POLITECNICO DI TORINO

Department of Management and Production Engineering

Master of Science Thesis

Implementation of 5S Methodology in a warehouse improvement – A case study of MEGAHOLOD LLC: Review in literature

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Abstract

Just as living organisms, organizations are subjected to continuous changes. This statement is equally valid for warehouses as a part of organizations or as single entities. Material flow is coming in, shipped out, or just moved round the warehouse premises on a commonplace. This makes it difficult to manage the work setting in terms of order and orderliness, or to stay neat facade, and should result in disruption of processes, which on the opposite hand affect the general performance. Contribution to the changes of the work environment have also the workers, and therefore the incontrovertible fact that even as every individual has unique character, he also has unique work-habits, and it's these habits that outline the work culture of the organization.

Practical example of the statement above is that the case of MEGAHOLOD LLC. The firm is implementing 5S within the warehouse department so as to enhance the visibility, material flow, work organization and standardization of processes. Per the matter areas and counteraction of the corporate, this thesis turns to the issues of improvement of efficiency and value adding through the implementation of 5S within the warehouse of the firm.

The thesis presents theory of organizational culture and management, staring at it in an exceedingly warehouse setting and from Lean perspective and can discuss manners to sustain, and possibilities of tracking changes from the implementation of Lean 5S.

Acknowledgements

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1. INTRODUCTION

The initial purpose of the study was to make a deeper understanding of the sensible implications, the follow up, and possibly the results of the implementation of the 5S tool within the warehouse of Megaholod. The study was initiated within the December of 2019, during period of time training at Pietro Fiorentini SPA(Rosate, MI). The run was completed during the time of this trainig and also the experience, and results are valuable source of data. However, due to the very fact that the implementation of 5S within the warehouse remains in process, no complete description of the method was possible, and also the scope of this thesis moved to an outline of the matter areas within the warehouse which led to the necessity of the implementation of 5S. Focal point of this research is that the warehouse of Megaholod and also the implementation of 5S tool in it. thanks to the fore-mentioned factors and so as to enhance its performance and outmatch its competitors, Megaholod is occupied with active learning and development, a part of including deployment of Lean. Thus, research problem underpinning this Master's thesis is how the implementation of Lean 5S can contribute to the advance of the warehouse of Megaholod and the way the changes of the deployment of 5S may be sustained.

Overview and structure of the thesis

The principal structure of the thesis is divided into four main parts, which are subdivided into 6 chapters. **Chapter 1** leads to roots and the formulation of the problem. **Chapter 2** elaborates the ground theory, which presents ideas for research and practice. The theoretical background is chosen based on the main concepts knitted into the problem i.e. Lean, Warehousing. **Chapter 3** discusses objectives of warehousing, typology and definition of warehouse and general warehouse operations (*receiving, storing, picking* and finally *shipping*). **Chapter 4** describes the company Megaholod with details. Including its history, working principles, scope and etc. **Chapter 5** is devoted to a discussion of the results of this research, conclusion.

