Chapter 7
Intelligent Lean Manufacturing: Lean Manufacturing, Lean Transformation, and Digital Transformation Relationship Evolution

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ABSTRACT

Lean manufacturing approach, in other words, the Toyota production system, is examined in the context of its historical development by using the articles researched from reputable journals in this field. Lean manufacturing, digitalization, and the interaction between these two developments are handled and attention is drawn to the change in the role of human factor in production. The aim of this study is to draw attention to digitalization in the automotive and electronics sectors, as well as in other branches of the manufacturing sector, where the lean manufacturing approach is widely used. As a result of this, it is stated that organizational transformation will be inevitable within the framework of future technological developments in enterprises. In this study, it will be revealed that the human role in production has changed and even decreased within the framework of the relationship between lean transformation and digital transformation. However, the concept of intelligent lean manufacturing was used for the first time in the literature.

1. INTRODUCTION

Increasing and decreasing customer demands from the market, which also require a wide variety, are balanced with the competencies of the manufacturer and its suppliers. In this context, the capacities of the workstations and consequently of the production lines have gained more importance. In order to increase the performance of workstations, to increase their availability and to produce quality products, the queue, transportation, waiting, preparation and operation of five parameters, respectively, related to the operation supply period, namely the capacity, came to the fore in the production process. After World War II, Eiji Toyoda and Taiichi Ohno came up with the idea of lean production, which will spread to industrialized and developing countries in the process from the mid-twentieth century to the present. The

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most important reason for the development of this approach was the habit of working with overstocks, which caused excessive losses, especially in the automotive industry, which makes mass production.

For the effective implementation of the lean manufacturing approach, it has been thought to create a healthy infrastructure with a human-oriented total quality management (TPM) and continuous improvement approach (Kaizen). TPS from the Japanese auto industry consists of several interlocking applications that provide superior performance. These include two important umbrella concepts namely just-in-time (JIT) delivery of parts, Jidoka (the practice of stopping the line when defects are uncovered) (Adler and Borys, 1996; Pil and Fujimoto, 2007; Spear and Bowen, 1999). Along with these two concepts, the following has also been used. These are respectively leveling of production volume and product mix (heijunka); reduction of ''muda'' (non-value adding activities), ''mura'' (uneven pace of production) and ''muri'' (excessive workload); production plans based on dealers' order volume (genryo seisan); on-the-spot inspection by direct workers (tsukurikomi); fool-proof prevention of defects (poka-yoke); real-time feedback of production troubles (andon); assembly line stop cord; Gemba Walks to ask questions to machine operators to see the actual process of production;.value stream mapping (VSM); emphasis on cleanliness, order, and discipline on the shop floor (5-S); total productive maintenance (TPM) applications to ensure worker participation in preventive maintenance and reduce machine downtime or stop; use of Single minute exchange of dies (SMED) to reduce set-up, calibration, set-up times for die change, as well as to reduce inter-station times in the production line; Pulling systems (KANBAN) used to control production resources and prevent unnecessary stock holding in accordance with the just-in-time approach in production and so on.

Sugimori et al. (Sugimori et al., 1977) pointed out that one of the pillars of the Toyota production system is making the most of the working environment and excellent employees in production. In this context, it is encouraged by the workers to eliminate their unnecessary movements, to take into account the safety of the workers, to show their skills by giving more responsibility and authority to the workers by rewarding them.

According to reputable scientists who have demonstrated the relationship between the human factor and lean production very well, the importance of the employee within the organization has been emphasized in order to improve production. Accordingly, sharing responsibilities with employees, teamwork, and employee participation in continuous improvement are essential for the success of lean manufacturing (Cooney, 2002; Jones, 1992).

We can explain the transformation of the concept of Lean Production into the Intelligent Lean Production concept based on the quality, speed, time, quantity and efficiency parameters within the framework of Industry 4.0, and by associating the lean manufacturing techniques used, such as VSM, 5S, TPM, SMED and KANBAN system, with the seven basic wastes in lean manufacturing. These seven basic wastes are overproduction, faulty production, waiting, unnecessary production, overstock, over-handling and over-processing. This association and the desired result will constitute the purpose of this study. In this study, the most commonly used VSM, 5S, TPM, SMED and KANBAN techniques will be discussed to explain the relationship between lean transformation, digital transformation and Intelligent Lean Manufacturing. The effects and especially the meaning of digital transformation can be seen better with these lean production techniques, whose subject is human. While using these lean production techniques in production, the activities and benefits that need to be made will be discussed. The activities listed in the tables are based on the knowledge and experience, as well as all the references used while doing this study. The aim of this study is to consider Intelligent Lean Manufacturing from this aspect and to discuss it for the first time in the literature.

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