

## Chapter 6

# Lean Manufacturing: Principles, Tools, and Practices

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### ABSTRACT

*Lean has become a new mantra in today's manufacturing sector. In this millennium, companies are facing a challenge to be economically competitive in manufacturing. Many of them have realized that the old style of mass manufacturing is no longer successful. Hence, lean manufacturing is being embraced by the companies to simultaneously achieve a competitive edge and economic growth. Many studies have shown that lean organizations are capable of meeting customer's expectations consistently, at each step of the production systems. Lean manufacturing also implies efficient use of non-renewable resources in order to maintain a sustainable environment. To reach the full potential of an organization, lean must be embraced as a holistic business strategy. In this chapter, the history of lean innovation will be briefly discussed, followed by the principles of lean manufacturing and various tools in implementing lean practices. Examples of organizations that have experienced significant improvements once transformed to lean manufacturing will also be cited.*

### INTRODUCTION

*Be ready to revise any system, scrap any method, abandon any theory, if the success of the job requires it. (Henry Ford, 1923)*

Henry Ford, the iconic leader of the automobile industry, introduced assembly line and mass production in manufacturing in the late nineteenth century. He revolutionized manufacturing in the West by revising the system, scrapping the existing methods, and abandoning the old theories. Industrial companies in the United States and Europe adopted his innovation of mass manufacturing systems and experienced tremendous success due to abundance of raw materials, energy and low labor costs. Manufacturers from other countries, notably Japan, had high respect for Ford's innovation in auto manufacturing – they

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had visited and learned the production process from North American companies and had applied the knowledge to upgrade their own manufacturing process. The production strategy was based on a push production system driven by the product demand forecast.

However, after World War II, Japanese companies were faced with many problems such as reduced product demand, shortage of capital, raw materials and space for inventory, high labor and machinery cost. The mass production strategy ceased to be a viable option. Toyota was one of those companies struggling to survive. Out of necessity, the management, supervisors, and workers of the company had to innovate – after a several iterations, they found success under the supervision of Mr. Taichi Ohno. Their decade-long success was noticed by western manufacturers and scholars, which resulted in a five-year, 5 million dollar global study of auto industries by MIT in 1984, called *International Motor Vehicles Program* (IMVP). They recognized *Toyota Production System* (TPS) as a new kind of manufacturing process - it was different from the mass production strategy of the Detroit Auto industry, and it produced superior results. The new production system was coined as “Lean Production” (Krafcik, 1988), since it took considerably less time and cost, and produced less defective parts, compared to the mass production strategies of the Western manufacturing system. TPS was exemplary of the Lean Production.

The auto industries in North America and Europe have been following the success of the Japanese manufacturing strategy. However, they were unsure whether it could be adaptable in the western cultural environment. At the same time, Toyota wanted to expand, and bring its technology to the United States. As an experiment, a joint venture, the *New United Motor Manufacturing, Inc.* (NUMMI) was established in 1984 between General Motors (GM) and Toyota. GM took the opportunity to learn Lean Production, or Lean Manufacturing techniques, while Toyota obtained a chance to implement TPS in a different cultural and labor environment. The success of this project proved that the Lean Manufacturing is not restricted by the cultural differences and can be applied in any country. Since then, many manufacturers have implemented lean strategy and found success in their undertaking. However, they have also realized that implementing lean is neither easy nor fast. A holistic approach and understanding of the principles are necessary to achieve a lean organization (Fullerton, Kennedy, & Widener, 2014).

In this chapter, the principles and the tools of lean strategy will be discussed to provide readers a thorough understanding of the Lean Manufacturing. If applied properly, it has been shown to lead the company in reaching its fullest potential.

## **BACKGROUND**

Lean Manufacturing (LM) is rooted in the Toyota Production System (TPS). After Japan’s defeat in WWII, Toyota was faced with many obstacles as discussed earlier. To be competitive, their only option was to produce many varieties of automobiles in small quantities because of the low market demand for each type. Mr. Taichi Ohno, the chief architect of the TPS, developed and implemented a variety of low-cost techniques to increase the competitive advantage of the company. He described his methods very simply as “a manufacturing strategy that reduces the timeline between the customer order and the shipment by eliminating non-value added waste” (Ohno, 1988) (Box 1).

Mr. Ohno’s innovation was however influenced by the American Supermarket System. He was fascinated by the grocery buying process - customers bought exactly what they needed and when they needed,

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