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Lean Manufacturing: a concept towards a sustainable management

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Abstract. In this paper, we will analyze the concept of lean manufacturing, starting from the example illustrated by TPS (Toyota Production System) which is renowned for its focus on the reduction of the original Toyota seven waists in order to improve overall customer value, in spite of the existence of varying perspectives on how this is best achieved. The steady growth of Toyota, from a small company to the world's largest automaker (Bailey, 2008) has focused its attention on how it has achieved this success. It is a starting template that was also developed by other automotive makers, and not only. We will also identify the main elements of lean philosophy and propose a typology of the fundamental concepts of lean, using data analysis from research findings across studies on lean manufacturing and lean production published in the past two decades.

Keywords: lean manufacturing, waste, improvement, management, lean production, just in time.

1. Lean Manufacturing Fundamentals

When we say lean, we think that is a process centered on preserving value with less work. Lean manufacturing is a management philosophy derived mostly from the Toyota Production System (TPS) and identified as "lean" only in the 1990s (Womack, Jones & Roos, 1990; Holweg, 2007). Lean manufacturing is a concept, developed mostly in automotive plants. It is much more than tools and boards. Comparing building of a racket or plane with the automotive industry we are determined to say that is easier for the automotive industry, since building an automobile is much simpler than building a racket; moreover, the number of

component parts is about 5000 for a vehicle as compared to 60000 for a racket. Comparing the period of time it takes to build a racket and a vehicle, we can assert that a racket is built, generously, in few months, while the automotive industry builds from 500 to 1000 units each shift, and all of them can be different type. Imagine 10 options with possibility OK and NOK, resulting in 2^{10} different types. In this situation, it is not easy to build these 1000 cars in 8 hours without a perfect logistic and discipline. We contend that lean manufacturing is a concept that reorganizes not only the material flow, technology, the tools and devices, but also the behavior, the thinking, the culture. We have to take into consideration also "computing, technology, rapid innovation, prefigured by and under development by Gordon Moore's law: The computing power of microchips doubles every 18 months", (Smarandache & Vlăduțescu, 2014) that increase the automatisation degree in industrial processes. These kinds of processes decrease the number of production operators and increase the number and importance of maintenance operators. The questions that are raised are what, when, why, where and how to interact with material, people and machines in order to obtain the estimated efficiency, potentiality, the highest quality in minimum cycle time, to reduce the costs, and to finally satisfy the customer. In order to gather the production system tools/elements and processes to support a lean manufacturing environment we have to take into consideration three kinds of aspects: physical, operational and cultural. Logistics has an important role for: safety, sign-in sheet, objectives/observations, evaluation, housekeeping, agenda, parking lot, ground rules (Dima & Vlăduțescu, 2012). Ground rules suppose the starting and stopping on time, being open-minded and honest, one conversation at a time, taking responsibility for oneself, no rank in class, everyone being entitled to their own opinion, challenging one's own personal thinking, the existence of no dumb questions (Bosun, Teodorescu & Teodorescu, 2014; Modrak & Bosun, 2014; Bajdor & Grabara, 2014). Objectives or outcomes suppose that the participants be able to have a general understanding of the Value Steam Mapping process, that they identify the 7 wastes, understand what Policy

Deploy is and how it affects everyone, and that they have a general understanding of what is a Master Schedule.

Why change? Here is an excerpt from a speech by Konosuke Matsushita of the Matsushita Electric Industrial Co. delivered to visiting European & North American managers in 1979.

"We are going to win, the industrial West is going to lose: there's nothing much you can do about it, because the reason for your failure are within yourselves. Your firms are built on the Taylor model: even worse, so are your heads… For us, the core of management is precisely this art of mobilizing and pulling together intellectual resources of all employees in the service of the firm".

