LEAN PRODUCTION – APPLICATION TO WAREHOUSES

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Abstract
Lean manufacturing includes several best practices and processes which optimize resources to produce high quality products quickly and efficiently at a low cost and warehousing has as its first role the storage of goods that can be defined as the assignment of goods in a selected location. Lean philosophy applied to warehouses generates value for the company and for its customers. Lean projects should be implemented as part of a comprehensive companywide initiative and it should be a pervasive and permanent culture, not a limited-time project that works for everybody at every level.
The purpose of this paper is to investigate the application to the warehouse management and organization of lean production techniques, objectives and goals. The paper is based on a review of journal articles and books literature on lean production.

Keywords
Lean production, agile production, total quality management
Paper type
Conceptual paper

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1. Introduction

To define lean production or manufacturing it requires that we examine first its historical background, evolution and identify the different perspectives. It all started around 1927 when Henry Ford outlines his production philosophy and the basic principles that support the revolutionary Ford Production System (FPS) (Shah and Ward, 2007).
In 1937, Toyoda cousins Kiichiro and Eiji with Taiichi Ohno study the FPS and perfect the principle concepts and tools constituting the Toyota Production System (TPS) and Just-In-Time (JIT) production method is a key component of the TPS. Lean production descended from the Toyota Production System, based on the experiments developed by Taiichi Ohno over three decades in the Toyota Motor Company that formerly arrived in the United States in 1984, when the New United Motor Facturing, Inc. (NUMMI) plant was founded in a joint venture made between Toyota and General Motors Corporation.
This approach has become an integral part of the manufacturing procedure in the United States over the last decades and its link is the superior performance and its ability to provide competitive advantage to organizations. These goals are well accepted among academics and practitioners (Wood *et al.*, 2004).
As organizations attempt to transform themselves to compete successful in the future, they are turning to a variety of improvement initiatives: Total quality management, Just-in-time (JIT) production and distribution systems, Time-based competition, Lean production / Lean enterprise, Building customer-focused organizations, Activity-based cost management, Employee empowerment, Reengineering.
Each of these improvement programs has had demonstrated success stories, each competes for the time, energy, and resources of senior executives. And each offers the promise of breakthrough performance and enhanced value creation for many of a company's community: shareholders, customers, suppliers and employees (Kaplan and Norton, 1996).
In this paper we will define lean production and after we will focus the application of the lean production philosophy to the warehouses.

2. Lean production – literature review

Defining lean production is a challenging task mainly due to the fact that it is not clear the conceptual and the operational space that encompasses lean production and there is a set of operational measures that can be used to define it. The term "lean", created by John Krafcik (Russel, 2009), refers to using less of everything during production – less labor, less manufacturing space, less equipment, less inventory, and less engineering inputs during development and processing – all of which results in fewer defects and more variety. The lean production systems use the best advantage of handmade and mass production while reducing the costs and rigidity that are linked with each of these types of production. To accomplish this task, the lean methodology uses multi-skilled work teams and highly flexible increasingly automated machines. These measures lead to produce a large variety of products in increasing volumes. On the other hand we can say that lean manufacturing is not an extension of traditional thinking or techniques and that lean is neither an instant transition nor is it an extension of traditional thinking or techniques but rather a revolutionary thought process that requires abandonment of some old paradigms. Another point of view is that lean manufacturing is an increase of other manufacturing processes which precede lean and contend that lean manufacturing's origins can be traced back to Japan and their use of just-in-time production in the 1930's (Russel, 2009).
More precisely, lean manufacturing includes several best practices and processes which optimize resources to produce high quality products quickly and efficiently at a low cost (Filho and Fernandes, 2004). This philosophy uses a systematic approach to identify continuous improvement, pull production, pursuit of perfection, a set of initiatives

focused on eliminating all waste in production processes, a business system for organizing and managing operations that requires less human effort, space, capital and time to make products with fewer defects, a mechanism in which complex production processes can be organized to increase the flow of materials and reduce waste. The philosophy has a process with four stages that includes the definition of customer value, definition of the value stream, making flow by pulling from the customer, and effort for excellence.

