THE ROLE AND IMPORTANCE OF LEAN TOOLS IN WAREHOUSE MANAGEMENT

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Abstract

The aim of this study is to present lean tools which can be adopted in a warehouse. We think that lean is adaptable in warehouse operation, although companies in Hungary mainly introduce this method in production. This paper describes lean thinking, which does not only cover creating more value for customers with fewer resources, but it also refers to a complete philosophy. We provide insight into different lean methods and tools which can be effectively used by warehouses to operate more efficiently. Examples include 5S, kaizen, value stream mapping, standardised work and problem solving methods. Based on the case study method, this research focuses on the implementation of 5S in the material supply department of Lego Manufactuting Ltd. in Nyíregyháza. We interviewed Nagy Gyula, who is the material supply manager of the company. We think that lean tools (5S, standardised work) can be adopted by warehouses without any significant capital investment. However, workers still need to be convinced to use these tools in their everyday work, which is a rather difficult effort.

1. Introduction

Today, lean management is not only a mysterious concept, but an enterprise organisation and management philosophy used by an increasing number of companies. In the beginning, lean principles were spreading rapidly in production, especially in the car industry. Service providers also started to use these principles from the 2000s. Today, there are already lean offices where processes take place more flexibly, more quickly and with less errors. However, lean is not only about enterprises. The phrase 'lean supply chain' is used at an increasing frequency. Lean management is no longer used solely by enterprises, but it appears as a novel requirement for suppliers to use these basic principles during their operation. This study aims at pointing out the role and significance of lean tools to be used in warehouses. Myerson (2012) and Liker (2008) pointed out that lean can be successful and sustainable in the case of an enterprise if it is possible to establish an organisational culture which supports the related radical changes and if the top management is committed to lean in the long run. However, we think that there are certain lean tools which would be suitable for improving performance in warehouses without any significant investment even if the complete philosophy is not adopted. Examples include 5S or standard work. This study aims at the demonstration of 5S through a case study. During the visits paid to several large enterprises in the North Great Plain region, it was observed that lean is already used in production, but its introduction in warehouses is still ahead.

2. Lean in warehouses

2.1. Lean attitude

The different standpoints regarding the phrase 'lean' are not uniform either in the Hungarian or the international technical literature. The phrase first appeared in western technical literature in the paper titled "Triumph of the lean production system" written by J. F. Krafcik in 1988, as American researchers described the production system of Toyota as "lean" in comparison with the production systems established in their own country. Even today, there are different synonyms used for lean: synchronised production, Toyota Production System (TPS) or Just-in-time (Losonci 2010). Several professionals think that lean and TPS are not the same and this study does not aim to settle this argument. At the same time, we also think that the two means the same, with a few differences. As regards its basic principles and tools, TPS is essentially the same as lean, but the differences in culture required certain modifications of TPS in order for the employees of American and European companies to understand and be able to use the system.

Womack and Jones interpret lean production systems as the use of the system outside Toyota. With the books "The Machine that Changed the World" (1990) and "Lean Thinking" (1996), these two researchers contributed to spreading lean all over the world. They see the significance of lean attitude in achieving greater results with less equipment, human effort and time by using lean, while customer needs can also be met more accurately. Muda is one of the key methods to be used, referring to the recognition of defects, i.e. the elimination of all actions which use resources but do not create values. Taichii Ohno (who is considered to be father of TPS) distinguished seven types of muda as follows:

1) overproduction: production ahead of demand when there are no orders on behalf of customers
2) waiting: cases in which no value creating activities are performed on the product which is, as a result, stuck between work stages
3) motion: unnecessary steps which do not result in the creation of value
4) transport: all activities which are related to material and component transport, as well as their repeated handling
5) over processing: resulting from poor tool or product design creating activity
6) inventory: in most cases, there is a need for a certain stock size, e.g. for counterbalancing production, but abundance should be avoided
7) defect: production and repairing of faulty components (Liker 2008).

Liker (2008) mentions unused employee creativity as an extra type of loss.

Lean has five basic principles which are of chief importance from the aspect of implementing the system:

1) *Identify value:* based on the dialogues established with customers, it has to be defined what specific values enterprises create to satisfy customers and whether the products or services they create and provide satisfy customers' needs.
2) *Map the value stream:* the whole value stream (i.e. all processes from raw materials to end products) has to be identified for each product/product family which assures to explore defects in the stream.
3) *Create flow:* continuously performing activities of the value stream in order to guarantee that the product goes through all steps without stopping, waste or reflow

from planning to the end product stage in which the product can be taken over by the customer.

