Various Industrial Engineering Tools & Techniques Applicable for Plastic Converting Machinery Industry

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Abstract

In the aggressively competitive and innovative market, quality and productivity improvements plays a very important role in determining success for any organization. Plastic industry is one the major industry growing rapidly in today's competitive market. Plastic products are widely used in various other industries such as automotive industry, aerospace industry, pharmaceutical industry, and foods and packaging industry. To be on competitive notch, industries needs to apply various tools & technique. In the present study, various industrial tools and technique are evaluated for application at plastic converting machinery industry. A specific emphasis is considered towards the lean manufacturing and six sigma tools & technologies for this study report.

KEYWORDS: Plastic Industry, Industrial techniques, Lean Manufacturing, Lean, Six Sigma

I. INTRODUCTION

The Plastic industry is a substantial contributor to the economic growth and developments in the country. Plastic industry contributes to Agriculture, Infrastructure, Healthcare, Horticulture, Automotive, construction industry and food & packaging industry. Plastic industry continues to explore the new domains of industry and thereby enabling the Indian industry to churn out products with light weight and cost-effective. The Indian plastic industry has a huge potential of growth but at the same time plastic industry has to encourage sustainable development by investing in to industrial tools and techniques to protect environment, reduce waste, and simulate growth. Challenge of managing plastic waste needs to address with industrial techniques such as Lean, Six sigma, etc.

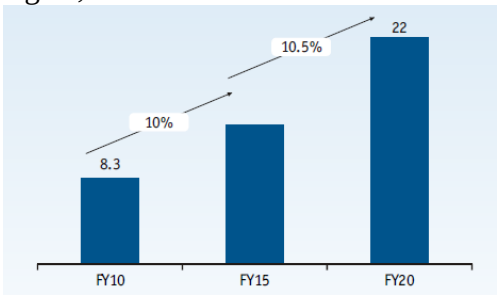

Figure 1. Market Trend of Plastic Industry
Source: FICCI report -2017

The Plastic industry has grown at compound annual growth rate of 10% from fiscal year 2010 to year 2015 and is expected to grow at the rate of 10.5% until year 2020. Figure 1 depicts the bar chart of the market trend of the plastic industry in terms of consumption.

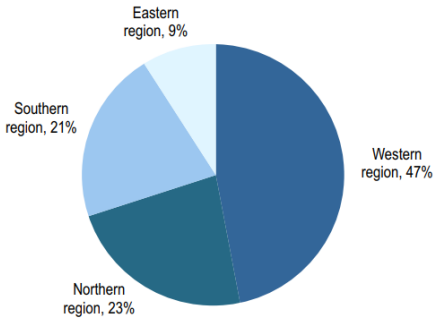

Figure 2. Region based Plastic Consumption in India
Source: FICCI report -2017

A report published from Federation of Indian Chambers of Commerce and Industry (FCCI) demonstrates that western region of India comprising of Gujarat, Maharashtra, union territory of Diu & Dadra, and Daman & Nagar Haveli, including Madhya Pradesh has plastic consumption of approximately 10 metric ton per annum. Also, figure 2 shows the region wise distribution of plastic consumption. It indicates that western region has been the largest consumer of plastic accounting approximately 47% of total consumption.

II. PROBLEM ENCOUNTERED

With increase in demand, there is always a compromise made for quality. Process improvements and Quality deliverables are always at risk to meet the order requirement in timely manner. Hence, there is a need for industrial tools & technique which can help to meet the market requirement by keeping quality and process intact or improved. Below is the list of the problems observed at the surveyed company.

- Unorganized shop floor area
- Messed up storage area
- High search time for items
- Higher production and assembly time
- Lower productivity
- Employee frustration and lower morale
- Longer wait time, lead time for assembly
- Transportation waste, Waiting waste
- Improper inventory management
- Loss of items
- Quality Issues
- Customer complaints

III. SOLUTION

There is enormous numbers of tools &techniques available and have been practiced throughout the various domains of industries. Manufacturing and production giants as well as service and non- profitable organizations are utilizing these industrial tools & techniques now a day. Below are the some of the Industrial techniques used for improving the efficiency.

