

Preface

This book presents the state-of-the-art contributions of Lean Manufacturing (LM) applications in the developing world, including essentially input from Latin American authors. These contributions are not easily found in the literature nowadays and, because of its quality and importance, they need a forum to be published. Lean Manufacturing is a multidimensional approach that embraces a wide variety of management practices in a unified system. These practices comprise just-in-time, quality systems, cellular manufacturing, work teams, and supplier management, among others. Some other practices have been adopted more recently such as Human Factors and Ergonomics approaches. The essence of Lean is that these practices, in a synergistic way, can generate an efficient, high-quality system that produces finished products according to customers' demand with almost no waste.

This book was conceptualized for an audience of mainly graduate and undergraduate students; however, it can also be consulted by engineers and companies managers who search for the state-of-the-art applications of Lean Manufacturing within a wide diversity of sceneries and conditions. The book is intended to be an excellent source for divulgation of applied researches, lean concepts, and practices that have been successfully applied in the developing world domain. The book contains some trends in LM, concepts, and study cases organized into 27 chapters distributed conveniently for readers in four parts.

Part I: Introduction

Part I entitled Introduction is composed by only [Chap. 1](#) from Salinas-Coronado et al. which first presents the main concepts, common techniques, tools, and methodologies related to Lean Manufacturing. Also, this introduction Part includes an application of Lean in a production process for the automotive industry in the Mexican maquiladora sector from the state of Baja California.

Part II: Main Lean Manufacturing Tools and Techniques

Part II is composed of 11 chapters dealing with LM management practices aiming to transform organizations into more quick to respond and competitive entities. This Part also contains a variety of applications of the most effective and popular Lean tools. [Chapter 2](#) by Tapia-Esquivias et al. illustrates a troubleshooting proposal for solving problems in LM environment, as well as common tools of LM, specifically the A3 format and the kaizen events. Also, authors illustrate an application to a carwash in the city of Celaya, Guanajuato, Mexico. [Chapter 3](#) by Rodríguez-Borbón and Rodríguez-Medina and [Chap. 4](#) by Meza-Jiménez et al. present a discussion related to Statistical Process Control (SPC) for quality assurance followed by its applications in the Maquiladora sector in Ciudad Juarez, Mexico, and the textile sector in Colima, Mexico.

In [Chap. 5](#), Tlapa-Mendoza et al. discuss the six sigma approach that is applied in the maquiladora sector in the Mexican state of Baja California as an important tool applied for quality control. The six sigma concept evolved to lean-sigma concept have created synergy, which is discussed by Estrada-Orantes and Alba-Baena in [Chap. 6](#). Also, in [Chap. 6](#), some applications to maquiladora industry are discussed.

Usually, quality control requires the application of several advanced technologies for inspections, and Vergara-Villegas et al. in [Chap. 7](#) discuss an elemental process for computer vision applied to a production system through a case study applied to apples selection. Since this inspection difficulty is based on repetitive inspection of products made by workers, total quality control is a philosophy that must be applied to enhance human labor. Rivera-Mojica and Rivera-Mojica in [Chap. 8](#) discuss the Kaizen philosophy, in which they expose the current situation of Mexico in relation to other countries and report a structural equation model to identify critical success factors for the implementation of this philosophy.

However, high-quality manufactured products not only need people, they also require reliable equipment and the best operational conditions to satisfy the strictest specifications demanded by costumers. Therefore, in [Chap. 9](#), Torres reports a Total Productive Maintenance approach and the key success factors for its implementation so that the integration of human-machine duo can offer improved results. Nevertheless, it should be noted that one of the most important quality requirements is the delivery of products just-in-time in production systems. Thus, arrivals of raw material must be on time, as well as deliveries between production processes and the final product delivered to customers. Therefore, Rivera-Mojica and Rivera-Mojica discuss the Just-in-Time (JIT) philosophy in [Chap. 10](#). Authors include JIT concepts and identify the key factors for its successful implementation in the maquiladora industry that is established in Ciudad Juarez, Mexico.

Meanwhile, in [Chap. 11](#), Villanueva-Ponce et al. focused their study on the supplier's selection process by taking into account that JIT philosophy implementation implies the compliance and best performance of production programs. Authors also discuss in this chapter the main techniques and most commonly used attributes for supplier evaluation and expose an example by applying a multi-attribute technique called TOPSIS. Finally, in the last chapter of this part ([Chap. 12](#)), Lagarda-Leyva et al. discuss and analyze flow of materials from a more holistic view, proposing a mega planning approach for all the logistics in the company, and they illustrate some examples for the improvement of small and medium businesses located in the Mexican city of Hermosillo.