4) *Establish pull:* it is important to produce exactly what the customer wants and when the customer wants it. This can be done by applying the pull strategy, i.e. letting the customer pull the product from the enterprise instead of pushing the product to the customer. Forecast will not be necessary anymore, customer demands will become more stable and stocks will be reduced.
5) *Seek perfection:* since the previous four basic principles constitute a vicious cycle, it is necessary to constantly look for better methods of value creation, i.e., constant development is essential (Womack, Jones 2009).

If, by applying the above described basic principles, an enterprise successfully becomes a lean organisation, it will yield various benefits. The positive effects of lean attitude on business administration were proven by various authors, including Bicheno, Holweg (2009); Liker, (2008); Martichenko, (2013); Monden, (2012); Myerson, (2012); Schonberger, (2006); Womack - Jones (1990, 2009) and Péczely et al., (2009). Losonczi et al. (2010) also concluded that there is an obvious positive correlation between competitiveness and becoming lean. The positive impacts of various lean tools are described in detail in the next section.

2.2. Lean tools to be used in a warehouse

The majority of lean tools can be successfully used not only in production, but also in warehouse management. The majority of large companies operating in Szabolcs-Szatmár-Bereg and Hajdú-Bihar counties in Hungary have adopted or they are still adopting lean only in production, but they already plan to introduce lean tools in their warehouses. Experts usually recommend the introduction of 5S as a first step of becoming lean. This methodology was named after five Japanese phrases:

1) Seiri (Sort)
2) Seiton (Set)
3) Seiso (Shine)
4) Seiketsu (Standardise)
5) Shitsuke (Sustain)

The first step is sorting, i.e., unnecessary things are eliminated. In practice, this step is usually carried out by sticking a red label on the things which are probably not needed. In the next step, the location of necessary tools and materials is determined and marked. The location of each tool and material should be obvious to everyone. In the next step of cleaning or "shining", irregularities are revealed. During the fourth step, repeatable processes and stable quality need to be standardised. The final step is to sustain the achieved results. In order to do this, it is indispensable to perform regular audits and to properly educate workers (Kosztolányi, Schwahofer 2012a), because one of the foundations of the task implementation is knowledge (Bencsik, Juhász 2014).

Table 1 shows the activities of each 5S step in warehouse management:

Table 1. Using 5S in the warehouse

Step	Content
1S – Sort	Removing obsolete/defective stock, faulty equipment, damaged pallets and packaging waste from the work area Reducing the amount of time needed for material handling
2S – Set	Labelling locations ABC analysis (often used things should be placed at easily accessible locations) Slotting analysis (storing the stock and material handling tools at the best and most optimal place in order to improve the efficiency of operation)
3S – Shine	Identification and removal of broken pallets Installing boxes at the end of each corridor for waste collection Making cleaning tools easily accessible
4S – Standardise	Creating and documenting new standards and introducing them in each work field Standards need to be communicated with easily readable and understandable documents illustrated with photos
5S – Sustain	It has to be guaranteed that workers accept changes, step up a level and do not return to the old practice Regular supervisory discussions need to be held between workers and team leaders

(Own construction based on Richards, Grinsted 2013)

The significance of 5S lies in the fact that it establishes the basis of kaizen (continuous improvement), i.e., it establishes an organisational culture in which workers sustain order by themselves and they are able to come up with development ideas in this working environment (Kapás, 2008). The use of 5S results in various benefits for both workers and the enterprise. These benefits are summarised in Table 2.

Table 2: Benefits from 5S

Benefits for workers	Benefits for the enterprise
safer work	both downtime and the number of faulty products decrease
better work environment	visual management becomes possible
more likeable work environment	continuous improvement becomes possible
less frustration and difficulties	quality improves and productivity increases
no more searching	improving communication between workers
possibility of improving one's own workplace	less customer complaints
	reducing space use
	problems can be detected more easily
	improving stock management

(Own construction based on Kosztolányi, Schwahofer 2012a)

In addition to the above mentioned aspects, 5S activates the organisation, improves ownership approach and worker discipline, as well as the overall image of the enterprise (Kővári, 2010).

In addition to 5S, kaizen can also be successfully used in warehouse management. Kaizen is much more of a way of thinking than a method, the origin of which is associated with cavemen, as they were also constantly trying to improve their tools. However, as a method, it was first defined in relation to TPS. The basis of kaizen is constituted by simple and cheap solutions and it has four basic principles:

1) *Shortening:* this could refer to either a movement (by bringing something closer if one wants to reach it) or an action (leaving out an unnecessary step)
2) *Connection:* seeking the possibility of using tools and performing actions simultaneously
3) *Reorganisation:* work efficiency can be improved by changing the order of operations or the arrangement

4) *Simplification:* the possibility of error is much higher in the case of complicated things; therefore, one should try to simplify these methods and tools while still complying with the related requirements.

