

CHAPTER 3

PRODUCTION MANAGEMENT BY USING TOOLS OF LEAN MANUFACTURING

Paulina Rewers¹, Justyna Trojanowska¹

¹ Poznan University of Technology, Piotrowo 3, 60-965 Poznan, Poland
paulina.h.rewers@doctorate.put.poznan.pl
justyna.trojanowska@put.poznan.pl

Abstract

Chapter shows results of the analysis of the use of Lean Manufacturing tools for capacity utilization, based on a survey of manufacturing enterprises in the Great Poland. The aim of the study was to demonstrate what Lean Manufacturing tools are the most common implementation in manufacturing enterprises of various industries and the effects which brings their use. The article also attempts to demonstrate the influence of the enterprise on the use of the tools of Lean Manufacturing.

Keywords: lean manufacturing, 5S, kaizen

3.1. Introduction

Globalization of emerging markets and increasing speed of technological change has enlarged competition worldwide and also in Poland. The tensions created by the appearance of foreign products, new product introductions by competitors, more innovative methods, items with shorter life and advances in production and information technology forced enterprises to respond to these demanding and growing challenges, as stated by Karim, Smith, Halgamuge and Islam in 2008 (Karim et al., 2008, p.847). As a result, organizations that understood the importance of belonging to a global market sought to become more

competitive through the use of operational methods based on modern concepts of production management, distinct from traditional manufacture models unable to meet the requirements and paradigms of the current situation. Enterprises have been forced to look beyond costs, looking for a greater emphasis on products that are needed by customers, while providing answers more quickly than its competitors and exceeding the quality requirements (Rawabdeh, 2005, p.803). According to Womack and Jones in order to achieve these objectives outlined by the organizations it is useful to apply concept of lean manufacturing (Womack, Jones, 2003, p. 57). Implementation of Lean is the cultural revolution that requires a comprehensive high qualifications and commitment (Grudzewski, Hejduk, 2004, p. 209). Implementation of Lean brings significant benefits for the enterprise, such as:

- reduction of work in progress,
- reduction of finished products inventory,
- streamlining the process shifts between stocks,
- ability to quickly obtain information about the current level of stocks of finished products,
- elimination of unnecessary activities that occur in processes at the enterprise,
- the elimination of waste.

3.2. Lean manufacturing tools

Lean manufacturing is a management concept. It boils down to the fact that all employees continually strive to reduce costs, shorten the delivery cycle and increase the quality of products, and all this in order to meet customer expectations and become more competitive in the market. The concept of Lean Manufacturing focuses on eliminating waste (Muda Japanese), which is all that brings the cost, and brings no added value. Muda appears in place of manufacture, or Gemba (Pająk, 2013, p.82). Implementation of Lean enterprise is an efficient and effective way to reduce the cost of the enterprise without incurring high capital expenditures. Applying Lean also increases the competitive advantage while reducing the operating costs of the enterprise (Trojanowska et al., 2011, p.34).

The most commonly used Lean Manufacturing tools that can be successfully applied to the optimization of the production process are:

5S

One of the basic tools of Lean Manufacturing, from which the enterprise often begin their adventure with LM is 5S. 5S is the first step to improve production, and at the same time is universal - you can adapt it to all conditions, both in production and in the office (Shook, Schroeder, 2010). The aim of the 5S is to create an orderly and well-organized workplace. The implementation of this tool can improve the quality of the products and services provided, raise productivity, improve safety and hygiene of work, and as a result increase the stability of processes and reduce operating costs of the enterprise (Gapp et al., 2008).

