

Unit 5016: Lean Manufacturing

Unit Code: M/651/0877

Level: 5

Credits: 15

Introduction

Lean manufacturing is a systematic approach to minimising waste in a manufacturing system, by focusing on the activities that add the most value through the eyes of the customer. The basis of lean manufacturing originated in the car industry and was developed by Toyota in Japan. Lean is now used extensively worldwide, in all types and size of organisation, to improve international competitiveness. It is therefore crucial for manufacturing engineers to be able to design and operate manufacturing systems that employ lean successfully.

The aim of this unit is to introduce students to the principles and processes of lean manufacturing, so that they can become an effective and committed practitioner of lean in whatever industry sector they are employed in. To do this, the unit will explore the tools and techniques that are applied by organisations practicing lean. The students will consider both the benefits and challenges of using lean manufacturing, and become sufficiently knowledgeable about the most important process tools and techniques to be able to operate and use them.

Among the topics included in this unit are: scoping and defining lean manufacturing, the benefits and challenges of adopting Lean thinking, , common tools and techniques associated with lean manufacturing and process improvement, and the most appropriate improvement tool(s) to tackle a problem.

On successful completion of this unit students will be able to learn about the common principles of lean manufacturing, a range of the process improvement tools used within lean manufacturing, and effective communication skills in order to lead the process of continuous improvement across an organisation.

Learning Outcomes

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

- LO1 Examine the common principles of lean manufacturing and how the implementation of a lean production system contributes to business success
- LO2 Evaluate the lean approach applied to the modern manufacturing environment
- LO3 Specify a range of the process improvement tools used within lean manufacturing
- LO4 Demonstrate effective communication skills in order to lead the process of continuous improvement across an organisation.

Essential Content

LO1 Examine the common principles of lean manufacturing and how the implementation of a lean production system contributes to business success

Scoping and defining lean manufacturing:

The common principles of lean manufacturing philosophy

Origins of lean, Toyota production system.

Defining lean and its importance to the customer

Identifying and eliminating material and process waste that adds no value from the customer's perspective

Standardization, line balancing and Takt time.

Benefits and challenges of adopting lean:

Why an organisation would consider adopting a lean philosophy

Productivity, quality, customer satisfaction, delivery performance

The benefits of a lean organisation to the customer, the employees, and the shareholders

Outline the benefits of lean in terms of cost, quality, delivery, customer satisfaction, management complexity and cost to serve

Challenges of implementation: change management, managing expectation, empowerment, motivation, 'burning platform', investment, supply chain.

LO2 Evaluate the lean approach applied to the modern manufacturing environment.

Lean Production Systems:

Toyota lean production system and other modern lean production systems for manufacturing

Research lean manufacturing and identify its fundamental elements and the motivation behind creation

Compare Lean thinking with the recognised theory and production systems publicised by other global manufacturers: how do they differ and how they are similar?

How the common principles are now being adopted outside manufacturing

Consider the core principles of lean thinking to support Industry 4.0.

LO3 Specify a range of the process improvement tools used within lean manufacturing

Common tools and techniques associated with lean manufacturing and process improvement:

Six Sigma, 8 Wastes, Workplace organisation such as 5S's (sort, set in order, shine, standardise and sustain), Kaizen, continuous flow, kanban (pull System), just-in-time (JIT), lean simulation activities, value stream mapping, Poke Yoke (error proofing), 5 Whys (Root Cause Analysis), Total Preventive Maintenance (TPM), Total Quality Management (TQM)

Plan-do-check-act (PDCA), Single Minute Exchange of Die (SMED), A3 Reporting, Visual Management.

Selecting the most appropriate improvement tool to tackle a problem:

Tools for improving quality and delivery. Types of faults/defects recorded and analysed to improve future performance, Failure Mode and Effects Analysis (FMEA), Fishbone, Practical Problem Solving (PPS), Process Failure Mode and Effects Analysis (PFMEA)

Equipment needed to perform data collection and analysis, e.g., automatic test equipment, visual automatic inspection system, data acquisition equipment, software programmes to analyse the data and inform operators in real time, analysis and interpretation of data for documentation such as Parts Per Million (PPM and quality adherence).

Use of Industry 4.0 tools/technologies and integration (e.g. automation, robots, PLCs, digital systems and manufacturing engineering systems).