The main idea of Toyota Production System is to produce the kind of units needed, at the time needed and in the quantities needed such that product inventories (raw materials, production materials and finished material) can be reduced or eliminated. The goal of this tool is the cost reduction (waste elimination) and to achieve this goal there are three mains stages set that are quantity control, quality assurance and respect for humanity. These goals are conquered through the following concepts: JIT, Autonomation, Flexible workforce, Empowerment of workers (Monden, 1983). TPS includes standardization of work, uninterrupted work flows, direct links between suppliers and customers, and continuous improvement based on the scientific method. Lean production uses half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time. It requires keeping half the needed inventory, results in many fewer defects, and produces a greater and ever growing variety of products (Womack *et al.*, 1990). Lean Production is an integrated system that joins production of goods or services with minimal middle costs.

Lean philosophy uses standard techniques such as visual communication of information, process mapping, process control, and identification and elimination of defects. Some of the best-known lean tools and techniques include value-stream mapping (a diagram of the material and information flows required to bring a product from order to delivery); just-in-time production; the "5 Ss" (five principles of an organized workplace); work leveling (ensuring consistent type and quantity of work over a period of time to avoid batching and backlogs); *kaizen* (continuous improvement) and Plan-Do-Check-Act (an improvement cycle that consists of proposing a process change, implementing the change, measuring the results, and taking appropriate action)

Holweg (2007) mapped out the key events and major publications: (next page)

In order to give the historical background and point out the processes definitions we will mark the critical phases in the lean production evolution and after we will map the conceptual definitions, except Lean manufacturing and Toyota Production System that were already highlighted above (Shah and Ward, 2007 use this approach).

Critical phases

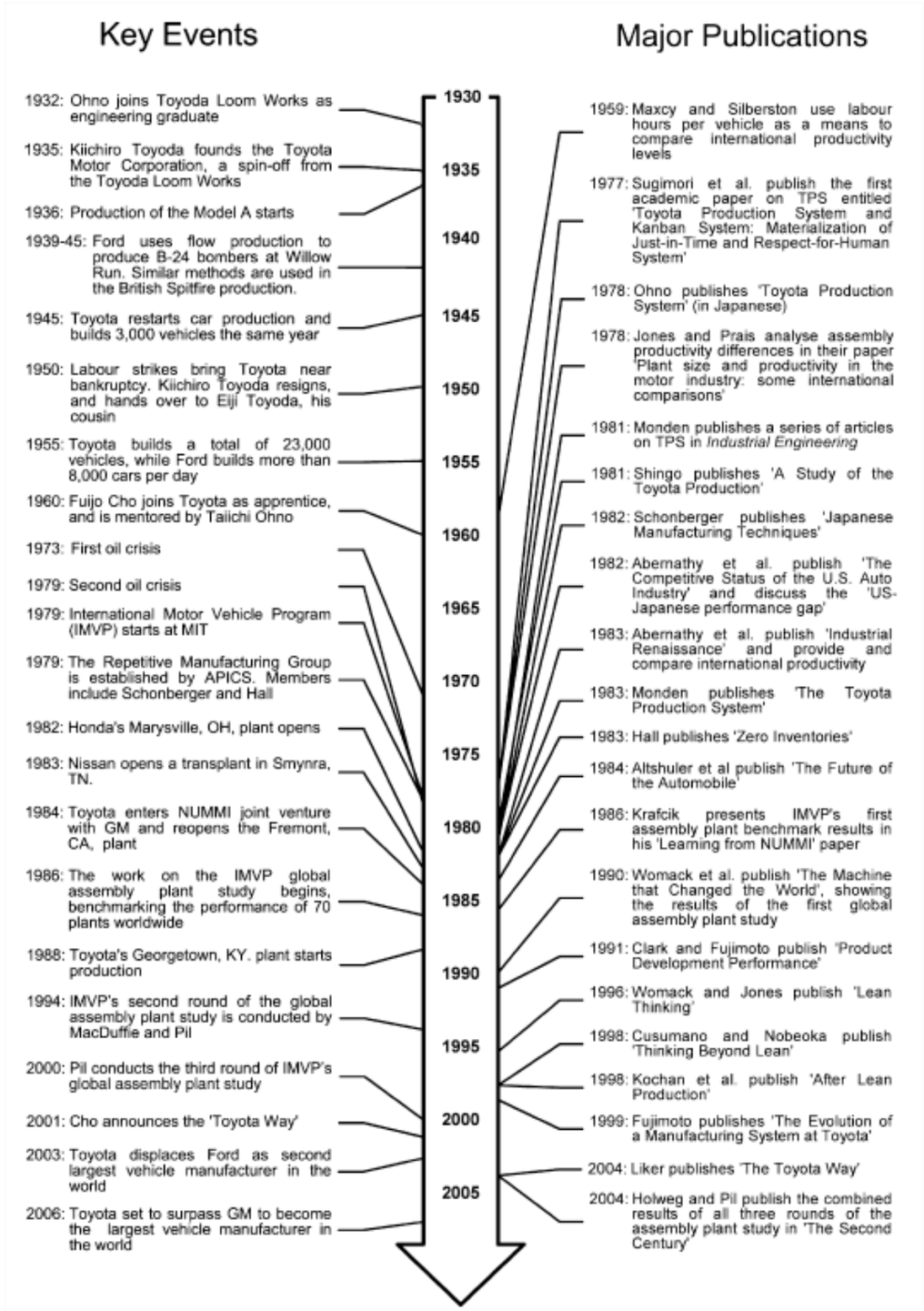
1927 and before:

Henry Ford outlines his production philosophy and the basic principles underlying the revolutionary Ford Production System (FPS) in "Today and tomorrow" in 1927.

1945 - 78 Progress in Japan:

1937 - Toyoda (later Toyota) Motor Company is established in Koromo, Japan. Toyoda cousins Kiichiro and Eiji, with Taiichi Ohno study FPS and perfect the principle concepts and tools constituting Toyota Production System (TPS). Just in time (JIT) production method is a key component of TPS.

1978 – Taiichi Ohno publishes "Toyota Production System" in Japanese. He recognizes Ford Production System and the American supermarket as the origin of his just in time thinking. According to Ohno, the primary goal of Toyota Production System is cost reduction (waste elimination), it can be achieved through quantity control, quality assurance, and respect for humanity. Ohno recommends that we should produce only the kind of units needed, at the time needed and in the quantities needed.



1973 - 88 Toyota Production System arrives in North America

1973 - Oil crisis in the world especially in North America. It generates immense interest in the Japanese manufacturing and management practices followed by publication of numerous academic and practitioner books and articles.

1977 - First academic article in the Lean Manufacturing field is published by Sugimori *et al.,* "Toyota Production System and Kanban System Materialization of Just-in-Time and Respect-for-Human System" in the International Journal of Production Research; focused articles on topics such as Kanban and Just-In-Time production; academic articles focused in production smoothing and level loading appear and they are made by Yasuhiro Monden.

1984 - NUMMI, a joint venture between Toyota Motor Company and General Motors opens a plant in California.

Middle 1980 - Relevant books are published including Monden's Toyota Production System (1983); Ohno's Toyota Production System: Beyond large-scale production (1988) is published in English. The understanding of TPS is detached and its constituent elements; equivalence between JIT production, kanban and TPS is suggested.

1988 - 2000 Academic progress

1988 - Krafcik creates the term "lean" to describe the manufacturing system used by Toyota.

1990 – The book "The machine that changed the world" written by James Womack, Daniel Jones and Daniel Roos is published. The book establishes "lean production" to characterize Toyota's production system including its underlying components in the popular dictionary. The book describes a lean system in detail but does not offer a specific definition.

Middle 1990 - Articles related to measuring Just-In-Time, Total Quality Management, their interrelationships and the impact of other organizational variables on their implementation are published in the academic journals.

1994 – The book "Lean Thinking" by James Womack and Daniel Jones is published. The book extends the guiding principles and philosophy subject to lean at a company level.

2000 - Present

Several books and articles written by practitioners and consultants and a few academic conceptual and empirical articles highlighting the in-depth nature of lean production are published. The definition of Lean is still not clear and specific.

2006 – Toyota Motor Company will become the number one automobile manufacturer in North America.

