Case Study: Lean Techniques used in different Manufacturing Industries

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Abstract

The Micro, Small and Medium Enterprises (MSMEs) have huge potential to apply lean techniques in their day to day chores in order to minimize waste and increase productivity. Toyota is a pioneer in applying lean techniques. But many MSMEs are of opinion that applying lean tools into manufacturing systems is an expensive matter and the benefits of applying lean system do not justify the associated cost. Its time to understand MSMEs that lean systems have tremendous benefits associated with it in the longer run. This paper presented the case study of some MSMEs where lean techniques like MUDA, MURA has successfully implemented.

Keywords

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

1. Introduction

There are many 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 an MSME is of utmost importance as not all MSMEs are capable of spending money on applying all these lean techniques. Yang et al. (2011) studied the relationship between lean practices, environmental management practices and its impact on business outcomes. Bergmiller and Mccright (2010) correlated waste reducing techniques and strength of business management which ultimately resulted in improved business. Deif (2011) presented a system model capturing various planning activities for migrating from green to greener to more eco-efficient manufaucting.

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 in 3 different factories viz. Avval Industries, Ganesh Metal, and Siddhi Industries. We have attempted to elaborate on various lean tools in short in the next section.

3. Techniques of Lean and Green Manufacturing

The various techniques of lean and Green manufacturing are

3.1. Kan-Ban System or pull systems

This technique uses coloring 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 to adjust the next manufacturing process in the industries to reduce changing time-based on customer requirement. This method helps to reduce the amount of wastage generated from various sources like raw materials and unprocessed materials in the working process.

3.3. 5s

This technique consists of 5 step program. Each step starts with the letter 'S'. First 'S' stands for Sort which means removing the un-wanted material which is not needed or use), Second 'S' means Set In Order implies to organize in proper sequencing to provide remaining things. Third 'S' stand for Shine means clean and inspect different-different worker working place, fourth 'S' is Standardize means that write the standards operating procedure and fifth 'S' is Sustain means regularly follow the all 4 steps and check whether the steps are followed or not.

3.4. Value Stream Mapping (VSM)

VSM basically reduces the time and waste of all processes in the manufacturing process.

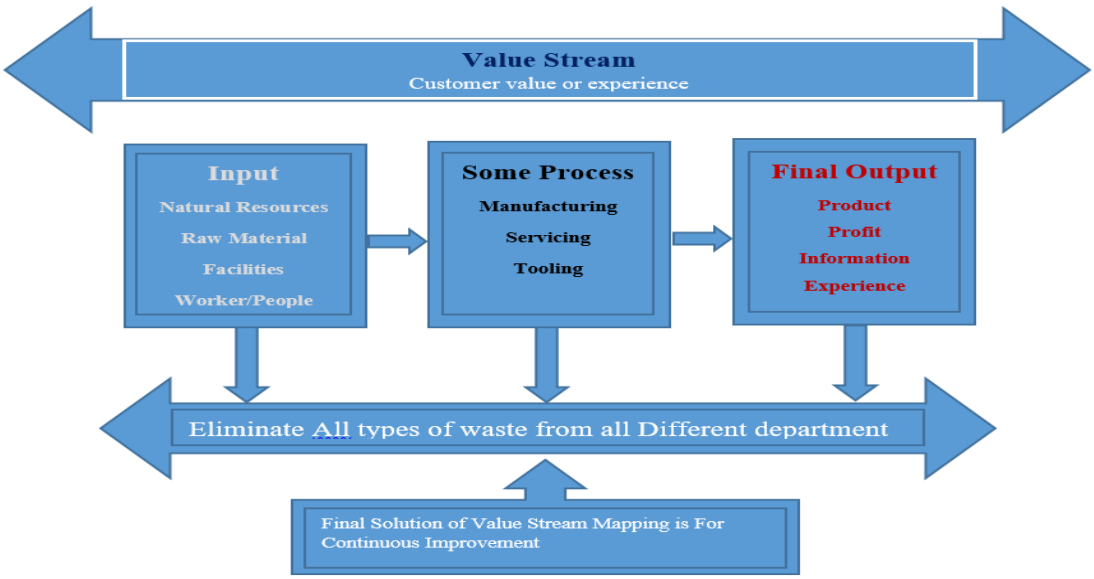

Fig 1. Value Stream Mapping

3.5. Production leveling (HEIJUNKA)

This lean technique produces intermediate goods at a constant rate which ensures further processes can also be carried out at this rate.

