

LEAN MANUFACTURING – A SUCCESS KEY INSIDE OF AN INDUSTRIAL COMPANY

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Abstract. A Lean Management System is based on cycles of organizational learning in all areas of the company. Its premise is that the most valuable asset in a lean and profitable manufacturing company isn't the expensive equipment; it is not machines that produce things. Productivity is an effect of human beings working together. Machines are merely an extension of their collective imagination and energy. One of the most used methods for a continuous business improvement is Lean Manufacturing. Lean Manufacturing could be considered an organization management philosophy focusing on reduction of seven wastes to improve overall customer value. These wastes appear on: transportation, inventory, motion, waiting time, over-production, processing itself and defective product. The present article intends to make a brief presentation of Lean Manufacturing and the main terms that are used in this area, such as: muda, kaizen, kan-ban or poka-yoke, and also to punctuate the key lean manufacturing principles. The paper contains also, an example of a lean implementation program and operational benefits of lean. The study leads to the idea that being directed for performance, lean is the way for the continuous growth of a business.

Keywords: lean manufacturing, kanban, poka-yoke, waste

1. Introduction

Lean Manufacturing, a management method that seems to be recently discovered, is based actually on principles mentioned in the time of Benjamin Franklin. In *Poor Richard's Almanack* it is said that avoiding unnecessary costs could be more profitable than increasing sales. Also, Franklin's *The Way to Wealth* says the following about carrying unnecessary inventory. "You call them goods; but, if you do not take care, they will prove evils to some of you..." [1, 2].

The name of "Lean thinking" comes from a 1990's bestseller called "The Machine That Changed the World: The Story of Lean Production". The book chronicles the transitions of automobile manufacturing from craft production to mass production and to lean production.

Lean production took form at Toyota Motor, therefore Mr. Taiichi Ohno, the Vice President is considered to be the father of the kanban and Just-In-time concepts. He's motto was that improvement must never stop.

Lean production combines the best features of craft production (that involves high-quality, individualized, custom-made products) and mass production (which means manufacturing at great quantities to satisfy broad consumer needs at

lower prices. The application of Lean principles have led to significant improvements in the automobile industry in terms of cost, quality, and productivity as described in the book *The Machine That Changed The World*. Lean Manufacturing, described as a success key inside of an industrial company, brings many benefits, among them we enumerate the most important ones: efficient use of resources, rapid product development cycle, higher quality at lower cost, greater flexibility, and environmentally sustainable production.

Lean principles have been applied successfully worldwide in the auto industry and are being increasingly employed in many other industrial sectors.

2. Definitions and principles

2.1. Definitions of Lean Manufacturing and main terms used in this area

The perspectives of Lean are very much depending upon the industry, the source, how long the organization has been learning about Lean, and what that organization's real objectives are for adopting Lean. Also, there are many different definitions of Lean Manufacturing; between them we have the one given by MIT's International Motor Vehicles Program (IMVP): Lean Production (a term coined by IMVP researcher John Krafcik) is "lean"

because it uses less of everything when compared to mass production-half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time. Also, it requires keeping far less than half the needed inventory on site, results in many fewer defects, and produces a greater and ever growing variety of productions.

At the website of the Lean Aerospace Initiative (LAI) it is said that Lean is not a new concept and there are companies that use Lean methods, without being conscious about it, through the following activities: reducing inventory, expanding jobs and responsibilities, participating on a multi-functional work team, benchmarking, or creating and maintaining relationships with customers.

Dr. Jeffrey Liker of the University of Michigan credits Mr. John Shook, one of the first Americans to work directly in the Toyota Production System in Japan, with a Toyota Production System-based definition of "lean": Lean Manufacturing is a manufacturing philosophy which shortens the time between the customer order and the product build/shipment by eliminating sources of waste.

The Toyota production system seeks the total elimination of waste which is the main purpose of the method we present: "Lean Manufacturing is a management philosophy focusing on reduction of the seven wastes to improve overall customer value" [2]. At Toyota, in order to proceed with their man-hour reduction activities, they divide wastes into the following seven categories:

1. overproduction
2. waiting time
3. transportation
4. inventory, unnecessary stock on hand
5. unnecessary motion
6. processing itself
7. defective products.

At the previous list were added two more types of waste, thus, technically, there are now nine 'deadly wastes' [3]. The other two waste categories are:

1. safety because unsafe work areas creates lost work hours and expenses;
2. information (age of electronic information and enterprise resource planning systems (ERP) requires current / correct master data details).

The waste arising from overproducing is different from all others, because unlike other

wastes, it overshadows all others. Other wastes give us clues as how to correct them. But the waste arising from overproducing provides a blanket cover and prevents us from making corrections and improvements [1]. Thus, the first step in any man-hour reduction activity is to eliminate the waste arising from overproducing. To this end, production lines must be reorganized, rules must be established to prevent overproduction, and restraints against overproduction must become a built-in feature of any equipment within the workplace.

The waste arising from time on hand (waiting time) is created when a worker stands idly by an automated machine to serve as a watchman, or when he cannot do anything constructive manually because the machine is running.

The waste arising from transporting refers to waste caused by an item being moved a distance unnecessarily, being stored temporarily or being rearranged. An instance of waste arising from transporting occurs when parts are moved from a warehouse to the factory, from the factory to the machines and from the machines to the hands of workers. At each of these steps, parts have to be rearranged and moved.