The name '5S' comes from the first letters of the five Japanese words that describe the next steps in implementing this tool (Michalska, Szewieczek, 2007):

- seiri: sort/separate – Identification and removal of from work place in all subjects, tools, etc., Which are unnecessary and are not used during operation. These activities very often supports the so-called. action red cards. It consists on determination of items recognized as superfluous red labels, and then remove them from work place. For items that are rarely used, but are necessary for the position, is glued to yellow card. Then a decision is made, where such items put. 1S action should also include the work in progress. If the quantity of the position exceeds the needs of the workplace, they should be sent to the processes responsible for the excess,
- seiton: set in order/straighten – determination of storage locations for each item that should be on the post after 1S, according to the principle 'a place for everything and everything in its place.' In designating these places should also take into account the principles of ergonomics. Items must be placed where will be easily find them and put down. Often at this stage the use of labels, colored lines, shadow tables and various types of visuals,
- seiso: sweep/shine/scrub – daily cleaning is often associated with the inspection, so that it is possible to early detection of defects and faults. Cleaning strengthens the employees a sense of ownership of the workplace,
- seiketsu: standardize – the introduction of standards for solutions worked out at earlier stages. Instructions should create here, the standards of visual diagrams, schedules, checklists, maps workspaces, tables 5S, photos ideal state, etc., as well as a list of tasks and obligations of workers associated with the maintenance of 5S,
- shitsuke: sustain – the use by employees in previous stages of the rules and procedures. At this stage there are inspections, audits of workplaces to help employees to form habits to comply with accepted assumptions.

The purpose of the first three steps is the introduction of tools 5S, while two more - to maintain accepted assumptions. With the implementation should be involved production workers because their jobs most apply about this tool (Gapp et al., 2008).

SMED

Another popular tool is the SMED - a method of shortening the set-up time machine, which by S. Shingo. SMED is a set of techniques enabling for the replacement of tooling or set a production line in less time than 10 minutes. The basic premise of the method is a marked decrease the size of production batches in order to adjust production to the constantly changing demand. Therefore there is a need to shorten the time of retooling, because that usually these which determine the size of production batches (Birmingham, Jelilnek, 2007). The method comprises the following stages of implementation (Birmingham, Jelilnek, 2007):

1. Separation of internal and external operations.

Internal activities are all activities needed for retooling the machine, which the operator must perform machine is switched off. External other hand, is such that the employee can perform during the machine is running, eg. Transport the aid workshop preparatory activities. Separation of these activities can reduce setup times by up to 50%.

2. The transformation operations internal in external.

At this stage, re-examine the activities and determines whether any external action has not been wrongly classified into internal operations. We are looking also for ways to transform operations internal in external.

3. Improvement of preparatory activities.

Improvement of internal operations consists of parallel implementation of activities retooling, eliminating regulation and the use of mechanization. Improvement of external actions while concerns storage and transport of workshop aids through the use of packages warehouse and transportation, and determination of their storage.

POKA-YOKE

Poka-Yoke is a method of preventing errors in the following mistakes employee or a random event, for example. inappropriate setting of the work piece, the omission of one of the operations, etc. This method is a set of technical and assistive devices prevent defects and errors in manufacturing processes resulting from the tendency of physical and psychological man (Productivity Press, 1986).

Potential causes errors workers can be divided into the following categories (Hirano, Shimbun, 1989):

- forgetfulness,
- intentional errors,
- aware of errors,
- random defects,
- a mistake due to lack of experience,
- defects caused by the slowness,
- errors caused by lack of standards,
- mistakes in the identification,
- confusion resulting from misunderstanding,
- confusion caused by the effect of surprise.

The main principle in the system Poka Yoke is that the errors do not blame the people, processes only. Analyzing the process of product defects should be noted that between the mistake and the ensuing defect, there is one potential option: notice mistakes and improve it. Hence the conclusion that the way to reduce the deficiency is to create conditions in which the error cannot happen or will be immediately visible (Antosz et al., 2015).

Prove solution Yoke characterized in that prevent any mistake in the process. This is just one of their advantages. Other advantages will be counted (ProdPublishing, 2010):

- less time required for staff training,
- elimination of many operations related to quality control,
- promote activities related to the improvement of the work,
- reducing the amount of defects,
- immediate action when a problem occurs,
- the 100% of control in the process.

KAIZEN

Kaizen is the Japanese for continuous improvement. It is a philosophy of continuous improvement of quality and productivity at work, which involves all employees and allows for rapid improvement in efficiency without the need for expensive investments (Wittenberg, 1994). Production efficiency is a very important issue from the point of view of processes organised in a enterprise and in a supply chain. Improving the efficiency of a production process is therefore a very important factor in controlling actions (Kolinski, 2013).

