Pearson BTEC Level _ Higher Nationals in Engineering (RQF)

Unit 50: Advanced Manufacturing Technology

Unit Workbook 2

in a series of 2 for this unit

Learning Outcome 2 & 3

Advanced Manufacturing Products & Industry 4.0

Contents

INTRODUCTION

Analyse an existing product and associated processes to introduce proposals for possible improvements based on the introduction of advanced manufacturing technologies.

- *Manufactured Product:*
    - Research the traditional methods used to manufacture an existing product, determine the associated processes required to bring it to market and identify the limitations of these methods and processes.
    - Explore how advanced manufacturing technology could be applied to produce this product and suggest how applying such processes would influence its production, costs, time to market and customer satisfaction (e.g. healthcare/medical such as hip joint, traditional method vs mass customisation and the possible use of 3D printing).
    - 3D printing and its availability is opening up new markets, but also new business models for organisations; explore the future possibilities for self-serve/or self-production of items.

Evaluate the concept of the next industrial revolution to determine the impact on both manufacturers and the consumer.

- *Next Industrial Revolution:*
    - Industry 4.0.
    - Internet of Things: over time industry has transformed from being local-based to communication-based technology, the possibilities for connected technology and connected factories are ever increasing.
    - Cyber-physical systems: collaborative robotics and highly integrated manufacturing systems.
    - Mass customisation: there is a growing demand and desire for individual products. In 1908, referring to the Model T, Henry Ford said, "You can have any colour, as long as it's black." In 2015 you can have trillions of variations of the Ford F150; advanced manufacturing technology and the ability to manage complexity is key to that realisation.
    - Digitalisation and increased automation; the ability to simulate and create a digital twin has the potential to dramatically reduce time to market.
    - The drive to increase efficiency requires innovation and innovative technology; 25% of all energy used is required by industry alone.
    - Big data; the development of an ever-connected production environment alongside cloud computing presents a challenge of having a stream of production data and the need to analyse this in order to make timely informed decisions.

GUIDANCE

This document is prepared to break the unit material down into bite size chunks. You will see the learning outcomes above treated in their own sections. Therein you will encounter the following structures;

Purpose

Explains *why* you need to study the current section of material. Quite often learners are put off by material which does not initially seem to be relevant to a topic or profession. Once you understand the importance of new learning or theory you will embrace the concepts more readily.

Theory

Conveys new material to you in a straightforward fashion. To support the treatments in this section you are strongly advised to follow the given hyperlinks, which may be useful documents or applications on the web.

Example

The examples/worked examples are presented in a knowledge-building order. Make sure you follow them all through. If you are feeling confident then you might like to treat an example as a question, in which case cover it up and have a go yourself. Many of the examples given resemble assignment questions which will come your way, so follow them through diligently.

Question

Questions should not be avoided if you are determined to learn. Please do take the time to tackle each of the given questions, in the order in which they are presented. The order is important, as further knowledge and confidence is built upon previous knowledge and confidence. As an Online Learner it is important that the answers to questions are immediately available to you. Contact your Unit Tutor if you need help.

Challenge

You can really cement your new knowledge by undertaking the challenges. A challenge could be to download software and perform an exercise. An alternative challenge might involve a practical activity or other form of research.

Video

Videos on the web can be very useful supplements to your distance learning efforts. Wherever an online video(s) will help you then it will be hyperlinked at the appropriate point.

1.1 Manufactured Product

1.1.1 Existing Product Analysis

Designers and Engineers use a variety of tools and techniques to analyse the status of current products and associated processes in order to create a product analysis report. The purpose of this report is to identify weaknesses and threats whilst suggesting the strengths and opportunities for improvement of the product and processes. Advanced manufacturing processes and technologies offer potential improvements in terms of quality, productivity and sustainability. In order to quantify and justify the implementation of any potential changes, a product analysis report should be produced. In an overall product report, there should be several sections analysing the many different relevant facets; examples of tools and techniques to analyse products include ACCESSFM and SWOT.

Figure 1.1: *ACCESSFM & SWOT Templates*

1.1.3 3D Printing Markets & Business Models

The implementation of 3D printing and additive manufacturing in general, is becoming more prevalent in industry, an indeed society today. There are wide-ranging impacts of this technology's insertion on businesses, consider the capability and flexibility improvements, along with the financial ramifications and customer value propositions. (Customer value propositions are essentially just reasons or statements that describe why a customer would buy a product).

It is important to consider what is meant by a business model, it is essentially a construct/blueprint for how value is created, delivered and captured. The purpose of a business model is to provide understanding of the fundamental workings of an organisation and insight into possible routes for different markets and changes in the organisation. Whilst also offering an assessment of the range of changes that could be made, along with the effects and advantages the changes could have.

Business models can be used to show how 3D printing leads to increased market opportunities in supplying what customers want, where and when they want it, as well as producing small quantities of customised products.

Video

The following video offers a detailed insight into how 3D printing is impacting design, current markets and business models:

https://www.youtube.com/watch?v=3aQrRrYQob8

There are several ways that 3D printing could impact on business models:

Firstly, 3D printing facilitates a change in the traditional design which was based on ideal manufacturing to manufacturing to an ideal design. That is to say, products are traditionally designed to be manufactured in high quantities, with little variation, however 3D printing flips this paradigm and enables very short runs of products with high customisability potential. 3D printing also has the added benefit of enabling reduced production, manufacturing and inventory costs. Complicated and varied geometries can be printed, using a variety of different materials, all of which is achievable at a reduced output cost with reduced manufacturing times.

