A STUDY OF AUTO COMPONENT SUPPLIERS WITH SPECIAL REFERENCE TO ELECTRICAL AND ELECTRONIC COMPONENT MANUFACTURERS

Dr. Dattatry Ramchandra Mane
Professor, Department of Management Sciences, Savitribai Phule Pune University, Pune

INTRODUCTION

The Indian Auto Components Industry is expected to grow to US$ 33-40 Billion, by 2015 from around US$ 7 Billion, at present. By 2016, the automotive sector is expected to contribute 10% of the country’s GDP and 30-35% of the Industry.

There is tremendous pressure on giants in the field to produce vehicles and fulfill the demand for the same. This has resulted into a lot of changes in the production processes carried out by these companies. These changes are distinct from the changes forced by the technological development. Further, these changes have added different dimensions to the traditional approaches in almost every function of the business. Certain new concepts have emerged, such as, Vendor Development, Supply Chain Management, Forward and Backward Integration of the production processes, Outsourcing etc. While introducing each new concept, it has been stated that these concepts will lead to reduction of cost with high quality and greater speed in the production processes.

This outsourcing has led to increase in SSI units supplying material to these giants. Even the giants have shown interest in starting such a venture. The work load was such heavy that these vendors (i.e. SSI units) have further processed for sub- vendor ship. This has led to the creation of multi-layer production process for the production of one unit/ part of the unit.

The small-scale sector has emerged as a dynamic and vibrant sector of Indian Economy. The Sector contributes 40% of the industrial production, 35% of the total exports and employs about 167 lakh persons in about 30 lakh SSI units in the country. The sector acts as a "nursery" for the development of entrepreneurial talent. This sector which manufactures a wide range of more than 7500 products, supplies the lower income groups with inexpensive consumer goods and services. Due to its flexibility, the sector is better able to weather downturns in the country.

Small-scale sector suffers from certain handicaps and economies of scale are also not available to it. Support to small industries virtually is a universal phenomenon and exists in one form or the other in almost all countries of the world whether developed or developing.
Objective of the Study

The objective of the study is to check whether multi layer outsourcing, hierarchical process has really benefited the auto industry by reducing the cost and increasing the quality of the product or this multi layering has lead to increased rework and rejection at every layer.

Scope of the study

The major products from the Pune cluster are clutch components, gear components, brake components, shafts, axles, valves, engine components, electrical components, etc.

For the purpose of this research the researcher had selected various electrical and electronic components supplier and the information for 40 components was collected for the study.

The researcher had collected and made an analysis on the number of tiers involved in the process, their quality performance in terms of rejection in PPM (Parts Per Million), distance travelled by the component due to multi vendor involvement, and the effect of in sourcing of operations on rejection level.

Sampling technique used

It was not possible, nor it was necessary, to collect information from the total population. Instead, a smaller subgroup of the target population or a sample was selected for the purpose of study. Sampling is the strategy of selecting a smaller section of the population that will accurately represent the patterns of the target population at large. The main purpose of the sampling was to improve quality of data by focusing on a smaller group.

The research is about Automobile Sector in Pune region. Pune region has been selected as there are plenty of SSI’s in this sector and secondly, the researcher found it convenient to focus on the region on the grounds of vicinity. In the context of the topic, vendors were identified at three different levels.

It was desirable on the part of the researcher to gather relevant information from all the three categories. Though multi stage sampling is a part of random sampling the researcher has used multistage sampling for non random sampling for Tier-I and Tier-II vendors.

Data Collection

Data collection means gathering information to address those critical evaluation questions that you have identified earlier in the evaluation process. There are many methods available to gather information, and a wide variety of information sources. The most important issue was to select the most appropriate information or evidence to answer the questions.

Taking into consideration all the facts the researcher has used:

1) Questionnaire: A structured questionnaire was prepared.
2) Records: Information, data specifically related to the rejection rate and outsourcing tendency was taken from the records.
3) Individual interviews: Individual’s responses, opinions and views were considered.