3.6. Continuous improvement (KAIZEN)

Continuous improvement is the technique in which firms attemps to improve system problem in small steps in a continuous manner.

3.7. Re-use of the internal element

It means all types of material waste which are recyclable and Polluted water recycling.

3.8. Best Internal Housekeeping

This tool helps to reduce internal material handling, better control of tool and material, reduce extra inventory and space, and eases material flow.

3.9. Employee Involvement

Employee involvement focuses on the "4P" model (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 is a measure of machine productivity loss for an actual machine. Three categories of loss considered in OEE calculation are:

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

4. Case Study on Avval Industries

4.1 Problem Statement

Avval Industries manufactures Anti-locks for Energy meters. Customer demand per month of anti-lock is 22,500 pieces. Company work for 25 days per month. the 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 is 26.4 second. Raw material inventory is 14 days. Raw material passes through processes like Moulding, separation of molding parts, inspection, finishing, packaging to convert into a finished product. Present lead time is 30 days. But there is a need for reduction in lead time.

Based on discussion with management and domain experts in the industry, we decided to use 5S, Single Minute Exchange of Dies (SMED), Kanban, and Value Stream Mapping (VSM).

4.2 Solution to the problem statement

Calculation:

value-added activity time = 510-60-30 = 420 minute

pieces produced / day = 22,500 / 2 = 900

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

In current value stream mapping, manufacturing time comes out to be 30 days.

Table No 1. Current Value Stream Map

Sr. No	Process	Days
a)	Moulding	14
b)	Separation of Final Moulding	4
c)	Inspection	2
d)	Finishing	2
e)	Packaging	8
Total Days		30

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

After: Finish good inventory=794 piece

Benefit: 55 %

SMED

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

Implementation steps: 5S, internal and external setup, separate internal and external setup

After: After the smaller anti-lock job is completed it takes 5 seconds to search for the 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 ongoing 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 an 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 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 the application of Lean manufacturing tools:

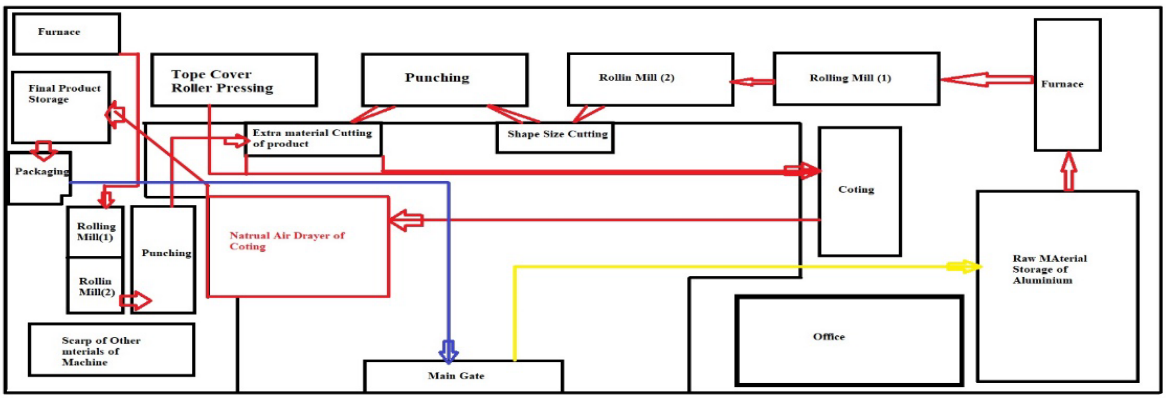

Fig. 2 Process layout before lean implementation

After the application of Lean Manufacturing Tools:

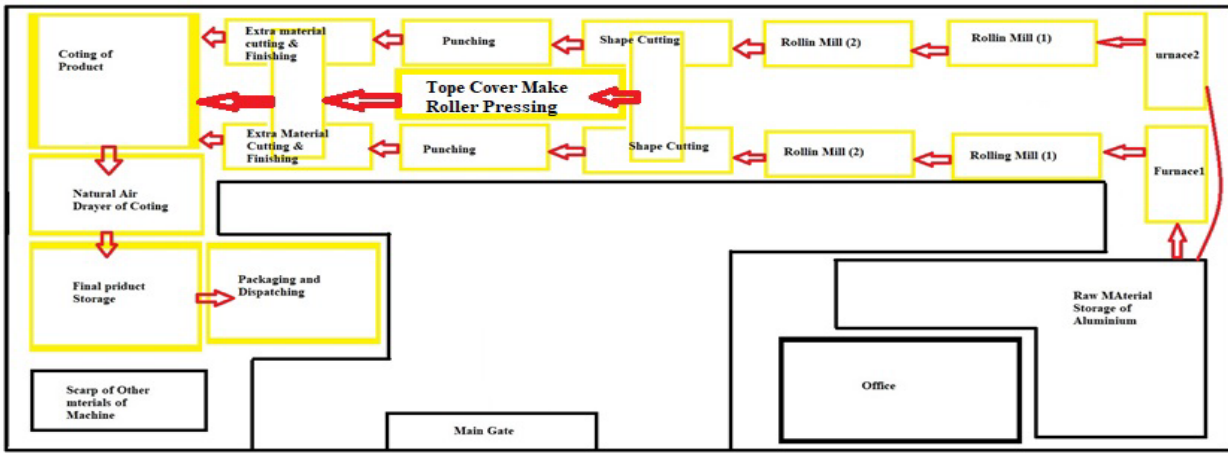

Fig. 3 Process layout after lean implementation

5.2 Overall Equipment Effectiveness (OEE)

Fig 4 Cold rolling machine and Die punch machine

OEE can be calculated using the following formula

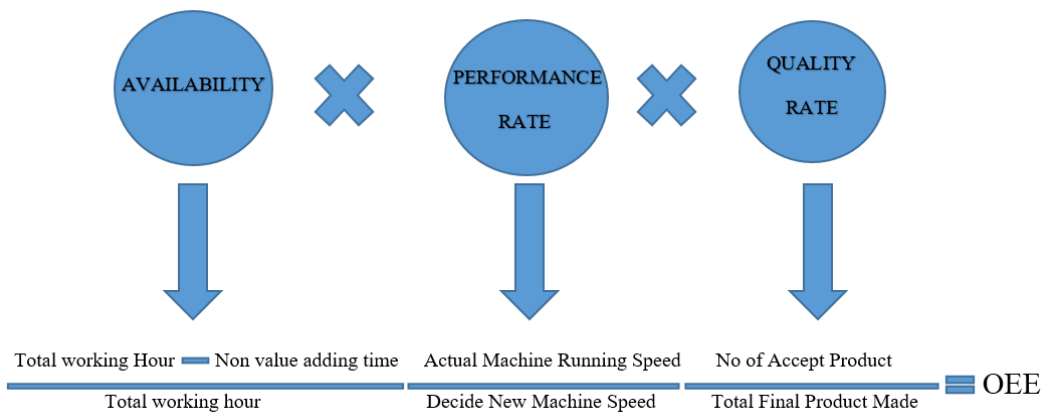

Fig 5. OEE Formula

Machine press 1	**Interval: 1 shift**

Report range From 15/08/2018 To 27/08/2018

Availability	**Interval period 3/09/2018 To3/09/2018**
A. Total Available time	480 min
B. Planned Downtime	0 min
C. Net available time (A-B)	480 min
D. Unplanned Downtime	103 min
E. Operating Time (C-D)	377 min
F. Availability (E/C)*100	76.6 %

Performance Efficiency	
G. Total cycle run	21,703 cycles
H. Ideal production rate	3600.0 cycle/hr
Actual production rate calculated cycle time	3450.0 cycle/hr
I. Performance Efficiency ((G/E)/(H/60))*100	95.8 %

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 effectiveness and it has a direct impact on company annual profit. OEE is basically a Lean Manufacturing Tool. A greater return on investment in machine is expected by a better OEE. Thus, in Ganesh Metals, the rolling press 1 is having the potential to enhance its effectiveness.