Conceptual Definitions

JIT – Just-In-Time

Just-In-Time philosophy has only the necessary products, at the necessary time, in the necessary quantity (Taylor, 2001). Kanban system, production smoothing and setup time reduction are critical components of any JIT system (Monden, 1981). JIT philosophy is associated with three criteria's: JIT manufacturing techniques, total quality management and people involvement and empowerment. Programs associated with JIT include elimination of waste, full utilization of people, equipment, materials and parts (Davy *et al.*, 1992). JIT is an approach to continuous manufacturing improvement and its main concern is the waste elimination in the manufacturing process. In this philosophy, elimination of waste is achieved through the simplification of the manufacturing processes, such as reduction or elimination of excess inventories and large lot sizes, which usually cause unnecessary long cycle times of production and deliveries to final costumers (Flynn *et al.*, 1995). The main idea behind JIT is composed by three main concepts: flow, quality and employee empowerment.

TQM – Total Quality Management

Total Quality Management (TQM) is an management philosophy and set of practices that stresses continuous improvement meeting customer requirements and for that we must reduce rework, long term thinking, increase employee empowerment and teamwork, process redesign, competitive benchmarking, team-based problem solving, constant measurement of results and closer relationships with suppliers and customers (Ross, 1993).

TQM is an approach to improving the quality of goods and services through continuous improvement of all process, customer driven quality, production without defects, focus on improvement of processes and data driven decision making (Flynn *et al.*, 1994).

Continuous Improvement

Continuous improvement is a philosophy that must be adopted by the entire organization. Management must support both the continuous improvement effort and the people who engage in the effort on a daily basis. Employees must buy into the philosophy as they are critical to identifying areas for necessary improvements, suggesting what improvements should be made, and implementing necessary improvements.. Continuously solving root problems drives organizational learning which results in higher quality, lower costs, shorter lead times, improved safety, and better employee morale.

Elimination of Waste

Elimination of waste is central to lean production. For the Japanese flexibility became a key factor for production a large variety of vehicles using scarce resources and limited workforce (Sugimori *et al.*, 1977). This key factor led to the discovery that shorter lead times and flexible production lines lead to higher quality, better customer responsiveness, better productivity, and better utilization of capacity and equipment. As a result, the waste is eliminated and Toyota is able to give customers what they want, when they want it, at the right price, with the highest quality.

After mapping the critical phases and the conceptual definitions, now we will focus the differences between TQM and lean production. To highlight these differences, we will use the work made by Hackman and Wageman (1995) in three vectors (basic assumptions, change principles, interventions):

Basic assumptions

We will start the assumption with quality and this term do not receive the same attention in lean philosophy as it receives in the TQM, on the lean philosophy the main focus is the just-in-time (JIT) production. JIT has the goal to decrease total cost and emphasize the problems. In order to achieve this goal we must reduce the resources in the system, so that buffers do not cover up the problems that may arise. In the short run, the reduction of resources has as result a direct reduction of cost and in the log term, the reduction and elimination of buffers will emphasize the problems that exist in production, so they will become an important source of continuous improvement (Ohno, 1988). Several authors say that the purpose of lean is waste elimination although the literature points out that waste elimination is an important aspect of the concept. Reducing waste is also an important part of TQM, but under the flag of poor-quality-costs. A major difference between TQM and lean in this aspect is the precision in defining waste. For the most of lean literature, waste is based on the seven forms defined by Ohno (1988), whereas TQM has a very general definition of poor-quality-costs, including everything that could be eliminated through improvement.

Another issue related with quality, is that, this is the responsibility of senior management. Lean and TQM share this concept, but with some differences. In TQM managers should create structures that support the employees in producing products of high quality. In lean the rationale for doing this seems to be centered around eliminating the human factor from the system through Jidoka (don't pass defects downstream, prevent defects by preventing errors, etc.), and Poka Yoke (smart automation as tools necessary to achieve the principle) (Pettersen, 2009).

Regarding the employees and the quality of their work, the lean concept has a weak employee's perspective. The proponents of lean production usually have a strong instrumental and managerial perspective, discussing employees in terms of components in the production system (Berggren, 1993). The lean literature suggests that employees cannot be trusted to produce good quality, so there is the need of removing the possibility of human error from the system.

What Lean and TQM have in common is seeing the organization as a system, just with a small difference in the concept. The focus of TQM is on the internal structure and integration of departments within the organization. The

focus of lean is a supply chain perspective, seeing the internal production operations as a part of a value stream from the sub-suppliers to the end customer (Jones and Womack, 2002).