IMPORTANT NOTE

The range of quality, as measured by defects found in incoming components – expressed in ‘parts per million’ defective. International best practice for car makers in the U.S., Japan and Europe predominantly competing in after-market spare currently aims to bring the large majority of suppliers under 100 PPM. Indian and Chinese companies are fairly similar. In each case, about half of the suppliers achieve a figure under 100 PPM. The tail of the distribution is also similar: the fraction of suppliers with defect rates exceeding 1500 ppm is about one-eighth.
Data analysis

Electronic Components
Data collected for the month of April, May and June from various suppliers. Number of component taken for survey are 40. Number of parties involved in the process and the operations
1) Tier 1- only testing no manufacturing in done
2) Tier 2- PCB (printed circuit board) manufacturing
3) Tier 3- assembling of component
4) Tier 4- hot air leveling

Processes involved
Tier 1 vendor is the direct supplier to Automobile Company who has the vendor code for supplying finished components. Tier 1 doesn’t have sufficient spare capacity for fulfilling the demand hence he had developed another vendor who can do the manufacturing.

Tier-3 vendor has the facility for assembling the components but doesn’t have the facility for PCB (printed circuit board) manufacturing. Hence further this vendor had developed one more vendor who can do the job of PCB manufacturing and hot air leveling.

Tier-2 vendor does PCB (printed circuit board) manufacturing but for hot air leveling he again has to rely on some another party as this facility was not available with this vendor.

Once the PCB (printed circuit board) manufacturing and hot air leveling is done it went to tier 2 for assembling of components.

After component assembling is done the finished component is supplied to the first vendor where 100 percent inspection is carried out and if found correct it is supplied to the Automobile company. In turn the number of parties involved in the process comes out to four. i.e. four Tiers.

Data analysis
For checking the performance of the vendors the researcher has done the analysis on the basis of the sequence of operation.

1) Tier -1 there is no data available as no process is being carried out at this stage, only inspection of components received from tier 2, 3 and 4 is carried out as 100 percent job (processes) are outsourced.

2) Tier -2 PCB (Printed circuit board) manufacturing.
Some of the check points which are to be confirmed by inspecting the job for quality standards the list of which is given below. Analysis of this is done below
Reasons of non conformance with the standard
1) Material Rejection
2) Material mishandling
3) Track cut
4) Pad cut
5) Grooving cut
6) Routing problem
7) Masking peel off
8) Drill shift
9) Punching problem
10) Under etching
11) Over etching
12) Non PTH
Observation: From the analysis it is observed that major rejection is due to
1) Over etching with 27%
2) Track cut 25%
3) Drill shift 17%
4) Non PTH 13%
Total comes out to 82%

3) TIER -3 - Assembling of component
Tier 3 is the second vendor in the line who gets the PCB assembling work done from tier 2 and further assembles the component and supply the finished component to tier 1.
At assembling line rejection are due to:
1) Dry solder
2) Solder short
3) Wrong value
4) Component missing
5) Harness sequence wrong
Average Percentage of rejection due to (NC) non conformance of components with the standards set for the month of April, May and June.

<table>
<thead>
<tr>
<th>Month</th>
<th>Dry solder</th>
<th>solder short</th>
<th>wrong value</th>
<th>wrong polarity</th>
<th>component missing</th>
<th>harness sequence wrong</th>
<th>Total NC qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr-08</td>
<td>516.141</td>
<td>0</td>
<td>6.129</td>
<td>8.581</td>
<td>0</td>
<td>4.903</td>
<td>535.75</td>
</tr>
<tr>
<td>May-08</td>
<td>460.414</td>
<td>0</td>
<td>5.231</td>
<td>1.743</td>
<td>1.743</td>
<td>3.487</td>
<td>472.6228</td>
</tr>
<tr>
<td>Jun-08</td>
<td>626.006</td>
<td>0</td>
<td>7.033</td>
<td>21.101</td>
<td>0</td>
<td>2.344</td>
<td>656.486</td>
</tr>
<tr>
<td>Average</td>
<td>534.187</td>
<td>0</td>
<td>6.131</td>
<td>10.475</td>
<td>0.581</td>
<td>3.578</td>
<td>554.9529333</td>
</tr>
</tbody>
</table>

**Observation:** From the analysis and graph it is observed that major reason for rejection is dry solder with 96 percent followed by wrong polarity having rejection of 2 percent followed with wrong value components and harness sequence wrong both with 1 percent.