- Operation Analysis
- Value Engineering
- Process analysis
- Lean Six sigma
- Six sigma
- Statistical Quality Control
- Variety reduction
- Standardization
- Process improvement
- Activity based management
- Waste reduction
- 5S
- Standard costing
- Kaizen
- Kanban
- Lean manufacturing or Lean system

After careful consideration of problems observed at surveyed company, it was found that Lean manufacturing tools & technique would be most appropriate way to resolve the problems.

IV. DIFFERENT TYPES OF LEAN MANUFACTURINGTOOLS& TECHNIQUES

Lean manufacturing focuses on the process improvement and value stream and ensures that non-value adding elements are eliminated from the workflow and value adding components are brought forefront. Main objective of lean manufacturing is to enhance overall customer experience and focus on elimination or reduction of seven types of waste. These seven type of wastes are as below:

- Transport
- Inventory
- Motion
- Waiting
- Overproduction
- Over-processing
- Defects

Toyota Production System (TPS) house or Lean house is widely recognized framework which explains the philosophy of Lean manufacturing.

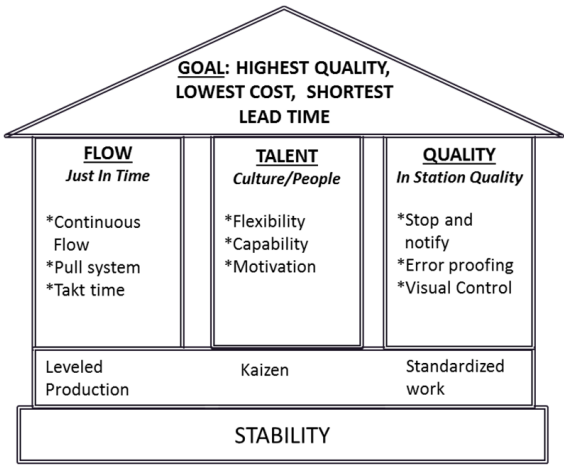

Figure 3. Lean house

Some of the tools & techniques applicable to plastic converting machinery industry and to surveyed company are discussed below:

5S:

5S is very simple but powerful technique which falls within the paradigm of lean manufacturing. It is a Japanese tool that is used to organize the workspace/area in a very efficient way, clean and safe manner. 5S helps in increasing productivity, visual management and work standardization. 5S is combination of five "S" - Seiri, Seiton, Seiso, Seiketsu and Shitsuke which translated in English means Sort, Set in Order, Shining, Standardize and Sustain.

For any organization 5S is the foundation for following the roadmap of lean manufacturing. The 5S tool works methodically in 5 different phases:

- **Seiri(Sort**) is the first step for the implementation of 5S which involves sorting of the all the mess within the workplace or work area. Sort mean to keep only items which are necessary, important and extremely useful in the work area. Unnecessary items needs to be removed.
- **Seiton (Set in Order)** is the second step that describes the process of arranging the decluttered items in an efficient manner so as to be used using the principles of ergonomics.
  During this step it is ensured that there is place for everything and everything has been placed and proper location.
- **Seiso (Shine)** is third step that comprises a detailed cleaning of the workspace/area, tools, systems or subsystems, machines and equipment to be used in the company. This process ensures that all items, apparatus, machines, tools

etc., are as good as new and eliminates any non-conformity that may create any technical difficulties.

- **Seiketsu (Standardize)** is the fourth step which make sure that workcompleted during Seiso or shine activity are now standardized. This process establishes the common standards and establishes rules and process for how we need to work among the team. Standardization is very crucial phase of lean manufacturing and thus is key component.
- **Shitsuke (Sustain)** is the fifth and final step which ensures that the organization keeps up to the standards adhered and conformed to. This phase involves housekeeping and auditing of the processes and tools and equipment. This phase develops the work routine and culture of the organization.

To achieve fruitful results by implementing 5S, each step of 5S needs to implemented successfully and followed by previous step. Success of each step depends on the previous step of 5S. And thus it forms the wheel of the 5S. Below figure shows the wheel of 5S for successful implementation.

Figure 3.Wheel of 5S
Source: https://www.epa.gov/lean/lean-thinking-and-methods-5s

Total Quality Management (TQM):

Total Quality Management (TQM) is a continuous quality program designed to bringing teamwork of the departments to come together and ensures self-sufficient workflow for optimum quality of process or product. TQM focuses with customer needs and expectation and focuses on the participative management and accordingly aligns the process of production and timelines of the organization. Followings are the key component of Total Quality management Technique.

