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INTRODUCTION TO LEAN MANUFACTURING

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ABSTRACT

Lean manufacturing is now one of the most powerful manufacturing systems in the world. Numerous plants around the world have attempted to implement or adopt it to enhance their efficiency. The purpose of this study is to explain the approach of adopting lean by identifying 8 wastes which cause low efficiency and cost increase in industries/organisations and also a case study has been explained to show the importance of lean.

Keywords- *Lean Practice; Toyota Production System(TPS); Total Quality Management.*

I. Introduction

Manufacturers in all types of industrial sectors have been affected by the economics of globalization. Companies try to stay competitive by making their manufacturing facilities more efficient and effective [1]. On-time delivery, lead time, capacity utilization, cost calculations, and quality levels are always used as performance indicators [2]. To overcome competitors in the same sector, a company has to find innovative business strategies or suitable production systems.

Lean manufacturing has been widely embraced since a report on the first implementation of lean manufacturing in the automotive industry was published in The Machine That Changed the World. Lean manufacturing has become popular because of its ability to reduce costs, improve quality, and guarantee reliability. Actually, lean manufacturing is based on learning derived from Toyota's principles and practices [3]. The concept of a lean approach involves integrating different tools for eliminating waste and responding to customer needs [4].

II. Lean manufacturing

A. Definition of Lean

"Lean is a systematic approach to identifying and eliminating waste (non-value added activities) through continuous improvement (Kaizen) by lowering the product at the pull of the customer in pursuit of perfection."

B. Development of Lean

- Lean was born in U.S.A through Ford Production System (1913).
- Lean was first practiced in Japan by adopting Toyota Production System (TPS, revealed in 1917).

C. Globalization of lean

- Manufacturing
- Education
- Banking / Finance
- Retail
- Software
- Lean increasingly integrated into corporate strategies.

III. Ways to Implement lean

1. *Prepare and motivate people*
   - Workers should be recruited, trained and motivated with appropriate skills.
   - Create common understanding of need to change to lean.
2. *Employee involvement*
   - Push decision making and system development down to the "lowest levels".

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- Trained and truly empower people.

3. *Share information and manage expectations*
4. *Identify and empower the best operations managers*
   - Remove roadblocks (i.e. people, layout & systems).
   - Make it directive but empowering.
5. *Inventive Atmosphere*
   - Tolerating mistakes, patience, etc.
   - Encourage employees to take risks.
6. *Installing "enlightened" and realistic performance measures, evaluation and reward systems.*
   - Do away with rigid performance goals during implementation.
   - Measure results and not number activities/events.
   - Tie improvements, long term, to key macro level performance targets (i.e. inventory turns, quality, delivery, overall cost reductions).
   - After improvement in operations, extend across *Entire* organization.

IV. DIFFERENCE BETWEEN TRADITIONAL & LEAN MANUFACTURING

TRADITIONAL MANUFACTURING	LEAN MANUFACTURING
• Production is driven by sale forecasts and firms trended to stockpile inventory in case needed. • Problems are viewed as just that, PROBLEMS. • If a process is working (if it isn't broke) don't fix it. • Work in process (WIP) is viewed as a normal part of operations.	• Production is driven by real customer demands. • Always viewed as opportunities for improvement often through root cause. • Always look for ways to improve processes. • Work in process (WIP) is a sign that a process needs to be improved and is considered a type of waste that should be reduced or eliminated.

V. PRINCIPLES OF LEAN

The five-step thought process for guiding the implementation of lean techniques is easy to remember, but not always easy to achieve.

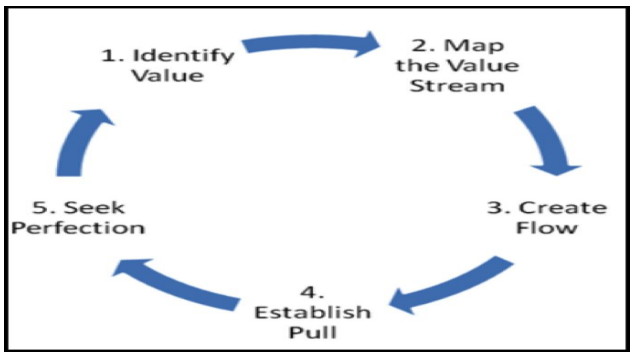

Fig. 1 Principles of Lean

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1. As value is specified, value streams are identified, wasted steps are removed, and flow and pull are introduced, begin the process again and continue it until a state of perfection is reached in which perfect value is created with no waste.

2. Specify value from the standpoint of the end customer by product family.

3. Identify all the steps in the value stream for each product family, eliminating whenever possible those steps that do not create value.

4. Make the value-creating steps occur in tight sequence so the product will flow smoothly toward the customer.

5. As flow is introduced, let customers pull value from the next upstream activity.

VI. BENEFITS

- Reduced scrap and waste
- Reduced inventory costs
- Cross-trained employees
- Reduced cycle time
- Reduced obsolescence
- Lower space/facility requirements
- High quality & reliability
- Lower overall costs
- Self-directed work teams
- Lead time reduction
- Fast market response(Agility)
- Longer machine life(Total productive maintenance)
- Improved customer communication
- Lower inventories(Just In Time, JIT)
- Improved vendor support and quality
- Higher labor efficiency and quality
- Improved flexibility in reacting to changes.