A recommendation system should be established to manage kaizen suggestions (development ideas from workers). This system has to be operated in a way that it provides proper motivation to workers. This motivation can either be of financial nature, but since each person is motivated by different things, it is often not money. Workers should feel that they are important and they can influence their environment and improve various processes (Schwahofer, Kosztolányi 2012a). It seems that those who practice the lean attitude mostly agree on the fact that the best way of changing processes and enterprises is kaizen. Kaizen is really a wonderful thing (Womack, 2016).

The third important lean tool to be used in a warehouse is standard work which basically refers to the best possible way of performing work, while safety (being free from accidents, maintaining the health of workers), efficiency and quality are guaranteed. The aim of this tool is to increase predictability and to establish the basis of constant improvement while maximising productivity and maintaining the proper level of safety and quality. Standard work can only be used in the case of recurring human activities, since it can only be improved in practice by means of coming up with new ideas. As a matter of fact, it is a constant cycle, since if there is a change in any of the main parameters (order of actions, number of workers, etc.), overall changes have to be initiated. After the initial standardisation, arising losses have to be searched for, followed by the identification and elimination of the main causes. Various problem-solving methods can be used to perform this activity. Once it is confirmed that the final status is better than the initial status, the next step is standardisation. With this method, workers can take part in improvement, while their education and training become simpler and quicker. Productivity increases and the proportion of faulty products decreases, while the organisational culture develops and the production system of the enterprise is constantly improving (Kosztolányi, Schwahofer 2012c).

Since the second step of introducing lean is the identification of the value stream, it has to be known which processes are present at the given enterprise and what customers consider to be a value. The identification of the value stream can be perfectly performed with value stream mapping (at Toyota, it is known as "material and information flow analysis"). As a matter of fact, this method serves the illustration of the whole process of material and information flow from the supplier to the customer with specific labelling. By using this method, it is possible to identify losses in the process and to understand the production system, while the value stream can be observed and managed as a single unit. Value stream mapping can be performed in five main steps. The first step is choosing the product or product family whose map is intended to be drawn up. As a next step, create a current state value stream map which shows the current processes based on current information. After this, problems are identified, i.e., the points where material or information flow is not efficient are marked on the map. As a next step, the future state value stream map is created, which shows the objectives of the given enterprise. The last step is implementation. It is important to start actions as soon as possible because of the change of processes, but it still might be necessary to do some changes on the plans. Decisions have to be made by taking the whole value stream into consideration and optimising it. Without a doubt, the biggest benefit of mapping is the reduced stock and lead time (Kosztolányi, Schwahofer 2012b).

It is important to constantly experiment – this is what kaizen is about –, to search for better methods of operation and to incorporate new methods into the standard system as soon as they

are shown to be better than the old ones. In these cases, external senseis are of the greatest benefit as they motivate people to work out better methods (Womack, 2016).

Of the various lean tools, various problem-solving methods can be used in warehouses to make more grounded decisions. However, these methods can only be used if there is a proper quantity of proper quality information available in relation to the problem to be solved. The non-exhaustive list of problem-solving methods include brainstorming, KJ affinity diagram, Gantt diagram, 5W1H (when, where, who, what, why, how), 5 whys, quality circles, Pareto chart, cause and effect diagram, PDCA, benchmarking, SWOT, network diagram etc. (Schwahofer, Kosztolányi 2012b). In addition, the use of visual management, team building, balancing and kanban could improve operation, but we do not describe these methods in detail due to size restrictions.

3. 5S case study

The aim of this study is to present the lean tools which can be used in warehouse management. Due to size restrictions, we wish to present 5S from the practical point of view by means of a case study. During this case study, "a given group or event is observed at a given point of time, usually following a phenomenon which caused a certain change" (Ghauri, Gronhaug 2011:79).

In order to be able to present 5S in an enterprise environment, we conducted a personal interview with the material supply manager of the material warehouse of the Nyíregyháza plant of Lego Manufacturing Plc. According to Majoros (1997), the topic of discussion is previously agreed upon, while the interviewer and the respondent can freely talk about the given topic.

In the Lego Group, the adaptation of lean is called LCI (Lego Continuous Improvement). The establishment of the lean attitude started in 2005. The organisation is characterised by a small group structure which was established on the basis of Toyota's example as they work in workgroups consisting of 5-7 people.

