LEAN PRODUCTION IN LOGISTICS AND MANUFACTURING

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Abstract

Lean production can be generally understood as a process that is constantly trying to eliminate potential bottlenecks in the company. Each system has at least one significant restriction that prevents the achievement of higher levels of performance. Likewise, also manufacturing organizations often have a number of limitations preventing them from producing more profit. These limitations, however, may not relate only to manufacturing resources but also to marketing, internal directives, time and people's attitudes. All these mentioned areas may contain significant sources of reducing performance. Nowadays, lean production is implemented not only in manufacturing but also in connected areas. High competition forces all business entities to constantly seek reserves in their processes. The paper analyzes the use of the tools of lean production in logistics and manufacturing. It assesses the possibility of applying such tools in these fields as well as feasible potential benefits.

Keywords: Cost, logistics, price, competition

1. INTRODUCTION

Lean production means doing only such activities that are needed, doing them correctly on the first occasion and faster than others while spending less money [1]. So far, however, nobody has become rich due to saving money; lean production consists in improving the performance of the company by producing more than competitors using the same area, by achieving higher added value than others with the given number of people and equipment, and by executing more orders within the given time while consuming less time for individual business processes and activities. Streamlined company focuses on doing exactly what customers want, with a minimum number of activities that do not increase the value of its products or services. Being lean therefore means earning more money and making money faster with less effort. [2]

Lean production does not imply any purposeless cost reductions. It mainly relates to maximizing the added value for the customer [3]. Streamlining is a way to produce more, to have lower overhead costs and use available areas as well as manufacturing resources more efficiently. Lean production cannot perform without close links to product development and production technical preparation, logistics and company administration [4]. For example, production processes and product development activities are physically separated in many companies, which is a mistake. Lean business undertaking is created already in pre-production stages and a large part of the parameters characterizing lean businesses is heavily influenced by logistics chain or administration processes [5].

In general, lean production can be understood as a tool that allows the removal of all sources of wasting [6]. To implement the principles of lean production, it is possible to use a variety of tools and methods that enable us to identify and eliminate individual sources of inefficiencies [7]. These, however, may not occur only in the production. For this reason, the efforts to build a lean company must include all activities and departments. Lean enterprise can therefore be seen as a system that constantly seeks potential sources of wasting in all its parts. The result of such a process can then be primarily perceived as an effectively working and sophisticated management of skills that will enhance competitiveness of the company on a long-term basis.

Unfortunately, many businesses and companies are only trying to implement separate tools of lean production. Based on their results, they then conclude about the current state of the lean production concept. Nevertheless, this approach is mistaken in the long term. Lean production tools are then frequently used only in manufacturing. Naturally, manufacturing is very involved in the creation of added value for customers; the rate and effectiveness of earning money, however, is also affected by other business areas. The paper analyzes the use of selected tools of lean production in manufacturing and logistics processes.

2. PROBLEM FORMULATION

Lean production is essentially a philosophy that aims to shorten the time between customers and suppliers by eliminating inefficiencies in the chain between them. Inefficiency (wasting) can be considered everything that increases the cost of the product or services without increasing their value. Key attributes of lean production include: lean workplace, teamwork, Kaizen, processes of quality and standardization of work, and more. The above elements of lean production allow us to eliminate individual sources of wasting. These can be classified into the following categories:

- Overproduction (making the store - production is too high).
- Unnecessary work (unnecessary activities).
- Unnecessary movement (not adding any value to the product).
- Inventory / supplies (redundant with respect to the plan).
- Waiting (time loss due to waiting for a part, information, order).
- Defects (rework of non-conforming products).
- Transport (excess material transport).
- Unused capabilities / skills of workers.

All of these sources of wasting can be relatively easily quantified using a selected variable, except unused capabilities and skills of workers. This aspect can be very hardly transformed into a precisely evaluable parameter. Nevertheless, such sources of wasting can be regarded as the most important factors as they significantly affect the company's competitiveness in the long run. Generally speaking, it is the human capital and its quality what substantially decides about the success of the company. All other input sources for the production can be relatively easily and quickly acquired. Human capital and its development, however, is always a long and never-ending process.

To optimize logistics processes, it is possible to use a wide range of different methods and tools. For example, the most used approaches can include: optimization of logistic routes, cooperation with suppliers, value stream management, and more.

3. EXPERIMENTAL WORK

The conducted research evaluated the possibility of using selected tools within logistic and manufacturing processes. These methods are as follows: 5S, TPM, Kaizen. Individual tools were analyzed and their usefulness was assessed.

5S method

Good management system refers to order and discipline in the workplace and is often also abbreviated as 5S. These 5S relate to the initial letters of five Japanese words that describe proper management. The absence of 5S means wasting, inefficiency, a lack of self-discipline, low working morale, poor quality, high costs and inability to perform deliveries. Five steps to good management can be classified into the following points:

1S - Seiri (sort)

In the first step, all items in the workplace are sorted. The items are classified as necessary and unnecessary. Unnecessary items are then removed from the workplace. In the workplace, there should be no instruments

and objects that are not used on a long-term basis. Subsequently, the tools not removed must be well organized / arranged in the workplace.