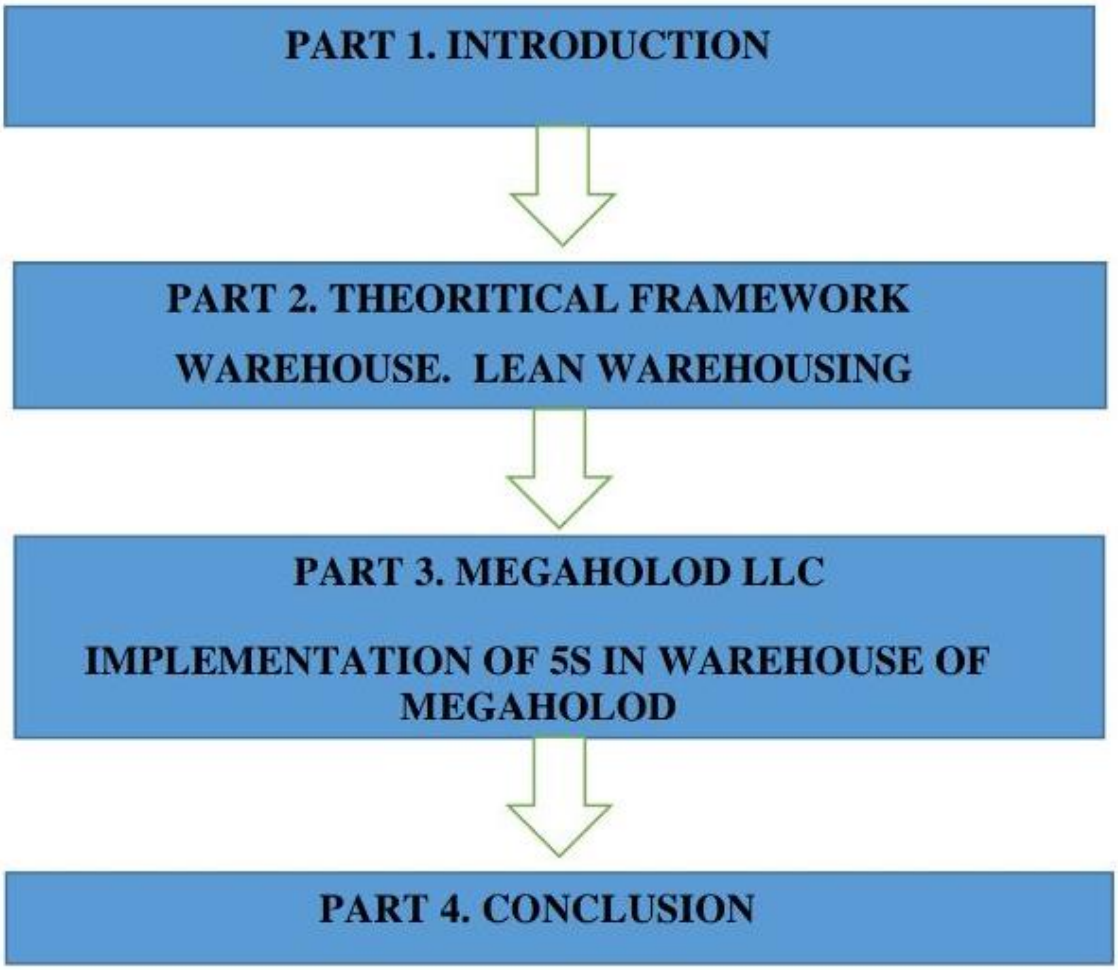


Figure 1. Structure of the thesis

2. THEORITICAL FRAMEWORK

2.1. Lean Principles

The term 'Lean' goes back to the 1990s when a book called '*"The Machine That Changed the World: The Story of Lean Production"*[1] introduced the term 'lean production' (Holweg 2007). The book follows up transfer of manufacturing ideas from craft production to mass production to Lean production (Poppendieck 2002). It origins come from the automotive industry and the Toyota Production System (TPS) in particular but nowadays it has been applied in other lines of businesses such as Lean Design and Lean Construction. The objective of Lean is to eliminate waste, to increase productivity and efficiency, to add value, to reduce costs, as well as to increase the competitive performance. All that aim at bringing customer satisfaction (customers, being the center of Lean).

Leanness can be achieved through follow-up of the following key principles

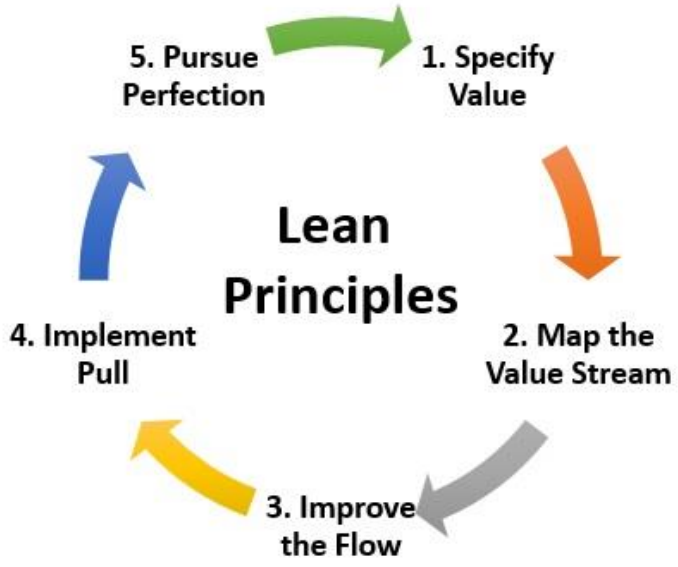


Figure 2. Principles of Lean
Source: http://knowledgeblob.com/ Lean principles

1. The Machine That Changed the World: The Story of Lean Production, by Womack, James P., Jones, Daniel T., Roos, D, Harper Perennial; 1991

1. Specify Value

To better understand the primary principle of defining customer value, it's important to know what value is. Value is what the customer is willing to get hold of. It's paramount to find the particular or latent needs of the customer. Sometimes customers might not know what they need or are unable to articulate it. this can be especially common when it involves novel products or technologies. There are many techniques like interviews, surveys, demographic information, and web analytics which will facilitate your decipher and find out what customers find valuable. By using these qualitative and quantitative techniques you'll be able to uncover what customers want, how they need the merchandise or service to be delivered, and also the price that they afford.