Change principles

Regarding the learning and continuous improvement, the learning aspects are not emphasized as much in literature on lean, there is a clear focus on continuous improvement, which implies that some form of learning is required. TQM is focused on stimulating creativity and individual efforts for improvement, whereas lean places strong emphasis on the standardization of work and collective learning.

Management by fact is implicit in the description of lean practices, many of which are analytical tools designed to help to achieve JIT production. There is a slight difference between lean and TQM regarding this area, in TQM the analysis of variability is made through the use of statistical tools is a central concept. In lean, this is not seen as equally important. In fact, some authors argue against the use of statistical tools for analyzing production performance, recommending alternative tools such as increased inspection and visualization of problems.

Focus on processes is also an area to look. In the lean concept the term value stream is used. In TQM, the term process is usually used at a lower level of abstraction and is called sub-processes or activities. The conception that management should analyze and improve the processes and train the employees is also shared by the two philosophies.

Interventions

In the analysis of customer requirements, the customer focus is one of the main goals of TQM, where every improvement should be based on an investigation of the customer's requirements, whether the customer is internal or external. The lean concept does not emphasize customer interests; the purpose of lean is to please the customer, but methods for analyzing customer requirements are needed.

In the supplier partnerships field, they are seen as important in both lean and TQM. Both concepts stresses the point that long term partnerships should be made with suppliers and that improvements should be done in collaboration with them. Improvement teams and quality circles have a central role in much of the TQM literature, and can be put to use in problem solving or improvement activities. In the lean literature, improvement teams are explicitly discussed by just about half of the authors. However, they are often implicated in discussions about improvement activities.

Scientific methods for performance measurement and improvement in TQM and lean are employed, various scientific methods for analysis and evaluation of performance. These methods differ significantly and the tools associated with one concept are generally not mentioned on the other one. The purpose of measurements also differs, in TQM measurements are done in order to identify problems and to document improvement, in lean the measurements should be made for planning and synchronization purposes.

For the process management techniques, different techniques are presented for both overall process level and individual activities. At an organizational level, value stream mapping (VSM) can be used for highlighting several kinds of problems in the processes. At a more operational level, different time/work study techniques are discussed (E.g. spaghetti charts),

To sum up, at a philosophical level lean and TQM have many ideas in common, particularly concerning continuous improvement and the systems perspective. However, at a more operational level, the two concepts differ significantly. The fundamental values of the two concepts are also quite different, especially regarding humanistic values. Lean manufacturing is not just applicable for production and plants, however, its techniques and tools can be adapted to almost any type of operation.

In what concerns to the warehouses the lean philosophy can improve efficiency, inventory, safety, and costs reduction. Another, very important fact, is that it changes the way people think about processes and communication, it can be especially effective in helping facilities use warehouse labor more efficiently and reducing costs.

3. Lean warehouses

Initially we will define warehousing, that has as its first role the storage of goods that can be defined as the assignment of goods in a selected location. The second role of warehousing is the implementation of the goods flows from one part of supply chain to another resulting in the transformation of the warehouses into distribution centers. After these roles, we can say that the essential issue for warehousing is the management of space and time. In the beginning the warehouse was looked as a buffer against uncertainty of supply. Nowadays warehousing is done for many other reasons, for example for the stored inventory, warehousing is most used as a buffer against the uncertainty of demand and is used to improve the customer service. The closer the warehouse is to its customers, the better service it can provide. A further shift has occurred in the type of warehousing, to varying general purpose, customized, owned, leased, or operated by third parties. The third party logistics are used when a company decides to outsource this activity with an external operator (Ackermann and Brewer, 2001).

The main processes of the warehouse or distribution center include:

- Receiving: this includes the monitoring of goods, both in terms of quantity and quality, often with depalletizing and transferring to a storage area; and the receipt of returned goods.
- Storage: this includes organizing goods according to bulk, long and short lead time products, seasonal or promotional products, and replenishment storage.
- Order picking: this includes assigning order lists to teams and teams to zones, and the organization of pickers, whether picking is done manually or electronically (e.g., pick-to-light).
- Dispatch: this comprises packaging and order consolidation, which may include staging or interim storage and shipping.