From the analysis it is observed that major rejection is due to **Dry solder which is 96 percent of overall rejection.**

4) **Tier-4- Hot air leveling**

Hot air leveling processes is carried out once the PCB is manufactured at Tier -2 it is sent to Tier- 3 for hot air leveling at this stage there is large percentage of rejection. Following table shows the percentage of rejection at this stage for the month of April, May and June.

<table>
<thead>
<tr>
<th>MONTH</th>
<th>Roughness</th>
<th>Bridging</th>
<th>Hole Block</th>
<th>Copper Visible</th>
<th>Masking shed</th>
<th>Total Faults in percentage.</th>
</tr>
</thead>
<tbody>
<tr>
<td>APRIL</td>
<td>0</td>
<td>0</td>
<td>5.64</td>
<td>0.08</td>
<td>3.52</td>
<td>9.25</td>
</tr>
<tr>
<td>MAY</td>
<td>0</td>
<td>0</td>
<td>5.75</td>
<td>0</td>
<td>2.46</td>
<td>8.2</td>
</tr>
<tr>
<td>JUNE</td>
<td>0</td>
<td>0</td>
<td>8.16</td>
<td>0</td>
<td>8.73</td>
<td>16.89</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MONTH</th>
<th>Roughness</th>
<th>Bridging</th>
<th>Hole Block</th>
<th>Copper Visible</th>
<th>Masking shed</th>
<th>Total Faults in percentage.</th>
</tr>
</thead>
<tbody>
<tr>
<td>APRIL</td>
<td>6.516666667</td>
<td>0.02666667</td>
<td>4.903333333</td>
<td>0.08</td>
<td>3.52</td>
<td>9.25</td>
</tr>
<tr>
<td>MAY</td>
<td>0</td>
<td>0</td>
<td>5.75</td>
<td>0</td>
<td>2.46</td>
<td>8.2</td>
</tr>
<tr>
<td>JUNE</td>
<td>0</td>
<td>0</td>
<td>8.16</td>
<td>0</td>
<td>8.73</td>
<td>16.89</td>
</tr>
</tbody>
</table>

690
Average Percentage of rejection due to non conformance of components with the standards set for the month of April, May and June.

Observation: From the graph it is observed that out of five parameters Hole blockage rejection is highest with 57 percentages followed by Masking shed with 43 percentages.

COMBINE ANALYSIS FOR ALL THE FOUR TIERS

1) Rejection for the month of April, May and June of the components at all the Tiers (four Tiers) combined together and its average rejection

<table>
<thead>
<tr>
<th>Month</th>
<th>Tier-1</th>
<th>Tier-2</th>
<th>Tier-3</th>
<th>Tier-4</th>
<th>Total PPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr-08</td>
<td>0</td>
<td>3023</td>
<td>535.75</td>
<td>703</td>
<td>4261.75</td>
</tr>
<tr>
<td>May-08</td>
<td>0</td>
<td>2668</td>
<td>472.6228</td>
<td>1126</td>
<td>4266.6228</td>
</tr>
<tr>
<td>Jun-08</td>
<td>0</td>
<td>1826</td>
<td>656.486</td>
<td>6837</td>
<td>9319.486</td>
</tr>
<tr>
<td>Average</td>
<td>0</td>
<td>2505.66</td>
<td>554.95</td>
<td>2888.66</td>
<td>5949.28</td>
</tr>
</tbody>
</table>

Average rejection in PPM for the month of April, May and June form all the Tiers as against allowed (standard) PPM.
Observation: Here Tier -4 supplier i.e. Hot air leveling has the highest percentage of rejection of 42 percent followed by Tier -2 supplier PCB manufacturing with 42 percentage of rejection followed by Tier – 3 process assembling with 9 percentage of rejection Tier – 1 has no rejection as not a single process is carried out at this vendor he is the direct supplier having vendor code and out sources all it processes down the line and supplies the finished part to the party.

