# Impact of the Application of Lean Tools for Process Improvement in a Cooker Manufacturing Company

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## Abstract

Organizations in today's context need to focus on continuous improvement in order to satisfy the customers by delivering high-quality products which in turn maximizes the profit through waste minimization in the production flow. Lean thinking is the main philosophy that helps the company to identify and reduce waste. The use of lean tools for organizations is considered to be a simple, efficient, and cost-effective solution for productivity improvement. It is the technique that originated in the automotive industry first. The main objective of this paper was to analyse and reduce the lead time of the cooker manufacturing process by evaluating each step of cooker manufacturing. Non-value-added activities were identified, and suggestions were given to reduce the same. Overall Equipment Efficiency of each machine was calculated for a month and suggestions were given to improve OEE. Pareto chart, why-why analysis, cause and effect diagram were used, and suggestions were given to reduce the cooker manufacturing lead time.

**Keywords:** Lean, OEE, Pareto chart, Why-Why analysis, Productivity

## I. Introduction

India's Pressure Cooker Market registered a decline of -11.27% in value shipments in 2022 as compared to 2021 and an increase of 8.87% CAGR in 2022 over a period of 2017. In the Pressure Cooker Market India is becoming more competitive as the HHI index in 2022 was 7315 while in 2017 it was 7787. India has reportedly relied more on imports to meet its growing demand in the Pressure Cooker Market. India is shifting towards local production to meet its demand as we see the trend is shifting towards reducing imports. The import factor of the Pressure Cooker Market in 2022 was 6.09 while in 2017 it was 8.57. China, Germany, Türkiye, Viet Nam, and China, Hong Kong SAR were among the top players of the market in 2022, where China acquired the largest market share of 85.39% with a shipment value of 71.84 million USD in 2022. The Indian pressure cooker market witnessed an upward growth trajectory in recent years on account of the growing inclination of urban consumers to buy pressure cookers over normal cookers as they reduce the cooking time leading to rising fuel cost savings.

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The pressure cookers are extensively used in households for preparing food. The pressure cookers have a preference over conventional cooking utensils due to the advantage of retaining the nutritive value and flavour of the cooked food and less time required for cooking and thus affecting considerable savings in time and fuel. It has been observed, keeping in view the average family, that medium-size/capacity pressure cookers have a greater market. With the rapid advancement in the general living standards of the people, the demand for pressure cookers is increasing day by day. Accordingly, there is great scope for setting up the new units for manufacturing pressure cookers to standard specifications. Pressure Cookers are conventionally made of Aluminium alloy sheets or Circles. The main body and lid of the pressure cooker are manufactured of aluminum alloy sheets/Circles of different thicknesses depending upon the size and specifications of the Cookers. The components i.e., pressure regulator, Bakelite Handles and Lugs, Rubber Gasket, fusible Plugs, Screws, Rivets, Packing Boxes, etc. are usually purchased from outside sources by the pressure cooker manufacturers. In the manufacturing of pressure cookers, operations like circle cutting, deep drawing of body, drawing of lid, trimming of body and lid, notching of body, drilling of holes in body and lid, fixing of lugs, handles, vent pipe, buffing and polishing, testing, packing, etc. are involved. A pressure cooker is an airtight cooking device that cooks food quickly. A pressure cooker is a hermetically sealed pot that produces steam heat to cook food quickly. The higher temperature of a pressure cooker penetrates food quickly, reducing cooking time without diminishing vitamin and mineral content. Pressure cookers are especially useful at high altitudes, where they alleviate the problem of low-temperature boiling caused by reduced atmospheric pressure.

Lean Manufacturing tools are intended to help drive out waste, simplify everything, create efficient flow, improve quality control, and make the most of factory resources. The implementation of Lean manufacturing- its principles as described by Womack in 1990- as depicted in literature and the case studies on various industries do not seem to follow a specific methodology. Instead each time, the principles are applied according to the experience and the suggestions of the engineer or consultant responsible for bringing LM into a facility (Tsigkas, 2013). This suggests that a different combination of lean tools can be utilized, depending on the various aspects of the value-creating process, in order to turn to a lean approach. Lean tools are the concept of customer satisfaction increase aimed at eliminating waste, boosting the efficiency and effectiveness of manufacturing operations, and enhancing management processes to respond immediately to environmental changes.

## II. Literature Review

**Anand S. Relkar 2012** - In this paper, an attempt has been made to measure and analyse the overall equipment efficiency of critical machinery producing important components. By measuring the performance of the existing system reference values are obtained for design experiments. By using minitab, an experiment has been done on three factors and two levels of OEE. A survey was conducted in 50 automobile ancillary companies to observe mean-time failure and mean-time repair. This study indicates that OEE is useful to improve the performance rate to achieve optimized values.