2. Map the Value Stream

The second Lean principle is identifying and mapping the worth stream. During this step, the goal is to use the customer's value as a point of reference and identify all the activities that contribute to those values. Activities that don't add value to the tip customer are considered waste. The waste is broken into two categories: no value added but necessary and no value also unnecessary. The later is pure waste and may be eliminated while the previous should be reduced the maximum amount as possible. By reducing and eliminating unnecessary processes or steps, you'll make sure that customers are becoming exactly what they require while at the identical time reducing the price of manufacturing that product or service

3. Improve Flow

After removing the wastes from the value stream, the following action is to ensure that the flow of the remaining steps run smoothly without interruptions or delays. Some strategies for ensuring that value-adding activities flow smoothly include: breaking down steps, reconfiguring the production steps, leveling out the

workload, creating cross-functional departments, and training employees to be multi-skilled and adaptive.

4. Implement Pull

Inventory is taken into account one amongst the most important wastes in any production system. The goal of a pull-based system is to limit inventory and add process (WIP) items while ensuring that the requisite materials and knowledge are available for a smooth flow of labor. In other words, a pull-based system allows for Just-in-time delivery and manufacturing where products are created at the time that they're needed and in mere the quantities needed. Pull-based systems are always created from the wants of the top customers. By following the worth stream and dealing backwards through the assembly system, able to make sure that the products produced are able to satisfy the wants of shoppers.

5. Pursue Perfection

Wastes are prevented through the achievement of the primary four steps: 1) identifying value, 2) mapping value stream, 3) creating flow, and 4) adopting a pull system. However, the fifth step of pursuing perfection is that the most vital among all of them. It makes Lean thinking and continuous process improvement an element of the organizational culture. Every employee should strive towards perfection while delivering products supported the customer needs. the corporate should be a learning organization and always find ways to urge a touch better each and each day.

Applying the Principles[2]

The five Lean principles provide a framework for creating an efficient and effective organization. Lean allows managers to get inefficiencies in their organization and deliver better value to customers.

[2] https://theleanway.net/The-Five-Principles-of-Lean

The principles encourage creating better flow in work processes and developing never-ending improvement culture. By practicing all 5 principles, a company can remain competitive, increase the worth delivered to the purchasers, decrease the value of doing business, and increase their profitability.

2.2. TPS (Toyota Production System)

The idea of integration of production processes in a very continuous flow came from industrialist within the beginning of the 20th Century. His practices were benchmarked by Kiichiro Toyoda, Taiichi Ohno at Toyota, and further developed the concept know as Toyota Production System (TPS).

Toyota Production System relies on the thought of optimization of production through complete elimination of waste, which results in work efficiency and lower costs. Its name and origin come from the japanese Toyota Motor Corporation and is additionally remarked as "Lean Manufacturing system" or "Just-In-Time (JIT) system". The term also became referred to as "Lean Thinking" or "Lean Philosophy", which is because of the wide-optional nature of applicability of the advance concept. Samples of the implementation of the concept come from, but aren't restricted to health care sector, service sector, sales, maintenance, government.

The fundamentals of TPS are visualized within the model developed by Toyota, referred to as Toyota Production System House

