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Lean Manufacturing Tool and Techniques in Process Industry

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ABSTRACT

The purpose of this paper is to highlight the lean principles, tools and benefits of lean concepts in industries. Lean manufacturing is plethora of principles that focus on cost reduction by identifying and eliminating non value added activities. The fiercely globalised and competitive markets of 21st century demand for increasing high variety of products at reducing cost, lesser lead time and perfect quality. This changing scenario calls for a new manufacturing that would enable them to compete in this competitive globalization market. This research addresses the application of lean manufacturing concepts to the continuous production/process sector with a focus on the steel industry. The ideas are tested on large manufacturing company.

KEYWORDS: Lean manufacturing, waste, lean principles & tools.

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INTRODUCTION:

Lean is defined as a strategy for achieving significant continuous improvement in performance through the elimination of all wastes of resources and time in the total business process.. It evolved from Toyota after world war 2nd as a business strategy due to the limited resources available in Japan, in contrast to the vast resources available to manufactures in the US. Its principles apply to nearly all business operations, from administration and product design to hardware productions. Lean manufacturing is about eliminating waste and non value added tasks. Examples of waste in manufacturing include overproduction, over processing, waiting, unnecessary part movement, excess inventory and defects, As applied to hardware production lean manufacturing focuses on eliminating all sources of waste by applying the following strategies 1. One piece workflow 2. Take time 3. Pull system Lean identifies the bottlenecks in design and development processes that add unnecessary delays and cost. It can help create a more efficient system that reduces time to market without compromising on quality.

Lean has a key role to play in new product development and the improvement of existing products and the improvement of existing products, including idea creation, design for manufacture, assembly and test, rapid prototyping, product portfolio management, market and competitor analysis, risk management, sales forecasting, setting key performance indicators and value analysis to reduce the cost of existing products.

The concept of Lean manufacturing is derived from the methods developed at the shop floor of Toyota, which are described in detail by the authors like Taiichi Ohno and Shiego Shingo. But these concepts in the form of lean manufacturing system (LMS) got an international recognition, as a result of the book, "the machine that changed the world" written by the researches Womack et al. According to Womack Jones, and Roos, LM uses less of everything compared to mass production-half the human efforts in the factory, half the manufacturing space, half the investment in tools and half the engineering hours to develop a new product. In addition, it requires keeping far less than half of the needed inventory on site, results in many fewer defects and produces a greater and ever growing variety of products. In short, it is called lean manufacturing because it uses less or the minimum of everything required to produce a product or perform a service.

LEAN THINKING:

Lean thinking is the dynamic knowledge driven and customer focused process by which all people in a defined enterprise continuously eliminate waste with the goal of creating value. Womack and Jones

describe lean thinking as “the antinodes “ to muda. Muda is the Japanese word for waste and specifically “any human activity that absorbs resources but creates no value”. The essence of lean thinking is the elimination of muda whenever it exists –within the individual firm but also along the whole supply chain.

There are several typical categories of waste (muda in Japanese) as follows

1. Defective units (scrap) or rework

The existence of defective units in a process is typically the result of a poor preventive quality system. When an error or defect is passed onto the next operation or even worse to the customer, a loss is inevitably occurred. As a result, something has to be manufactured, assembled or serviced twice, whereas the customer will rightfully only pay once for the goods or service. Thus doing everything right the first time is the most efficient, least wasteful way.

2. Over-processing

Over processing is adding unnecessary features that are not value adding in the eye of the customer. Poor process design can lead to producing better products or services than a customer needs or is willing to pay for.

3. Motions

Unnecessary movement of people , products or equipment does not add value to a product. For example workers walking back and forth from the work area to the supply area, moving around unneeded equipment or performing redundant motions can be completely eliminated or automated to speed up the process.

4. Overproduction

5. Overproduction consists of making either unneeded excess goods or making needed goods too early or in excessive quantity. It is also described as making goods just in case rather than Just in Time (JIT). Traditionally, manufacturers have used the concept of Economic Order Quantity (EOQ) which is also known as economic lot size or minimum cost order quantity to determine their optimal manufacturing batches and lot sizes.

6. Waiting

Waiting includes delays coming from people, processes, or Work in Progress (WIP) inventory sitting inactive while waiting for instructions, information, raw materials or any other resources. Wasteful waiting ties up capital, increases the risk of obsolescence or damage, and other requires additional handling and movement of goods

7. Excessive inventory

Stock that is sitting without providing value to a product accumulates cost. This is usually a costly way to cover up quality problems such as rework and defects manpower or production scheduling problems excessive lead time and supplier problems.