**Anderson C, Bellgran M (2015),** examines the study of available theory indicating that a gap

between these implications from a theoretical perspective vs the industrial perspective. Productivity measures and Overall equipment efficiency are the tools used. The result shows that if a high degree of complexity in definition and calculation when applied in operational conditions might be perceived, this paper will show that a systematically used combined set of OEE and productivity measures can successfully drive production improvements.

**Arief Rahmana , Muhammad Fauzy , Annisa Maharani Suyono, 2021** in their research explained the 5 Why Analysis Implementation To Detect Root Cause of Rejected Products (Study At Aerospace Industry)

**Baudin (2012)** describes the application of the technique in manufacturing as a tool for ensuring quality. In manufacturing, the classical Pareto analysis partitions items based on only one type of defect. Analysts then plot a bar chart of the relative frequencies of each defect in the population tested. The top 20 percent of the categories hold 80 percent of the quantity in question.

**Duranik Tomas, Markus Stopper, and Juraj Ruzbarsky (2011)** described the application of value stream mapping to identify hidden reserves and avoid bottlenecks. The aim behind the application of VSM was to identify any type of waste and develop a current state map. Then they described an ideal state showing only zero waste processes and finally a future state that could give answers on how to improve the production flow and efficiency, reduce production costs, and increase flexibility.

**Gheorghe ILIE, Carmen Nadia CIOCOIU – 2010,** studied the application of a fishbone diagram to determine the risk of an event with multiple causes.

**S. Neha, M.G. Singh, and Simran, (2013)-** Lean tools are used to reduce the time between the placement order and the delivery time of the final product by eliminating waste from the product during manufacturing

**Richard Hedman, 2016** - the purpose of this paper, increase the digitalization of industry and provides means to automatically acquire and analyze manufacturing data. As a consequence, companies are investing in Manufacturing Execution Systems (MES) where the measurement of Overall Equipment Effectiveness (OEE) often is a central part and important reason for the investment. The purpose of this study is to identify critical factors and potential pitfalls when operating automatic measurement of OEE. The findings and recommendations of this study can be incorporated to fully utilize the potential of automatic data acquisition systems and to derive accurate OEE measures that can be used to improve manufacturing performance.

**T. N. Issa,2018 -** the study emphasizes the importance of a systematic approach in the implementation of Value Stream Mapping and the selection of appropriate lean principles for waste reduction.

**Valerie et al., 2008** -in their case study on lean technique in a contract pharmaceutical industry represented a number of possible opportunities for specific areas of improvement and suggested an overall change in the manufacturing mindset. Lean manufacturing techniques were utilized in the

development of new systems. Using value stream mapping 75% of lead time reduction was achieved. The company benefited from the current state and an envisioned future state of their operation which employed potential and lean technique.

**Vijay Kumar, 2014** - the purpose of this paper is to determine the delivery performance of any organization by assisting in planning, and scheduling to improve production planning and process improvement through OEE. The approach involved reviewing present planning and scheduling methodologies, identifying bottlenecks, changeover procedures, and reworks in work in progress. As a process improvement, the SMED tools help to achieve higher setup time reduction and process improvement.

## III. Objectives

### Primary Objective:

1. To conduct a study on cooker manufacturing lead time reduction using Lean tools at Coimbatore

**Secondary Objectives:**

1. To study the current manufacturing process of pressure cookers.
2. To assess non-value-added activities and suggest measures to reduce them.
3. To assess the defects and suggest measures to reduce them.
4. To assess the performance of machines and suggest measures for improvement.

## IV. Research Methodology

### Descriptive Research

Descriptive research includes surveys and fact-finding inquiries of different kinds. The major purpose of descriptive research is to describe the current state of affairs.

### Details of the Organization

A reputed well-known cooker manufacturing company located in Coimbatore was taken for the study. It is known for its innovative kitchen and household products. They are one of India's leading brands in cooker manufacturing.

### Method of data collection

The data for the study was mainly collected from primary sources including observation and interviews. The researcher spent time observing all the processes and collected the primary data mainly through interviews with the employees and department heads.

## V. Toold Used

### Pareto chart

A Pareto chart, named after Vilfredo Pareto, is a type of chart that contains both bars and a line graph, where individual values are represented in descending order by bars, and the cumulative total is represented by the line.

### Cause and Effect Analysis

A fishbone diagram, also called a cause-and-effect diagram or Ishikawa diagram, is a visualization tool for categorizing the potential causes of a problem in order to identify its root causes. Dr. Kaoru Ishikawa, a Japanese quality control expert, is credited with inventing the fishbone diagram to help employees avoid solutions that merely address the symptoms of a much larger problem. A fishbone diagram is useful in brainstorming sessions to focus conversation. After the group has brainstormed all the possible causes for a problem, the facilitator helps the group to rate the potential causes according to their level of importance and diagram a hierarchy. The design of the diagram looks much like a skeleton of a fish. Fishbone diagrams are typically worked right to left, with each large “bone” of the fish branching out to include smaller bones containing more detail.

