Case Study: Lean Techniques used in different Manufacturing Industries

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Abstract

There is a huge potential for Micro, Small and Medium Enterprises (MSMEs) to apply lean techniques in their day to day chores in order to minimize waste and increase productivity. Many MNCs like Toyota have already perfected the art of applying lean techniques in their manufacturing systems and their success is proof of that. But many MSMEs are of opinion that applying lean tools into manufacturing systems is an expensive matter and the benefits of applying lean system does not justify the costs associated. What these MSMEs need to understand is that applying lean systems have so many benefits associated with it and the benefits associated by applying these techniques do justify the cost in longer run. This paper shows the survey of some MSMEs whom I have successfully convinced of applying lean techniques. It shows how these MSMEs have introduced different Lean Techniques to achieve minimization of waste (MUDA) which can cause problems without sacrificing productivity. It also shows how these MSMEs have addressed waste created through overburden (MURI) and unevenness in workloads (MURA).

Keywords

Lean manufacturing, Value Stream Mapping (VSM), OEE, and ZED.

1. Introduction

There are a lot of lean manufacturing tools like 5S, Kaizen, Just-in-Time, Kanban, Value Stream Mapping, Jidoka, Total Productive Maintenance, Overall Equipment Effectiveness etc. All the tools have their own benefits and own methods of application. So deciding which tools are more critical to a MSME is of utmost importance as not all MSMEs are capable of spending money on applying all these lean techniques. Therefore, when applying different lean techniques to different industries, I found out which techniques were more critical to address the industries problems. (Yang, M.G., Hong, P. and Modi, S.B. (2011)).

2. Research Methodology

We have applied different lean manufacturing techniques like Overall Equipment Effectiveness (OEE), 5S, Kanban, Value Stream Mapping (VSM), Process Layout, Single Minute Exchange of Dies (SMED), Zero Defect Zero Effect and Capability Analysis on 3 different factories Avval Industries, Ganesh Metal, Siddhi Industries.

3. Techniques of Lean and Green Manufacturing

The various techniques of lean and Green manufacturing are

3.1. Kan-Ban System or pull systems

Basically use colouring cards, Bins and Activity board to track what needs to be produced within the factory (Bergmiller, G.G. and McCright, P.R. (2009b)).
3.2. Single Minute Exchange of Die (SMED)

It is a practice that helps the industries to reduce changing time in order to adjust the next manufacturing process based on customer requirement. It is method to reduce the amount of wastage generated from raw materials and unprocessed materials in the working process. (Bergmiller, G.G. and McCright, P.R. (2010)).

3.3. 5s

It means Sort (remove the un-wanted material that which is not to be needed or use), Set In Order (organize in proper sequencing to provide remaining things), Shine (clean and inspect different different worker working place), Standardize (write the standards operating procedure to above), Sustain (regularly follow the all 4 steps and check whether the steps are follow or not).

3.4. Value Steam Mapping (VSM)

VSM basically reduces time and waste of all processes not just in manufacturing process.

![Value Stream Mapping](image)

3.5. Production levelling (HEIJUNKA)

In this technique we produce intermediate goods at a constant rate so that further processes can also be carried out at this rate. (Deif, A. (2011)).

3.6. Continuous improvement (KAIZEN)

Continuous improvement in the inputs is an important step in the lean technique of manufacturing.

3.7. Re-use of Internal Element

It means All types of Material Waste which is recyclable and Polluted water recycling.

3.8. Best Internal Housekeeping

It means reduce internal material handling, easy material flow and better control of tool and material, reduce extra inventory and space. (Bergmiller, G.G. and McCright, P.R. (2010)).
3.9. Employee Involvement

Basically focus on “4 P” model of (philosophy, process, people and corporate partner and problem solving) and create awareness about work, then developing the team leader to motivate individual worker and own responsibility. Green manufacturing also helps with the high involvement of employees.

3.10 Overall Equipment Effectiveness (OEE)

OEE (Overall Equipment Effectiveness) is the Most Effective standard for measuring Machine manufacturing productivity. OEE structure for measuring machine productivity loss for a actual machine manufacturing process. Three categories of loss are tracked:

- Availability (e.g. downtime)
- Performance (e.g. slow cycles)
- Quality (e.g. rejects)

4. Case Study on Avval Industries

Lean tools used: 5S, Single Minute Exchange of Dies (SMED), Kanban, Value Stream Mapping (VSM)

4.1 Problem Statement

Avval Industries manufactures Anti-locks for Energy meters.