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 occurring defects and its root cause. After collecting data of sleeves, capability analysis was carried out to find whether the process is capable or not. We studied the variation in data and made control charts to study the capability of the manufacturing process. The data was taken at an interval of 20 minutes from 08:00 AM in the morning to 04:40 PM. It includes 2 reading of thickness from the top and bottom end of sleeves on a regular time interval of 20 minutes. T1 and T2 are top measurements while T3 and T4 are bottom measurements.

Table 2 Capability analysis Data

TIME	T1	T2	T3	T4
08:00	0.34	0.35	0.34	0.33
08:20	0.34	0.36	0.34	0.35
08:40	0.34	0.33	0.34	0.36
09:00	0.34	0.35	0.33	0.34
09:20	0.35	0.33	0.34	0.34
09:40	0.35	0.33	0.34	0.33
10:00	0.35	0.35	0.34	0.34
10:20	0.35	0.33	0.34	0.34
10:40	0.35	0.33	0.34	0.34
11:00	0.35	0.33	0.34	0.35
11:20	0.35	0.34	0.35	0.34
11:40	0.35	0.34	0.34	0.35
12:00	0.34	0.35	0.33	0.34
12:20	0.34	0.33	0.34	0.34
12:40	0.33	0.34	0.35	0.33
13:00	0.35	0.33	0.34	0.35
13:20	0.33	0.34	0.35	0.34
13:40	0.33	0.33	0.34	0.35
14:00	0.35	0.33	0.34	0.34
14:20	0.35	0.33	0.34	0.34
14:40	0.33	0.34	0.35	0.34
15:00	0.33	0.34	0.35	0.34
15:20	0.34	0.35	0.34	0.35
15:40	0.34	0.35	0.34	0.35
16:00	0.35	0.34	0.35	0.34
16:20	0.34	0.34	0.34	0.33
16:40	0.32	0.34	0.36	0.34