### OEE (Overall Equipment Effectiveness)

OEE (Overall Equipment Effectiveness) is the gold standard for measuring manufacturing productivity. It identifies the percentage of manufacturing time that is truly productive. An OEE score of 100% means only Good Parts are manufactured, as fast as possible, with no Stop Time. In the language of OEE that means 100% Quality (only Good Parts), 100% Performance (as fast as possible), and 100% Availability (no Stop Time).

OEE = Availability * Performance * Quality.

### VSM (Value Stream Mapping)

Value-stream mapping is a lean-management method for analysing the current state and designing a future state for the series of events that take a product or service from its beginning through to the customer with reduced lean waste as compared to the current map. A value stream focuses on areas of a firm that add value to a product or service, whereas a value chain refers to all of the activities within a company.

### Why-Why Analysis

A Why-Why Diagram is a Tree Diagram where each child’s statement is determined simply by asking ‘why’ the parent occurs. It is thus very similar in use to a Cause-Effect Diagram, and techniques may be borrowed from Cause-Effect Diagram usage. Its simplicity can make it useful in less formal situations.

#### E-draw Max

It is a software used to model the value stream maps and flow charts.

## V. Analysis

### I) Overall Equipment Effectiveness

#### Calculating Availability

Availability takes into account all events that stop planned production long enough that it makes sense to track a reason for being down (typically several minutes).

Availability is calculated as the ratio of Run Time to Planned Production Time

| MACHINES | AVERAGE OF AVAILABILITY |
|---|---|
| Kaushico press 400T | 0.5052868332 |
| Oriental 250T | 0.6414039286 |
| Kaushico press 250T | 0.7137156686 |
| Verson press 250T | 0.3739421014 |
| Hydraulic press 2000T | 0.7363758923 |
| Narendra press 100T | 0.6621347691 |
| Ameteep press 250T | 0.8242387249 |
| Ameteep press 400T | 0.8188426218 |
| Kaushico press 100T | 0.7447921314 |
| **GRAND TOTAL** | **0.6689702968** |

**Table 1**

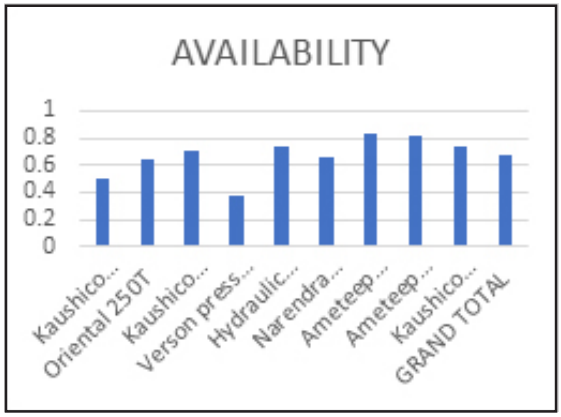


**Chart 1**

#### Inference

Availability is calculated for the whole month of every machine and its varieties of products. Ameteep press 250T is 82% available and Ameteep press 400T is lower than the Ameteep press 250T and its availability is 81% which is calculated by using running time and production planning time. Where availability is better in these two machines, the rest of the machines need to improve their availability.

**Calculating Performance :** Performance takes into account anything that causes the manufacturing process to run at less than the maximum possible speed when it is running (including both Slow Cycles and Small Stops). Performance is the ratio of Net Run Time to Run Time.

| MACHINES | AVERAGE OF AVAILABILITY |
|---|---|
| Kaushico press 400T | 0.9655749521 |
| Oriental 250T | 0.9723014367 |
| Kaushico press 250T | 0.9801869018 |
| Verson press 250T | 0.9782216228 |
| Hydraulic press 2000T | 0.9890548356 |
| Narendra press 100T | 0.9673821045 |
| Ameteep press 250T | 0.9851035597 |
| Ameteep press 400T | 0.9677841651 |
| Kaushico press 100T | 0.9723823374 |
| **GRAND TOTAL** | **0.9755466666** |

**Table 2**

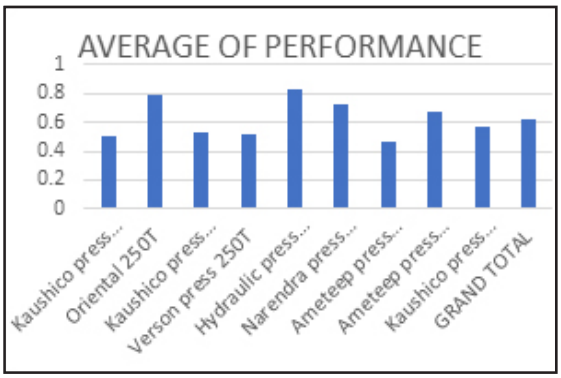


**Chart 2**

### Inference

Performance is calculated for the whole month of every machine and their varieties of products. Hydraulic press 2000T performs at 82% and Ameteep press 250T is the lowest in performance at 46% which is calculated by using total quantity, running time, and production rate.