Kaizen should be implemented at the operational and tactical levels of management and among the employees directly forming products. The whole

process should take place with the support of top management, whose task is to create an appropriate work culture conducive to continuous development. When a problem arises, do not solve it from behind the desk, please go to the site (Japanese 'gemba' which literally means 'source'), in which there is a problem and analyze it there. After proper solution of the problem should be developed procedures for determining appropriate standards (Wittenberg, 1994).

Development and implementation of Kaizen brings results in improved product quality, working conditions and reduce costs. Besides, you increase the qualifications of employees, improve communication between them and management and increase teamwork (Singh, Singh, 2009)

JUST IN TIME

The primary purpose of the concept of Just in Time is to ensure timely production and delivery, while minimizing inventories. Just in Time requires keeping stocks as low as possible, immediate detection and removal of damaged parts, materials and improper operation (Ohno, 1988).

Selected principles of JiT (Ohno, 1988):

- each process is a supplier and customer of another process,
- the production process must be free from defects,
- exchange of products, services and information between processes should be implemented as soon as possible,
- transport should be prepared to supply and unload directly to the production line,
- it is recommended the continuous expansion of specific quality expectations for suppliers,
- suppliers must be involved in the process of product design and process,
- generally they should be used Kanban cards.

JiT allows you to synchronize all the steps in the production process by using the pull system and continuous flow. In this method, they are used Kanban, which determine when the production process should be launched. Kanban are the clear signals, such as the availability or lack of a product range (The Productivity Press Development Team, 2010).

The most important benefits of implementing JiT include (The Productivity Press Development Team, 2010):

- improved material flow,
- more efficient use of staff,
- minimizing storage space,

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- less possibility of delinquency or destruction of stocks,
- improving the quality of production,
- increase productivity.

JiT system should be gradually developed, because only improvements, reduction of losses and expenses and, most importantly, on time guarantee obtaining a competitive advantage in the market.

KANBAN

One of the tools the concept of Just in Time is Kanban. Kanban control is a method of manufacture. This method is based on the individual data sheets, their circulation and analysis. It involves the organization of the manufacturing process, so that each organizational unit produced exactly as much as at the moment it is needed. In this method, a factor critical materials management considered inventory control (Mikiharu, 2013).

The idea of Kanban most fully captures the password '7 x any' (Mikiharu, 2013):

- any deficiencies,
- any delays,
- any inventory,
- any queues - anywhere and at anything,
- any idle,
- any unnecessary operations technology and control,
- any movements.

The most important feature of the method is the elimination of pre-magazines, interoperable, and finished products. Materials and semi-finished products are delivered from suppliers with hourly precision, thanks to reserves, production capacity and flexibility of the production process it is possible to produce almost any item at any time, and production orders are closely synchronized with orders received from customers (Ohno, 1988).

TPM

Total Productive Maintenance (TPM) is one of the tools of Lean Manufacturing. It is used to eliminate losses of technological machines, such as crashes, retooling and regulations, short downtime and idle, reduced speed of operation, quality defects of products and start-up of production. Eliminating or minimizing individual loss is increased hardware performance and achieved better results with production (Suzuki, 1992).

TPM aims to achieve the following objectives (Leflat, 2001):

- to maximize the effectiveness and efficiency of machines and equipment,
- design and development of a full system maintenance machinery and equipment, which will take into account preventive measures, modernization, easy operation and machine design,
- increased cooperation between machine designers, engineers, operators and maintenance personnel.

The main goal of TPM is to maintain principles of zero accidents and zero defects caused by improper operation of the machine.

VSM

Value Stream Mapping (VSM) is a visualization tool that is used to map the flow of the enterprise. The main purpose of value stream mapping is mapping the current state (current state), which is designed to provide all the dependencies and information present in a given process. With the map can be an easy way to get the following information (Rother, Shook, 2003):

- method and organization of the process,
- the amount of value added (value added) in the whole process and its individual parts,
- losses / waste (do not add value),
- information affecting and flowing out of the process,
- frequency of the information,
- The type of information (kanban, verbal information, electronic information, instruction, etc.),
- tact process,
- buffers of time and materials,
- quantity in a given unit of measure (quantity, seconds etc.),
- amount of human resources.

