THE ANNALS OF "DUNĂREA DE JOS" UNIVERSITY OF GALAȚI
FASCICLE V, TECHNOLOGIES IN MACHINE BUILDING, ISSN 1221-4566
2008

Implementing Lean Manufacturing

Eng. Ana ROTARU
University of Pitești

ABSTRACT

Lean manufacturing evokes images of efficiency and minimizing unnecessary costs, an attractive value for many companies. Nowadays Lean Manufacturing is the most important management method for the manufacture industries because it provides remarkable results, without needing complex additional systems and equipments. The paper presents the indicators must be controlled along the transit to Lean System.

Keywords: *lean manufacturing, performance, 5S, manufacturing cell, quicker changeover, total productive maintenance.*

1. Introduction

Industrial revolution began in the 1860 and one of the first modifications in this domain was the development of the manufacturing management. At that time the *manufacturing industry* was predominant, and it was characterized by the fact that the equipments were fixed, and the employees moved around them. Within the framework of this type of production organization the quality of the products was high; the conversion costs were high and the productivity small.

By the 1913 appears the *repetitive manufacturing,* which led to a fall in conversion costs but also in the quality of the products, so that in the 1944 there appeared at the Ford Willow Run factories the *conveyer-line production (assembly production).*

In 1950 within Toyota's manufacturing system appeared for the first time the production concept Just in Time, which some years later through its assembly with Kaizen, Total Quality Management, Total Productive Maintenance, Cellular Manufacturing and Six Sigma it would led to the appearance of the Lean Manufacturing production system.

By the 1980's Toyota had increasingly become knowing for the effectiveness with which it had implemented Just-In-Time (JIT) manufacturing systems. Today, Toyota is often considering one of the most efficient manufacturing companies in the world and the company that sets the standard for best practices in Lean Manufacturing. The term "Lean Manufacturing" or "Lean Production" first appeared in the 1990 book *The Machine that Changed the World.*

2. Principles of lean manufacturing system

The difficulties, which appear in the leg work of the Lean Manufacturing method are due to its two essential characteristics:

- The first one is the necessity of creating a rational measure (step) founded on real essentials;
- The second characteristic is the fact that the final results of the method depend on all participants, that is, if the operators do not respect the working standards or do not participate at the continuous improvement of the Lean process it won't ever have any results

Lean philosophy consists in:

- The achievement of a superior quality, of some small delivery terms and the obtaining of small costs
- Tolerance zero for losses achievement of a stable environment
- The product accomplishment is made only at the customer's demand
- Manufacture lots as small as possible (formed if possible from a single constituent)
- Continuous improvement
- Finding and elimination of anomalies

In the framework of Lean Manufacturing production system the main purpose is minimizing the achievement time of the benchmarks and of the number of resources used in their fabrication by eliminating all losses

.

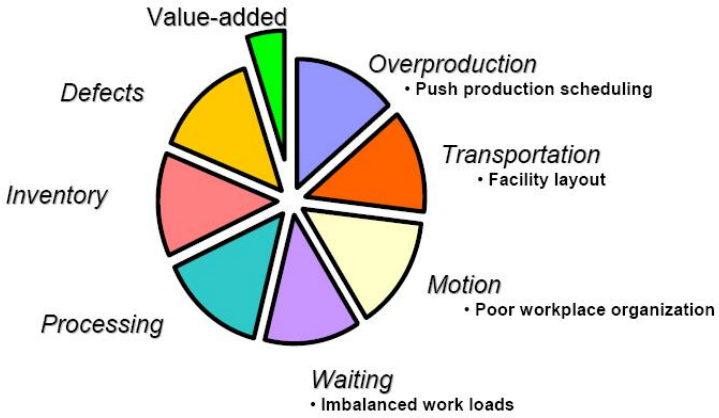

Figure 1. *The 7 Losses*

The seven types of losses that the lean strategy tries to eliminate from the production frame are:

- Overproduction
- Processing
- Motion (movement)
- Transportation
- Inventory
- Defects
- Waiting

Lean organizations achieve such benefits by eliminating waste or non-value creating activities using a set of tools and principles. They create a culture of continuous improvement, and within that culture, they employ the tools of lean to eliminate waste. Not surprisingly, it begins with the customer (not the plant manager or industrial engineer). The customer is the definer of value. Once value is clearly defining, then value streams can be clearly identified. Single-piece flow is applied where possible; pull systems are applied where single-piece flow is impossible. After using value stream mapping to create a plan to archive this kaizen is used to eliminate waste. Process kaizen tools include:

- *5S*, which is a system for organizing the workplace. It helps to create a culture of continuous improvement at the shop floor level. It can also be applied to administrative processes in the office.