Customer demand per month of anti-lock is 22500 pieces, company working days are 25 per month, number of working shift per day is 2 and each shift working hour is 8.5 (510 minute) excluding lunch break (30 min) and tea break(15 min). Present Takt time 26.4 second. Raw material inventory is 14 days. Raw material passes through processes like Moulding, Separation of Moulding parts, Inspection, Finishing, Packaging to convert into finished product. Present lead time is 30 days. But there is need for reduction in lead time.

4.2 Solution to the problem statement

Calculation:

So (510-60-30) = 420 minute is value added activity

22500/25 = 900 piece to be produced / day

Takt time = net production time/ no of units produced = 420 minute/ 900 = 0.44 minute / units (26.4 second/ units)

Apply Kanban technique then finish good inventory 1780 piece to reduce 794 piece because of eliminating extra non value adding activity. In current value stream mapping, manufacturing time comes out to be 30 days.

Table No 1. Current Value Stream Map

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Process</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Moulding</td>
<td>14</td>
</tr>
<tr>
<td>b)</td>
<td>Separation of Final Moulding</td>
<td>4</td>
</tr>
<tr>
<td>c)</td>
<td>Inspection</td>
<td>2</td>
</tr>
<tr>
<td>d)</td>
<td>Finishing</td>
<td>2</td>
</tr>
<tr>
<td>e)</td>
<td>Packaging</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td><strong>Total Days</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>
4.3 Results after Lean Technique Application:

**VSM Calculation**

Before VSM application: Lead time = 30 days

Processing time (309 sec) = process (a) 1.3 sec + process (b) 1.9 sec + process (c) 3.27 sec + process (d) 3.27 sec + process (e) 300 sec

After VSM application: Lead time = 20 days process (a) 14 + process (b) 0.50 + process (c) 0.25 + process (d) 0.25 + process (e) 5

Processing time (280 sec) = process (a) 1.3 sec + process (b) 1.9 sec + process (c) 3.27 sec + process (d) 3.27 sec + process (e) 270 sec

**Kanban System**

**Before:** Finish good inventory=1780 piece

**Implementation steps:** Using Kanban cards that track production within a factory

**After:** Finish good inventory=794 piece

**Benefit:** 55 %

**SMED**

**Before:** After smaller anti-lock job is completed it takes 3 minute to search for next job

**Implementation steps:** 5s, internal and external setup, separate internal and external setup

**After:** After smaller anti-lock job is completed it takes 5 seconds to search for next job

**Benefit:** 90%

**5s and Re-use of waste**

**Before:** Finding of product sample in sample bank takes 5 minute

**Implementation steps:** Short, set in order, shine, standardize, sustain

**After:** Finding of product sample in sample bank takes 1 minute

**Benefits:** All type of work or activity is faster than the older

**VSM and better house keeping**

**Before:** Lead time of production= 30 days , Processing time= 309 second

**Implementation steps:** Select the product group or family, draw the current on-going state map, draw the future planning state map, Develop work plan implementation future state

**After:** Lead time of production= 20 days, Processing time= 280 second

**Benefits:** 10% in Lead time and 29% in processing time

**Employee involvement**

**Before:** Defective pieces= 50 per day
Implementation steps: Survey of employee within the company, creation of work distribution Chart based on skill, work satisfaction, worker performance.

After: Defective pieces=10 per day

Benefits: 40%

4.4 Conclusion

After applying different Lean techniques in Avval Industries and using tools like finding TAKT Time, applying Kan-Ban Technique, making new Eco-Green Value stream mapping, 5s, Single Minute Exchange of die, and motivating employees, it is clearly found that there are multiple future benefits in successfully implementing of the Lean and Green technique in micro, small, medium, and large scale industries. The notable results found: Reduction in inventory, reduction in defectives, increase in profitability, increase in efficiency, and decrease in lead time.

