# EXAMPLE OF LEAN MANAGEMENT IN PRACTICAL USE BASED ON REDUCTION "NVAT" ACTIVITIES IN THE PRODUCT ASSEMBLY PROCESS

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#### Abstract

The long recession and the need to maintain competitive advantages have triggered businesses in manufacturing sectors to question the efficiency of their business processes. Cost reduction has become the dominant orientation of business strategies in domestic enterprises because, while reducing operating income, costs should also be kept under control if we want to ensure the survival of the company. Cost reduction can be achieved by improvements and enhancements of existing manufacturing processes, using methods of quality improvement such as Six Sigma, introduction of Lean concept to eliminate unnecessary business activities or implementation of new technologies thereby increasing technological equipment of the company to the next level and thus provides an advantage in relation to other competitors in the market.

Western business practices, in the past four decades, shows that the application of methods and techniques of Lean Management can help businesses to optimize their business processes and eliminate unnecessary activities in a business system that only increase costs, and do not generate additional value.

The aim of this paper is to examine the applicability of Lean concept in real business environment in the domestic enterprises to identify business activities that do not bring value to the product (NVAT activities) and try to reduce any NVAT activities with Lean management techniques and thus speed up the process of making products.

Results of the study show that the Lean concept is useful tool to speed up the existing production processes as well as to increase the efficiency of the process.

**Keywords:** Lean Management, Lean Manufacturing, production improvement, business excellence.

JEL Classification: M11, O32

## 1. INTRODUCTION

Looking at the global economy, we see that at the present time in the market to be "good is not good enough" and business organizations must aspire to business excellence if they want to survive in the market. In order to retain existing and win new competitive position in the market, many businesses realize that the traditional ways of managing business systems and other historical approaches are no longer sufficient. View today's business practices draws attention to one business philosophy used by Western businesses, and whose roots are in Japanese thinking organization of production. It is Lean Manufacturing or Lean concept.

The hypothesis of the paper assumes that the application of Lean concepts is possible, in the real production process, identify and reduce activities that do not bring value to the product (NVAT activities) and expedite the process of making products. As a testing ground for hypotheses was selected domestic business subject that is engaged in producing parts for the automotive industry.

#### 2. CONCEPT OF LEAN MANAGEMENT

Lean management is also known as lean manufacturing, lean enterprise, or simply Lean. The term refers to a system of methods and techniques that emphasize the identification and removal of all business activities that do not add value to the product and/or service. These activities are called "waste" and seek to eliminate them from the process of production.

Lean Business Systems is characterized by rapid development of business cycles, "Just-In-Time" method, pull systems, few or no supplies, a continuous flow of production, levelling production and reliable quality. Business organization that applies Lean concept in this manner is called the Lean enterprise. Lean companies are efficient, flexible and understanding of consumer needs (Paul; 1999, 21). Karlson and Ahlstorm believe that Lean concept should be included in all business functions of enterprises; in the procurement of raw materials, production and distribution of products. Furthermore, Lean concept should be seen as a way in which to navigate through and not as a state to be achieved after a certain time (Karlson & Ahlstorm; 1996, 2, 11)

#### 2.1. HISTORICAL OVERVIEW OF THE LEAN MANAGEMENT

Lean business philosophy began its development in America at the end of 70ies of the last century. But if we look a little deeper into the past, the roots of Lean production we find in the automotive industry in the late 19th century. Usage of Ford's assembly-line for assembling the car indicated the need for adequate organization of business processes, introduction of quality management systems, efficient logistics and procurement of raw materials and the appropriate channels of product distribution. These are all activities that we find today in the business concept of Lean Production. The most significant contribution to the evolutionary development of Lean concept contributed to the founders of the Toyota production system, Kiichiro Toyoda and Taiichi Ohno. They have, over the years, developed and rewrote the effective methods and techniques for improving operations that are still successfully used in large international companies. These are SMED (Single Minute Exchange of Die - change work tools in one minute), Kaizen, 5S, Kaikaku, Kanban, Jidoka, Poka-Joke, etc. (Lazibat; 2009, 272). Most of these techniques we find today in the concept of Lean Manufacturing, which are used primarily in order to achieve the fundamental principles of Lean management.

