ASSESSMENT OF LEAN TOOLS IMPLEMENTATIONS IN AUTO PARTS INDUSTRIES OF LUDHIANA

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Abstract: Lean Manufacturing plays an important role in achieving the productivity targets of industries. The impact of lean manufacturing is lower in India as compared to the developed countries. This study is an assessment of Lean Manufacturing tools and techniques in Auto parts industries. The main objective to conduct this study is to find the level of degree used in lean tools and techniques, benefits and the barriers when implementing lean tools in auto parts industry. Survey has been done in 80 Auto parts industries Ludhiana. ANOVA and post hoc test had used to analyze the data. After doing analysis it has been found that medium scale industries use greater amount of lean tools as compared to the small and micro scale industries. Most important lean tool used in micro, small and medium was visual factory, PDCA and smart goals respectively. Barriers and benefits were also found for all type of industries. Major barriers founded in micro, small and medium industries were lack of communication, attitude of shop floor management and degree of investment respectively. Main benefits preferred by micro, small and medium scale industries were lead time reduction, reduction in cost and reduction in scrap respectively.

Keywords: Lean Manufacturing, Auto Parts industry, ANOVA, Post Hoc test.

1. INTRODUCTION

Lean Manufacturing in simple words is defined as steady or continuous improvement. The main function of lean manufacturing is to eliminate non added value activities. This word was originated in Toyota Company coined.

1.1. Lean tools

Some of the most common Lean tools are given below:


1.2. Auto parts industries

Auto parts industries are the back bone of Punjab Industries. There are three main cities which manufactures large amount of auto parts industries namely Ludhiana, Jalandhar and Amritsar. Out of these cities Ludhiana had highest amount of auto parts industries. It is also called the Manchester of India. According to the newly enacted Micro, Small and Medium Enterprises Development Act 2006, enterprises are classified into Micro, Small and Medium as shown in following Table 1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Type of Industries</th>
<th>Degree of investment on equipment and machinery components</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Micro scale</td>
<td>Less than Rs 25 Lakhs</td>
</tr>
<tr>
<td>2</td>
<td>Small scale</td>
<td>More than Rs 25 Lakhs but less than Rs 5 Crore</td>
</tr>
<tr>
<td>3</td>
<td>Medium scale</td>
<td>More than Rs % crores but less than Rs 15 Crore</td>
</tr>
</tbody>
</table>

2. LITERATURE REVIEW

Bernburg compared the effects of 3d virtual reality with 2d stimulations and with dummy objects. Survey was done. One way ANOVA and
post hoc test was used. After the analysis it was revealed that 3d virtual reality had greater effect on customer as compared to other objects [1]. Singh conducted survey in electronic industries (Mohali). The main objective of the research was to study the assessment of lean manufacturing tools in electronic industries. From the analysis it was showed that most lean tool which they followed were multi skilled department followed by policy development [2]. Nordin et.al explored the study of implementation on lean tools in automobile industries of Malaysia. Survey was conducted in 60 industries. From the questionnaire collected it was pointed out that the main barriers were lack of understanding lean tools [3]. Muslimen et al. carried out case study in Malaysian automotive Industry for implementing lean manufacturing. After conducting interview, five members team was formed by the company. The main motive was to eliminate the inventory wastage. After reducing the inventory wastage other wastages were also removed by continuous improvement [4]. Kumar carried out a survey in the Indian Garment Industries so as to find out which lean tool is most used and how aware are the Indian garment industries with lean manufacturing topic. After the analysis results were found which stated that most preferable tools used in Indian garment industries were value stream mapping, 5s and kaizen [5]. Kumar et al. founded variables that are very vital to install the lean tools in Indian Automotive Industries. Hypothesis model was formed and from the questionnaire results were obtained which found 9 independent variables and 9 dependent variables which affects the lean manufacturing [6]. Chaple et al. presented the assessment of the lean manufacturing tools in Indian Industries. Enablers and Barriers were founded. Methodologies which were used in implementing the lean tools were also identified [7]. Loha and sukto aimed at determination of lean manufacturing tools in small and medium enterprises of two industries in Northeast of Thailand (shoe and garment industry). From the analysis it was displayed that 30% of lean manufacturing was done in shoe industry and 34% of lean manufacturing was done in garment industry. An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it [8].

3. RESEARCH METHODOLOGY
The methodology for the present work is shown in the Fig. 1.

![Methodology for the present work](image)

3.1. Selection of industries
For installing new industries auto parts industries had more potential than other type of industries, so this type of industries were selected. Total population was selected from AUTO PARTS MANUFACTURING ASSOCIATION LUDHIANA (APMA). Total industries situated in Ludhiana were 450. Sample size was taken as 207 with 95% confidence level.

3.2. Selection of parameters
After studying literature review three main parameters were selected, Lean tools and techniques, benefits and barriers.