LO4 Demonstrate effective communication skills in order to lead the process of continuous improvement across an organisation

Communication:

Facilitate a small group in the application and use of one of the lean tools (e.g., 5 Whys technique, A3 Report)

Evaluate factors that influence engagement within a group, facilitation skills development, address continuous improvement and change management processes.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Examine the common principles of lean manufacturing and how the implementation of a lean production system contributes to business success		D1 Critically evaluate the advantages and disadvantages of implementing a lean production system.
P1 Examine how lean manufacturing principles can improve business performance.	M1 Analyse the benefits of adopting lean manufacturing. M2 Analyse the key challenges encountered when implementing lean manufacturing.	
LO2 Evaluate the lean approach applied to the modern manufacturing environment		D2 Evaluate lean elements that are critical in making the approach successful in supporting Industry 4.0.
P2 Evaluate the key principle of lean thinking that will support the next industrial revolution. P3 Research and assess alternatives to lean production system approaches. P4 Examine the origins of lean and specify its early applications.	M3 Assess key barriers to the implementation of lean thinking into the modern manufacturing environment.	
LO3 Specify a range of the process improvement tools used within lean manufacturing		
P5 Specify which tools are commonly associated with lean manufacturing and what contexts they would be applied in.	M4 Evaluate how the most common lean tools can be applied to eliminate waste in a manufacturing process.	D3 Develop a justified recommendation for a lean tool to be applied in addressing a specified process improvement.
LO4 Demonstrate effective communication skills in order to lead the process of continuous improvement across an organisation		D4 Critically evaluate the importance of the higher order skills required to successfully deploy change for continuous improvement in an organisation.
P6 Demonstrate skills in developing a communication approach to manage change in an organisation.	M5 Evaluate the impact of this communication approach, including an evaluation of impact on employees and personal effectiveness.	

Recommended Resources

Note: See HN Global for guidance on additional resources.

Print Resources

Ajay, Singh H., Parveen and Almangour B. (Editors) (2023) *Handbook of Smart Manufacturing – Forecasting the Future of Industry 4.0*. 1st Ed. CRC Press.

Blackwell D., George M.L. and Rajan D. (2019) *Lean Six Sigma in the Age of Artificial Intelligence: Harnessing the Power of the Fourth Industrial Revolution*. 1st Ed. McGraw-Hill.

Cudney E.A., Furterer S. and Dietrich D. (Editors) (2021) *Lean Systems – Applications and Case Studies in Manufacturing, Service, and Healthcare*. CRC Press.

Díaz-Reza J.R., García-Alcaraz J.L. and García A.S.M. (2022) *Best Practices in Lean Manufacturing: A Relational Analysis*. Springer.

Dillon A.P. (2019) *A study of the Toyota production system: From an Industrial Engineering Viewpoint*. Routledge.

Pink S. (2022) *Emerging Technologies/Life at the Edge of the Future*. 1st Ed. Routledge.

Silva F. and Ferreira P.L. (2019) *Lean Manufacturing: Implementation, Opportunities and Challenges*. Nova Science Publishers.

Tarantino A. (2022) *Smart Manufacturing: The Lean Six Sigma Way*. Wiley.

Vinodh S. (2023) *Lean Manufacturing: Fundamentals, Tools, Approaches, and Industry 4.0 Integration*. 1st Ed. CRC Press.

Womack, J., Jones, D. and Roos, D. (1990) *The Machine That Changed the World*. Free Press.

Journals

Note: Example journals listed below provide a broad range of articles related to unit content and those relevant for the qualification. Staff and students are encouraged to explore these journals and any other suitable journals to support the development of academic study skills, and subject specific knowledge and skills as part of unit level delivery.

[International Journal of Engineering Business Management](#)

[International Journal of Lean Six Sigma](#)

[International Journal of Technology \(Lean Manufacturing Articles\)](#)

[Journal of Intelligent Manufacturing](#)

[Journal of Manufacturing Processes](#)

[Quality Magazine: Lean Manufacturing](#)

Links

This unit links to the following related units:

Unit 5015: Manufacturing Systems Engineering

Unit 5017: Advanced Manufacturing Technology

Unit 5018: Sustainability.