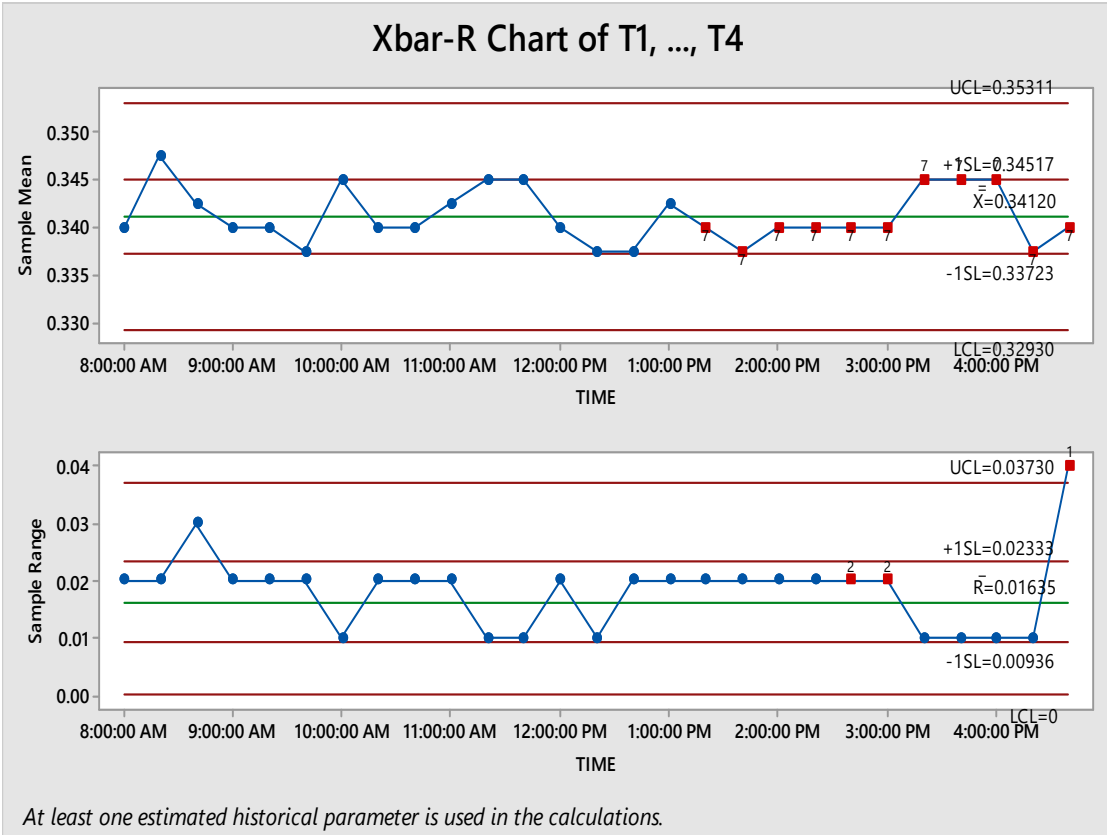

Fig 6. Control chart with 1 sigma level indicator

Here, the red points indicate that the process is out of control at those specific points. This conclusion was made based on the rules of control charts. Control chart with 2 sigma level indicator is also shown for better and easy assessment.

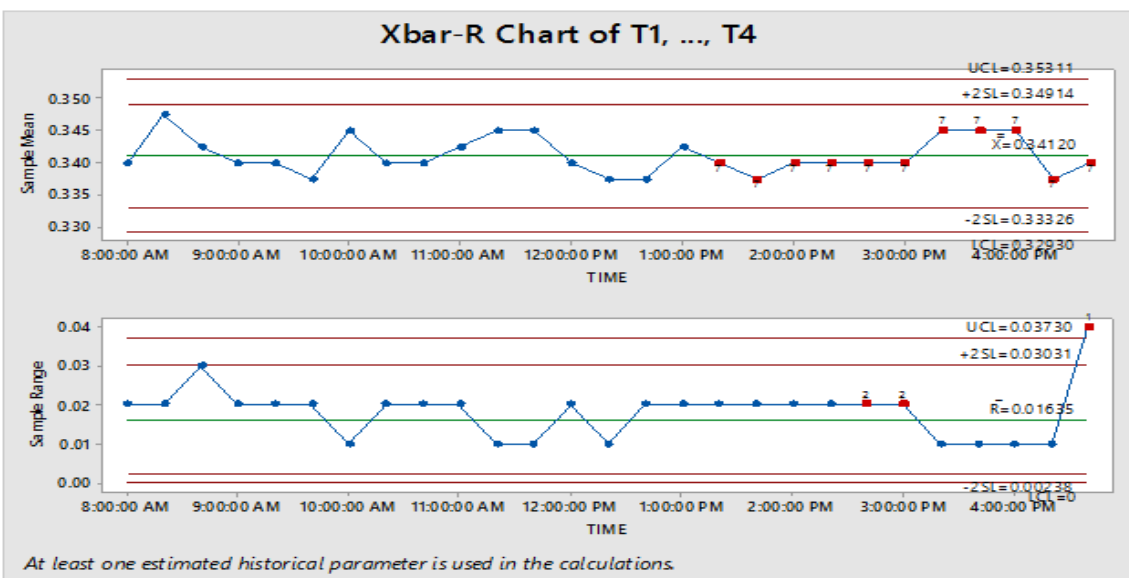

Fig 7. Control chart with 2 sigma level indicator

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.