3.3. Design of questionnaire
From the literature review and experts questionnaire was designed.

3.4. Design of questionnaire
Random sampling technique and interview method was used to carry out survey. Out of 207 only 80 industries had given responses with a response rate of 39.76%.
3.5. Data validation
Cronbach’s alpha test was applied on medium, small and micro scale industries. Reliability test was done on 80 industries out of which 20,10 and 50 were micro, medium and small scale industries. If the values are in between 0.7 – 1 then the questionnaire is acceptable. Following are the results which are obtained after using this test. This validation was done in SPSS 21. Value of Cronbach’s alpha for micro, small and medium scale industries is 0.732, 0.715 and 0.813 respectively.

4. DATA ANALYSIS AND DISCUSSIONS
4.1. Type of Industries
Fig. 2 shows the type of Auto parts industries in Ludhiana.

4.2. Number of Employees
Fig. 3 shows about the number of employees working in industries. The blue bar represents the total number of employees working in industries.

4.3. Lean Manufacturing according to Industrialists
Fig. 4 shows about the definition of lean manufacturing according to industrialists.

4.4. Degree of use of lean tools
Respondents were asked to rate the usage of lean tools in their industries on five point Likert scale.
ranging from strongly disagree as 1 to strongly disagree as 5. From that the mean values were calculated and ranks given to the lean tools these are shown in Table 2.

4.5. Benefits achieved by industries after implementing lean tools

In Table 3 ranking has been done, benefits with maximum value are located in top while benefit with minimum value is located in bottom.

<table>
<thead>
<tr>
<th>Benefits achieved by industries</th>
<th>Mean values</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction in cost</td>
<td>4.025</td>
<td>1</td>
</tr>
<tr>
<td>Reduction in stock</td>
<td>3.88</td>
<td>2</td>
</tr>
<tr>
<td>Increased customer satisfaction</td>
<td>3.81</td>
<td>3</td>
</tr>
<tr>
<td>Reduction in scrap</td>
<td>3.8</td>
<td>4</td>
</tr>
<tr>
<td>Improved delivery time</td>
<td>3.45</td>
<td>5</td>
</tr>
<tr>
<td>Increased profitability</td>
<td>3.43</td>
<td>6</td>
</tr>
<tr>
<td>Reduction in wastage</td>
<td>3.36</td>
<td>7</td>
</tr>
<tr>
<td>Increased product quality</td>
<td>3.31</td>
<td>8</td>
</tr>
<tr>
<td>Increased efficiency</td>
<td>3.3</td>
<td>9</td>
</tr>
<tr>
<td>Increased competitive edge</td>
<td>3.16</td>
<td>10</td>
</tr>
<tr>
<td>Lead time reduction</td>
<td>2.68</td>
<td>11</td>
</tr>
<tr>
<td>Reduction in cycle time</td>
<td>2.26</td>
<td>12</td>
</tr>
<tr>
<td>Increased staff morale</td>
<td>2.4</td>
<td>13</td>
</tr>
<tr>
<td>Reduction in unplanned maintenace</td>
<td>1.85</td>
<td>14</td>
</tr>
</tbody>
</table>

4.6. Barriers Faced by Industries While Implementing Lean Tools

While implementing lean tools in industries there are always some barriers which are faced by industries. Table IV show the level of barriers faced by industries.

<table>
<thead>
<tr>
<th>Barriers faced by industries</th>
<th>Mean values</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude of shop floor managemen</td>
<td>4.3</td>
<td>1</td>
</tr>
<tr>
<td>Lack of understanding lean principles</td>
<td>3.52</td>
<td>2</td>
</tr>
<tr>
<td>Degree of investment</td>
<td>3.16</td>
<td>3</td>
</tr>
<tr>
<td>Attitude of top management</td>
<td>3.11</td>
<td>4</td>
</tr>
<tr>
<td>Existence of multiple location</td>
<td>3.08</td>
<td>5</td>
</tr>
<tr>
<td>Being unable to quantify benefits</td>
<td>2.8</td>
<td>6</td>
</tr>
<tr>
<td>Low priority by management</td>
<td>2.78</td>
<td>7</td>
</tr>
<tr>
<td>Opposition of anything new</td>
<td>2.73</td>
<td>8</td>
</tr>
<tr>
<td>Poor nature of manufacturing facility</td>
<td>2.5</td>
<td>9</td>
</tr>
<tr>
<td>Company culture</td>
<td>2.37</td>
<td>10</td>
</tr>
<tr>
<td>Lack of communication</td>
<td>2.1</td>
<td>11</td>
</tr>
</tbody>
</table>

4.7. Significant difference in the level of implementation of Lean tools, Benefits and barriers among MSMEs.

One way ANOVA was used for finding the significance difference between and within groups. Following were the hypothesis assumed for the study. $H_0$ = There is no significance difference of application of lean tools, benefits and barriers among micro scale, small scale and medium scale industries.

$H_1$ = There is significance difference of lean tools, benefits and barriers among micro scale, small scale and medium scale industries.

$H_0$ will be accepted if the significance value is greater than .05 and $H_1$ will be accepted if the significance value is less than .05.