#### 2.2. Principles of Lean Management

According to Womack and Jones function Lean management is easiest to describe through the five basic principles, namely (Womack & Jones; 1996, 26):

- 1. Elimination of waste / losses (jap. muda).
- **2. Determining the flow value** includes all activities necessary to deliver product to the consumer.
- **3.** To achieve flow through the process allow easy movement through the business process.
- **4. Determining the speed of work to pull signals** the achievement of system in which the final consumer is helping to create a new product.
- **5. Continuous quest for perfection** create a business system without errors, or actual defects.

According to these principles, it is evident that Lean management emphasizes the production of small series products and the progress of individual pieces through the production process. The term *pull* implies that nothing is being produced until it is ordered by buyers. The main goal of Lean Production is to eliminate waste in a way that all business ongoing value activities create value, which is the object of pursuit for perfection. (Womack & Jones; 1996, 31)

#### 2.3. Activities according to Lean management

The main objective of Lean system is to increase the speed of the process through the relentless elimination of waste in business processes. Organizations that apply this system implanted it in full flow values, i.e. In all activities undertaken since receiving consumers request throe the delivery of the final product and / or services (Meisll et al.; 2007, 2) According to the Lean methodology, business enterprises, may appear three types of activities that affect production costs, and thus directly on the price of products or services. These activities are (Womack & Jones; 1996, 45):

- 1. Activities that add value to the product or service (VAT)
- 2. Activities that do not add value to the product or service (NVAT)
- 3. Other activities that do not add value to the product or service (WT).

VAT activities (Value Added Time) – are activities where resources are transformed from one form to another. These activities include the processes of transformation of raw materials, processes of exchange of necessary information or production workflows. It is important that these activities consumers perceive as desirable and that they are willing to pay for them. Also, it is impor-

tant to VAT activities are carried out without errors, otherwise occurs waste and losses.

NVAT activities (Non Value Added Time) – are activities that are a necessary loss, it is impossible to eliminate them from the process, and do they do not create added value to the product or service. The most common consequence of the existing level of technology, prescribed working rules or business policy. These activities included the procedures of intermediate and final control of products, measurements and similar activities.

WT or other activities (Waste Time) – these are activities that represent a loss and need to be removed from the production process. These activities consume resources, extend the production process of products or services, and consumers are not willing to pay for them. This group includes a variety of activities waiting (waiting for transport, raw materials waiting, waiting in intermediate stages of production), excess inventories, stock manipulation and the like.

## 3. THE CONCEPT OF LEAN PRODUCTION IN THE PRACTICAL APPLICATION

The hypothesis of the paper was tested in the domestic business subject, manufacturer of plastic parts for the automotive industry. As a testing ground selected was semi-automatic line where compiled handrails, safety elements of every modern car. The product consists of seven parts that must be assembled in the integral whole, and thus to ensure the proper function of the handle. Since the assembly process is based on a greater proportion of manual work these jobs are a bottleneck in the observed production process.

#### 3.1. Description of the product assembly process

The manufacturing assembly process of products included three assembly line handrail schematically shown in Figure 1. The lines are operated in two shifts, and three operators had the task to manually take all components (parts) from the tank, set bookmarks "S", and them stacked them according to a specified schedule in semi-automatic device for product assembly. After correct positioning of parts, the operator's hand closes assembly device, visually check the signal display and with activation of two-handed switch start the assembly process of product in 5 steps. At the end of the assembly process of product operator opens the protective cover, takes product and visually checks out the finished product he examines the function of the product. Upon control products completion correct products are dumped in cardboard boxes, and defective products go to recycling.



Figure 1. Scheme of semi-automatic assembly handrail

Source: created by authors

Measurement of the labour time required to perform the operations according to the scheme first showed that for product assembly is required 26 working operations. Work operations are performed in a time between 1 and 6 seconds, and a total time assembly cycle of products is 51 seconds. It is also the working stroke of this process.

#### 3.2. Process analysis according to Lean activities

If we analyse the sequence of the operations according to the figure 1, using the previously explained Lean activities, we observe that only 5 working operations can be classified into group activities that add value to the product or service (VAT). A close analysis of the remaining 21 working operations has shown that they do not add value to the product, but also that they are not activities that represent the loss in production (WT). These are manual work activities necessary to ensure that all needed parts of handrail are positioned in the device for product assembly and final inspection activities of the product. Specified activities must be carried out due to the limitations of technological process of the product and as such can be classified into group activities NVAT. The ratio of the observed process of the product and the total operating time is shown in the first diagram.