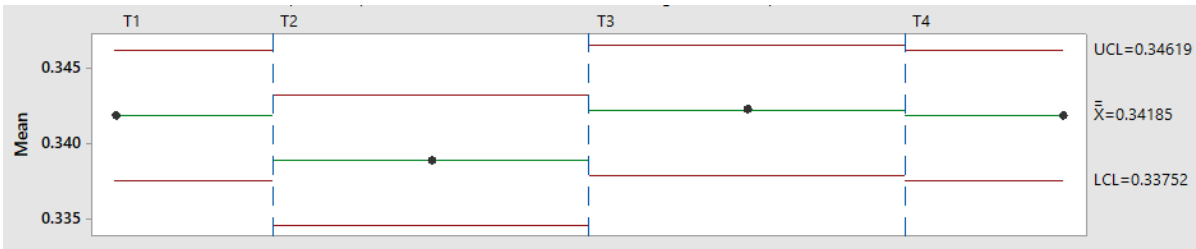

Fig 8. Variation in data

This shows that the T_2 readings were not taken properly.

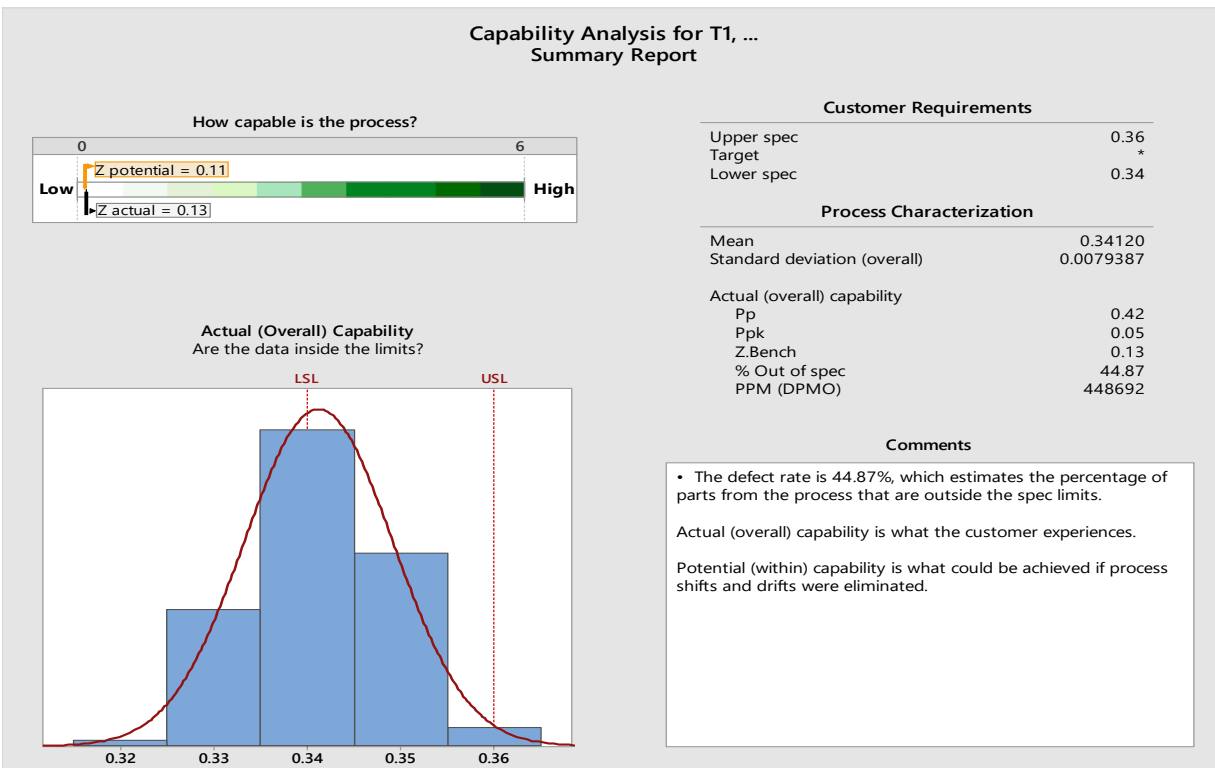

Fig 9. Actual capability report with z level indicator.

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

6.2 Conclusion after applying capability analysis

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

7. Future scope of Lean and Green manufacturing techniques

There is always a scope for the 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 a great increase in productivity, profitability, efficiency, etc. in these industries.

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Biographies

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