Principles behind the lean thinking:

- Customer focus: make sure that all the activities of the organization are driven by the customer needs and expectations
- Eliminate waste with the goal of creating value: elimination of waste throughout the value chain. I.e. those activities which does not add any value to goods or services in the eye of customers or any for which the customer is not willing to pay.
- Pursue knowledge driven enterprise transformation: utilize the ideas and skills of everyone in the organization to implement systematic changes
- Foster a dynamic process of change and capability building: pursue a proactive , relentless process of ongoing change and capability building to ensure the sustains competitive advantage.

THE FIVE STEPS INVOLVED IN THE THINKING:

Step 1: Specifying Value

Womack and Jones states that value can only be defined by the ultimate consumer and is only meaningful when expressed in terms of a specific product with specific capabilities which meets the customer's needs at a specific price at a specific time. The problem is that while value is defined by the customer, it is created by the producer and many things get in the way when producers try to express how they provide value.

Step 2: Identifying the value stream

Value stream is defined as: all the specific actions required to bring a specific product(whether a good, a service) Identify all the steps across the whole value stream, tracking the sequence of processes from raw materials to finished goods that deliver customer value.

Step 3: Creating flow

Make sure those steps flow better ensures actions, which create value flow properly and eliminate delays and interruption to create a smooth process.

Step 4: The concept of pull

Pull in simplest term means that no one upstream should produce a good or service until the customer downstream asks for it."Because of its responsiveness, this form of small lot, even single item, production means that the plant only makes what is ordered when it is ordered.

Step 5: The hunt for perfection

Strive for perfection by continually removing successive layers of waste, which is defined as anything that does not add value to a product or service.

To implement lean manufacturing five primary elements need to be worked upon

Manufacturing flow concerns with the uninterrupted flow of material from the store through to value addition processed to the shipping

Organization deals with peoples roles and responsibility and to train them in new ways of thinking working and communication

Process controls concerns with all that is required to monitor, control and improve discrete manufacturing process steps.

Metrics it is the criteria to judge the success of lean manufacturing implementation, it established visible, results based performance measures, determining targets for improvement and recognizing work teams for process improvements

Logistics it is the backbone of lean manufacturing. In case of working with minimum level of raw materials inventory, it becomes very important to ensure on time, correct, flexible and good quality supplies. The relations between supplier and customer take a very leading role, So, logistics concerns with the systems and mechanisms to ensure good supplies. It defines operating rules and mechanisms for the flow of material.

LEAN MANUFACTURING PRINCIPLES INCLUDE:

- Pull processing products are pulled from the consumer end (demand) not pushed from the production end (supply)
- Perfect first time quality- quest for zero defects revealing & solving problems at the source.
- Waste minimization- eliminating all activities that do not add value & 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.
- Building and maintaining a long term relationship with suppliers through collaborative risk sharing , cost sharing and information sharing arrangements.

TABLE 1: Summary of the Data

	Company 1	Company 2	Company 3	Company 4	Company 5
Title of Interviewee	Quality system coordinator	Control and Business Service	Corp. Strg & Development Mgr.	Internal Consultant	Supt. Qual & Process Tech
Driving Force	Log M/S downtime , customer push us to implement lean, reduce cost	Become Cost competitive	Liquidity	Losing money	Economiccs, save money
Lean tools used	JIT, TPM	JIT TQM, TPM	JIT, TPM, TQM	TPM, TQM, 5S, Cell Mnfg	JIT, TPM, Setup reduction, TQM
How far along implementation	0-25%	51-75%	26-50%	26-50%	0-25%
Expectation from lean	Improve cost	Better customer service, lower cost, higher cash flow	Cost competitive	Clean & safer workplace better planning procedures	Lower Cost, reduce inventory
Results obtained from lean	Reduced M/C downtime	See improvement in cost	Process improvement, cut cost significantly	Made profit for entire year since implementing lean, clean & safer workplace	Save some money
Challenges faced when implementing lean	N/A	Changing historical rules	Union issues, Automation issues	Internal Consultant	Inflexibility of union
Support of top management	Neutral	Very supportive	Very supportive	Very supportive	Neutral

LEAN TOOLS AND TECHNIQUE:

Various techniques such as Kaizen, Minute exchange of dies(SMED),Six Sigma, Kanban, Value Stream Mapping(VSM), 5S, Total Quality Management (TQM), Theory of constraints(TOC), Total Productive Maintenance (TPM), Business Process Management (BPM), Visual Management, etc

supports the lean transformation in order to remove waste, variability and overburden and deliver improvements in specific areas.

