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AN INTRODUCTION TO APPLICABILITY OF LEAN IN WAREHOUSING

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Abstract- The paper presents theory of organizational culture and management, looking at it in a warehouse setting and from Lean perspective and will discuss manners to sustain, and possibilities of tracking changes from the implementation of Lean. Just as living organisms, organizations are subjected to continuous changes. This statement is equally valid for warehouses as part of organizations or as single entities. Material flow is coming in, shipped out, or simply moved around the warehouse premises on a daily basis. This makes it difficult to control the work setting in terms of order and orderliness, or to keep neat facade, and may lead to disruption of processes, which on the other hand affect the overall performance. The implementing Lean in the warehouse department in order to improve the visibility, material flow, work organization and standardization of processes. According to the problem areas and counteraction of the company, this paper turns to the problems of improvement of efficiency and value adding through the implementation of Lean in the warehouse of the shipyard.

Keywords:- **Lean design & construction, warehousing, TPS, NSPR.**

I. INTRODUCTION

The term 'Lean' goes back to the 1990s when a book called "*The Machine That Changed the World: The Story of Lean Production*'' 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).

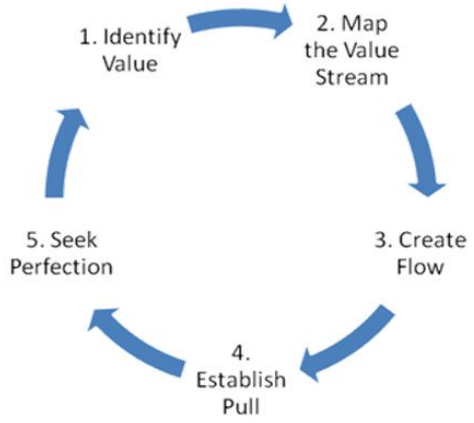

Figure 1: Principles of Lean

1. ***Identify the value*** **–** investigate the processes from customers perspective i.e. define the needs of the customers out of the processes. It can be done with tools as value management, function deployment and simulation.
2. ***Map the value stream*** **–** the consequence of processes required to make a product is defined as value stream, and mapping of those processes will help understanding how the value for the customers is build through the processes.
3. ***Create flow of the processes*** **–** the aim is to create a value stream and one-piece flow, as well as to avoid or reduce the batch and queue, if possible.
4. ***Establish Pull*** **–** adjustment of the production to the customers' needs and requirements, i.e. produce when and what the customers want. The production processes should be supported by JIT and standardization.
5. ***Seek perfection*** **–** once the above-listed actions are performed, they should be supported by continuous improvement, evaluation of the changing processes and waste elimination in a repetitive manner in order to consolidate the changing processes.

Furthermore, the following methods are sound supplement of the above-mentioned key Lean principles for Lean production.

I. Implement a *plan-do-check-act (PDCA)* improvement framework to achieve results fast.

II. Use *metrics and performance feedba*ck to improve real-time decision-making and problem solving.

III. Approach improvement activities from the perspective of the *whole enterprise or system*.

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Lean practices help organizations to improve fundamentally their competitiveness, by cost reduction, increased quality and response to customer needs. Rationale behind the implementation of Lean is typically strong business drivers, and successful implementation of Lean requires significant transformation of the organization's culture and practices. Lean practitioners assert that time of crisis is when changes are most successfully fostered and followed in (Ross&Associates Environmental Consulting 2004).

With the necessary adaptation, the principles of Lean have expanded its applicability from the production, to service industry, the military, and in construction processes, which speaks about the universality, and efficiency of the concept. Liker (2004) clams that every type of organization business can benefit from Lean not by imitating the tools used by Toyota in a particular manufacturing process but rather, by developing principles that are the right ones for the organization or businesses and by practicing them, to achieve high performance that continues to add value to the customers and society.