- *Quick Changeover*¸ which is a system for reducing setup or changeover time. This allows organizations to produce smaller batch sizes, with the ultimate goal of one-piece flow.

- *TPM or Total Productive Maintenance,* which is a system for properly maintaining equipment. More effective than simple preventative maintenance, TPM involves operators and makes use of teams to increase the uptime of equipment. Near 100%, uptime is critical for the lean producer.

- *Manufacturing Cells/Cellular manufacturing***,** which are effective systems for manufacturing or assembling product using one-piece flow. Instead of moving product from area of the factory to another in batch-and-queue fashion, cellular manufacturing makes for much shortened lead times and makes one-piece flow possible

3. Five S

The Five S's are some rules for workplace organization which aim to organize each worker's work area for maximum efficiency.

- **Sort** – Sort what is needed and what is not needed so that the things that are frequently needed are available nearby and as easy to find as possible. Things which are less often used or not needed should be relocated or discarded.

- **Straighten (or "Set in order")** – Arrange essential things in order for easy access. The objective is to minimize the amount of motion required in order for workers to do their jobs. For example, a tool box can be used by an operator or a maintenance staff who must use various tools. In the tool box, every tool is

placed at a fixed spot that the user can quickly pick it up without spending time looking for it. This way of arrangement can also help the user be immediately aware of any missing tools.

- **Scrub (or "Shine")** – Keep machines and work areas clean so as to eliminate problems associated with un-cleanliness. In some industries, airborne dust is among the causes of poor product surface or color contamination. To be more aware of dust, some companies paint their working places in light colors and use a high level of lighting.
- **Stabilize (or "Standardize")** – Make the first 3 S's a routine practice by implementing clear procedures for sorting, straightening and scrubbing.
- **Sustain** – Promote, communicate and train in the 5 S's to ensure that it is part of the company's corporate culture. This might include assigning a team to be responsible for supervising compliance with the 5 S's.

4. Quicker changeover

Lean Manufacturing aims to reduce unnecessary downtime due to machine setup or product changeovers since machine downtime is a significant source of unnecessary waste. This requires a culture of continuous improvement in which the company is continuously trying to find ways to reduce changeover and setup times.

Often quicker changeover times can be achieved to some degree by having very standardized (and well-documented) configuration settings for the production of particular products so that there is no uncertainty about how to reconfigure the equipment during a changeover. Companies with a wide range of product mix, color and specifications often underestimate the conversion cost every time the production process is halted to replace molds, clean leftover materials with a different color or specification, adjust machine settings, etc.

Other ways to minimize the changeover/setup time include changing the physical layout of a process, having all materials and tools needed available, and using dual/spare storage bin to eliminate cleaning downtime.

5. Total Productive Maintenance

Machine breakdown is one of the most important issues that concern the people on the shop floor. The reliability of the equipment on the shop floor is very important since if one machine breaks down the entire production line could go down. An important tool that is necessary to account for sudden machine breakdowns is total productive maintenance. In almost any lean environment setting a total productive maintenance program is very important.

There are three main components of a total productive maintenance program: preventive maintenance, corrective maintenance, and maintenance prevention. Preventive maintenance has to do with regular planned maintenance on all equipment rather than random check ups. Workers have to carry out regular equipment maintenance to detect any anomalies as they occur. By doing so sudden machines breakdown can be prevented, which leads to improvement in the throughput of each machine.