After creating maps and analyzing the current state must design a future state map. Here we create such a process, which we will be satisfied in terms of quality, production time, etc. In designing the map of the future state are also considered tools to support the pursuit of lean production (Czerska, 2009).

3.3. Tools of lean manufacturing in Polish enterprises

In order to research the interest of Polish entrepreneurs the concept of LM and the impact of the use of selected tools LM on the operation of manufacturing

enterprises in Poland was conducted in 2015 a survey among enterprises of all sizes and from various industries.

Survey questionnaires consisted of closed questions concerning the fact of making the Polish enterprises activities related to the implementation of the concept of LM, due to their making or failing to take and the extent of use of selected tools LM, taking into account the effects of their use in various areas of the enterprise. The survey also contained extensive Imprint, through which it was possible to analyze the survey results in relation to the size of the enterprise, the operation of the market, the strategies pursued by the production and the characteristics of clients.

The survey was conducted among 56 respondents from various industries, representing enterprises of all sizes (after 14 of micro, small, medium and large) with other industries.

Analyses show that most often take actions related to the Lean Manufacturing large enterprises - 86%. This follows from the fact that in such enterprises, usually with foreign capital, awareness of the elimination of waste and its impact on the productivity and efficiency of production is very high. These enterprises also have, like the Japanese, in its structure departments responsible for improving production. In medium-sized enterprises More and more growth LM deployments. This is because these enterprises wanting to compete with the pioneers in their industries must attract the customer price and quality of its products. Lowering the price of the product should therefore be the result of lower costs associated with production, and these can be reduced by taking appropriate action related to Lean Manufacturing. Small and micro usually do not take any action relating to the implementation of LM. Often, such enterprises can not afford to experts working in this field, and the employees themselves usually do not have sufficient knowledge of Lean Manufacturing. Enterprises do not also have enough money to send their praconików additional studies or training. Employees of those enterprises participating in the survey, the most frequently declared that it does not take actions related to the LM in their enterprises because they are not familiar with such issues or lack of funds for such investments. Figure 3.1 shows the number of enterprises in which decisions or actions are associated with Lean Manufacturing, depending on the size of the enterprise.

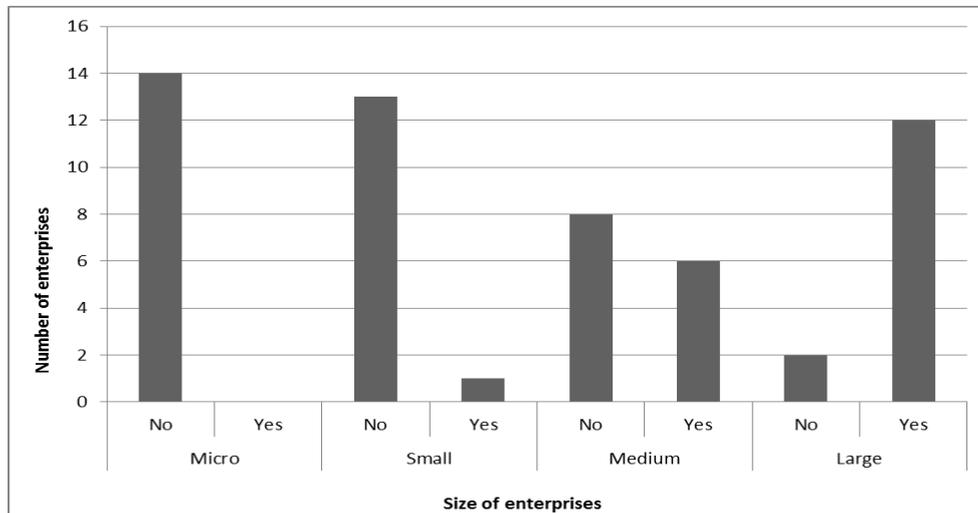


Fig. 3.1. The number of enterprises engaged in activities related to the Lean Manufacturing depending on enterprise size

Source: own study

The literature distinguishes the following production strategies: make to stock (MTS), assembly to order (ATO), make to order (MTO), mixed production (MTO/MTS), engineering to order. Analysis of the responses showed that, depending on the strategy of the enterprise's production deploy various tools of Lean Manufacturing. Table 3.1 shows the number of enterprises implementing various tool LM depending on the nature of the production.