2S - Seiton (organize)

After removing the unnecessary things, all the remained items must be adequately organized. Seiton means that things should be classified according to their use and arranged so that they can be found with a minimum time and effort. To achieve this, each item must have its determined place, name and amount. It is also optimal to organize tools in a special "folder" that provides clarity and simple arrangement (**Fig. 1**).

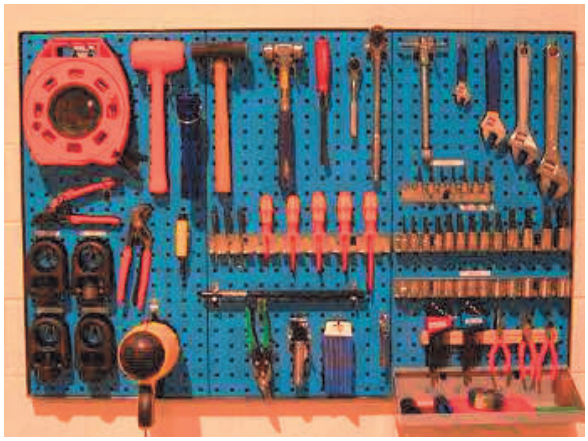

Fig. 1 Correct arrangement of tools [1]

3S - Seiso (clean)

Seiso means cleaning the workplace, i.e. machines, tools, but also floors as well as all working areas. This step is also associated with checking. During cleaning, machine operators may discover various minor faults and failures. If the machine is coated with a layer of dirt, it is difficult to identify any problems that may occur on the machine. During cleaning, however, it is easy to identify oil leaks, cracks in the casing or loose connections. Most failures on the machines start with vibrations (because of loose nuts and screws), penetration of foreign particles into the machine (due to a cracked casing) or lack of lubrication.

4S - Seiketsu (systematize)

The fourth step consists in systemizing the established principles of cleaning, order and discipline. With regard to all activities, procedures for their implementation and monitoring are systematically introduced. This step also includes an assessment of the progress achieved.

5S - Shitsuke (standardize)

The last step concerns standardization of all processes. Within changes that have taken place in implementing the 5S system, the progress achieved may gradually be degraded. Therefore, it is always necessary to try to improve the current situation. It is necessary to standardize all the processes and activities that will not only lead to maintaining the status quo but also to further development.

Introduction of 5S principles can be generally seen in the following aspects and potential benefits for manufacturing organizations:

- Creating a clean, hygienic, comfortable and safe working environment.
- Revival of the workplace and major improvement in employee morale and motivation to work.
- Removal of various types of wasting through better access to tools and implements.
- Facilitation of work, limitation on physically demanding work and clearing the space in the workplace.

- Creating an organized workplace.
- Reduced delays and losses, increased productivity in the manufacturing process.
- Reduction of mistakes and errors.
- Higher quality.
- Greater process control.
- Influence and engaging the interest of the customer.
- Building a competitive company.
- Introduction of systematic prevention of accidents at work.

Total Productive Maintenance (TPM)

This method focuses on increasing productivity of manufacturing equipment. The aim is to enhance the available capacity of machinery and remove any potential downtimes. Total productive maintenance establishes cooperation between all involved parties of the organization, especially between production and maintenance activities in the pursuit of production efficiency and continuous operation. The main objective is to create a production environment without disturbances. Today, TPM is undoubtedly one of the most effective ways to build a lean organization with limited response time and to improve operational effectiveness. TPM is a set of activities leading to the operation of machinery under optimum conditions and preservation of these conditions.

When implemented on an enterprise basis, the TPM then covers the following aspects:

- Total efficiency in the use of machinery and equipment.
- Total maintenance system including preventive and predictive maintenance.
- Total involvement of all employees (not only operating and maintenance staff).

TPM focuses on eliminating the causes of significant losses:

- Failures of machinery and unplanned downtime.
- Losses associated with the replacement and adjustment of tools.
- Losses caused by interruptions in the machinery performance, short-term faults.
- Losses of speed.
- Losses of quality.
- Reduced performance in the phase of start-up and testing.

These losses mean that machines produce fewer products than it would be possible - TPM aims at reducing individual losses.

TPM also aims at learning the operators to:

- Distinguish between normal and abnormal operation of the machine.
- Maintain normal conditions.
- Repair machines - respond to abnormal conditions.

TPM divides maintenance of machines into two categories - autonomous maintenance and professional maintenance. Autonomous maintenance includes all activities of operators that lead to restoring and maintaining normal functional status of their machines. Through improving the ability of the respective operators, it preserves the initial conditions of the equipment and contributes to reducing the number of failures.