### Calculating Quality

Quality takes into account manufactured parts that do not meet quality standards, including parts that need rework. Remember, OEE Quality is similar to First Pass Yield, in that it defines Good Parts as parts that successfully pass through the manufacturing process the first time without needing any rework. Quality is taken as the ratio of Good count to total count.

| MACHINES | AVERAGE OF AVAILABILITY |
|---|---|
| Kaushico press 400T | 33.870298631 |
| Oriental 250T | 25.685582608 |
| Kaushico press 250T | 38.570008294 |
| Verson press 250T | 51.979630502 |
| Hydraulic press 2000T | 82.428044137 |
| Narendra press 100T | 56.968368061 |
| Ameteep press 250T | 48.584283008 |
| Ameteep press 400T | 16.686988994 |
| Kaushico press 100T | 23.809688438 |

**Table 3**

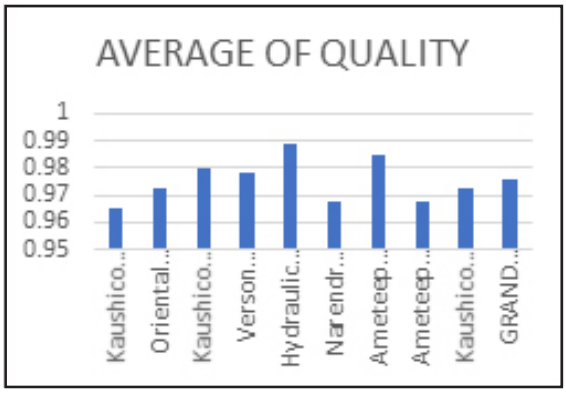


**Chart 3**

**Inference**

Quality is calculated for the whole month of every machine and their varieties of product. Every machine has a quality of more than 90%, which is analyzed by using total quantity and good quantity of production in every machine and it shows that there is no problem in the quality segment.

**Calculating OEE (Overall Equipment Effectiveness)**

| | |
|---|---|
| Kaushico press 400T | 0.4994493371 |
| Oriental 250T | 0.7879301834 |
| Kaushico press 250T | 0.5348205888 |
| Verson press 250T | 0.5197250446 |
| Hydraulic press 2000T | 0.8236345147 |
| Narendra press 100T | 0.7199157814 |
| Ameteep press 250T | 0.4678123476 |
| Ameteep press 400T | 0.6672391864 |
| Kaushico press 100T | 0.5697804722 |
| **GRAND TOTAL** | **0.6211452729** |

**Table 4**

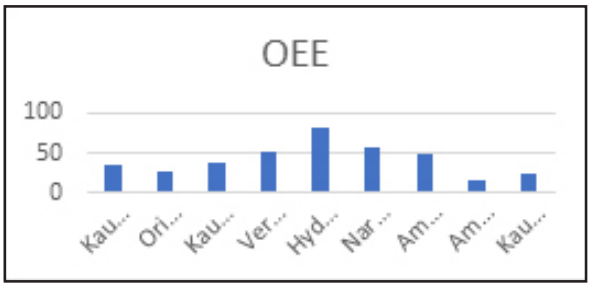


**Chart 4**

**Inference**

By analyzing the production data for every machine and for each day, Hydraulic press 2000T has an overall equipment efficiency of 82% and Narendra press 100T has an OEE of 56%. Only these two machines have more than the average percentage of OEE. The remaining machines have a lower OEE.