Corrective maintenance deals with decisions such as whether to fix or buy new equipment. If a machine is always down and its components are always breaking down then it is better to replace those parts with newer ones. As a result the machine will last longer and its uptime will be higher. Maintenance prevention has to do with buying the right machine. If a machine is hard to maintain (e.g., hard to lubricate or bolts are hard to tighten) then workers will be reluctant to maintain the machine on a regular basis, which will result in a huge amount of lost money invested in that machine.

6. Manufacturing Cells

Cellular manufacturing is one of the cornerstones when one wants to become lean.

Cellular manufacturing is a concept that increases the mix of products with the minimum waste possible. A cell consists of equipment and workstations that are arranged in an order that maintains a smooth flow of materials and components through the process. It also has assigned operators who are qualified and trained to work at that cell.

Arranging people and equipment into cells has great advantage in terms of achieving lean goals. One of the advantages of cells is the one-piece flow concept, which states that each product moves through the process one unit at a time without sudden interruption, at a pace determined by the customer's need. Extending the product mix is another advantage of cellular manufacturing. When customers demand a high variety of products as well as faster delivery

rates, it is important to have flexibility in the process to accommodate their needs. This flexibility can be achieved through grouping similar products into families that can be processed on the same equipment in the same sequence. This will also shorten the time required for changeover between products, which will encourage production in smaller lots. Other benefits associated with cellular manufacturing include:

- Inventory (especially WIP) reduction
- Reduced transport and material handling
- Better space utilization
- Lead time reduction
- Identification of causes of defects and machine problems
- Improved productivity
- Enhanced teamwork and communication
- Enhanced flexibility and visibility

7. Conclusions

Through Lean Manufacturing it is reduced:

- At half the outlet time of a product from the manufacturing;
- At half the fault number at the finished products level;
- One third of the designing time;
- At half the manufacturing space necessary for obtaining the same results;
- At a tenth or less the stream unfinished production

Being based on the reduction of losses from the manufacturing processes, this method uses efficient working tools and techniques, by a creative involvement of personnel. The resources involved by the manufacturer in the implementation of this solution are at least ten times smaller than the results of its use; this method does not refer to re-technological investments or to downsize the personnel (to make the personnel redundant). It has remarkable results in expansion of productivity and reduction of delivery time, even when there is a great variety of a manufactured product.

Bibliography

[1]. Beau Keyte, *Value Stream Mapping in the office,* Lean Service Summit, 2004.

[2]. Daniel Högfeldt, *A value stream mapping and overall equipment effectiveness study*, Master of science programme, Lulea University of Technology, 2005

[3]. Freddy Balle, *L'Lean, un mecanisme de progres continu,* Ingeniurs de l'automobile,nr. 781, Paris 2006

[4]. **Ion Hohan,** *Lean Management versus Gemba Kaizen,* Universitatea Valahia din Târgoviște, 2005

[5]. Vicente A. Reynal, *Production system design and its implementation in the automotive and aircraft industry*, Georgia Institute of Technology, 1996

[6] *The Vision of Lean Manufacturing*, Johnson Controls, Mioveni 2004

[7]. *Îmbunătățirea competivității prin creșterea productivității în întreprinderile din România*, Consiliul National al Întreprinderior Mici și Mijloci în Romania, București, 2005 ;

[8]. *Lean and Environment Toolkit Training Modules*, Version 1.0 – January 2006

Implementând Lean Manufacturing

Rezumat

Lean Manufacturing evocă imagini de eficiență și minimizare a costurilor inutile, o situație favorabilă pentru multe companii. În prezent Lean Manufacturing este cea mai importantă metodă de management deoarece furnizează rezultate excepționale, fără a fi nevoie de sisteme și echipamente suplimentare complexe. În acest articol sunt prezentați indicatori care trebuie controlați de-a lungul tranzitului la un sistem Lean.

En implémentant Lean Manufacturing

Résumé

Lean Manufacturing évoque les images de l'efficience et minimalisation des coûts inutiles, une situation favorable pour la plupart des entreprises. Au présent Lean Manufacturing est la plus importante méthode de management car elle donne des résultats exceptionnels, sans avoir besoin des systèmes et des équipements suplémentaires complexes. Dans notre article on présente les indicateurs qui doivent être controlés au long du transit à un système Lean