Autonomic maintenance can be divided into the following steps:

- Selection of suitable machinery for the implementation of autonomous maintenance; initial cleaning of these machines and removal of any identified anomalies.
- Measures against sources of dirt and pollution that disallow or impede the detection of anomalies on machines.
- Initial production of standards and inspection procedures.

- Expansion and deepening of inspection skills and general supervision.
- Autonomous control based on competencies gained in previous steps.
- Linking machine operation, product quality and maintenance conditions.
- Self-managing operational teams.

Kaizen

Kaizen is a key word of Japanese management. According to many authors, it stands behind the phenomenal economic success of Japan and is a feature that brings a "permanent" competitive advantage to Japanese companies.

According to Masaaki Imaie, the spiritual father of Kaizen principles, the continuous improvement is the only path to success. Kaizen means continuous improvement in personal, domestic, social and professional life. When applied to a workplace, Kaizen means continuous improvement involving everyone - from managers to ordinary workers. The main motto is to continuously improve also things that, at first glance, do not need any improvement.

Within the meaning of Kaizen, improvement is seen as an ongoing process consisting of small steps. In each area and in each segment, it is always possible to seek and make minor changes that will improve the current situation. Therefore, the main engine of Kaizen strategy is an effort to make things better. The sequence of small but continuous improvements is even incorporated into the word “Kaizen” which is composed of two words: "Kai" = change and "zen" = good.

The scheme of continuous improvement through small steps is basically the opposite of improvements implemented through major investments and costly projects. These processes, formulated in the philosophy of the so-called reengineering, are typical of the "western" concept of improvement.

Introduction of Kaizen principles does not require any special techniques; it uses proven methods which are known and used for a long time in many cases: a focus on the customers, absolute quality control, process automation, quality control groups, system of improvement proposals and discipline in the workplace, just-in-time and movement of zero defects.

Kaizen can therefore be understood as an umbrella term for the aforementioned management practices. Most of these techniques have been taken over by "western" companies from Japan. Nevertheless, managements often expected that the introduction of one or more of these techniques would bring results which finally did not come. Companies wanted to achieve radical improvements through one-time innovations. Kaizen essence, however, lies in working with people. The system teaches workers to think in terms of best quality. All employees try and are motivated to do their job to the nines and expect the same from their colleagues who work in the manufacturing process. Everyone must realize that the results of his/her work are dependent on the worker performing the previous operation. Kaizen system requires maximum informedness, cooperation and communication between employees.

4. RESULTS

The application of monitored tools in the area of logistics and manufacturing is very versatile. Specific conclusions are presented within **Table 1**. All of the three monitored tools can be well applied to production processes. The tools are useful in production processes of various characters (metallurgy, casting, material forming). Analyzed methods can substantially eliminate wasting and inefficiencies.

In the field of logistic processes, it is feasible to use a system of good management as well as Kaizen philosophy. Many logistic activities directly incite to apply the principles of small but long-term changes. The TPM concept rather focuses on manufacturing conditions. Overall, it can be said that the mentioned tools are

very useful and easy to apply. At the same time, they usually do not require any major investments in their implementation.

Table 1 Application of selected tools in the area of logistics and manufacturing

	Logistics	Manufacturing
5S	Yes	Yes
TPM	Limited	Yes
Kaizen	Yes	Yes

5. CONCLUSIONS

Lean production and its tools can significantly help in building competitiveness of companies. Each production and non-production company must continuously look for possible sources of wasting in their processes. Lean manufacturing tools are very interesting and cost-saving alternative. In general terms, their use is not subject to major changes or high entry investments. Overall, the principles based on the concept of lean manufacturing can be perceived as highly versatile and widely usable. Applications of these tools can now be met not only in production but also as part of commercial or office premises and processes.

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REFERENCES

[1] WILSON L. How to Implement Lean Manufacturing. McGrawHill Professional, 2009.

[2] LENORT R., BESTA P. Hierarchical Sales Forecasting System for Apparel Companies and Supply Chains. FIBRES & TEXTILES IN EASTERN EUROPE, Vol. 21, No. 6, 2013, pp. 7-11.

[3] PERINIĆ M., IKONNIĆ M., MARIČIĆ I. Die casting process assessment using single minute Exchange of diees (SMED) method. Metalurgija, Vol. 48, No.3, 2009, pp. 199-202.

[4] MALINDŽÁK D., TOMÁŠ L., DUBAS P. The stochastic aspect in the maintainance operative planning of the distribution networks. TRANSPORT & LOGISTICS, Vol. 9, No. 16, 2009, pp. 56-75.

[5] LENORT R., BESTA P. Logistics of End of Life Electronics Equipment Disassembly. Acta Montanistica Slovaca, Vol. 14, No. 3, 2009, pp. 268-274.

[6] KOŠTURIAK J., FROLÍK Z. a kol. Štíhlý a inovativní podnik. Praha: Alfa Publishing, 2006.

[7] STRAKA M. Systém distribučnej logistiky firmy Alfa, a.s. Acta Montanistica Slovaca., Vol. 15, No. 1, 2010, pp. 34-43.