**REWORKS FOR SHIFT A and SHIFT B**

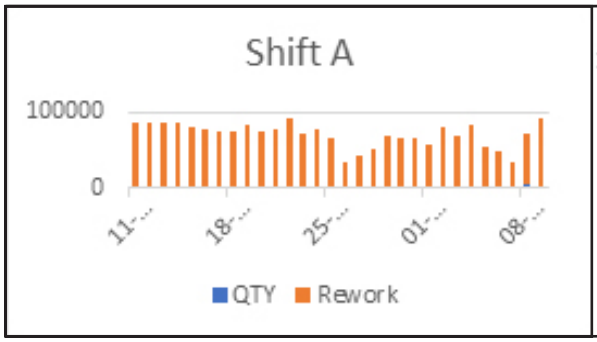


**Chart 5**

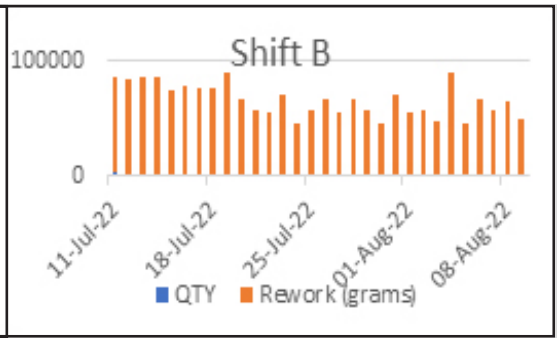


**Chart 6**

**Inference**

Rework for both Shifts A & B for the entire month was calculated. Heavy rework for the particular date was noted.

**WHY-WHY Analysis:**

1. **Flow process of Why-Why analysis**

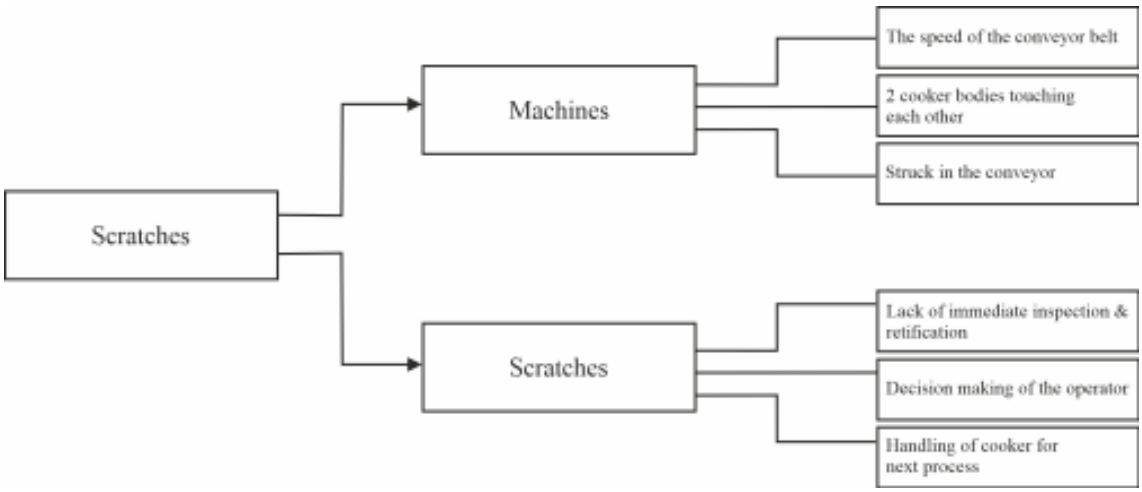


**Figure: 1**

**Inference**

From this analysis, problems at each stage can be identified. Figure 4.2.8 states that the major cause for the scratches found on the cooker occurred due to two cookers touching each other on the Conveyor belt. The speed of the conveyor belt shall be reduced according to the production requirement and human capability. Picking up two or more cookers with one hand could lead to the same cause.