In conclusion, 3D printing offers potential improvements to current businesses as well as enabling new business models based on mass customisation, low volume, cost-efficient manufacturing.

Component	From	To
Customer	Mass Market	Individuals
Finance	High Fixed Cost, Low Variable Costs	Low Fixed Cost, High Variable Cost
Capabilities	Supply Chain Provides Subassemblies	Supply Chain Provides Raw Materials
Value Proposition	Mass Produced	On-Demand Customization

Figure 1.2: *Impact of 3D Printing*

1.2.2 Internet of Things

The (Industrial) Internet of Things (IIOT) is a wide-ranging term that covers a range of technical aspects, broadly including Machine Learning, real-time Analytics, Sensors, Embedded Systems and Big Data. The internet itself is a commonly used tool, within offices and homes throughout the world today and the internet of things is, to put it simply, an extension of the internet as we know it. Connectivity is proliferated through a variety of devices and machines and, through the use of sensors and other hardware, these devices and machines are able to communicate and interact with each other, as well as with human operators.

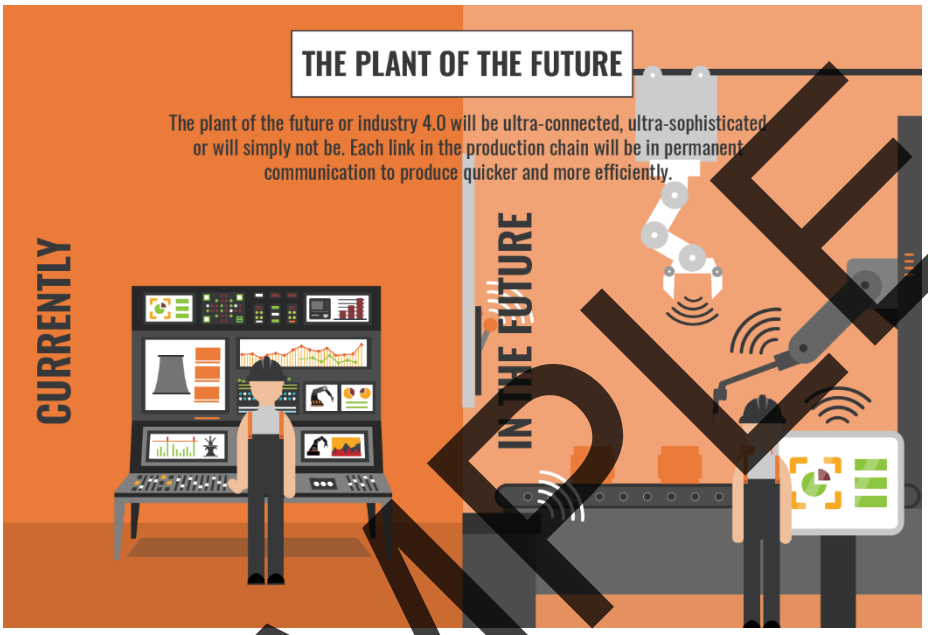

Figure 1.3: *Manufacturing of the Future*

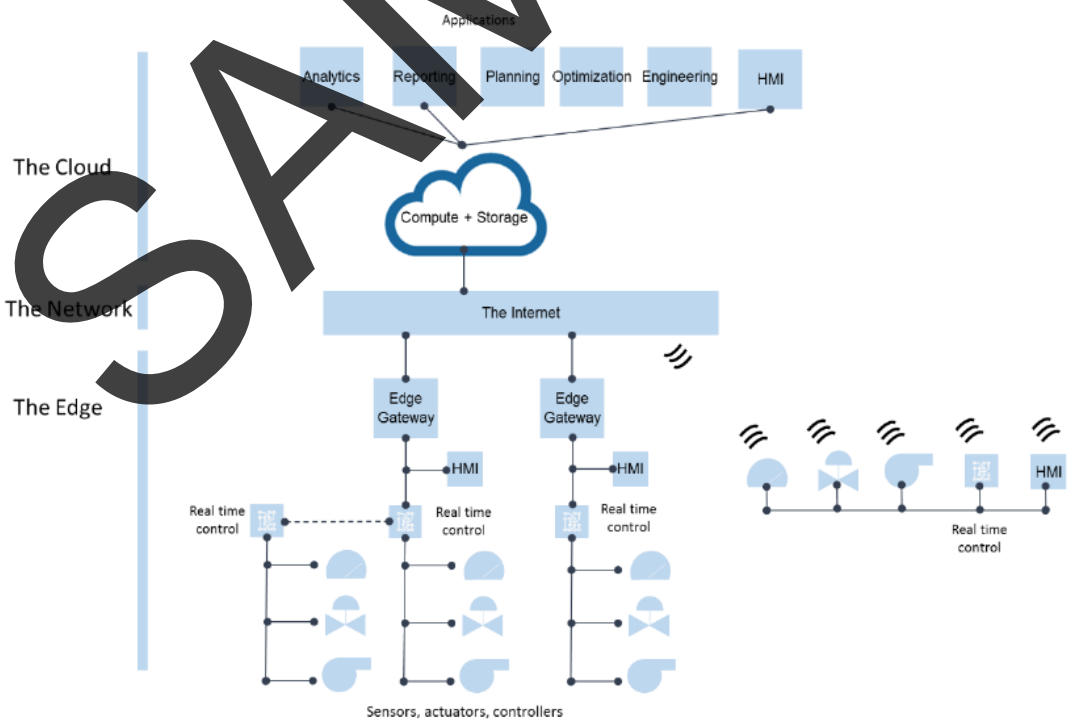

Figure 1.4: *Architecture of the Industrial Internet of Things*