Another issue related with warehouses, is the quality of service that it can provide to the organization and to their internal and external costumers. One of the best metrics used to account this perception is the feedback given by the costumers and team that works in the warehouse. There are six quality metrics that are based on costumer perceptions:

- Costumer complaints
- On time delivery
- Timely receiving
- Accurate and timely documentation
- Compliance with rules for loading and marking
- Internal organization

Some quality measures are primarily internal, but if neglected they may influence costumer perceptions, these internal measures include the following:

- Work practices
- Accidents
- Employee turnover
- Equipment downtime
- Product damage
- Compliance with government regulations

Since quality of service and storage are key elements to measure the quality of service provided, the use of the lean philosophy becomes very important, since quality is one of the key elements in this approach. Lean has born in the car plants, but the lean philosophy can also be applied to the warehouses (Hines et al. 2001), mainly involving:

- Reduced bin sizes
- Storage by part type, with frequently used parts near the front or aisle end

- A division of working day and tasks into standard work cycles
- Synchronized order-pick-pack-dispatch and delivery steps for each delivery route (milk route) out to a group of local dealers
- Staggered outward delivery routes
- Controlled progress and irregularities trough binning or picking ticket bundles for each cycle (preventing working ahead), and visual control boards
- The logging of irregularities and prioritization in order to conduct root-cause elimination of the most frequent problems to prevent recurrences and hence improve the process

In the Toyota's regional distribution center the application of these procedures lead to a stock reduction of 20 weeks, from 24 to 4 weeks. The service rate and productivity have improved three times compared with a regular organized distribution center, without any automation of processes.

Lean concepts can be successfully applied to a warehouse environment. Value stream mapping (VSM) can be a valuable tool for developing and implementing warehousing lean improvement projects. The process of creating the value stream map helps to train the warehouse team on lean techniques and to reveal opportunities to reduce waste. Some of the traditional lean techniques such as cellular manufacturing and setup time reduction may not be applicable to most warehouse environments. However, once the value stream map has been developed, the waste in the warehouse process can be easily identified and eliminated using:

- Reduction in material handling time in order picking, putaway, and palletizing
- Reliability issues with the strapping and metal detection machines
- Reduction in truck loading time
- Reduction in time spent checking inventory location and aging
- Improved order processing and tracking
- Reduced material handling
- Improved inventory organization
- Cross training
- Quality tracking

Using the VSM, the goal in developing the future state map is to make the flow continuous and to eliminate as much waste as possible. Lead time is shortened as much as possible by implementing lean techniques. The flow in the future state map is built around the takt time, or how frequently a unit must be completed to meet customer demand. Takt time is simply the available working time per shift divided by the rate of customer demand per shift. The lean improvements, implemented in a warehouse can reduce order processing time by 50% and lead time by 25% (Garcia and Director, 2004).

As seen above lean concepts can lead to significant costs reduction, so warehouse and distribution center managers spend a lot of time trying to figure out how to handle the greatest amount of product in as little time as possible, with the highest level of service, and at the lowest possible cost. That's because even in the most efficient facilities, there is waste to be found: wasted motion, wasted time, wasted inventory, and more. One direction to eliminate waste - defined in lean philosophy as anything that does not provide value to the costumer and to the company - is through the kind of continuous improvement program associated with lean.

Lean's objectives in a plant are similar to those of warehouse and distribution centers operators. The seven wastes that lean management seeks to eliminate are all present in warehouses and they include (Gooley, 2013):

- Transportation (driving a forklift without a load)
- Defects (time spent fixing work done incorrectly, such as mispicks)

- Inventories (piling staged product in locations that create congestion)
- Motion (temporarily placing inbound pallets on the floor instead of directly into storage)
- Wait time (waiting to load or unload trucks)
- Overproduction (making or ordering more product than is needed or before there is demand for it)
- Over processing (performing steps in a process like packing and shipping that are unnecessary)

There are another wastes that the companies realize, like unused employee creativity or knowledge and over engineering (applying a complex solution when a simple one would suffice) as warehousing-related wastes they try to avoid.