The waste arising from processing itself occurs, for example, when a guide pin in the jig does not function properly and the worker has to hold the jig with his left hand. The processing does not go smoothly and time is wasted.

In addition, there are wastes arising from unnecessary stock on hand, from unnecessary motion and from producing defectives, but explanations for each of these are not necessary.

By eliminating waste (muda), quality is improved, production time and costs are reduced. To solve the problem of waste through the instrumentality of Lean Manufacturing can be use several tools, such as: constant process analysis (kaizen), "pull" production (by means of kanban) and mistake-proofing (poka-yoke). A brief presentation of kanban and poka-yoke will be presented in the following:

a) Kanban

The kanban contains information that serves as a work order. It is an automatic directional device which gives information concerning what to produce, when to produce, in what quantity, by what means and how to transport it. The kanban system was created to do the following: engage in standard operation at any time, give directions based on the actual conditions existing in the workplace, prevent addition of any unnecessary

work for those engaged in start-up operations, and prevent a deluge of paper which cannot serve as future source materials [1]. Another kanban function is to move with the actual material. If the actual material and kanban can consistently move together, the following become possible: no overproduction will occur, priority in production becomes obvious (when the kanban for one item piles up, that is the item that must be produced first), control of actual material becomes easier. Kanban has six rules that must be abide:

- don't send defectives to the subsequent process;
- the subsequent process comes to withdraw;
- produce only the quantity withdrawn;
- equalize production;
- kanban is a means to fine tuning;
- stabilize and rationalize the process.

The shape of the kanban is not fixed. Depending on the processes they are made of iron, they can be in size or triangular in shape. The shape that kanban takes matters very little, the important consideration is how best to transmit the requisite information accurately.

b) Poka-yoke (foolproofing)

Defectives can be uncover by foolproofing the process. The process of foolproofing (poka-yoke) must be standardized to ensure that stable quality can be assured with a minimum number of man-hours, even when another shift comes in. Among the devices to be considered are the following:

- if there is a misstep, the device does not allow goods to be mounted to jigs;
- if a disorder is found in the goods, the device does not allow the machine to start processing;
- if there is a misstep, the device does not allow the machine to start processing;
- if there is a misstep in work process or in motion, it is automatically adjusted, and the device will allow the processing to proceed;
- the disorder that has occurred in the preceding process is examined at the next process, and the device will stop defectives;
- if a certain operation is forgotten or skipped, the device does not allow the next process to begin.

2.2. Principles of Lean Manufacturing

Key Lean Manufacturing principles include:

- Pull processing: products are pulled from the consumer end, not pushed from the production end;
- Perfect first-time quality - quest for zero defects,

- revealing and solving problems at the source;
- Waste minimization – eliminating all activities that do not add value and safety nets, maximize use of scarce resources (capital, people and land);
- Continuous improvement – reducing costs, improving quality, increasing productivity and information sharing;
- Flexibility – producing different mixes or greater diversity of products quickly, without sacrificing efficiency at lower volumes of production, through rapid set-up and manufacturing at small lot sizes;
- Building and maintaining a long term relationship with suppliers through collaborative risk sharing, cost sharing and information sharing arrangements.

The implementation of a lean program can bring amazing results after only a few years [1, 4]. One of the advantages of Lean Manufacturing method is the reduction of the lead time with almost 90% [4]. Lead time is the time it takes one piece to move all the way through a process or a value stream, from start to finish. Envision timing a marked part as it moves from beginning to end.

Most companies waste 70%-90% of their available resources. Lean Manufacturing and also Cellular Manufacturing improve material handling, inventory, quality, scheduling, personnel and customer satisfaction [5]. Cellular Manufacturing and workcells are at the heart of Lean Manufacturing. Their benefits are many and varied. They increase productivity and quality. Cells simplify material flow, management and even accounting systems.

3. An example of a lean implementation program

In the following we will summarise an example of a lean implementation program. The main steps would be:

- Senior management to agree and discuss their lean vision;
- Management brainstorm to identify project leader and set objectives;
- Communicate plan and vision to the workforce;
- Ask for volunteers to form the Lean Implementation team (5-7 works best, all from different departments);
- Appoint members of the Lean Manufacturing Implementation Team;
- Train the Implementation Team in the various lean tools - make a point of trying to visit other non

competing businesses which have implemented lean;

- Select a Pilot Project – 5S is a good place to start. 5S is a reference to five Japanese words that describe standardized cleanup: Seiri (tidiness, organization), Seiton (orderliness), Seiso (cleanliness), Seiketsu (standards), Shitsuke (sustaining discipline);
- Run the pilot for 2-3 months - evaluate, review and learn from your mistakes;
- Roll out pilot to other factory areas;
- Evaluate results, encourage feedback;
- Once you are satisfied that you have a habitual program, consider introducing the next lean tool. Select the one which will give you the biggest return for your business.

4. Conclusions

Lean is basically all about getting the right things to the right place, at the right time, in the right quantity while minimizing waste and being

flexible and open to change. As it stands the method is resultfull, comparatevely with the investments, but as it involves all employees all of these concepts have to be understood, appreciated and embraced by them. Being directed for performance, lean is the way for the continuous growth of a business.

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