**Cause and Effect Diagram**

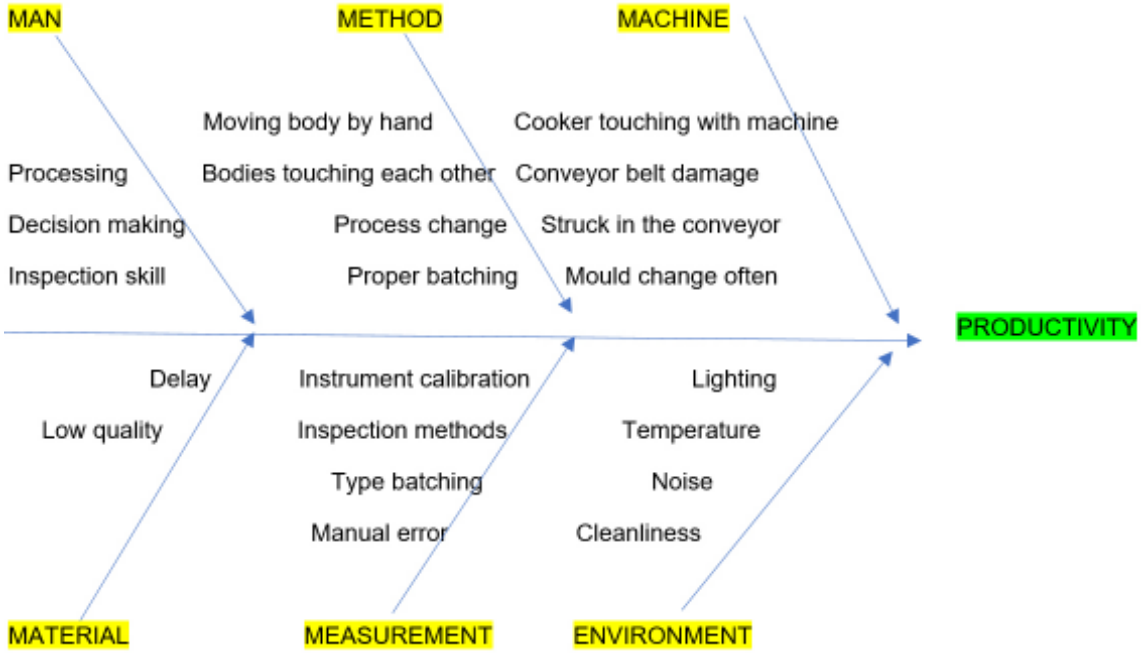


**Figure 2**

| S. No | Problem | Causes | 5M+1E |
|---|---|---|---|
| 1 | | Skill | Man |
| 2 | | Training | Man |
| 3 | | Bodies touching with each other | Man |
| 4 | | Communication barrier | Man |
| 5 | | Low Quality | Material |
| 6 | | Batching Type | Material |
| 7 | | Delay | Material |
| 8 | Productivity | Non uniform mix distribution | Method |
| 9 | | Improper Racking | Method |
| 10 | | Process change | Method |
| 11 | | Improper Batching | Method |
| 12 | | Noise | Environment |
| 13 | | Temperature | Environment |
| 14 | | Cleanliness | Environment |
| 15 | | Lighting | Environment |

| S. No | Problem | Causes | 5M+1E |
|---|---|---|---|
| 16 | | Friction | Machine |
| 17 | | Conveyor Belt damage | Machine |
| 18 | Productivity | Overheat | Machine |
| 19 | | Instrument Calibration | Measurement |
| 20 | | Wrong Adjustment | Measurement |
| 21 | | Mould often change | Measurement |

**Table 5**

**Inference**

A cause-and-effect diagram also called a “fishbone” diagram, can help in brainstorming to identify possible causes of a problem and in sorting ideas into useful categories. Cause and effect analysis is used to identify the common cause, the core problem, for all the observed symptoms. The major causes for delay in productivity was identified. The reasons were found to be based on Machine and Method.

## Parero Chart

A Pareto chart, named after Vilfredo Pareto, is a type of chart that contains both bars and a line graph, where individual values are represented in descending order by bars, and the cumulative total is represented by the line.

| Nature of Defect | Frequency | Cum | % |
|---|---|---|---|
| Training | 60 | 60 | 28% |
| Bodies touching each other | 35 | 95 | 44% |
| Improper batching | 25 | 120 | 56% |
| Conveyor belt damage | 20 | 140 | 65% |
| Mould change often | 20 | 160 | 75% |
| Delay | 20 | 180 | 84% |
| Friction | 15 | 195 | 91% |
| Process change | 9 | 204 | 95% |
| Instrument calibration | 8 | 212 | 99% |
| Machine | 2 | 214 | 100% |

**Table 6**

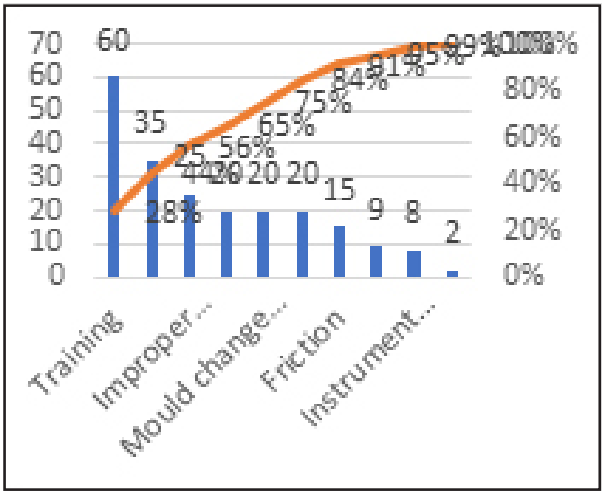


**Chart 7**

It could be found from the Pareto chart analysis, that problems for not having stable production occurs due to machine and method problems. The major problem is because of not proper training for the employees and the cooler bodies touching each other.