Part III: Human Factors and Ergonomics in Lean Manufacturing

It is well-known that the success of LM is mainly derived from the effort of workers, supervisors, and managers in production systems; therefore, Part III of this book presents applications of Human Factors and Ergonomics in a Lean Manufacturing environment. This part of the book includes seven chapters that promote ergonomic practices and describes new concepts and theoretical frameworks for the Lean culture.

First, in [Chap. 13](#), Naranjo-Flores and Ramírez-Cárdenas discuss from a general point of view the human factors and its importance in LM, specifically the Lean Ergonomics concept. Prado, in [Chap. 14](#), presents an epidemiologic review of studies related to low back pain treated as a musculoskeletal disorder; he thus emphasizes on the main occupational risk factors.

Lean Manufacturing has been contributing to the success of numerous companies all around the world, which are permanently making efforts to improve their decision-making processes to assure competitiveness. This improvement includes the evaluation and selection of Advanced Manufacturing Technology (AMT). However, human factors and ergonomics aspects have been neglected in the actual decision-making models for AMT. In this way, Maldonado-Macías et al. expose in [Chap. 15](#) an innovative fuzzy axiomatic design approach for ergonomic evaluation of Advanced Manufacturing Technology (AMT) proposed under the theoretical framework of Lean-Six Sigma. In the same matter, in [Chap. 16](#), Realyvásquez-Vargas proposes an expert system approach based on fuzzy if-then rules for ergonomic assessment of AMT for Lean environments.

Furthermore, with the inclusion of this technology, important changes in the levels of mental and physical effort performed by workers have been experimented. In [Chap. 17](#), Hernández-Arellano et al. present the comparison of fatigue scores of two processes including (AMT). The former involves machining of steel pieces using Computerized Numerical Control (CNC) lathes, while the latter deals with Constant Velocity (CV) Joints assembly using hydraulic presses, this is a case

study of the assessment of human fatigue in industrial environments. Human fatigue effects have generated a wide variety of approaches, including accident analysis. In this way, researchers have emphasized on the need to incorporate human factors in risk assessment, due to the increasing relevant role of humans in the modern work environment. Hence, in [Chap. 18](#) Reyes-Martínez et al. develop a theoretical approach for accidents' causality identification in industrial environments.

Part IV: Alternative Methodologies for Lean Manufacturing

This part content was designed to expose modern alternative methodologies that have facilitated Lean Manufacturing implementation, and are explained in nine chapters in next paragraphs.

[Chapter 19](#) concerns optimization problems in manufacturing processed by Alvarado-Iniesta et al. In this chapter, authors easily describe the genetic algorithms methods and present an example step by step. This example will surely be useful to readers wishing to know quickly the power of this tool. Meanwhile, Adarme-Jaimes et al. in [Chap. 20](#) refer to a technique that is applied very frequently with the total preventive maintenance; however it is more a philosophy than a technique, as it depends entirely on persons and refers to the 5's, which help determine and identify waste in a production system to be optimized.

However, the application of techniques, philosophies, and tools in a production system focused on Lean Manufacturing should be monitored. Therefore, Rivera and Manotas in [Chap. 21](#) propose a performance measurement in Lean Manufacturing environments so that managers can identify the tools or philosophies that best fit their production system, as well as those that must be modified.

Still in the context of alternative methodologies, one of the most used is the plant layout for material flow optimization, since the transport of materials is seen as a waste and the source of accidents. This issue is discussed by Blanco-Fernández et al. in [Chap. 22](#). Authors analyze the different techniques used and solve an example as a case study. Another large waste that has been observed in production systems is the preparation of equipment for new batch production, usually called setup. Therefore, in [Chap. 23](#), Carrizo-Moreira discusses the SMED (Single-Minute Exchange of Die) system and reports the cases of seven companies.

These production systems have generally required adjustments to the process, which may be due to mismatch of machines and its sensors; therefore, in [Chap. 24](#), Molina-Arredondo presents a model permitting fast adjustment to process, having information feedback obtained from production processes. Such adjustments prevent the production of whole lots with defects. However, obtaining parameters in LM is very difficult since it is a very broad concept; thus, specific parameters are often obtained, such as supply chain indicators. For this reason, in [Chap. 25](#), Avelar-Sosa et al. compile the tendencies of techniques and attributes for supply

chain performance measurement, which can tell the manager what they can do to improve the flow of raw materials and information.

To end with this part, optimization methodologies such as Design of Experiments (DOE) and dynamic analysis are covered. In [Chap. 26](#), Becerra-Rodríguez et al. present an optimization case for manufacturing using DOE, and Sánchez-Ramírez et al. expose a dynamic analysis of inventory policies for improving scheduling in [Chap. 27](#).

Jorge Luis García-Alcaraz
Aidé Aracely Maldonado-Macías
Guillermo Cortes-Robles

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García-Alcaraz, J.L.; Maldonado-Macías, A.A.;
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