Every tool has its own way of eliminating waste, SMED reduces waiting and overproduction by creating shorter machine setup times. Value Stream Mapping draws the actual product flow through the manufacturing resources and can uncover important areas for improvement. Kanban reduces inventory by introducing a consumer pulled production system.

- Poka Yoke (Error Proofing) Error proofing is a structured approach to ensure quality and error free manufacturing environment. Error Proofing assures that defect will never be passed to next operation. Poka Yoke means fool proofing, it is all about ensuring that the mistake doesn't happen. Error proofing is a manufacturing technique of preventing errors by designing the manufacturing process, equipment and tools so that an operation literally cannot be performed incorrectly. The basic concept of this is avoiding the problems by correcting the process.
- JIT: A philosophy of manufacturing based on planned elimination of all waste and continuous improvement of productivity. It encompasses the successful execution of all manufacturing activities required to produce a final product.
- Kanban: A method for maintaining an orderly flow of material. Kanban cards are used to indicate material order points, how much material is needed, it should be delivered. Production Kanban are also used to control production.
- Kaizen: The Japanese term for improvement continuing improvement involving everyone managers and workers. In manufacturing, kaizen relates to finding and eliminating waste in machinery, labour or production methods. Kaizen is a simple parts-movement system that depends on cards and boxes/containers to take parts from one workstation to another on a production line. The essence of the kanban concepts is that a supplier or the warehouse should only deliver components to the production line as and when they are needed, so that there is no storage in the production area.
- Lean Metric: Lean metric allow companies to measure ,evaluate and respond to their performance in a balanced way, without sacrificing the quality to meet quantity objectives or increasing inventory levels to achieve machine efficiencies. The type of lean metric depends on the organizations and can be of following categories; Financial performance, behavioral performance and core process performance.
- One piece Flow: One piece flow or continuous flow processing is a concept means that items are processed and moved directly from one processing step to the next, one piece at a time. One piece

flow helps to maximum utilization of resources, shorten lead times, and identify problems and communication between operations.

- Tact Time: The time required between completions of successive units of end product. Tact time is used to pace lines in the production environments.
- Overall equipment effectiveness: To calculate OEE for the constrained operations. Measures the availability, performance efficiency and quality rate of equipment- it is especially important.
- Perquisite Tree: Is a logical structure designed to identify all obstacles and responses needed to overcome them in realizing and objective.
- Process Route Table: Shows what machines and equipment are needed for processing a component or assembly. These tables aid in creating ordinary lines and grouping work pieces and work cells.
- Quick Change Over: Quick change over is a technique to analyze and reduce resources needed for equipment step up, including exchange of tools and dies.
- Standard Rate or Work :The length of time that should be required to set up a given machine or operation and run one part ,assembly ,batch or end product through that operation .
- Total Productive Maintenance: Total productive maintenance is a maintenance program concept, which brings maintenance into focus in order to minimize equipment usage .The goal of TPM is to avoid emergency repairs and keep unscheduled maintenance to a minimum.
- Transition Tree : Is a cause and effect logic tree designed to provide step by step progress from initiation to Completion of a course of action or change. It is an implementation tool.
- Value Stream Mapping: Value stream mapping is a graphic tool that helps you to see and understand the flow of material and information as a product makes its way through the value stream.
- Value Stream Costing: Value stream costing methodology simplifies the accounting process to give everyone real information in a basic understandable format.
- Visual Management: Is a set of techniques that makes operation standards visible so that workers can follow them more easily.
- Work flow diagram: Shows the movement of material, identifying areas of waste. Aids team to plan future improvements.

CONCLUSION:

The current level of lean implementation in industries is examined. It also showed that certain techniques could work universally. It has been concluded that major manufacturing industries have been trying to adopt manufacturing initiatives in order to stay alive in the new competitive market place .Lean manufacturing is one of these initiatives that focus on cost reduction by identifying and eliminating on value added activities .In Indian industry a lot of scope is their to improve inventory control, reduce lead time, set-up timer which will lead to competitiveness of Indian industry.

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