## Value Stream Mapping

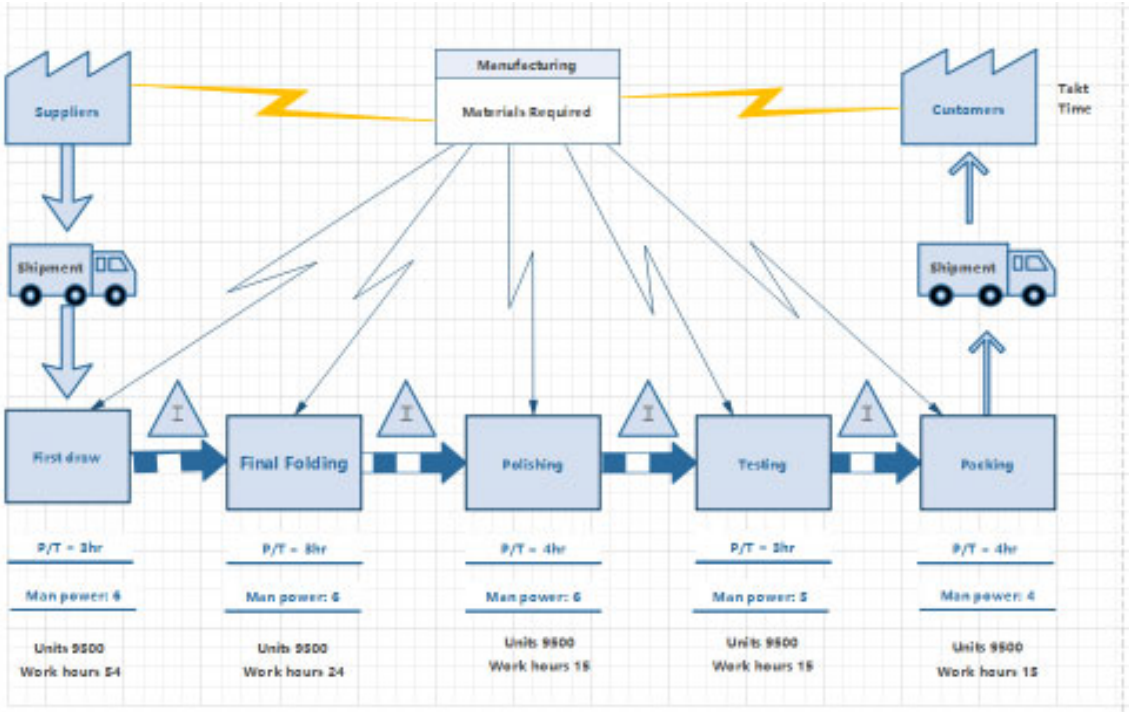


**Figure 3: VSM Current State**

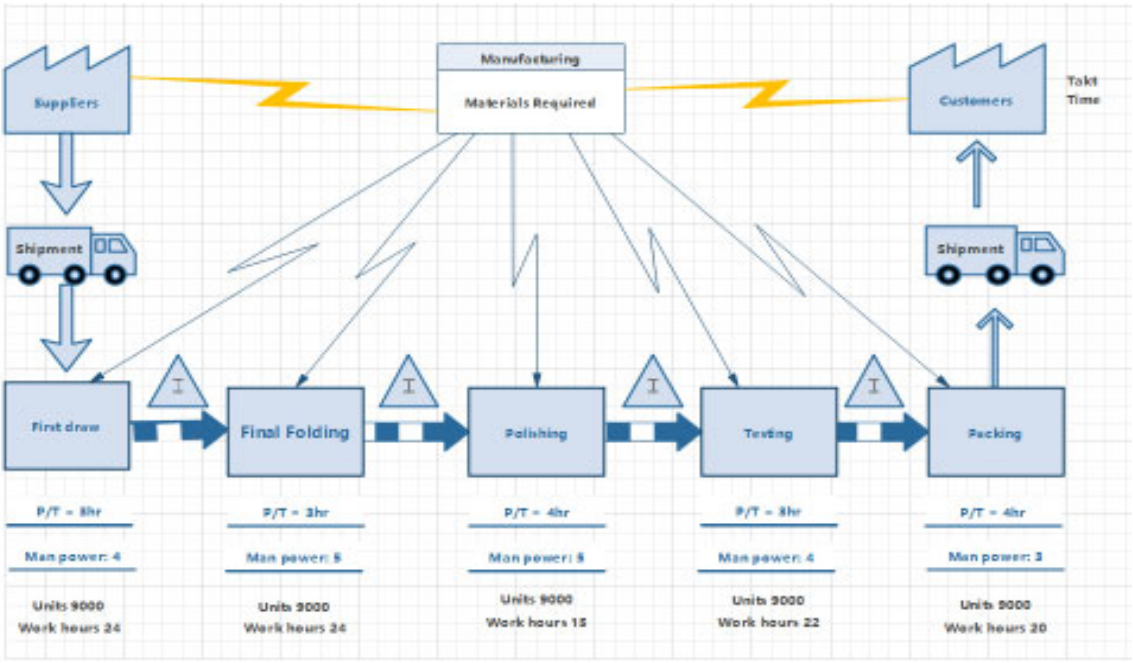


**Figure 4: VSM Future State**

VSM is a lean manufacturing technique used to map the flow of materials and information required to bring a product to the customer. It mainly helps to identify the wastes in value streams and improvement areas. It also finds an appropriate route for waste removal. VSM is analysed from the starting process of raw materials to the dispatch of finished products till it reaches the end customer. The time taken for each process is analysed (cycle time) and the overall time taken to produce a single product is calculated (total lead time). Non-value-added time is reduced to increase the effective production time.