The 5S processes were introduced in the factory in 2009. The system was centrally developed by the lean office; therefore, a top-down process was introduced. However, since the 5S approach was missing from several levels of the company's hierarchy, especially from the operator level, constant support was necessary which was implemented by means of weekly held 5S audits. During these audits, it was constantly supervised whether the given area conforms to the requirements prescribed in 5S standards. PDCA (Plan, Do, Check, Act) tracking sheets were used to make measures in the case of non-compliance, while standards were constantly supervised and recommendations could also be made if necessary. A 5S display was also installed to visualise audit results. In 2013, there was a major change in the life of the enterprise, as they moved to new and larger premises. Even though 5S was stable by this time, the new location still made it necessary to rethink processes. There was a large amount of construction waste left at the premises. Although the necessary technology (frames, levers, drying equipment) was available, the optimum arrangement of the tools and equipment needed for the transport of base material (mechanical handling equipment and their refuelling stations, fundamental tools, mastermix supermarket) was not performed due to the lack of proper resources. In less than a few weeks following the launch of the factory, the manager decided that the processes were stable enough to rethink 5S in the field of material supply.

As a first step of 5S (sort), the dangerous construction waste and the tools which the contractor left at the site were removed. The whole material supply team walked around and inspected the site twice a week to collect waste into the large plastic containers placed in each

room. As a next step, the collected waste was supervised and discarded if necessary. It was important to let workers know in each step what they were doing and why. Therefore, the material supply manager constantly supported the establishment of 5S approach by explaining the causes and effects of each step to the team members. By the time only the necessary tools and equipment were left at the site, step 2 (set) could be performed. During the weekly 5S inspections, the team members designated the location of the necessary tools with the help of the so-called information displays. Every team member was informed personally if there were any modifications related to organising the area. This way, all necessary tools could be placed in accordance with their intended purpose during the implementation of step 2. It was time for step 3 (shine). Since there were no cleaning rules in force when the factory was launched, the lack of cleanness caused serious problems. The equipment was dusty and the ground was dirty. Since part of the cleaning activities was outsourced, it was necessary to designate the areas cleaned by the workers of the material supply unit and the areas cleaned by the external company. As a result, the streets between the frame systems and the pathways of the drying room are cleaned by the external company and chemical cleaning is also performed by them. The cleaning of the areas whose cleanness is critically important from the quality aspect was designated to workers by introducing a set of cleaning rules related to workers. The compliance to these rules is supervised during weekly 5S inspections. Standardisation is necessary in order to maintain these measures. For this reason, the 5S standards used at Lego consist of three parts. The first part briefly describes the standards (time of supervision, version, etc.), while the second part documents the proper state also by attaching a photo. The third part illustrates the inappropriate state; therefore, workers can easily decide whether the current state complies with what is expected. These standards were commonly established with other team members; therefore, everyone has the opportunity to change them and they are urged to do so if the ongoing processes necessitate a change. Finally, the last step was taken, since the proper state has to be sustained which is guaranteed by 5S inspections in the case of Lego and the team receives immediate feedback about any non-standard or inappropriate state. Every step of 5S is scored and the scores are displayed on a radar diagram for the sake of visualisation. The main objective is to develop the 5S approach to a level where workers provide feedback themselves in the case of deviation during the implementation of the value stream, thereby making supervision unnecessary.

4. Conclusions

This study presented lean tools which can be used in warehouse management, while also covering what lean attitude means and what standpoint we have in relation to this attitude. The main mudas and the five basic principles of introducing lean were presented. We provided a brief summary of the main tools by focusing on the main benefits and the requirements of their use. Due to size restrictions, we only focused on the introduction of 5S at the enterprise we selected. Based on the interview conducted with the material supply manager, we compiled a case study to present how 5S was introduced in the material warehouse of the Nyíregyháza plant of Lego. We think that this tool could be useful not only in the warehouses of large enterprises, but also in the case of smaller companies. 5S does not call for any significant capital investment, while it is possible to gain good results with a little effort. However, it is necessary to have committed workers, which is very difficult to achieve. The key to becoming lean is a change of attitude and culture and it calls for serious effort both on behalf of top management and workers. It is undisputable that lean is not only a collection of tools, but a complete philosophy, but we

think that certain tools (5S, standard work) could be adapted in the warehouses of enterprises which have not reached serious achievements in the process of becoming lean. However, it is very difficult to convince managers who are not aware of the lean attitude, its main purpose and tools, even if it would greatly improve the efficiency of the company's activities and the operation of the warehouse.

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