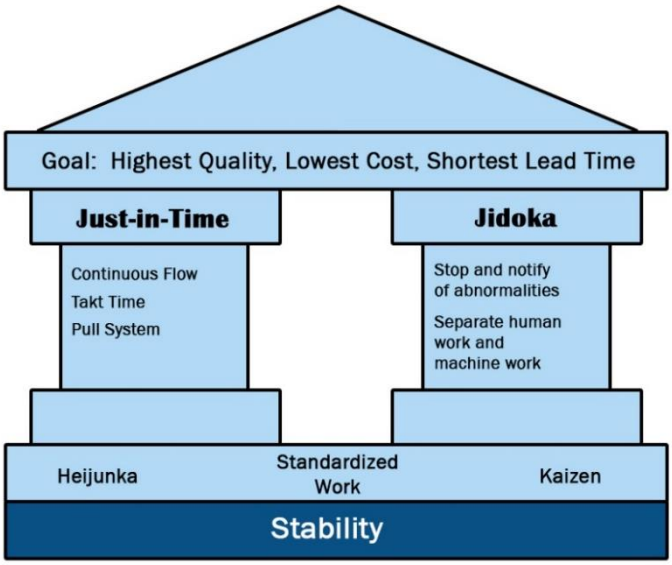


Figure 3. Toyota Production System House

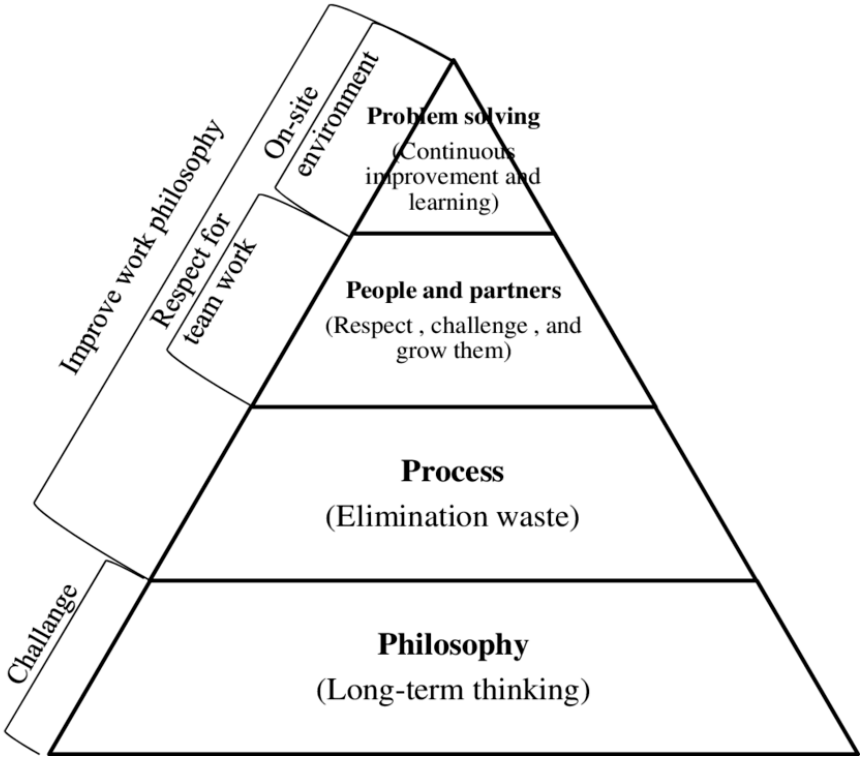
Source: www.projectengineer.net What to learn from TPS

TPS is based on two concepts – "Jidoka" and "Just –In-Time", which are occupied with the elimination of the defective products and wasteful practices. The first concept is translated as "automation with a human touch"[3] and referrers to the visualization of the problems during production, i.e. the ability of the machine to recognize and stop the production in case defects occur, which ultimately leads to improved quality in the production. The concept of JIT refers to the consistency and reliability of production in a continuous flow with elimination of waste e.g. extra inventory, extra material handling etc.

TPS lays ground on stability - through work standardization and therefore the tools of continuous improvement (Kaizen), and waste reduction - through production leveling (Heijunka). Toyota's business philosophy is predicated on motivation and training of the personnel, therefore central role within the success of the processes, the continual improvement, and therefore the system sustainability play the commitment and good training of the personnel.

[3] Toyota Production System, Source: http://www2.toyota.co.jp/en/vision/production_system/ (07.03.2010)

Continuous improvement and stability are often sustained through techniques like 5S, Standardization, Visual control and management. Liker (2004) suggests that Lean has four dimensions and so as to make a Lean organization, all of them need to be applied. These four dimensions are captured within the Toyota model of successful management style and uniqueness called the "4P" model (Liker 2004).



Fifure 4. The Toyota Way - '4P Model'

Source: www.researchgate.net 4P Model of Toyota way

Liker (2004) asserts further, that despite employing style of TPS tools, it's possible to follow only a choose few of the Toyota Way principles, which can cause short-term, non-stable jumps on performance measure, while truly practice of the total set of Toyota Way principles are in accordance with TPS and can cause sustainable competitive advantage.

TPS has become well-known and studied worldwide. Toyota 4P model has been applied successfully in numerous forms of organizations for the development not only of production but also of assorted business processes,

and despite the actual fact that's a comparatively new philosophy it's already been proven as efficient. The Toyota model and TPS have laid the muse of a very new paradigm - Lean Thinking and Lean Production.

2.3. Lean Production and Lean Techniques

The foundation of TPS tools and techniques laid ground of Lean Production. Just as in the original concept of Lean, the principles behind Lean Production aim at minimization of resources, and by this minimization of waste in the context of mass production, i.e. less human effort, less manufacturing space, less inventory, less defects (NSPR 2004). Accordingly, Lean production aims at meeting customers' expectations by delivering quality products and services at the right time and at the right cost (Ross&Associates Environmental Consulting 2004).

