

Pearson BTEC Level 5 Higher Nationals in Engineering (RQF)

Unit 49: Lean Manufacturing

Unit Workbook 1

in a series of 4 for this unit

Learning Outcome 1

Common Principles of Lean Manufacturing

Contents

INTRODUCTION	3
GUIDANCE	4
1.1 Lean Manufacturing	5
1.1.1 What is Lean Manufacturing?	5
1.1.2 Origins of Lean Manufacturing	5
1.1.3 Principles of Lean Management	7
1.2 Benefits of Lean Management	9
1.2.1 Employees	9
1.2.2 Customers	9
1.2.3 Shareholders	9
1.2.4 Cycle of Prosperity	10
1.3 Lean Manufacturing Challenges	12
1.3.1 Change	12
1.3.2 The “Burning Platform”	12

Sample

INTRODUCTION

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.
 - Defining lean and its importance to the customer.
 - Identifying and eliminating material and process waste that adds no value from the customer's perspective.
- *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.

Sample

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 Lean Manufacturing

Lean manufacturing is a term that has been brought out using a philosophy adopted by Toyota, their well-planned and organised philosophies when it comes to the production line have put them in a prime position to become the largest automobile manufacturer in terms of sales.

1.1.1 What is Lean Manufacturing?

Lean manufacturing is the continuous optimisation of the manufacturing process to minimise the amount of waste produced, without any compromise to the productivity of the production line. Waste, from a manufacturing perspective, is any activity that does not add value from the customer's perspective.

A study conducted by the Lean Enterprise Research Centre has concluded that roughly 60% of production activities add no value to the product for the customer. Considering this value, production lines are able to shave off a lot of waste, and develop higher quality products at a significantly lower cost. Which will improve the business across a number of areas.

1.1.2 Origins of Lean Manufacturing

One of the biggest steps in the manufacturing process was the mass production line introduced by Henry Ford in 1913. Ford took the idea of interchangeable parts, along with creating a linear production line with special purpose machines to assemble individual components within a matter of minutes. Ford's production lines produced an incredible output, and could turn over a full inventory of materials within a matter of days.

The Model T, shown in Fig.1.1 was the manufactured product of Ford's production lines. Before the Model T, cars were a luxury item owned by the rich, the goal of the Model T was to bridge the gap across the classes, and make cars available for everyone. The Model T initially cost \$850 in 1909 (around £13,400 today) and available in a range of colours. Henry Ford's biography tells of his vision for the Model T...

"I will build a motor car for the great multitude. It will be large enough for the family but small enough for the individual to run and care for. It will be constructed of the best materials, by the best men to be hired, after the simplest designs that modern engineering can devise. But it will be so low in price that no man making a good salary will be unable to own one – and enjoy with his family the blessing of hours of pleasure in God's great open spaces."

Ford had incredible faith in his product to revolutionise the automotive sector, and shockingly announced in 1909 that the company will build one model, the Model T, the production process was to be as simple with as little variance as possible with his famous remark:

"Any customer can have a car painted any colour that he wants so long as it is black."



Figure 1.1: The 1909 Ford Model T

Ford's mass production philosophies were hugely successful at increasing the production rate, at the introduction in 1913, the production numbers were greater than the total from the past four years. By 1914, the production lines were able to produce thousands of the Model T every week and in 1924 the River Rouge Plant in Michigan could produce 10,000 engine blocks for the Model T every day. The total number of Model T's purchased is around 15 million over a 19-year period with the cost reaching as low as \$300, and accounted for roughly 40% of cars on the roads in the United States. Fig.1.2 shows the annual production output for the Model T, and a comparison of its price customers paid.