Lean philosophy is appropriate for any kind of process that includes a lot of steps, and warehousing and distribution certainly fits that profile. Lean management aims to create a culture of continuous improvement that engages employees at all levels, especially those who perform the work processes, identifying waste and developing and implementing remedies. But it's also applicable to the warehouse at a tactical level.

In a warehouse, every type of waste has an impact on labor in one way or another. If everyone in a facility can develop the spirit of looking for waste reduction and identify ways to eliminate it, it will have an immediate and direct impact on labor costs. Waiting (orders or people) is one of the biggest labor-related wastes inside a warehouse. If people are waiting for orders, you have labor that's not being utilized or being productive, and if orders are waiting for people, those workers will have to work harder and faster, and thus become stressed, ultimately they will have to work overtime, to keep up with the work. The lean principle that suits this kind of waste is work leveling, that is, controlling the flow and timing of activity to create level, unvarying demand during the available work time.

One of the most basic lean tools is the spaghetti chart, which maps out the path a product takes during a particular process and visually shows the motion required. That can help warehouse operators identify overly complex processes, enabling them to reduce labor costs by addressing wastes like over processing and unnecessary transportation. Order pickers would gather items and drop them off at a sorting station. Someone there would sort and consolidate the orders, and someone else would pack them. Another person would run the packages through the parcel shipping and place them for shipping. As a result, inventory would build up between each handoff.

There are mainly three things in regard to employee buy-in, first is reducing headcount should never be the goal of a lean initiative, and no full-time employee should ever be laid off because of one. Instead, warehouses can adjust their use of temporary labor, wait for staffing levels to drop through normal operation, or reassign workers to open positions. Second, contributions from the people who actually do the work are an integral part of any lean initiative. They know what actually happens, and they are in the best position to identify waste and implement improvements. Their active participation in a multilevel team is a critical success factor and will also encourage them to accept change. Third is the honest communication about the expected benefits for them, their employer, and their customers is important. While the benefits for the employer may be obvious, employees need to know that lean warehouse initiatives have personal benefits for them: a cleaner, safer workplace; less physical stress and time pressure; recognition for their ideas and achievements; and often, more business and therefore, greater job security and opportunities for promotions. Lean projects should be implemented as part of a comprehensive companywide initiative and it should be a pervasive and permanent culture, not a limited-time project that works for everybody at every level (Gooley, 2013). Lean is not easy to implement, but when done properly, it can transform a company's culture, not to mention the way a warehouse operates. We can say that lean philosophy applied to warehouses generates value for the company and for its customers.

Conclusion

Ford production system started the beginning of a new era in the management of automotive plants. The "father" of Toyota Production System, Taiichi Ohno, grabbed Ford's system improved it, to the final concept of produce the kind of units needed, at the time needed and in the quantities needed such that product inventories are kept low, almost zero, that is the essence of TPS. This philosophy enabled Toyota to reach the leadership in the automotive industry in the United States and in the world in 2006.

Toyota Production System arrived in the United States in 1984 with the implementation of a Toyota plant and it was the formal beginning of the lean philosophy. Since then, its scope of application is growing and it's being applied in several countries, in different kinds of plants, warehouses or even in offices of companies that only provide services.

Lean is not easy to implement, but when done properly, it can transform a company's culture, not to mention the way a warehouse operates. We can say that lean philosophy applied to warehouses generates value for the company and for its customers. Lean projects should be implemented as part of a comprehensive companywide initiative and it should be a pervasive and permanent culture, not a limited-time project that works for everybody at every level.

The top management and employee's commitment to the project are the key factors for a successful implementation of the lean techniques. The employees involvement and empowerment, the lean team, the daily lean activities are key concepts for the implementation of lean.

Lean allows companies to have excellent results without investing big amounts of money in projects of automation warehouse activities. Most of all, it allows the companies to look inside them and identify the problems and processes that need to be improved. The person that knows better what are the problems and the solutions for its activity is the person that daily performs it, so employee's involvement is the trigger that allows the long term application of the this tool and the continuous improvement of the company.

References

Ackermann, K.B. and Brewer, A.M. (2001), "Warehousing: A Key link in the supply chain", in A.M. Brewer, K.J. Button and D.A. Hensher (Eds.), *Handbook of Logistics and Supply-Chain* Management, 1st edition, pp. 225-237, Oxford, Pergamon.