2. 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 traditional mass production involves predetermined production of large lots of products referred to as 'batch and queue', the production processes in Lean Manufacturing are organized in such a way that processing steps are adjoining each other in a continuous, one-piece flow (*Lean Thinking and Methods*). Such production processes need to be closely controlled in a well maintained, ordered and clean operational environment, which incorporates JIT production principles. Moreover, shift to Lean production requires system-wide, continual improvement with the participation of all employees.

The extent to which Lean concepts in production systems have been adopted in various manufacturing industries brings in question the universality of the concepts of Lean in manufacturing. The doubt in the universality of Lean Production is supported by the fact that achieving production leveling and consequently the fundamental JIT for Lean manufacturing, dependent upon various factors such as business conditions or buyer-supplier relationship. When these conditions are not met, batch or mass flow may be a better manufacturing practice. However, the adaptation of some of the Lean production practices in batch and mass flows does not imply that they are 'in transition' to Lean production.'' (Cooney 2002, p.1145).

Lean production exists on both strategic and operational level. The strategic level refers to the customers value and identification of value stream, while the operational level deals with various tools and practices that lead to waste elimination and support continuous improvement (Demeter and Matyusz 2008). Accordingly, different opinions on which tools and practices are associated with Lean Production (see Appendix 1) have been expressed, however, some common concepts are recognized and in order to give insight into Lean Production some of them will be discussed below.Implementation of Lean in the production or in the various levels of an organization needs to be supported by establishment of Lean environment. This can be done through five processes for achievement of standardization, effective work place organization, and continuous improvement known as the 5S - short-stands from the Japanese words for sort, set in order, shine, standardize, and sustain.

Sort - organization and tidiness has to start from elimination of the unnecessary items at the work place. This will remove the excess, broken or obsolete materials, and will clear up floor space. Useful practice for sorting is the red tagging. The redundant items are tagged with a red paper note, and then taken out to a central holding area where they are further evaluated. The items which are considered useful are kept in an organized storage, while the rest of the items are discarded.

Set in Order – all the materials has to be well organized, and efficient and effective storage methods should be established. Strategies for effective storage of the items are painting of the floors, outlining working areas and locations, shadow boards, etc.5

Shine– after the clutter has been removed and the work environment organized, the working area has to be thoroughly cleaned and keeping it clean has to turn into a regular practice.

Standardize – having achieved the previous 3S's it is required to standardize the best practices in order to further sustain the processes.

Sustain – it is hard to change the ossified processed, so sustaining the changes is considered the most difficult ''S'' to implement and maintain. Resistance typically accompanies the changes, and the personnel easily turn bacback to the status quo, therefore understanding and promoting the changing processes is essential.

Even though not common in the literature, a sixth S has been recognized by some practitioners (DiBarra 2002). It stands for Safety and is positioned between Shine and Standardize. It refers to the safety of the work place and respectively of the employees. It is arguable whether the 6th S can be regarded as supplementary pillar to the 5S tool, or rather as an aspect of each of the 5S pillars, since safety is considered inherent to the concept of 5S. Bicheno (2004), for example, claims that safety procedures and their standardization should be developed, maintained and audited as part of the 5S program (Bicheno 2004).

The idea behind the 5S tool is that well-organized environment contributes to the optimization and productivity by: Creating and maintaining organization and orderliness; Using visual cues to achieve more consistent operational result; Reducing defects and making accidents more less likely;

The 5S principles refer to Manufacturing Management but are more popular in Lean Manufacturing Processes. However, this standard approach for housekeeping appeared to be applicable in various activities, such as data organization, office housekeeping, measurements and management systems within the supply chain and factory (Sheldon 2008).

Though Lean practices appear to be easy to grasp, they can be difficult to execute in consistency. Many companies have reached a superficial implementation of Lean and that is due to the fact that they are concentrated on some of the Lean tools like 5S or JIT, rather than grasp the concept and apply it as a cultural change throughout the whole organization (Liker 2004). Often companies implement only the first 3S but fail to standardize the processes and in this way doom the sustainability of the results of the project to failure, therefore the completeness of the 5S tool is essential.

