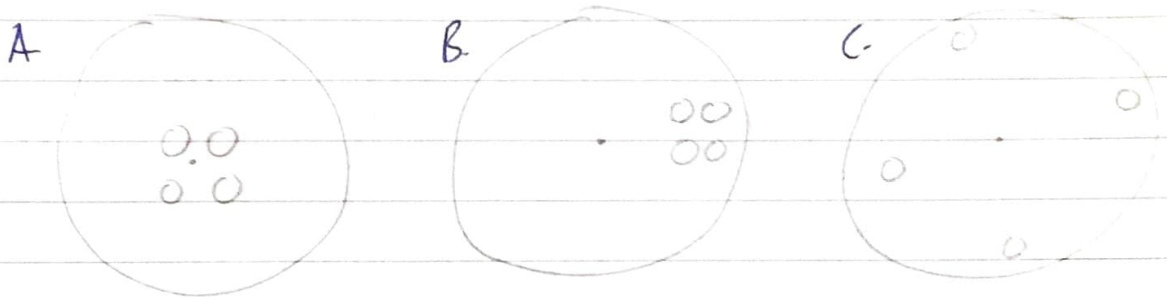
4. Reduced material waste and increased yield: Reduced scrap parts due to less QC failures.

5. Improved health and safety: Robots can carry out health threatening tasks

Automated Technology: Math Examination

- c) Accuracy: The measure of the difference between the true path ^{or} ~~point~~ programmed and the actual point taken.

Repeatability: A measure of a robots ability to a point along a path exactly, time and time again under the same conditions. This path may not be exactly the same as programmed.



A: High accuracy and repeatability

B: High repeatability poor accuracy

C: Poor accuracy poor repeatability

- d) Industrial robots are being used in conjunction with additive manufacturing to produce large scale parts due to the large working envelope. For example a large moon base is to be produced using moon dust as the build material.

- (4) a) Tool measuring: Can be done by touching onto a probe which is at a known location. ~~touching onto either~~ ^a side of the probe and the face of the probe will be a known dimension as it will be half the width and breadth and therefore a known dimension.



side

Tool offsets: Normally the tool offset is programmed to the number of tool ~~being used~~ to be used. e.g. first tool to be used

TO101

TO202

Tool 1: turning tool to face and machine

Tool 2 to centre drill component.

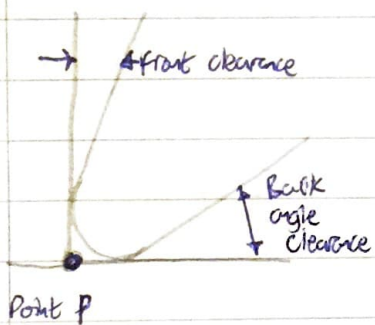
Automated Technology: Main Examination

- b) G71: Rough turning cycle U: 3: ~~finishing allowance~~
in X axis
Max depth of cut
radially in X axis R1: Tool lift off
1mm.

G71: Rough turning cycle. P70 Q130 U1 W0.5 F0.3
 Start and end of geometry in (X) and (Z) Finishing allowances Roughing feed rate
 for roughing cycle mm/rev

This cycle is a roughing cycle for N70-N130 with feed rates, finishing allowances, tool lift off and max depth of cut all programmed in.

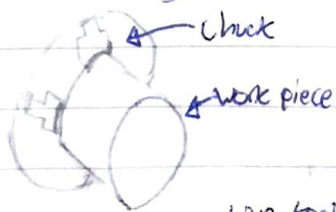
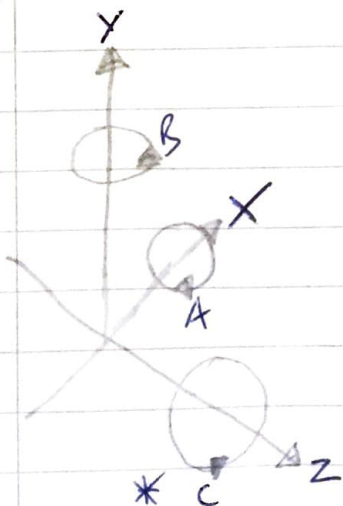
- c) Tool nose radius compensation: Every turning tool has a radius.



Point P is the tool setting point however it doesn't machine anything. Turning on G41 or G42 will allow for this to be accounted for as if it isn't dimensional inaccuracies will occur.

- d) C axis machining: C axis is ~~the~~ the rotational axis about Z.

The chuck rotates in this axis however live tooling such as milling cutters can be used



Live tooling in
CNCs e.g. milling cutter
or drill bit.

Automated Technology : Main Examination

- 5) a) Value Engineering: A systematic method to improve the value of a product by an examination of its function. ~~It is also~~
Value is a ratio of Function : cost.

Industry 4.0 impact: Allows for efficient manufacturing, environmental sustainability and bespoke products ~~with~~ whilst reducing the amount of physical work.