VII.8 WASTES OF LEAN MANUFACTURING

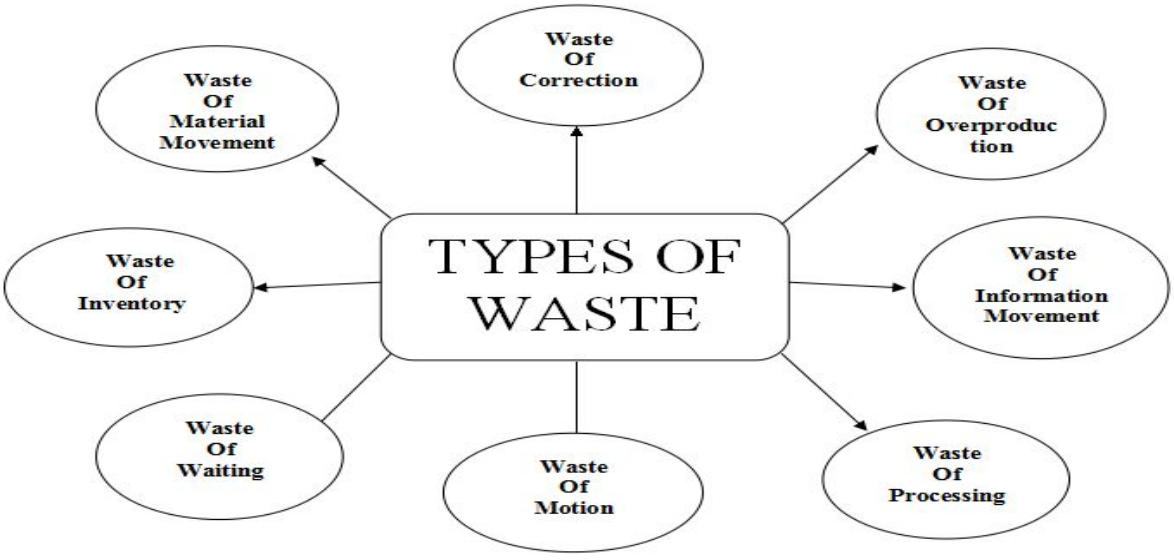

Fig2. 8 Wastes of Lean Manufacturing [5].

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1. *Overproduction*

Overproduction is a "just in case" mindset which can often lead to overproduction or storing of extra products, which leads to wastage of storage space, production time and energy. We also have a problem if the customer decides later that they don't want the item anymore, or there are ordering delays and the product spoils before delivery.

2. *Inventory*

This is the other side of the "overproduction" coin. If you order extra raw materials so they're available "just in case," that's also wasteful. The order specs may change, food products may get wasted, or again, the customer may not want the product anymore.

3. *Correction of Defects*

Defects and broken products can lead to customer dissatisfaction, and you spend extra time and money solving the problem, reworking the items, or paying for the customer to dispose of the waste. Shipping damage is also considered a defect.

4. *Processing*

Also called over-processing, this is where companies expend more energy to produce their items through wasted movement and time. This could be a result of extra/unnecessary manufacturing steps, using older and outdated methods, or not having standard work plans.

5. *Motion*

Unnecessary motion can happen as a result of an inefficient process, a lack of standardized procedures, or even a lack of training for employees. Wasted motion is a hidden cost because it's not something we can easily see, but only through careful observation and communicating with the workers.

6. *Material Movement*

The thing we see the most, since it's our job, is shipping damage. But this muda is much more than that. It includes pallets not being properly stretch wrapped (wasted material), or a truck is not loaded to use floor space efficiently.

7. *Waiting*

These are bottle necks in time, usually due to broken machinery, lack of trained staff, shortages of materials, inefficient planning, or as a result of the six other mudas. At their worst, they can lead to slowed production, delayed shipments, and even missed deadlines. At the very least, this is time that is paid for but unproductive; you're paying people to sit and wait.

8. Information Movement

Waste of information movement is concerned with unnecessary transfer of information between two or more dissimilar systems (computing systems or otherwise) .i.e., conversion from one format to another, upload and download of information, files retrieval and storage, unnecessary notification or notes, one-to-many communications instead of posting publicly [5

VIII. CASE STUDY

1. *The company*

The Parker Hannifin aircraft - wheel and brake division.

2. *The product*

Designer and manufacturer of aerospace, commercial & military aircrafts - wheel and brake system.

3. *The challenge*

To reduce high finished goods, work-in-process and spares components inventory levels and the need to reduce long engineering and manufacturing cycle times.

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4. *The project objectives*
   i. Reduce total Final Assembly (F-A) cycle time from 30 to 15 days.
   ii. Redesign F-A operations to:
      a. Integrate product-lines where feasible
      b. Optimize available floor space
      c. Minimize operational transportation.
5. *Measured Results*
   i. Implemented "one-piece flow" philosophy;
      a. Eliminated Build-to-Stock Paradigm.
      b. Reduced F-A Cycle Time from 30 to 4 days.
   ii. Saved approximately 3,200 sq. ft. of floor space (40 percent of area);
      a. Integrated four product-lines into three.
      b. Reduced Transportation up to 30 percent.

IX. BARRIERS TO LEAN MANUFACTURING

Following are some of the barriers for Lean implementation

- Lack of resources
- Lack of expertise
- Initial high cost which includes the cost of resources as well as expertise
- Poor supply chain structure.- Ineffective training and development of work force in the company
- Absence of continuous assessment of every individual in the organization
- Psychological factors such as fear of losing the job on account of its implementation
- Natural calamities.

X. CONCLUSION

Lean manufacturing has become popular because of its ability to reduce costs, improve quality, and guarantee reliability. In today's world of Globalization implementation of Lean to achieve competitive edge has become more relevant and thus lean is not the end but the beginning.

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