Chapter

Introductory Chapter: Introduction to Lean Manufacturing

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1. Introduction to Lean Manufacturing

Lean manufacturing, also called lean production, was originally created in Toyota after the Second World War in the reconstruction period [1]. It is based on the idea of eliminating any waste in the industry, i.e., any activity or task that does not add value and requires resources [2]. It is considered in any level of the industry, e.g., design, manufacturing, distribution, and customer service. The main wastes are as follows:

- Overproduction against plan
- Waiting time of operators and machines
- Unnecessary transportation
- Waste in the process itself
- Excess stock of material and components
- Non-value-adding motion
- Defects in quality

The wastes eliminated should improve the improvement of the quality and the reduction of the cost and time in the manufacturing. The main tools are [3, 4] the following:

- *Five S.* seiri (sort), seiton (set in order), seisō (shine), seiketsu (standardize), and shitsuke (sustain).
- Multiprocess handling. The manufacturing is preformed sequentially for multiple processes, contributing to the flow of materials.
- *Value stream mapping*. The tool compares the current state and future state of the events that depend on the product in order to reduce wastes. It is focused on the areas that incorporate value to the product.

- *Kanban* (pull systems). The lead time and cycle time are measured in several areas of the production in order to detect any problem and avoid it, e.g., to establish an upper limit to work in process inventory to avoid overcapacity.

- Mixed model processing.

- *Total productive maintenance*. The production system is considered as a whole, and the maintenance is focused on that. It leads the integrity of the maintainability, safety, quality to the assets, and human resources that add value to the production system.

- Elimination of time batching.

- *Control charts.* For checking mura (unevenness).

- *Rank order clustering. It is* employed in production flow analysis, considering the classification of machines and the technological cycle information control and generating a binary product-machine matrix.

- Single-minute digit exchange of die (SMED). The idea is that the changeovers and startups will be done in a "single-minute digit," usually 10 minutes. A similar concept is one-touch exchange of die (OTED), where the "single-minute digit" should be less than 100 seconds.

- Redesigning working cells.

- Single point *scheduling.*

- *Poka-yoke* (error-proofing). It is considered as the tool that leads to the operator to avoid (*yokeru*) mistakes (*poka*). It leads to reduce or eliminate the product defects.

The diversity of the issues is covered in this book from algorithms, mathematical models, and software engineering by design methodologies and technical or practical solutions [5, 6]. This book intends to provide the reader with a comprehensive overview of the current state of the art, case studies, hardware and software solutions, analytics, and data science in dependability engineering.

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