5. Case Study on Ganesh Metals Industries

Lean Tools used: Process layout and Overall Equipment Effectiveness

5.1 Basic Idea of Lean Implementation in Process layout

Before application of Lean Manufacturing Tools:

After application of Lean Manufacturing Tools:
5.2 Overall Equipment Effectiveness (OEE)

Fig No 4 Cold Rolling Machine and Die Punch Machine

5.2. OEE Calculation and Formula

<table>
<thead>
<tr>
<th>Machine press 1</th>
<th>Interval: 1 shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report range</td>
<td>From 15/08/2018 To 27/08/2018</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Availability</th>
<th>Interval period 3/09/2018 To 3/09/2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Total Available time</td>
<td>480 min</td>
</tr>
<tr>
<td>B. Planned Downtime</td>
<td>0 min</td>
</tr>
<tr>
<td>C. Net available time (A-B)</td>
<td>480 min</td>
</tr>
<tr>
<td>D. Unplanned Downtime</td>
<td>103 min</td>
</tr>
<tr>
<td>E. Operating Time (C-D)</td>
<td>377 min</td>
</tr>
<tr>
<td>F. Availability (E/C)*100</td>
<td>76.6 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Performance Efficiency</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>G. Total cycle run</td>
<td>21,703 cycles</td>
</tr>
<tr>
<td>H. Ideal production rate</td>
<td>3600.0 cycle/hr</td>
</tr>
<tr>
<td>Actual production rate calculated</td>
<td>3450 cycle/hr</td>
</tr>
<tr>
<td>Cycle time</td>
<td></td>
</tr>
<tr>
<td>I. Performance Efficiency ((G/E)/(H/60))*100</td>
<td>95.8 %</td>
</tr>
</tbody>
</table>
Quality Rate

J. Total Defects (Rework + Scrap)  
15 parts

K. Quality Rate ((G-J)/G)*100  
99.9 %

OEE

Overall Equipment Effectiveness (OEE)

By tool (F*I*K)  
73.3 %

5.3. Conclusion

OEE is a measure of overall Machine efficiency of an organization and it has a direct impact on Company Annual Profit. OEE is basically Lean Manufacturing Tool. A greater return on investment in machine is expected by a better OEE. Thus Ganesh Metals highly benefitted from application of these lean techniques.

6. Case Study on Siddhi Engineers

Lean Tools used: Zero Defect Zero Effect

6.1 Capability analysis

In order to achieve zero defect we did capability analysis and root cause analysis to find the most incoming defects and its root cause.

They gave us a random data of sleeves measured for capability analysis to find whether the process is capable or not. And also told to find the reason behind if it’s not capable. We studied the variation in data and made control charts to study the capability of manufacturing process.

The data was taken at the interval of 20 minutes from 08:00 AM in morning to 04:40 PM. It includes 2 reading of thickness from the top and bottom end of sleeves on regular time interval of 20 minutes. T1 and T2 are top measurements while T3 and T4 are bottom measurements.

Table No: 3 Capability analysis Data

<table>
<thead>
<tr>
<th>TIME</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
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<td>0.25</td>
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<tr>
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<td>0.35</td>
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</tr>
<tr>
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<td>0.35</td>
<td>0.35</td>
<td>0.34</td>
<td>0.34</td>
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<tr>
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<td>0.34</td>
<td>0.34</td>
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<tr>
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<td>0.84</td>
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</tbody>
</table>

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Fig No 6. Control chart with 1 sigma level indicator

Here, the red points indicates that the process out of control at that specific points. This conclusion was made based on the rules of control charts shown below.

Control chart with 2 sigma level indicator is also shown for better and easy assessment. Also the rules are shown below in figure.
After studying the control charts we concluded that the process is not in control. Therefore, we sat down with our mentor and showed them the results and together we brainstormed the probable defects.

This shows that the T2 readings were not taken properly.
Here, this graph shows that the values taken were not inside the specifications mentioned and are influenced towards the LSL (lower specification limit) specified by customer.

6.2 Conclusion after applying Capability analysis (ZED)

- Increased environmental and social benefits
- Superior quality, reduced reduction and higher revenues
- Zero Defect
  - Decrease in non-conformance/non-compliance
  - Reduction in waste
- Zero Effect
  - Decrease in pollution
  - Minimum wastage of resources

7. Future Scope of Lean and Green Manufacturing Techniques

There is always a scope for application of lean and manufacturing techniques in small scale industries where people tend to focus less on these areas. If such lean techniques are successfully implemented then there can be great increase in productivity, profitability, efficiency etc. in these industries.

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References:


Biographies

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