There is a common interchangeable usage between the terms Lean Thinking, Lean Production, Lean Manufacturing and TPS, which is due the a lack of a common agreed-upon definition but defying one is difficult since Lean is considered constantly evolving (Pettersen 2009; Demeter and Matyusz 2008).

While the standard production involves predetermined production of enormous many products cited as 'batch and queue', the assembly processes in Lean Manufacturing are organized in such some way that processing steps are adjoining one another in a very continuous, one-piece flow (Lean Thinking and Methods). Such production processes have to be closely controlled in a very well maintained, ordered and clean operational environment, which contains JIT production principles. Moreover, shift to Lean production requires system-wide, continual improvement with the participation of all employees. Differences between Lean approaches and traditional production paradigms are illustrated in Table: (Ross&Associates Environmental Consulting 2004).

	Craft Production	Mass Production	Lean Production
Focus	Task	Product	Customer
Operations	Single items	Batch and queue	Synchronized flow and pull
Overall Aim	Mastery of craft	Reduce cost and increase efficiency	Eliminate waste and add value
Quality	Integration (part of the craft)	Inspection (a second stage, after production)	Prevention (built in by design and methods)
Business Strategy	Customization	Economies of scale and automation	Flexibility and adaptability
Improvement	Master-driven continuous improvement	Expert-driven periodic improvement	Workforce-driven continuous improvement

Table 1. Comparisons between Craft, Mass Production and Lean Thinking
Source: Lean Aerospace Iniciative 2002

Waste Elimination

Lean thinking aims to get rid of wastes from work processes. Before diving into the 8 wastes, it's important to grasp what waste is. Waste is any action or step during a process that doesn't add value to the customer. In other words, waste is any process that the customer doesn't want to obtain. The original seven wastes (Muda) was developed by Taiichi Ohno, the Chief Engineer at Toyota, as a part of the Toyota Production System (TPS). The seven wastes are Transportation, Inventory, Motion, Waiting, Overproduction, Overprocessing and Defects. they're often noted by the acronym 'TIMWOOD'. The 8th waste of non-utilized talent or 'Skills' of workers was later introduced within the 1990s when the Toyota Production System was adopted within the Western world. As a result, the 8 wastes are commonly noted as 'TIMWOODS'.

Within the following section we'll examine each of those wastes intimately.

Figure 5. THE 8 WASTES OF LEAN (LEANOP)
Sourse: theleanway.net WASTES OF LEAN

1) *The waste of overproduction* – uncoordinated production - too early or just in case. That results in excess inventory;

2) *The waste of waiting* – prevention of the processes to move forward, or queuing. It can be due to lack of coordination in upstream and downstream activities;

3) *The waste of needless transportation* – movement of materials, which adds no value, extend the process-time and may lead to handling damages.

4) *The waste of extra processing* – the extra activities connected with overproduction, excess inventory or handling of defective parts, e.g. rework, reprocessing, storage.

5) *The waste of inventory* – this includes the raw materials, the material in process, and materials in store, which are not needed for the customers' orders.

6*) The waste of movement* – this refers to the motion of the personnel in vain, which occurs with processing of defects or from inefficient layout.

7) *The waste of defects* – finished goods that confront with the requirements of the customers, or parts or products which have defects and require correction.

8) *The waste of creativity* – the lack of utilization of creativity and ideas of the employees in the improvement of processes and practices. It is however arguable, whether this type of waste is inherent to the previous seven wastes (Hicks 2007).

Kaizen

Kaizen (from Japanese 'improvement') is considered a mindset for **continuous improvement of cycle** within an organization via problem solving and creative thinking, with the participation of both the managerial and the shop floor staff. It is not associated with any specific technique, but is represented by quality circles, which provide opportunities for the workers to participate in the processes of improvement and maintenance through periodical team meetings, on which ideas for problem-solving are proposed. Maintenance requires the building of standard operating procedures (SOPs), rules, directives and is achieved through discipline and human resource development measures. Improvement, on the other hand is achieved through continuous revision of the settled standards and further establishment of higher standards. Essential for the implementation and the success of this strategy are step-by-step actions, the managers' commitment, the employees' mindset, and the training and education of the personnel (Salem 2006).[4]