For many, lean is the set of "tools" that assist in the identification and steady elimination of waste (Tabără, 2012; Vlăduțescu, 2013; Zamfir, 2013). If the wastes are eliminated, the quality improves production time and costs are reduced. To accomplish this goal, there are implemented many procedures, methods, rules such as: Value Stream Mapping (a method for analyzing the current state and designing a future state for the series of events that take a product or service from its beginning through to the customer), 5 S (a list of operations: Sort, Systematize, Shine, Standardize, Self-Discipline), Kanban (a scheduling system for lean and just-in-time production), poka-yoke (error-proofing, active involvement by workers in trouble shooting and problem solving to improve quality and eliminate waste), Total Productive Maintenance (a concept to increase the productivity of plant and equipment), one piece flow, small batch production, synchronized to shipping schedules, defect prevention rather than inspection and rework, production planning driven by customer demand, team based work organizations with multi-skilled operators empowered to make decisions and improve operations, close integration of the whole value stream: Supplier and Customer (Womack and Jones, 2003).

Lean Manufacturing operating philosophy is to build a customer driven product sequence in a predictable and stable manner at the lowest total cost and time with the highest quality (Neacşu, 2005). Lean Manufacturing is becoming very

popular. A survey across more than 400 companies showed that 70% of the plants are implementing Lean Manufacturing, but this does not necessarily mean that it is working according to plan. Only 2% of them are achieving their targets (Data from Industry Week, 2008).

Successful companies have a clear vision where they want to go, they have set standards regarding how to work, everyone believes on their vision and they are committed to achieve it. Many companies spend a lot of resources for cleaning, for placing the responsibility of change on people with no power and they are focusing on implementing Lean Manufacturing tools without understanding them. An important tool of Lean Manufacturing is "Go & See" (gemba), designed to compare virtual reality with actual reality, (*gemba* refers to the place where value is created, and where problems are visible), (Womack Jim, 2011). Virtual reality means systems and paperwork, it never shows 100% the actual reality, it include lies, mistakes, opinions and visions, while actual reality reveals facts like going to the point where the activity takes place, getting the actual reality and asking the right questions, documenting what one really sees (Cojocaru, 2012 ; Cojocaru, Cace & Gavrilovici, 2013).

A traditional organization is characterized by top down management, week feedback, poor ownership and initiative, limited improvement activity, diluted communication, narrow roles and responsibilities, poor utilization of resources while a lean organization affects the whole organization, non value supports value adding, two way communication, roles and responsibilities are clear and broad, improvement is driven by all levels, work groups focus on internal improvements (*Lean culture*).

2. Elements of the Lean Philosophy

Amongst the elements or steps that can define the Lean philosophy, we identify the following:

1. Customer first: quality is defined by the customer (external and internal), value is defined by the customer (if it has not value to customer, so it is waste), the process creates results that are valued by the customer (each process must be focused on the customer, people work on process, processes create results, results create satisfied customers, lean manufacturing starts with people) (Sălcudean, 2009; Sandu & Caras, 2013; Vlăduțescu, 2014).

2. Create a Fear-Free Environment: fear prevents change (it drives people into a defensive posture, it inhibits the elimination of waste, it keeps issues submerged for years, it creates crisis orientation), employees must not be afraid of losing their jobs as a result of lean implementation (so the idea is to eliminate waste not people, to design cells and jobs with flexibility and to start the search for a redeployment to other value adding functions). In order to create a fear-free environment, the following pieces of advice should be followed: encourage risk taking (avoid "that's a stupid idea", encourage people to try the things just : try it", don't demand/expect cost savings detail for every change, when things don't work understand why and try something else), encourage speaking with data (use data to have a "fact based" critique of the process, gather data to understand issues, make a plan based on data, use data to learn and improve, determine what data will be used to measure process and outcome), follow the PDCA (plan, do, check, act) (Sandu & Caras, 2013; Traistaru, 2013 ; Grabara, Kolcun & Kot, 2014).

3. Waste and problems represent opportunities: the identification of waste is the first step (lean manufacturing is based on the identification and elimination of waste – the identification of waste makes the opportunity for improvement visible, all the more so as not all waste can be eliminated immediately), people are not problem, there must be a focus on the process (since processes are the problem, and people should be made part of the answer, by following the steps: focus on the root cause, repeat "why" five times), information is used for improvement not to judge or to control.