Diagram 1. Display VAT and NVAT activities in the work process

Source: created by authors

According to first diagram 22% of working activities in the process make VAT activities, and 78% are NVAT activities. This display shows that the proving process of the product there are many NVAT activities that do not add value to the product, the process can be improved to carry out the smoothing process of the product and thus speed up the workflow observed.

# 3.3. Processes improving by applying the methodology of Lean Six Sigma

After conducted analysis of the current product assembly processes shown in first figure it was decided to try to speed up the process of creating one automated workstations for product assembly. When designing new workstations DMAIC methodology was used with simultaneous applied Lean management principles whose aim was to speed up the product preparation process and eliminate NVAT activities in the production process. The project lasted a year, and in the development of new automated workstations participated experts and engineers form company Sinel Ltd. from Labin. The experience synergy, knowledge and use of modern information technology made the automated process of preparation of the product for which work is one operator sufficient, and the product has undergone structural changes so that the number of components increased from 7 to 11. New design products with more parts have enabled easier and faster installation in the car's interior.

#### 3.4. Automated preparation process

Improvement of product assembly process was carried out in a manner that in an automated work stations for product assembly reduced NVAT activities, a new, fully automated product preparation process, is shown in the second figure.

Figure 2. Automated handrail assembly process



Source: created by authors

On the second figure it is noticeable that the new assembly process is more complex compared to the previous process is shown in Figure 1. The main reason of this fact lies in the methods of automated addition of parts to assemble. Parts are in the assembly process introduced via elevator and rotational-vibrational conveyor thus speeding up the process, the operator adds body handrail in the machine and if necessary fills a tank with parts.

#### 3.5. Analysis of the new process according to Lean activities

The new product assembly process is shown in the second diagram consists of nine working operations whose unscrewing 11 parts installed in the products assembly. The sequence of the operations and results of new process time measuring are shown in the second diagram.



Diagram 2. Display of activities in the new assembly process

Source: created by authors

In the central part of the second diagram shown in red are VAT activities and those occur in the time period of one to three seconds. In the bottom of the chart, marked in orange, are shown NVAT activities, and in the upper part of the diagram shown in green are WT activities. In this case VAT activities are working operations product assembly from 11 parts, and NVAT activities related to taking parts from the feeder and positioning the movable desk. WT activities are waiting activities for automated feeder to complete the previous work operations. In the new process all work operations are performed simultaneously without barriers, and the working stroke of the process is reduced from 51 seconds to 9 seconds.

## 4. **RESULTS OF IMPROVING**

Verification of project advancement can be carried out by comparing the production parameters before and after improvements. The comparison process is shown in Table 1.

Observed parameters	Manual process	Automated process	%
Number of workers	6	3	-50
Number of machines	3	1	-67
Number of shifts	2	3	+50
Coefficient of the process	0,72	0,99	+38
Working stroke [s]	51	9	-82
Productivity [pcs/day]	2280	9500	+417

Table 1. Comparison of manual and automated product assembly.

Source: author's calculations

According to first table, it is evident that in the new product assembly process are 50% less operators and only on one machine, the number of shifts increased by 50% and the quality of the process (includes the amount of compliant products and the daily utilization of machines) grew by 38%. The working stroke of the production process is reduced from 51 seconds to 9 seconds which is an acceleration cycle by 82%, and productivity, observed on a daily basis, increased from 2280 to 9500 pieces of products, an increase of 417%.

#### 4. CONCLUSION

The example from the real business environment proves the initial hypothesis of work that by applying methods and techniques of Lean management can improve and speed up production processes. Processes improvement in this particular case was conducted by eliminating activities that did not bring value to the product (NVAT activities), which were necessary because of the semi-automated product forming method. Technological advancement and application of automation process product is integrated into a single workstation with automated final product control, and the working stroke of the process is shortened by 82%.

The measurement results of the process after several improvements indicate that the project has fully complied with the quality management principles as it is removed subjective evaluation of the product by the operator at the stage of final inspection and is assured and implemented effective components control at the entrance to the assembler. Herewith are the variations of the production process, increased productivity and the number of compliant products (less scrap), and increased efficiency and daily work units work in three shifts.

By improving the products preparation process, there are significant changes in the process because variability is reduced by implementing levelling production as the main objective of the Lean system. Levelling production is directly related to the flow of product through the production process, levelling a new process enables conduct of the adding operations and assembling parts simultaneously without obstacles.

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