[4] http://www.1000ventures.com/business_guide/mgmt_kaizen_main.htm

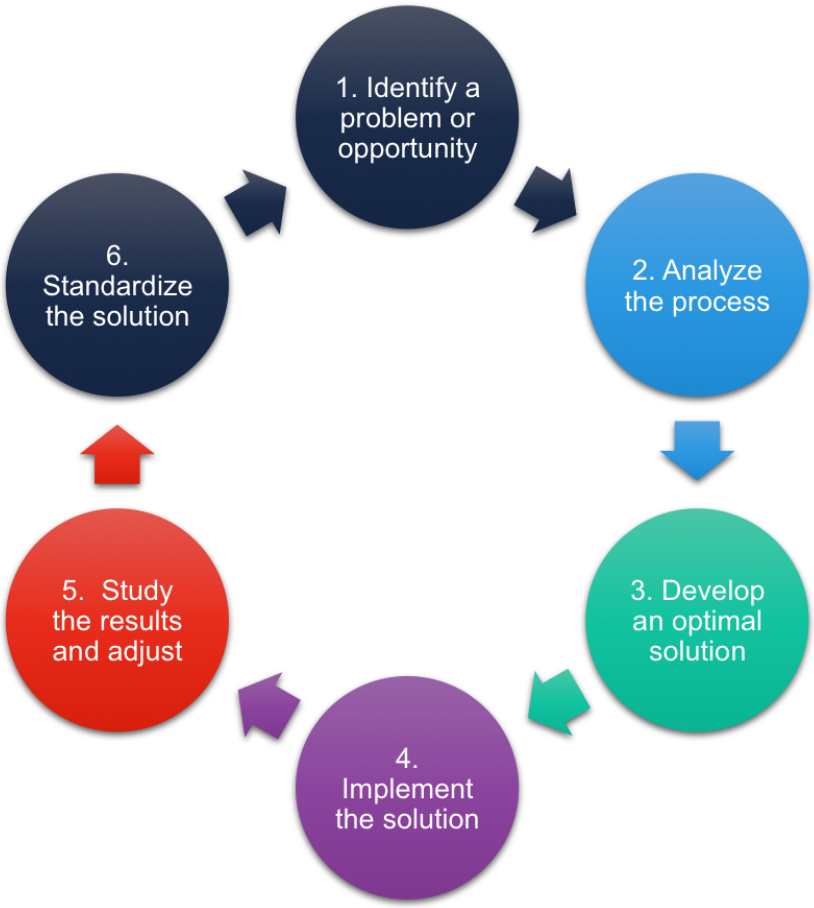


Figure 6.Continuous Improvement Cycle
Source: theleanway.net

5S

Implementation of Lean within the production or within the various levels of a corporation has to be supported by establishment of Lean environment. this could be done through five processes for achievement of standardization, effective work place organization, and continuous improvement called the 5S-

short-stands from the japanese words for sort, set so as, shine, standardize, and sustain.

Sort - organization and tidiness has got to start from elimination of the unnecessary items at the work place. this may remove the surplus, broken or obsolete materials, and can clear up floor space. Useful practice for sorting is that the red tagging. The redundant items are tagged with a red paper note, then taken resolute a central holding area where they're further evaluated. the things which are considered useful are kept in an organized storage, while the remainder of the things are discarded.

Set so as – all the materials has got to be organized, and an efficient and effective storage methods should be established. Strategies for effective storage of the things are painting of the floors, outlining working areas and locations, shadow boards, etc.[5]

Shine– after the clutter has been removed and also the work environment organized, the working area has got to be thoroughly cleaned and keeping it clean has got to transform a daily practice.

Standardize – having achieved the previous 3S's it's required to standardize the simplest practices so as to further sustain the processes.

Sustain – it's hard to vary the ossified processed, so sustaining the changes is taken into account the foremost difficult "S" to implement and maintain. Resistance typically accompanies the changes, and also the personnel easily turn back to the established order, therefore understanding and promoting the changing processes is important. The implementation steps of 5S, the activities that follow them are presented in summary within the table below:

[5] http://www.tpmonline.com/articles_on_total_productive_maintenance/leanmfg/5sphilosophy.htm

Japanese Term	English Equivalent	Meaning in Japanese Context
Seiri	Sort	Throw away all rubbish and unrelated materials in the workplace
Seiton	Straighten	Set everything in proper place for quick retrieval and storage
Seiso	Scrub	Clean the workplace; everyone should be a janitor
Seiketsu	Standardize	Standardize the way of maintaining cleanliness
Shitsuke	Sustain/Self discipline	Practice 'Five S' daily - make it a way of life; this also means 'commitment'

