

# Unit 50: Advanced Manufacturing Technology

**Unit code** R/615/1518

**Unit level** 5

**Credit value** 15

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## Introduction

The ability of successful companies to meet the growing demand of customers is heavily influenced by the development of advanced manufacturing technologies. Customers expect high complexity products, on demand, and with a growing element of customisation. In adopting advanced manufacturing technologies, successful companies will ensure faster time to market of new products, improve products and processes, use new, sustainable, materials, and customise to customer requirements. Manufacturing systems engineering underpins this development.

In order to meet changing customer expectations and gain competitive advantage, focus needs to be applied to developing smart factories and advanced manufacturing technologies. Manufacturing organisations will seek integration between manufacturing technology, high performance computing, the internet, and the product at all stages of its life cycle.

Industry 4.0 is the term that has been adopted to describe the 'fourth' industrial revolution currently underway, at present, in the manufacturing and commercial sectors of our society. It is a revolution based on the integration of cyber-physical systems with the Internet of Things and services. For the manufacturing sector, this integration has been enabled by successfully combining high performance computing, the internet and the development of advanced manufacturing technologies. Industry 4.0 is changing the way the world's most successful companies produce the products that their global customers demand.

On successful completion of this unit students will be able to analyse and evaluate the potential of using advanced manufacturing technologies to improve the competitive advantage of the organisations adopting them. The student will develop knowledge and understanding of advanced manufacturing technologies, digitalisation and a range of advanced manufacturing technologies. They will also develop their own research activities into the latest developments.

## Learning Outcomes

By the end of this unit students will be able to:

1. Recognise a range of advanced manufacturing processes and cite examples of where they are most effective.
2. Analyse advanced manufacturing technologies to determine their appropriateness for an application or process.
3. Analyse an existing manufactured product and associated process to introduce proposals for possible improvements based on the introduction of advanced manufacturing technologies.
4. Evaluate the concept of the next industrial revolution to determine the impact on both manufacturers and the consumer.

## Essential Content

### LO1 **Recognise a range of advanced manufacturing processes to cite examples of where they are most effective**

#### *Manufacturing processes:*

Pressing and forming, casting and moulding, joining and soldering, mixing, final assembly, packaging, material handling, quality control/inspection

#### *Advanced manufacturing processes:*

Additive manufacturing technology (e.g. replacing forming, moulding, pressing), 3D printing, impact on rapid prototyping, availability of spares/obsolete parts, medical components available and customised

Mass customisation through 3D printing, opening up a self-serve market

Robotics/human interface and automation, high-precision technology and productivity e.g. aerospace, automotive, electronics assembly

#### *Types of application or industry:*

Industry examples: aerospace, automotive, healthcare, electronics, food and beverage, chemical and pharmaceutical, minerals, oil and gas, retail, fashion

Application examples: assembly, joining, moulding, soldering

### LO2 **Analyse advanced manufacturing technologies to determine their appropriateness for an application or process**

#### *Manufacturing technologies:*

High precision robotics and automation: healthcare (components and processes), aerospace, automotive, process control and visualisation through automation technology

Improvement in productivity through greater automation

Quality of manufacturing processes improved through integration of robotics

Examples of using 3D printing and other forms of additive manufacturing to produce medical equipment, spares parts for items that may have become obsolete, mass customisation; what the customer wants, when they want it

**LO3 Analyse an existing manufactured product and associated process 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

**LO4 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

## Learning Outcomes and Assessment Criteria

Pass		Merit	Distinction
<b>LO1</b> Recognise a range of advanced manufacturing processes to cite examples of where they are most effective			<b>D1</b> Research and evaluate a manufactured product and identify the technology used
<b>P1</b> Recognise a range of advanced manufacturing process or technologies and cite examples of where they are most effective	<b>M1</b> Compare a traditional manufacturer to one employing advanced manufacturing to discuss the fundamental differences		
<b>LO2</b> Analyse advanced manufacturing technologies to determine their appropriateness for an application or process			<b>D2</b> Examine the potential justification for an organisation to invest in advanced manufacturing technology
<b>P2</b> Analyse advanced manufacturing technologies to determine their appropriateness for an application or process	<b>M2</b> Explore how advanced manufacturing could be applied, and give examples of where technology would be suited		
<b>LO3</b> Analyse an existing manufactured product and associated process to introduce proposals for possible improvements based on the introduction of advanced manufacturing technologies			<b>D3</b> Critically evaluate the impact of utilising advanced manufacturing technology rather than the existing method on both the customer and the manufacturer
<b>P3</b> Analyse an existing manufactured product and identify the key technology used to produce the item	<b>M3</b> Evaluate the effectiveness of the current method and suggest an alternative advanced manufacturing technology		

Pass	Merit	Distinction
<b>LO4</b> Evaluate the concept of the next industrial revolution to determine the impact on both manufacturers and the consumer		<b>D4</b> Investigate and justify the types of industry or product that would benefit most from an innovative advanced manufacturing approach
<p><b>P4</b> Evaluate the concept of a 4th industrial revolution</p> <p><b>P5</b> Identify the key elements of Industry 4.0</p>	<b>M4</b> Evaluate the impact of advanced manufacturing on both manufacturers and the customer	

## Recommended Resources

### Textbooks

LEFTERI, C. (2012) *Making It: Manufacturing Techniques for Product Design*. 2nd Ed. Laurence King.

WRIGHT, P.K. (2000) *21st Century Manufacturing*. New Jersey: Prentice-Hall Inc.

### Websites

<a href="https://www.gov.uk">https://www.gov.uk</a>	GOV.UK Future of manufacturing: a new era of opportunity and challenge for the UK (Report)
<a href="https://w3.siemens.com/">https://w3.siemens.com/</a>	Siemens The Future of Manufacturing (General Reference)
<a href="https://hvm.catapult.org.uk/">https://hvm.catapult.org.uk/</a>	Catapult High Value Manufacturing (General Reference)

### Links

This unit links to the following related units:

*Unit 48: Manufacturing Systems Engineering*

*Unit 49: Lean Manufacturing*

*Unit 51: Sustainability*