3. WAREHOUSE MANAGEMENT

Warehouses play key role in the supply chains by defining to a great extend the success of businesses (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 in the contemporary supply chains. The high expenses provoke the challenge for achieving low cost warehousing with a high level of customer satisfaction at the same 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).

4. 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):

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

Logistic costs take good part of the production cost. Being nods of the distribution activities, this is also valid for warehouses; therefore optimization of their performance is essential element in the cost structure of each company.

5. TYPOLOGY AND DEFINITION OF WAREHOUSES

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

1. By the stage in the supply chain: materials, work-in-process or finished goods.
2. By geographic area: national, local or regional, or such that may serve more than one country.
3. By product type: for example small parts, large assemblies, frozen food, perishables, security items or hazardous goods.
4. By ownership: owned by the user or owned by a third-party logistics company.
5. By company usage: for example a dedicated warehouse for one company, or a shared-user warehouse.
6. By area: classification according to the storage dimension in square meters.
7. By height: classification according the height – e.g. from 3 meters high to 'high-bay' warehouses that may be over 45 meters in height.
8. 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).

6. LEAN WAREHOUSING

Warehouse improvement refers to improvement of the material flow, order picking, replenishment, and dock operations. Improvement techniques such as material flow analyses, quality improvement and application of Lean can be applied. Successful application of Lean techniques would lead to reduced lead-time (the unnecessary time part of the order-to-delivery processes), order picking time, and the time for material handling. This can be achieved through reduction of the non-value adding activities, and improvement of velocity and flow in the warehouse (Garcia).

Lean thinking has become popular in the last 20 years and its techniques have been applied to different service industries. Examples are the replacement of the telephone operators by dialing systems, the implementation of self-check or home-print boarding pass option introduced by some airline companies, the implementation of ATM machines by the banks, and the implementation of the automatic payment devices implemented on the gasoline tanks on some gas stations (Ackerman 2007). These examples prove the versatility and adaptability of the concept of Lean and support the statement that the implementation of Lean in warehousing can doubtlessly be successful.

Warehouse optimization includes optimization of the functions and the material flow. Despite the common perception that Lean thinking is typically subscribed to the production processes (the origins of Lean come from the mass production of highly standardized products, in contrast, warehousing belongs to service industry), where the elimination of waste and the non-value added processes are most visible, and the fact that ‘’many practitioners consider the term warehouse and Lean mutually exclusive.’’ (Garcia), the application of Lean in the warehouse activities can lead to significant improvement, such as elimination of waste, improvement of the lead-times and better value creation.

Despite no concrete example for Lean warehousing is available, according to the practical experience of STL Warehousing with the implementation of Lean in warehousing activities shows that ‘’[…] Lean philosophy alone, is not enough to resolve (or pre-empt) all warehousing problems. But when combined with traditional project management skills, it is amazingly effective at transforming a warehouse into a clean and organized system that performs like a production line, delivering predictable and reproducible results with significantly less labour.’’

REFERENCES

[1] Ackerman, Ken, ed. 2007. Lean Warehousing: Ackerman Publications.

[2] Adcroft, Aandy, Williams, Robert, Hurst, Feff. 2008. A new model for managing change: the holistic view. Journal of Business Strategy 29 (1):40-45.

[3] Anonymous. Chapter 7 Methodology of Research [cited 19.09.2010. Available from www-best-information.eu/international-marketing-strategies/C7-Benchmarking.html.

[4] Aslesen, Sigmund. 2007. Lean Shipbuilding. Lean Construction Beyond Lean? In EGLC-5. Oslo, Norway: FAFO Institute for Applied Social Sciences.

[5] Aslesen, Sigmund, and Karolis Dugnas. 2009. Lageret - et nav i systemet.

[6] Berg, Jerone.P. van den, and W.H.M. Zijm. 1999. Models for Warehouse Management: Classification and Examples. International Journal of Production Economics 59 (1999):519-528.

[7] Bertelsen, Sven. 2007. Lean Shipbuilding. A Norwegian Research Project. EGLC 6.