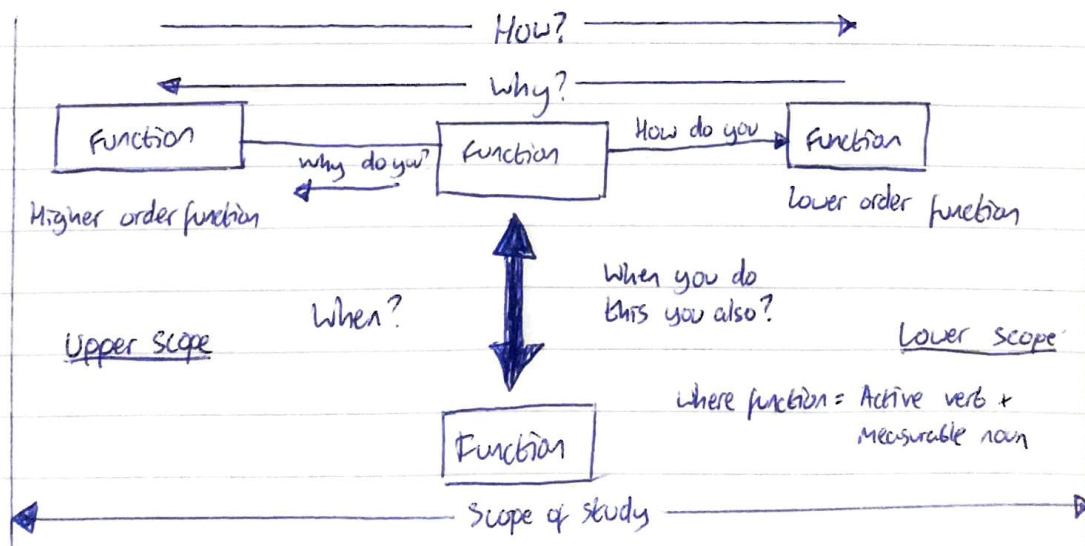
However due to the increased availability of data there might be a lack of security. There could also become ~~too much~~ an increase in dependence on technology resulting in the whole production process being halted if one system is down as if the whole process is automated a single problem will disrupt the entire process for a company. Also ~~allows for~~ provides accurate, real time product/manufacturing data.

6) FAST Diagram

Function Analysis Systems Technique : They are diagrams used to analyse cost.

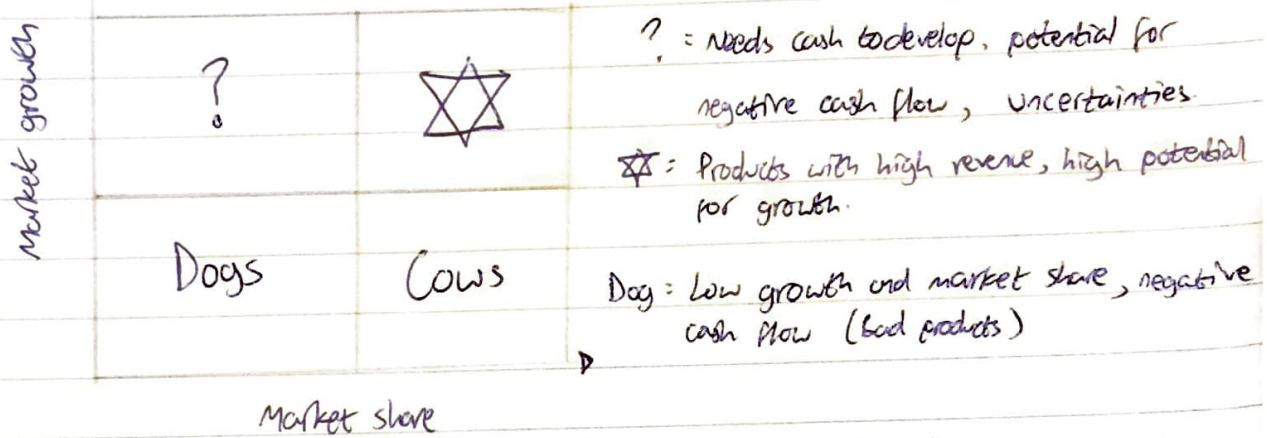
They provide a graphical representation of how functions are linked to deliver the intended service.

* Products such as flat screen TVs and laptops have benefited



Automated Technology: Main Examination

- c) Boston Matrix: A means of analysing the product portfolio to make informed market strategy decisions. It links growth rate, market share and cash flow together.



Cash cows: High market share, low growth, low cost to support and positive cash flow

- d) IIOT's influence on PLM: IIOT is having large effect on PLM due to a significant leap in data collection. Improved analysis ~~enables~~ results in faster reaction times and intelligent forecasting of how a product will do in regards to sales and growth.