- Involvement of Employees and Training of Employee
- Statistical methods
- Problem-solving teams

- Process and not people
- Focus on long-term goals
- Focuses on Customer satisfaction
- Customer driven quality deliverables
- Top management is involved directly as essential part for bringing change to the organization
- Quality increment being a continuous effort and one that needs to be continued as a long-term plan
- Improvement in work process and the maintenance of the production line

Visual Management:

Visual management is a massive part of Lean Manufacturing and the Toyota Production System (TPS). Visual management is one of the very simplest tools and often ignored, due to its straight forwardness. As the name suggest Visual Management is the ability to manage everything visually in the organization.

During the lean manufacturing path, Visual metrics should be first implemented. The display of data and metrics shows how each area is useful and collected information reveals the challenge in the current status. Visual controls helps to identify how each area works physically and which items are located. Housekeeping and Production flow can be controlled by visual management. Below are the few methods of Visual Management:

- First in First Out
- Kanban
- Two-bin systems

Kanban:

An Industrial engineer working at Toyota developed Kanban system to improve the efficiency of the manufacturing. Kanban is scheduling system of Lean manufacturing and Just-in-Time (JIT). For some companies Kanban system is also known as Toyota nameplate system as in this system cards tracks the production in the factory. Below are the six rules for the application of Kanban

- Each process issues requests (Kanban) to its suppliers as it consumes its supplies.
- Each process produces according to the quantity and sequence of incoming requests.
- No items are made or transported without a request.
- The request associated with an item is always attached to it.
- Processes must not send out defective items, to ensure that finished products will be defect-free.
- Limiting the number of pending requests makes the process more sensitive and reveals inefficiencies

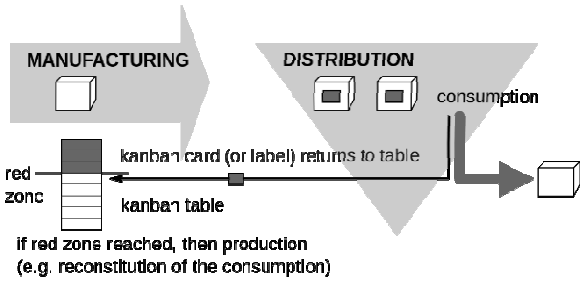

Figure 4. Kanban Principle
Source: Wikipedia.com

Just-in-Time (JIT):

Just-in-Time is methodology for inventory management that ensures raw material orders aligns with the production schedule. Major organizations are using JIT method and implements inventory strategy to increase the productivity and efficiency and decrease waste by receiving the raw material only when it is needed for production process. Following JIT in an organization helps to reduce inventory costs. Various advantages of Just-in-Time method are as below:

- Production runs are short
- Less expenditure on raw material as company buys the material when needed
- Less inventory management
- More space for storage area or warehouse
- Reduced wastage

Kaizen:

Kaizen is the Japanese technique used for continuous improvement. The Japanese word kaizen means Change for better. There are two types of Kaizen.

- Flow Kaizen
- Process Kaizen

Flow Kaizen is oriented towards the material flow and information flow in entire production area and even in an organization. Process Kaizen is about the improvement in individuals' work style such as improving the way worker do their job. The activity of Kaizen cycle is defined as Plan – Do – Check – Act (PDCA). This cycle is also known as Deming cycle.

V. CONCLUSION

This research paper shows the importance of industrial tools & techniques and which industrial tools & techniques are applicable to Plastic converting machinery industry. From the study of Lean manufacturing techniques, tools and methods, it is very obvious that Lean six sigma tools and technique are perfect match to resolve the problem encountered at surveyed company. As it can be seen from the review of the techniques that 5S can greatly help in decluttering, eliminating mess, good housekeeping and organizing the workspace area. Visual management along with 5S can help to reduce the search time for the items, will improve the work culture and morale of employees. 5S

along with Visual management also helps in eliminating or reducing the different types of waste. Technique like Just-in-time and Kanban can help to reduce the inventory stock and also helps in reducing the lead time and wait time. Total quality management helps in achieving customer satisfaction and meeting the customer requirement. Kaizen is process of change for better which helps in continuous improvement of the process and thus increases the productivity of the process.

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