Tab. 3.1 Number of enterprises implementing the various tools LM depending upon the manufacturing strategy

	Make to stock	Assembly to order	Make to order	Mixed Production (MTO/MTS)	Engineering to Order
KAIZEN	0	2	1	1	3
VSM	0	1	0	1	1
5S	1	4	2	5	5
SMED	0	1	2	2	1
TPM	0	1	0	1	1
KANBAN	0	3	0	0	0
JiT	0	1	1	2	4
POKA-YOKE	0	0	0	1	0

Source: own study

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Analyse of table 3.2 shows that the most enterprises implement 5S tool, and the least Poka - Yoke. This is due to the fact that 5S is the first step to improve production, and thus to implement Lean Manufacturing. 5S is also universal tool, it can be adapt to all conditions, whether in production or office process. In turn, Poka - Yoke are implemented in enterprises that already have the knowledge and experience in Lean Manufacturing. This tool requires prior stabilize and improve production. Enterprises which production strategy is engineering to order implement various tools to reduce the cycle time. These tools help eliminate waste, which contributes not only to improve productivity but also to the reduction of errors in the output. Enterprises which make to stock usually have stabilized process, the client does not wait for their product because the products sent to customers are always available in stock.

Lean Manufacturing tools are implemented in enterprises to deliver concrete improvements. We asked a group of respondents about what effects in their enterprises bring them implemented tools of lean manufacturing. The results are shown in Table 3.2.

Tab. 3.2 Number of enterprises in which the implementation of Lean Manufacturing tools brought assumed effects

	Safety improvement	Reduce inventory	Shorter operation time	Better information flow	Comfort improvement	Reducing the number of machines downtime
KAIZEN	3	2	3	2	3	3
VSM	0	1	2	3	1	1
5S	9	2	5	4	9	5
SMED	1	0	7	0	0	7
TPM	4	0	1	2	2	4
KANBAN	0	1	0	0	1	1
JiT	0	7	1	2	0	0
POKA-YOKE	1	0	1	0	1	1

Source: own study

Analyse of table 3.2 shows that 5S and Kaizen are the most universal tools that bring a variety of benefits in many areas, for example improves safety and comfort and also shorten operation time. In Kaizen this workers propose improvement of their workplace so changes can bring different effects. While 5S improving primarily safety and comfort. This is particularly important, because when the employee is not afraid of their health at work and does not get tired while doing it, he works more efficiently and effectively. This translates to the number of

completed units during the shift and product quality. Other tools are more focused on specific effects, for example SMED is focus on shortening set-up time, reducing the number of machine downtime and JiT mainly focus on inventory reduction. However all described Lean Manufacturing tools help achieve high performance and efficiency in enterprises.

3.4. Conclusions

The results confirm the fact that the concept of Lean Manufacturing tools are usually applied by large enterprises. There was also a rise in interest in this conception in medium-sized enterprises. Small and micro enterprises do not undertake activities associated with Lean Manufacturing, mainly due to the lack of adequate knowledge of the subject. This condition also results from the lack of awareness of management and limited funds. Larger enterprises have dramatically more capital, which allows you to take actions related to the improvement of production processes. Construction of awareness of employees of small and micro enterprises of the need to eliminate waste may translate into an increase in production efficiency, thus effective functioning on the labor market and to achieve better financial results. Among the most common solution Lean tools implemented in the surveyed enterprises was a 5S and Kaizen. This is due to the flexibility used of this tools. Both tools are the basis for the implementation of Lean Manufacturing methods in the enterprise. A small number of implementations of other solutions for lean manufacturing stems from the need to adapt them to specific production conditions.

In summary, the effective functioning on the market is possible thanks to the elimination of waste in production processes, but to make it so it is necessary to build awareness of lean manufacturing.

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