Table 2. The implementation steps of 5S

Source: www.researchgate.net implementation steps of 5S method

3. WAREHOUSE. LEAN WAREHOUSING

Warehouses play key role within the supply chains by defining to a good extend the success of companies (the company's competitiveness) in terms of cost levels and customer service. Despite the high expenses, which come by carrying inventories, warehouses function as a buffer between the variability of supply and demand, which makes them necessary element within the contemporary supply chains. The high expenses provoke the challenge for achieving low cost warehousing with a high level of customer satisfaction at the identical time. However, under the influence of factors like e-commerce, supply-chain collaboration, globalization, and new management techniques such as JIT and Lean production, successful warehousing is heading towards tighter inventory control, shorter response time and a greater variety (Frazelle 2002; Gu, Goetschalckx, and McGinnis 2007)

Figure 7. Sketch of Warehouse

Source: https://advancestorageproducts.com/fifo-vs-lifo-inventory-flow

3.1 Objectives of warehousing

Warehouses are storage systems whose functions support the efficiency and smoothness of the logistics operations by providing materials and supplies a in a timely and cost effective manners. Objectives for warehousing include the following (Warehousing and Distribution Operating Instructions 2009; Tostar and Karlsson 2008):

- Maximize the warehouse storage utilization, warehouse equipment and warehouse staff.
- Determine and maintain an inventory of Stock Keeping Units (SKUs) so that it can provide the requested quantities of stocked commodities needed by users.
- Maintain an inventory of critical SKUs so that zero levels of the latter do not occur.
- Reduce SKUs handling, maintain SKUs accessibility, and assure the designed SKU rotation or turns.
- Minimize the company's operating expenses

3.2 Typology and definition of warehouses

According to different characteristics various types of warehouse are recognized: (Rushton, Croucher, and Baker 2006, p.256):

- By the stage in the supply chain: materials, work-in-process or finished goods.
- By geographic area: national, local or regional, or such that may serve more than one country.
- By product type: for example small parts, large assemblies, frozen food, perishables, security items or hazardous goods.
- By ownership: owned by the user or owned by a third-party logistics company.
- By company usage: for example a dedicated warehouse for one company, or a shared-user warehouse.
- By area: classification according to the storage dimension in square meters.
- By height: classification according the height – e.g. from 3 meters high to 'high-bay' warehouses that may be over 45 meters in height.
- By equipment: from largely manual operations to highly automated.

Another classifications of warehouses presents the following three types: (Berg and Zijm 1999):

1. **Distribution warehouses** – products are collected (sometimes also assembled) from different suppliers and further redirected to the customers.

2. **Production warehouses** – storage of raw, semi-finished and finished products in a production facility.

3. **Contract warehouses** – warehouse facility used on behalf of one or more customers.

Frazelle (2002) on the other hand, presents another classification by distinguishing three types of warehouses according to their value-adding operations:

1. **Raw material and component warehouses** – hold raw materials at or near the pint of induction into a manufacturing or assembling process.

2. **Work-in process warehouses** – hold partly completed assemblies and products at various points along an assembly or production line.

3. **Finished goods warehouses** – hold inventories used to balance and buffer the variation between production schedules and demand.

Despite the various classifications based on different criteria, the essential difference between warehouses is confined to the perspectives of the sources, management and users of the warehouse. On the other hand, what brings them together is set of common operations: receiving, storing, picking and shipping (Tompkins 1998).

3.3 General warehouse operations

Market forces and the development of technologies within the material handling have brought influence on the warehouse operations (Van der Berg and Zijm 1999). However, the fundamental warehouse activities consist of:

Receiving

According to the standard procedures of receiving goods at warehouses, the products are delivered and unloaded at the receiving docks, and before their allocation, the products are identified, the quantities verified against the orders and random quality checks are performed. The strategy is completed by entering the knowledge for the delivery within the inventory system. Before transportation and allocation, the SKUs are labeled (e.g. a barcode label or an RFID tag are attached), and/or repacked within the correct storage modules (pallets, cartons, etc.) if necessary.

Storing

The SKUs have to be allocated away to their designated storage location, which is defined by the warehouse management system. Identification of the right location of the SKUs is important because "proper storage allocation rules optimize the space utilization as well as the efficiency of the warehouse processes (Van der Berg 2007, p.64)".

In connection with the putaway organization of the SKUs, several storage policies exist (Rouwenhorst et al. 1999):

- Dedicated storage – each product is assigned to a particular location.
- Random storage – the operator takes the decision where to place the SKUs.
- Class based storage (ABC zoning) – the products are classified in groups according to their turnover ratio and zones are allocated to those groups.
- Correlated storage/family grouping – nearby storage of SKUs if they are often required simultaneously.
- Forward/reserve and replenishment – which articles and in what quantity are stored in a separate reserve area (forward area), if such exists.

While stored, the SKUs have to be counted on a periodic base. Cycle counts aim at smoothing the inventory discrepancies by determining the imbalances between the actual product amount in stock and the amount registered in the warehouse management system.