4. Never Stop Improving: "Average is the enemy", lean means ongoing incremental improvement (lean never stops, it is a part of everyone's job description,

it is not an event, it is a way of doing work), that is why we should always search an opportunity for improvement.

5. Make decisions at the lowest level: that is allow change to happen where the value is added (involve front line workers and staff – those closest to the process need to be involved the most; develop systems to encourage change to occur where the value is added – do not simply develop a suggestion system, develop an implementation system), develop and maintain a "Bias for Action" (a plan for improvement is nothing until it is implemented, implementation of ideas is the true measure of lean deployment success, use PDCA – "D" stands for DO) (Vlăduțescu & Ciupercă, 2013 ; Smarandache & Vlăduțescu, 2013).

6. Create a Shared Vision: Total system (lean involves everyone in the organization, an understanding of how each piece of the organization fits together; this means to build an understanding of the interdependencies between groups, consideration of all critical factors, bring people together), lean is an umbrella concept (cultural awareness, workplace organization, visual management, standardized work, flexible operations, continuous improvement, quality and error proofing, quick changeover, total productive maintenance, material control/pull system level production), improvement vs. innovation (every improvement, no matter how small or insignificant is worthwhile, small improvements over time add up to a large total improvement, standardize, improvement should precede innovation, lean comes before innovation) (Dur, 1996; Emiliani, 1998; Vlăduțescu, 2007; Dur, 2012).

3. Fundamental concepts of lean

Amongst the fundamental concepts of lean manufacturing we identify:

1. Specify Value: in Lean Production, the value of a product is defined solely by end user customer, the product must meet the customer's needs at both a specific time and price; to view value through the eyes of the customer requires most companies to undergo difficult and comprehensive reorganization of human resources, their

mindset and behaviors and business processes and specifying value in interpersonal relationship means simply to understand the desires and expectations of the people that one interacts with.

2. Identify the Value Stream: identifying the value in lean production means to understand all the activities required to produce a specific product, and then to optimize the whole process from the view of the end-user customer; identifying the value stream in individual or group behavior means to understand what people do and why they do it (Stoica, 2004; Vlăduțescu, 2008).

3. Flow: In lean production, the flow means to process parts continuously, from raw materials to finished goods, one operation or one piece at a time; in a behavioral context, it means to behave in a manner that minimizes or eliminates delays or stoppages in the work performed by others.

4. Pull: the concept of pull in lean production means to respect the pull, or demand of the customer; in a behavioral context, it means to recognize that people operate under many different mental models which require us to adjust our style or approach often; forecasting the behaviors of others is pure waste because it is time consuming and often inaccurate, and should thus be eliminated. Practicing lean behaviors reduces ambiguity and re-work in interpersonal relationships.

5. Perfection: in lean production, perfection means that there are endless opportunities for improving the utilization of all types of assets; in behavioral context, it means to take advantage of the transparency brought about by the first four steps in order to more easily identify and eliminate behaviors that do not create value (Bob Emiliani, 2008).

Lean implementation is therefore focused on getting the right things to the right place at the right time in the right quantity in order to achieve perfect work flow, while minimizing waste and being flexible and able to change. The flexibility and ability to change are within bounds and not open-ended, and therefore often not expensive capability requirements. More importantly, all of these concepts have to be understood, appreciated, and embraced by the actual employees who build the

products and therefore own the processes that deliver the value (Rosenthal, 2002; Popova, 2013; Vlăduțescu, 2014).

The cultural and managerial aspects of lean are possibly more important than the actual tools or methodologies of production itself. There are many examples of lean tool implementation without sustained benefit, and these are often blamed on weak understanding of lean throughout the whole organization (Siminică & Traistaru, 2013 ; Avram & Traistaru, 2014)

4. Waste reduction thinking

Ford, in *My Life and Work* (1922), provided a single-paragraph description that encompasses the entire concept of waste: "I believe that the average farmer puts to a really useful purpose only about 5% of the energy he expends.... Not only is everything done by hand, but seldom is a thought given to a logical arrangement. A farmer doing his chores will walk up and down a rickety ladder a dozen times. He will carry water for years instead of putting in a few lengths of pipe. His whole idea, when there is extra work to do, is to hire extra men. He thinks of putting money into improvements as an expense.... It is waste motion— waste effort— that makes farm prices high and profits low".