[8] Bicheno, John. 2004. The New Lean Toolbox Towards Fast, Flexible Flow: PICSIE Books.

[9] Cameron, Esther, and Mike Green. 2004. Making sense of change management: a complete guide to the models, tools and techniques of organizational change., ed E. C. a. M. Green.

[10] Choi, Ty. 1995. Conceptualizing continuous improvement: Implications for Organizational Change. Omega, Int. J. Mgmt Sci. 23 (6):607-624.

[11] Cooney, Richard. 2002. Is "Lean" a Universal Production System? - Batch Production in the Automotive Industry. International Journal of Operations and Production Management 22 (9/10):1130 - 1147.

[12] De Jager, Peter. 2009. 7 ways to communicate change. ProQuest Health Management 119 (2):31.

[13] Demeter, K., and Z. Matyusz. 2008. The impact of lean practices on inventory turnover. International Journal of Production Economics 2010.

[14] DiBarra, Camilla. 2002. 5S - A tool for culture change in shipyards. Journal of Ship Production 18 (3):143-151.

[15] Dugnas, K., and I. Uthaug. 2007. Can Lean Philosophy Strengthen and Develop Cluster Advantages? - An Exploratory Research towards Lean Shipbuilding, Høgskolen i Molde, Molde.

[16] Fafo. Lean Construction NO. Nettverk for prosjektbasert produksjon. [cited 15.11.2010. Available from http://develop.fafo.no/lean/lean/article/1182.html.

[17] Fazelle, E., ed. 2001. Supply chain strategy. The logistics of Supply chain managment. Edited by McGraw-Hill.

[18] Frazelle, Edward. 2002. World-Class Warehousing and Material Handling, ed McGraw-Hill. New York.

[19] Garcia, Frank C., P.E. Applying Lean Concepts in a Warehouse Operation.

[20] Gu, Jinxiang, Goetschalckx, and Leon F. McGinnis. 2007. Reasearch on Warehouse Operations: A Comprehensive Review. European Journal of Operational Research 177 (2007):1-21.

[21] Hicks, B.L. 2007. Lean Information Management: Uderstanding and Eliminating Waste. International Journal of Information Management 27 (2007):233-249.

[22] Holweg, Matthias. 2007. The Genealogy of Lean Production. Journal of Operational Management 25 (2007):420-437.

[23] Huber, G. P. 1991. Organizational Learning: the contributing proceses and the literatures. Organization Science 2, No.1 (February 1991).

[24] Huf III, Alfred W. Organizational development and change - communication. Argosy University - Twin Cities.

[25] Jerez-Gomez, P., J. Cespedes-Lorente, and R. Valle-Cabrera. 2003. Organizational learning capability: a proposal of measurement. Journal of Business Research 58 (2005):715-725.

[26] Johnson, A., Wen-Chen Chen, and Leon F. McGinns. 2009. Large-Scale Internet Benchmarking: Technology and application in warehouse operations. Computers in Industry 61 (2010):280-286.

[27] Jones, Lisa M. 2007. An Examination of Social Influence Effect on Commitment to Change and Implementation Behaviours. dissertation, Department of Management, Kenan-Flagler Business School, University of Noth Carolina, Chapel Hill. Kang, Hyun Jung. Shipbuilding Industry.

[28] Koenig, P. &, N. Hitoshi, and K. Baba. 2002. Lean production in the Japanese Shipbuilding Industry? Journal of Ship Production 18 (3):2002.

[29] Koster, R. de, T. Le-Duc, and K.J. Rootbergen. 2007. Design and Control of Order Picking: A Literature Review. European Journal of Operational Research 182 (2007):481-501.

[30] Kozak, Metin. What is benchmarking? Understanding its Philosophy. edited by M. U. Turkey.

[31] Lamb, Thomas. 2001. World-class Shipbuilders: Thier Productivity and Useof Lean Manufacturing Principles. SNAME Transactions.

[32] Lean Thinking and Methods. Available from www.epa.gov/lean/thinking.