Order picking

Order picking is the process of retrieving products according to a specific request. The process of picking an order is performed manually or automatically and is guided by an order, which specifies the required products and the quantities. Orders can be picked individually (single order picking) or in batches. Two policies for picking exist – pick and sort (sequential), and sort while pick (simultaneous). A way to organize the order picking is through a routing policy, which defines the sequence and the route of the retrievals (Rouwenhorst et al.

1999). In cases when the order consists of multiple SKUs, the latter are accumulated and stored until shipping.

Order picking is identified as the most costly and labor-intensive operation in most of the warehouses, i.e. 65% of the total cost and 50% of the workforce of a warehouse (Figure 3-1) (Strack and Pochet 2009; Berg and Zijm 1999) . Bad performance of this operation may affect the whole supply chain through high operational costs and unsatisfactory service (Koster, Le-Duc, and Rootbergen 2007).

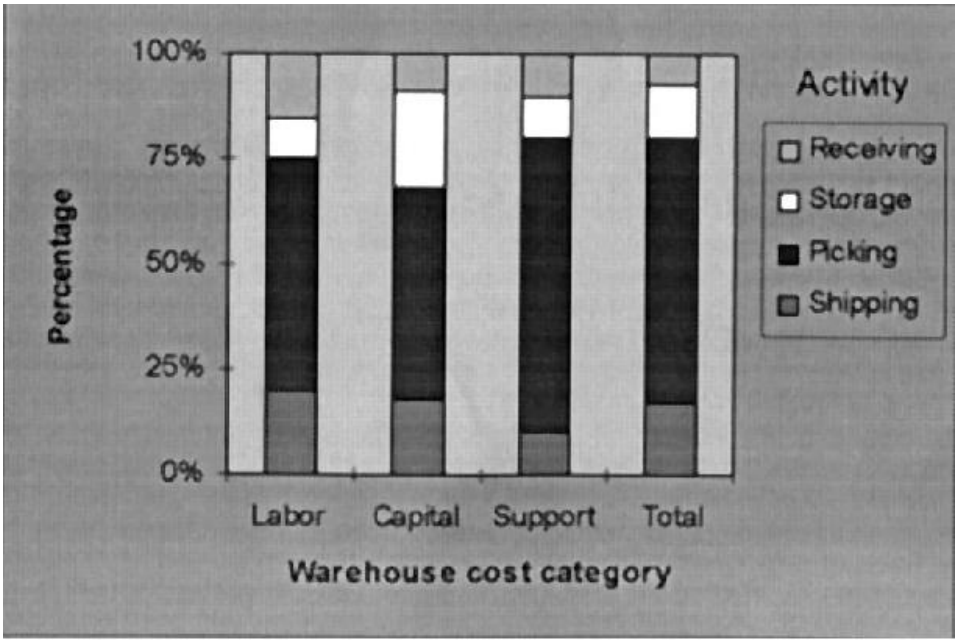


Figure 8. Warehouse costs by activity
Source: www.researchgate.net

Shipping

Many of the universal receiving principles apply for the shipping process but in reverse order (Fazelle 2001). Accordingly, shipping includes the picking up and delivery of the orders to the shipping dock where the SKUs are prepared to be shipped. Finally, the data for the SKUs, which left the warehouse is updated in the inventory system. For both shipping and receiving processes, scheduling of the incoming and outgoing loads would contribute for a better management of

the resources (personnel, staging space, dock doors etc.) and could promote creation of timetables for the warehouse operations (Longva 2009). This would contribute to standardization of the processes in the warehouse and thus for its improvement.

4. MEGAHOLOD LLC

4.1. History of company

4.2. Working principles

4.3. Scopes

5. IMPLEMENTATION OF 5S IN WAREHOUSE OF MEGAHOLOD

5.1. Warehouse at Megaholod

5.2. Problem areas in the warehouse operations at MEGAHOLOD

5.3. Implementation of Lean 5s in the Maintenance Department of MEGAHOLOD

5.4. Implementation of Lean 5s in the warehouse of MEGAHOLOD

6. Conclusion

References

1. https://www.youtube.com/watch?v=sKIgvsZvBtI
2. https://www.youtube.com/watch?v=RxDw0Q_gVt0
3. https://theleanway.net/The-Five-Principles-of-Lean
4. https://www.youtube.com/watch?v=wfsRAZUnonI
5. http://leanop.com/cms/en/glossary/
6. https://theleanway.net/The-8-Wastes-of-Lean
7. https://theleanway.net/what-is-continuous-improvement
8. https://theleanway.net/muda-mura-muri
9.