2) Significant difference in the level of Benefits achieved by MSMEs: Out of the 14 benefits 10 benefits shows significant difference in the level of usage. These are 1. Reduction in cost, 2. Increased customer satisfaction, 3. Increased profitability, 4. Increased product quality, 5. Reduction in wastage, 6. Increased staff morale, 7. Lead time reduction, 8. Reduction in cycle time, 9. Reduction in unplanned maintenance, 10. Reduction in scrap.

3) Significant difference in the level of Barriers faced by MSMEs: Out of the 11 barriers 09 barriers shows significant difference in the level of implementation. These are 1. Company culture, 2. Degree of investment, 3. Attitude of shop floor

4.8. **Student Newmann Keuls test (Post hoc test)**

After finding significant factors, Student Newmann Keuls test was used to obtain that where the significance difference occurs. This test was applied to significant factors only. The subset columns show the mean values of industries. If all the values are in same column it depicts that there is no statistically difference if the values are in different columns then there is statistically difference among them. Here the value of a (harmonic mean) = 17.647. Value of b = Group sizes are not equal and harmonic mean of size is used.

### 4.8.1. **Comparison of lean tools used by MSMEs**

Student Newmann Keuls test was used in the 17 lean tools to see the level implementation in each of micro, small and medium industry. First of all applied in the JIT tool whose results shown in Table V.

<table>
<thead>
<tr>
<th>Type of industries</th>
<th>N</th>
<th>Subset for alpha = 0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Micro scale</td>
<td>20</td>
<td>1.2667</td>
</tr>
<tr>
<td>Small scale</td>
<td>50</td>
<td>1.8000</td>
</tr>
<tr>
<td>Medium scale</td>
<td>10</td>
<td>3.4667</td>
</tr>
</tbody>
</table>

Medium scale uses highest amount of JIT with mean 3.4667 as compared to other industries. Similarly this test was applied to other significant factors. The mean values of all the factors are shown in Fig. 5.

From the graph following three results were observed:

1. Most common tools used in micro scale industries are visual factory with mean value 3.6, smart goals with mean value 3.2 and policy development with mean 3.

2. Most common tools used in small scale industries are PDCA with mean value 4.2, kaizen with mean value 3.7 and RCA with mean value 3.5.

3. Most common tools used in medium scale industries were Smart goals with mean value 4.7, 5s with mean value 4.4 and group technology with mean value 4.3.

4.8.2. **Comparison of benefits preferred by MSMEs**

Comparison of benefits achieved by industries from the Student Newmann Test is shown Fig. 6:

From the graph following things are observed:

1. Most common benefit achieved by micro scale industries are lead time reduction with mean value 3.8 and reduction in cost with mean value of 3.6.

2. Most common benefits achieved by small scale industries are reduction in cost with mean value 4.2 and increased profitability with mean value 3.6.

3. Most common benefits achieved by medium scale industries are reduction in scrap with mean value 4.6 and increase in customer satisfaction with mean value 4.6.

4.8.3. **Comparison of barriers faced by industries by MSMEs**

Fig. 7 shows the comparison of total barriers faced by industries. Blue, red and green bar indicates the mean values of barriers faced by micro small and medium scale industries respectively.
From Fig. 7 following things were observed:

1. The common barriers faced by micr scale industries were Lack of understanding lean principles with mean value of 4.2 and lack of communication with mean value of 3.4.
2. The common barriers faced by small scale industries were Attitude of shop floor management with mean value of 4 and attitude of the management with mean value of 3.87.
3. Common barriers faced by medium scale industries were degree of investment with mean value of 4.6 and existence of multiple locations with mean value of 4.4.

5. CONCLUSIONS

After study the following conclusions were made:

1. Visual factory is the most common lean tool used by Auto parts industries of Ludhiana. Reduction in cost is the main motive to implement lean tools in the Industries. The main barrier encountered by the industries is Attitude of shop floor management.

2. Most common Lean tools used by MSME’s are:
   - Micro scale: visual factory (mean value = 3.6), smart goals (mean value = 3.2) and policy development with mean 3.
   - Small scale: PDCA (mean value = 4.2), kaizen (mean value = 3.7) and RCA (mean value = 3.5).
   - Medium scale: Smart goals (mean value = 4.7), 5s (mean value = 4.4) and group technology (mean value = 4.3).

3. Most common benefits achieved by MSME’s are:
   - Micro scale: Lead time reduction (mean value = 3.8) and reduction in cost (mean value = 3.6).
   - Small scale: Reduction in cost (mean value = 4.2) and increased profitability (mean value = 3.6).
   - Medium scale: Reduction in scrap (mean value = 4.6) and increase in customer satisfaction (mean value = 4.6).

4. Main barriers faced by MSME’s while implementing lean tools are:
   - Micro scale: Lack of understanding lean principles (mean value = 4.2) and lack of communication (mean value = 3.4).
   - Small scale: Attitude of shop floor management (mean value = 4) and attitude of top management (mean value = 3.87).
   - Medium scale: Degree of investment (mean value = 4.6) and existence of multiple locations (mean value of = 4.4).

REFERENCES