In the future state, three stages are considered to reduce the time taken - mixing or batching, brick cooling process, and inspection process. In the inspection process poke yoke method is used by implementing a weight detection sensor and in the cooling process industrial fans can be used. In the mixing process, a mixer machine can be implemented.

## VI. Major Findings

From Pareto analysis it is inferred that 80% of delay is caused by training, Cooker bodies touching each other and Improper batching, and the remaining 20% of delay is caused by conveyor belt damage, Mould change often, Friction, Process change, Instrument calibration and machine respectively. From OEE analysis it is inferred that except for the two machines, the rest of the machines have less than 50% OEE. From the analysis of material wastage, rework is calculated for shift-wise A and B for the whole month. It shows that 100% of rework is affecting the quantity level and time wastage. Through the fishbone diagram, found many problems, that affect productivity and lead time. Through the why-why analysis method, overheating and adjustment causes were identified. By using the VSM method, three stages of non-value-added activity improvements were identified.

## VII. Suggestions

Performance can be improved by reducing the idle time of the machine. With proper autonomous maintenance and setups, machine availability can be improved. To reduce material wastage, there should be regular checks of rubber plates for every shift so that material wastage can be reduced. Training to be given to operators to avoid reworks. There should be continuous maintenance checks at the beginning of a shift so that unwanted maintenance can be reduced. Implementation of KAIZEN which will lead to continuous improvement in production and better returns may be introduced. Lean tools mainly help the organization to streamline the process by eliminating the waste generated from various processes. The major wastes are identified through the lean tools and continuous improvement measures are taken by the company to boost productivity.

## Conclusion

A trained worker is a productive worker or efficient worker, every organization in order to make its human resource more productive has to invest in human capital is the most reasonable capital expenditure for an organization which will bear fruits in nature. Realizing the importance of training rogrammers, the module of the training program must meet the expectations and capabilities of workers in order to yield better results. Communication is to be good between top-level management, middle-level management, and low-level management which helps to make workflow stable, which returns at a profitable level for the organization. Implementation of the above suggested lean tools and Kaizen will reduce the lead time for manufacture and improve the profitability of the organization.

## References


1. Andersson, C., & Bellgran, M. (2015). On the complexity of using performance measures: Enhancing sustained production improvement capability by combining OEE and productivity. Journal of Manufacturing Systems, 35, 144-154

2. Anand S. Relkar 2012 Optimizing & Analysing Overall Equipment Effectiveness (OEE) Through Design of Experiments (DOE) Academic research paper on “Materials engineering”

3. Austria, EU, Vol. 22, No.1, 2011, pp 0969-0970.J. Dinesh, A. Prabhukarthi, Reduction of Lead Time Using Value Stream Mapping in Pump Manufacturing Industry, MISSA, 2013.

4. Baudin, M. (2012). Revisiting Pareto in manufacturing. Industrial Engineer 44(1). 28-33.

5. Reserves and Avoid Bottlenecks, Annals of DAAAM and Proceedings of DAAAM International, Vienna,

6. Richard Hedman, 2016, “Analysis of critical factors for automatic measurement of OEE”, Science Direct, Pg 128-133.

7. S. Neha, M.G. Singh and Simran, (2013), “Lean manufacturing tool and techniques in process industry”, International Journal of Scientific Research and Reviews, Vol. 2, No. 1, pp. 54-63

8. Singh M.P., Ramphool Meena and Avinash Panwar, (2016) - A Survey on the Adoption of Lean Practices in Indian Manufacturing Sector, International Journal of Industrial Engineering Research and Development, Volume7, Issue 2

9. T. N. Issa, "Lean manufacturing implementation in fused plastic bags industry", ACM International Conference Proceeding Series, 10th International Conference on Information Management and Engineering, ICIME 2018, 2018, pp. 151–158.

10. Tomas Duranik, Stopper M., and Ruzbarsky J. Applying Value Stream Mapping to Identify Hidden

11. Valerie Maier – speredelozzi, etal., 2008. Integrating industrial engineering and lean techniques at a contract pharmaceutical manufacturer. The official magazine of ISPE, Vol.28, pp. 1-10.

12. Vijaya Ramnath, B., etal., 2009. Impact of lean manufacturing on improving productivity of auto components manufacturing industry. Manufacturing Technology Today, Vol.8, pp.20-26.