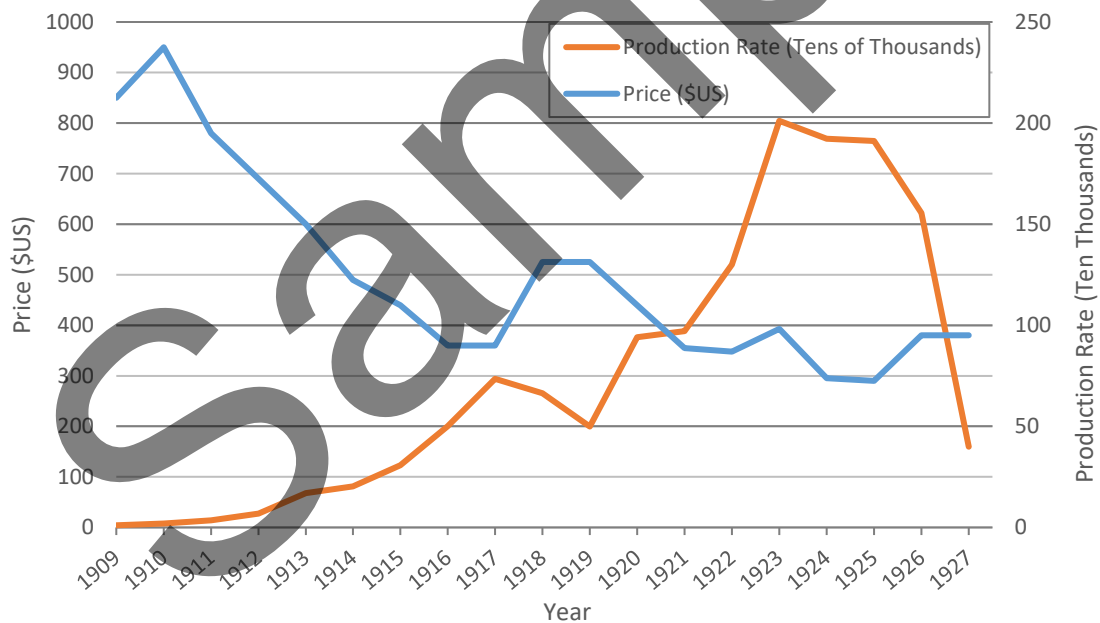


Figure 1.2: Production rate and price of the Model T by year

The trend of the production rate takes an unexpected dip after 1916, and the cost jumps up, why would this be the case?

The Model T for all its success, had one problem, it was inflexible; Ford stood by the idea of any car as long as its black, and that was the only colour available off the production lines after 1913. As machining techniques advanced, other companies were able to compete with production rates and Henry Ford was not

willing to move with the times. The Ford production line was dependent on labour force that was desperate for money and ready to do whatever it takes for a wage. The formation of labour unions and the prosperity that came about during the “Roaring 20s” conflicted with the exploitation of workers that Ford relied on. Some elements of Ford’s production line were adopted by other companies, including General Motors, and with their wider variety of models and colours, became the dominant force in the market in the 1930s.

Years of market dominance from Ford was no accident, but the crucial flaw was the inflexibility of the production lines, a 19-year cycle life of the Model T, with no updates to the design, was too long. It occurred to some at Toyota, however, that through a series of innovations in the production process, it could be possible to provide continuity in the production (the reason that the Model T could be sold so cheaply) and also incorporate a wide variety of products. Revisiting Ford’s concepts, they developed the “Toyota Production System”, which will be discussed in more detail in Work book 2.

1.1.3 Principles of Lean Management

The principles of lean management is not a point-to-point process, it is a continuous cycle of development and improvement. The cycle can be broken down into five principles, shown in Fig.1.3.

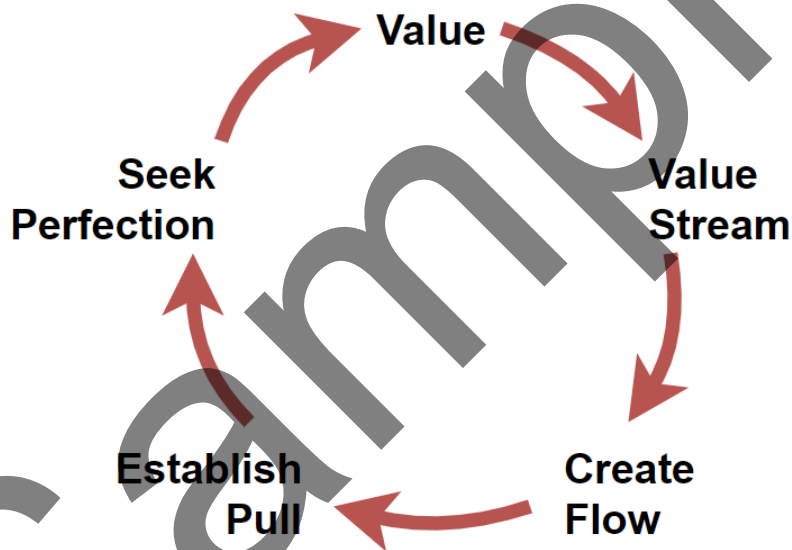


Figure 1.3: Five principles of lean manufacturing

- 1. Value:** Value is always defined as the customer’s need. Obviously, this can change depending on the market or sector, but determining the value should answer questions such as:
 - What is the timeline between manufacturing and delivery?
 - What Price?
 - What are important requirements or expectations of the product?
- 2. Value Stream:** *Other works may refer to this step as “process re-engineering”.* With the end goal defined (from the value stage) the route to achieve this goal should be plotted. It is important to break down each step across each department, whether it is design, procurement, delivery, customer service, production, or even HR and administration. By mapping out the entire process of the product, it is then possible to spot the waste (the processes that do not add value to the product) and develop