Berggren, C. (1993), "Lean production – the end of history", *Work Employment and Society*, Vol. 7, Nº 2, pp. 163-88.

Davy, J.A., White, R.E., Merritt, N.J. and Gritzmacher, K., (1992), "A derivation of the underlying constructs of Just-In-Time management systems", *Academy of Management Journal*, Vol. 35, Nº 3, pp. 653-670.

Filho, M.G. and Fernandes, F.C.F. (2004), "Manufatura Enxuta: Uma revisão que classifica e analisa os trabalhos apontando perspectivas de pesquisa futuras", *Gestão & Produção*, Vol. 11, Nº 1, pp. 1-19.

Flynn, B.B., Schroeder, R.G. and Sakakibara, S. (1994), "A framework for quality management research and an associated measurement instrument", *Journal of Operations Management*, Vol. 11, Nº 4, pp. 339-366.

Flynn, B.B., Sakakibara, S. and Schroeder, R.G. (1995), "Relationship between JIT and TQM: Practices and performance", *Academy of Management Journal*, Vol. 38, Nº 5, pp. 1325-1360.

Garcia, F.C. and Director, P.E. (2004), "Applying Lean Concepts in a warehouse operation", *IIE Annual Conference and Exhibition*, pp. 2819-2859.

Gooley, T. (2013), "Lean your warehouse workforce", accessed on 7th June 2013, http://www.dcvelocity.com/articles/20130528-lean-your-warehouse-workforce/?goback=%2Egde_2504457_member_245521060

Hackman, R. and Wageman, R. (1995), "Total Quality Management: Empirical, Conceptual, and Practical Issues", *Administrative Science Quarterly*, Vol. 40, Nº 2, pp. 309-342.

Hines, P., Jones, D. and Rich, N. (2001), "Lean Logistics", in A.M. Brewer, K.J. Button and D.A. Hensher (Eds.), *Handbook of Logistics and Supply-Chain* Management, 1st edition, pp. 171-194, Oxford, Pergamon.

Holweg, M. (2007), "The genealogy of lean production", *Journal of Operations Management*, Vol. 25, pp. 785-805.

Jones, D.T. and Womack, J.P. (2002), "Seeing the Whole", Brookline, Lean Enterprise Institute.

Kaplan, R.S. and Worton, D.P. (2001), "The balanced scorecard – Translating strategy into action", Boston, Harvard Business School Press.

Monden, Y. (1981), "Adaptable Kanban System helps Toyota maintain Just-in-time Production", *Industrial Engineering*, Vol. 13, Nº 5, pp. 29-46.

Monden, Y. (1983), "Toyota Production System: A practical approach to production management", Norcross, Industrial Engineers and Management Press.

Ohno, T. (1988), "Toyota Production System: Beyond Large-scale Production", Portland, Productivity Press.

Pettersen, J. (2009), "Defining Lean Production: some conceptual and practical issues", *The Total Quality Management Journal*, Vol. 21, Nº 2, pp. 127-142.

Ross, J.E. (1993), "Total quality management: Text, cases, and readings", Delray Beach, St. Lucie Press.

Russel, L.M. (2009), "Are Lean Organizations better prepared for disaster?", accessed on 16th June 2013, http://www.swdsi.org/swdsi2009/Papers/9S11.pdf

Shah, R. and Ward, P. (2007), "Defining and developing measures of lean production", *Journal of Operations Management*, Vol. 25, pp. 785-805.

Sugimori, Y., Kusunoki, K., Cho, F. and 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.

Taylor, S.Y. (2001), "Just-In-Time", in A.M. Brewer, K.J. Button and D.A. Hensher (Eds.), *Handbook of Logistics and Supply-Chain* Management, 1st edition, pp. 213-224, Oxford, Pergamon.

Womack, J.P., Jones, D.T. and Roos, D. (1996), "The machine that changed the world", New York, Harper Perennial.

Wood, S.J., Stride, C.B., Walt, T.D. and Cleg, C.W. (2004), "Revisiting the use and effectiveness of modern management practices", *Human Factors and Ergonomics*, Vol. 14, Nº 4, pp. 413-430.