We contend that Value Added means processes that change the product fit, form, function to meet customer specifications; work that customer is willing to pay for, whereas waste is the element of production that adds no value to the product, adding only cost and/or time; work that the customer is not willing to pay for (Stoica, 2007; (Mihnea Costoiu, Plesu, Arsene, Alesincu & Iancu, 2009; Costoiu, Adamescu, Svasta, Nicola, Pleşu, Iancu,... & Tălpuş, 2010).

Starting from Womack and Jones typology, we assert that the original seven waists are:

- Transport (moving products that are not actually required to perform the processing)

- Inventory (all components, work in process and finished product not being processed)
- Motion (people or equipment moving or walking more than is required to perform the processing)
- Waiting (waiting for the next production step, interruptions of production during shift change)
- Overproduction (production ahead of demand)
- Over Processing (resulting from poor tool or product design creating activity)
- Defects (the effort involved in inspecting for and fixing defects),(Womack & Jones, 2003).

Later an eighth waste was defined by Womack (Womack, 2003); it was described as manufacturing goods or services that do not meet customer demand or specifications. Many others have added the "waste of unused human talent" to the original seven wastes. For example, six sigma includes the waste of Skills, referred to as "under-utilizing capabilities and delegating tasks with inadequate training". Other additional wastes added were for example "space". These wastes were not originally a part of the seven deadly wastes defined by Taiichi Ohno in TPS, but were found to be useful additions in practice. In 1999, Geoffrey Mika in his book, *Kaizen Event Implementation Manual* added three more forms of waste that are now universally accepted; the waste associated with working to the wrong metrics or no metrics, the waste associated with not utilizing a complete worker by not allowing him to contribute with ideas and suggestions and be part of Participative Management (Adamescu, Costoiu, Corocăescu, Pleşu, Iancu, Adamescu... & Tălpuş, 2010; Costoiu, Plesu, Isopescu, Soriga, Alesincu & Arsene, 2012), and lastly the waste attributable to improper use of computers; not having the proper software, training on use and time spent surfing, playing games or just wasting time (Bicheno & Holweg, 2009; Crețu, 2009).

5. Conclusion

"Whether you're a giant factory making computer components or cars, or an individual at a desk producing reports, budgets or plans, you're a factory", states Markovitz, founder and owner of Time Back Management. One must thus take inputs and transform them into outputs that he/she wants. Markovits also asserts that "the principles that underpin lean manufacturing—that enable companies to produce more value with less work—also apply at an individual level". We conclude that lean manufacturing starts with the notion of 5S which has to do with maintaining a neat, organized workspace. 5S stands for sort, set in order, shine, standardize and sustain. When companies implement 5S as part of a lean initiative, we contend, in the line of Markovits, that these companies, including Toyota, remove all unnecessary work tools and supplies from the workspace (this equates with the operation of sorting), that all necessary tools (such as a computer, monitor, filing system or keyboard) find their specific places (this equates with the operation of setting in order), that work spaces are cleansed as work is carried out by employees (this equates with shine), that cleaning methods are employed consistently and continuously (this equates with the operation - standardize), and that the practice of 5S is continually improved (this equates with sustain).

Respect for people is specific to Toyota and other companies applying lean manufacturing and respect is essential to lean manufacturing as a concept for sustainable management since it implies two defining principles:

a) Respect: equates with considering every stakeholder's problems seriously and making every effort to build mutual trust. Taking responsibility for other people reaching their objectives;

b) Teamwork: supposing developing individuals and encouraging incentives through team problem-solving. The main purpose is to develop and engage people through their contribution to team performance. In this case we should think of specific teams, or of the whole site as a team.

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