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Improving the quality and productivity of steel wire-rope assembly lines for the automotive industry

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Abstract

The automotive industry is one of the most demanding sectors in the global market, since it requires a systematic increase in productivity. In the current economic scenario, the challenges at hand are great, demanding a reduction in costs and an increase in competitiveness, without investment. In order to address this situation, the only solution lies in the optimization of the product and/or processes. This study was developed in order to improve the assembly lines of the steel wire-ropes used to control some of the basic functions in cars, such as the elevation of car-door windows and so on. By applying Lean and PDCA methodologies based on an action plan, it was possible to ensure the implementation of some of the developed solutions, as well as the subsequent processes, and the registration of these as a record for the future.The performance of efficiency was dramatically increased by this study.

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Keywords: Lean manufacturing, Value Stream Mapping, PDCA, Automotive component industry, Productivity improvement.

1. Introduction

Companies in the automotive industry require constant development and reveal an enormous capacity to adapt to market demands. The level of competition in this sector has generated a need for productivity, efficiency and quality in order to meet customers' demands [1,2]. The emphasis placed on innovation in the production process is crucial

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to this sector; its purpose is to provide production systems that are more flexible and more productive. The innovation of processes is related to new components, equipment and methods of production [3]. The Toyota Production System (TPS) constitutes one of the examples of process innovation: its main goal is to increase productivity by resorting to various techniques [4,5]. The TPS was devised and based on tools and solutions which lead to the continuous improvement of processes and people [6]. This constitutes the basis of Lean Manufacturing or Lean Production [7], a designation which emerged in the 90s with the publication of reference studies by Womack and Jones, and generally known as the philosophy of Lean Thinking [8]. The implementation of Lean Manufacturing techniques has resulted in the reduction of costs and lead time, and has led to greater customer satisfaction [9,10]. Tools and techniques such as VSM (value stream mapping), visual management, 5Ss, standard work, Kaizen and the PDCA cycle are used in companies to provide support in the identification of the possibilities to reduce waste and improve the efficiency of production processes [11].

The work described in this article was developed at the Ficocables, a Ficosa Group company. Its main goal was to optimize the production process of an assembly line which produces cables for the door-release mechanisms. The ultimate aim was focused on reaching the capacity required to meet customer demand. The article is divided into five sections: section 1 constitutes the introduction; section 2 presents a review of literature related to Lean Manufacturing; section 3 deals with the methodology used to carry out this study; section 4 describes all the practical work developed at the Ficocables company and presents proposals for the improvement of the analyzed process. Also includes all the results obtained through the development of this study and, finally, section 5 presents the final conclusions.

2. Literature review

The automotive industry began at the end of the 19th century, more specifically in 1880. The type of production then in use was artisanal, which made it possible to provide the customers with exactly what they wished for. The drawback was that the waiting time and costs involved were extremely high. This type of production was soon confronted with problems difficult to overcome, thus paving the way to the era of mass production [12]. The mass production technique was subsequently implemented by Ford in 1913, when he considered a standard for production flow and work in his assembly line design. By resorting to this technique, Ford drastically reduced costs and, consequently, car prices. However, the drawback resided in the fact that the customer was restricted to very little choice; he could only select from the type of car that the production line produced in a standardized manner and in great numbers [13]. The aim of Lean production is to combine the advantages of artisanal production, which produces exactly what the customer requests, with those of mass production and the production of great quantities. To this end, one should opt for multifunctional workers at all organization levels, as well as resort to highly flexible and increasingly automated machinery in order to produce both a greater volume and a wider range of products [14].

The Toyota Production System (TPS) was designed and based on tools and solutions aimed at generating a continuous improvement of processes and people. The techniques used essentially focused on JIT (just-in-time) production and the elimination of waste [6]. Lean Manufacturing, a concept introduced by Womack and Jones in 1990, explores the various concepts used in the TPS and places great emphasis on: the elimination of the various types of waste which occur in the value chain, worker motivation and involvement, the equipment optimization, the reduction of costs and an increase of the end-customer satisfaction [8,11]. In terms of manufacturing, we can define waste as activities not able to generate added value to the product and which customer does not want to pay for [2,15]. Namely, companies should provide the processes, materials, people and technology needed to ensure the timely production of the correct quantities, products and/or services requested by the customer. Taiichi Ohno and Shigeo Shingo identified seven sources of waste: surplus production, waiting times, materials transportation, excesses in processing and in the inventory, as well as in unnecessary movements [16]. The Lean philosophy falls back on various support tools which aim to eliminate waste and thus optimize production. The most noteworthy of these are: VSM (value stream mapping), PDCA, Kaizen, Kanban; SMED (single-minute exchange of die), visual management, 5S and standard work, amongst others [17,18]. VSM mirrors the path of a product. Based on the visual representation of all the flow processes relating to materials and information, this technique makes it easier to identify waste and allows one to devise the value stream from the supplier to the customer [19]. This tool enables one to deal with process improvement in a systematic manner [20] with the purpose of detecting the different types of waste and eliminating these by means of Lean techniques and methods [21].

Although the beginning of Lean management is associated to the automotive industry, the validity of Lean solutions has been demonstrated by the successes experienced by many companies from a wide spectrum of