

Pearson BTEC Levels 4 Higher Nationals in Engineering (RQF)

Unit 14: Production Engineering for Manufacture

Unit Workbook 3

in a series of 4 for this unit

Learning Outcome 3

Production Systems Within a Manufacturing Plant

3.1 Computer Numerical Control and Automation

3.1.1 Computer Numerical Control

Theory

Computer Numerical Control (CNC) systems are a way to automate the manufacture of a 3D design generated on a computer; the system requires an input of a computer produced design, which will be converted into numbers, which will be considered to be the coordinates of a graph that will control the movement of the machinery.

3.1.2 Automated Materials Handling

Automating the handling process can save a lot of time in a production, and free up a lot of time for specialist labourers to not move materials around the production floor, especially when moving heavy products around the factory.

Video

The best example would be with the link below, the video is a time lapse of the Jaguar Land Rover manufacturing plant at Solihull. You can see the amount of travelling the product goes through, consider the mass and how tiresome it would be for workers to move this about the factory.

<https://www.youtube.com/watch?v=ot0mseRlmxY>

Video

While Jaguar Land Rover transports its product using a rail system, there are products that can be used on a more basic conveyer belt, or products can be guided using an automated guided vehicle (AGV), which will either be designed on a rail or programmed as a black line follower. An example of an AGV is shown in the link below.

<https://www.youtube.com/watch?v=aP6k5VYvGHc>

3.2 Manufacturing Systems

3.2.1 Production Design for Manufacture and Assembly

Theory

Design for manufacture is an approach that integrates the design process with production methods, materials, project planning, assembly, and quality assurance. Design for manufacture requires a fundamental understanding of the capabilities and limitations of materials, machinery, tools and manufacturing processes. It also requires consideration with regards to dimensional accuracy, processing time and efficiency of the production method to optimise the design to make manufacturing a simple and cost effective.

Production Design for Manufacture and Assembly is an important part of the design and manufacturing process, manufacturing the product can account for up to 60% of the total product cost, and a product that is easy to assemble can reduce the time of labour and save the company money. It stands that an easy product to assemble will be easy to disassemble, which is an important consideration for maintenance and recycling the individual components.

3.2.2 Cellular Manufacturing Systems

A manufacturing cell is a small area that consists of one or more workstations, each workstation is used to perform a different process on the part being produced. The machines are quick to modify to produce different products that use the same type of parts. Cellular manufacturing is typically left more towards processes that use machining, finishing and sheet metal working. Cell machinery is typically the likes of lathes, drills, grinders and milling machines, to name but a few.

3.2.3 Flexible Manufacturing Systems

Flexible manufacturing systems are designed to produce a wider range of products in smaller quantities. It is always desirable to have flexibility in manufacturing systems, but sometimes it is not always necessary, a large-scale production does not need to be flexible. It is also possible to create a flexible cellular manufacturing system by using CNC, with an AGV moving the product between cells.

3.2.4 Lean Manufacturing

Lean manufacturing is a concept that focuses on reducing as much waste as possible in the manufacturing process. This method of manufacturing requires a comprehensive analysis of the cost of each activity, and the costs for productive and non-productive labour, in a bid to reduce it as much as possible, without compromising the quality of the product.

Lean production focuses on:

- The efficiency and effectiveness of each step of the manufacturing process
- The efficiency of all the equipment used
- The activities of all personnel involved in each step of the process

3.2.5 Just-In-Time Manufacturing

The concept of just-in-time (JIT) manufacturing is:

3.3 Product Treatments

3.3.1 Heat Treatment Facilities

Theory

Some manufacturing plants will require their metallic products to be treated with heat (or “annealed”) this helps recrystallise the microstructure of the material and improve the mechanical properties; however, not all the manufacturing plants will have the facilities on site, whether their business is too small, or the amount of metal needing annealing is too low to justify having the facilities.

3.3.2 Paint and Coating Plants

Adding paint and coating to the product is not just an aesthetic choice, they are also a defence against material corrosion from the environment. Corrosion is a chemical (or electrochemical) reaction that degrades the material’s properties. As such, it is important to ensure that any perishable parts are covered and protected from the environment.

The most notable form of corrosion is of course, rust. If we think about an old car, the first place that rust occurs is the wheel arches, where the tyres would throw stones up and chip away at the paint, leaving it exposed to the environment, and accelerated by the addition of water thrown up by the tyres on a wet road. However, not all corrosion is bad, after all, it is the basis of electrochemistry and the reason why we have mobile electronics powered by batteries. Corrosion is also not always as detrimental as rusting iron, the Statue of Liberty in New York is made of copper, and was brown, over time however, the copper started to corrode, and the green copper oxide surface is the result

A song about the famous Forth Bridge in Scotland, made of iron, was painted to prevent corrosion and compromise the safety of the bridge. When the bridge first opened in 1890, it would take four years to paint the bridge in its entirety. Once painting was complete, the process would start all over again immediately.



Fig.3.1: The Chernobyl New Safe Containment, standing at 150m high, with an arch span of 275m, and weighing 31,000 tonnes.