[33] Liker, J., and T. Lamb. 2000. Lean Manufacturing Principles Guide. A Guide to Lean Shipbuilding. (University of Michigan, Ann Arbor, Michigan).

[34] Liker, Jeffrey 2004. The Toyota Way - 14 Management Priniciples from the World's Greatest Manufacturer. (McGraw-Hill).

[35] Liu, Yongmei, and Pamela L. Perrewe. 2005. Another look at the role of emotion in the organizational change: A process model. Human Resource Management Review 15 (2005):263-280.

[36] Longva, Kjersti K. 2009. Warehouse Management in a Lean Shipbuilding Perspective - An Exploratory Case Study of Ulstein Verft AS Masters in Logistcs, Høgskolen i Molde, Molde.

[37] Lyu, J., and A. Gunasekaran. 1993. Design for Quality in the Shipbuilding Industry. International Journal of Quality&Reliability Management 10 (4).

[38] Malone, Sarah A. 2007. Creating organizational capacity for continuous and adaptive change, Benedictine University.

[39] Norway's Shipbuilding Indutry. 2009 [cited 28.11.2009. Available from http://www.nmi2008.com/2009/02/19/norway%E2%80%99s-shipbuilding-industry/.

[40] NSPR, ASE. 2004. The National Shipbuilding Research Program and the Lean Shipbuilding Initiative. Reference Package developed for Students at the Defense Asquisition University.

[41] Oxtoby, B., T. MGuiness, and R. Morgan. 2002. Developing organizational change capability. European Management Journal 20 (3):310-320.

[42] Pettersen, Jostein. 2009. Defining Lean Production: Some Conceptual and Practical Issues. The TQM Journal 21 (2):127-142.

[43] Pluye, P., L. Potvin, J. Denis, J. Pelletier, and C. Monnoni. 2005. Program sustainability begins with the first evenets. Evaluation and Program Planning 28 (2005):123-137.

[44] Poppendieck, Mary. 2002. Principles of Lean Thinking(Poppendieck. LLC).

[45] Rushton, A., P. Croucher, and P. Baker. 2006. The handbook of logistics and distribution management. Edited by K. P. Limited.

[46] Salem, O., Solomon,J., Genaidy, A., Minkarah, I. 2006. Lean Construction: From Theory to Implementation. Journal of Management in Engineering 22 (4):168:175.

[47] Sanidas, E. 2001. The successful imitation of the Japanese Lean Production System by American firms: Impact on American Economic Growth. http://ro.uow.au/commwkpapers/33.

[48] Sarkar, Debashis 2006. 5S for Service Organizations and Offices. A Lean Look at Improvements. Milwakee: Quality Press

[49] Schneider, B., Brief, A.P., Guzzo, R. 1996. Creating a climate and culture for sustainable organizational change. In Organization change: a comprehensive reader, edited by W. W. Burke, Lake, D.G., Paine, J.W.

[50] Senior, B., and S. Swailes. 2010. Organizational Change.

[51] Sheldon, Donald H. 2008. Lean Materials Planning and Execution: a Guide to Internal and External Supply Management Excellence: J. Ross Publishing.

[52] Soy, Susan K. The case study as a research method. (Unpublished paper, University of Texas at Austin) 1997. Available from www.ischool.edu.

[53] Strack, Geraldine , and Yves Pochet. 2009. An Integrated Model for Warehousing and Inventory Planning. European Journal of Operational Research 204 (2010):35-50.

[54] Tompkins, James A., Smith, Jerry D. 1998. The Warehouse Management Handbook: Tompkings Press.

[55] Tostar, M, and P Karlsson. 2008. Lean Warehousing. Gaining from Lean thinking in Warehousing, Linkjøping Tekniska Høgskola.

[56] Sugimori, Y., Kusunoki, K., Cho, F. , Uchikawa, S. (1977), "Toyota Production System and Kanban System Materialization of Just-in Time and Respect for Human System". International Journal of Production Research. Vol. 15 No. 6, pp 553-564.