2) Total rejection in PPM for all the tiers (suppliers)

![Total PPM for the months by all the four tier](image)

Observation: From the data analysis it is observed that average rejection is 5949.28 PPM which is much high when compared to the standards.

3) Distance in kilometers and number of vendors: distance travelled by a component between the processes which are carried out at four different places.

<table>
<thead>
<tr>
<th>Vendors</th>
<th>Distance in Kilometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teir 1</td>
<td>3</td>
</tr>
<tr>
<td>Teir 2</td>
<td>7</td>
</tr>
<tr>
<td>Teir 3</td>
<td>7</td>
</tr>
<tr>
<td>Teir 4</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
</tr>
</tbody>
</table>
Correlation = 0.8733

**Observation:** It is observed that as the number of tier increases the distance traveled by the component during the process also increases. As in this case the first tier is 3 kilometers away from the customer the distance between the first tier and the second tier is 7 kilometers same is the case with tier three it is 7 kilometers from tier two and tier four is at a distance of 23 kilometers away from tier three. This clearly indicates that an each component travels 40 kilometers for getting all the processes complete. This also means that the total distance traveled by a component is 80 kilometers as once it is ready it follows the same route back to reach the customer end. This eventually increases the transportation cost for the company which is not logical.

**Reasons for starting the facility in-house**

1) Amount of rejection at tier -4 was 11.44 percent which was very high by any standards
2) As the rework and rejection was high at tier -4 visits of technical experts from tier -3 was very frequent according to the data at list 2 to 3 visits on daily basis were made which increased the cost for tier 3.
3) As rework and rejection was high 100 percent inspection of jobs coming from tier -4 was compulsory hence large number of man hours was spent in non productive work hence cost of inspection was going up
4) Distance between tier 3 and tier 4 was 23 kilometers this also increased the cost and efforts as technical people from tier 3 used to visit tier 4 daily and also the transportation cost of raw material and carrying finished goods back to tier 3 was very high. Also there was rework which lead to an additional cost of carrying the defective parts back for rework to tier 4 and after rework bringing it back to tier 3 was very high
5) Delays in supply of material were very frequent.

Taking into view all this drawbacks it was decided by tier 3 vendor to install the facility in-house so that rework cost, inspection cost, transportation cost, delays in supply of material and rejection would be avoided.
Following table shows the comparison of rejection before and after the process was brought in house the data is collected for the period of three months

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Rejection in PPM at Tier -4 ( before)</th>
<th>Rejection in PPM after (in-house )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>703</td>
<td>19.44</td>
</tr>
<tr>
<td>2</td>
<td>1126</td>
<td>10.83</td>
</tr>
<tr>
<td>3</td>
<td>2888</td>
<td>8.37</td>
</tr>
<tr>
<td>Average rejection</td>
<td>1572.333</td>
<td>12.88</td>
</tr>
</tbody>
</table>

Observation: It is been observed that the rejection in PPM for the tier-4 supplier was higher hence the company had installed the facility in house it comparison was done after comparing it is revealed that the rejection had reduced considerably due to in house process in PPM.

4) Comparison of rejection for outsourcing and in house:
Observation: From the analysis it is observed that after starting the facility of hot air leveling in-house the rework and rejection reduced down drastically. The average rejection earlier at tier four was 1572.333 PPM which after providing the facility in house reduced down to 12.88 PPM.

5) Saving in transportation (kilometers traveled by the component)

<table>
<thead>
<tr>
<th>Vendors</th>
<th>Previous distance in kilometers</th>
<th>Current distance in kilometers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Tier 2</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Tier 3</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Tier 4</td>
<td>23</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>17</td>
</tr>
</tbody>
</table>

Observation: From the above analysis it clearly indicates that due to installation of the facility of hot air leveling in house the distance traveled by a component has reduced from 40 kilometers to 17 kilometers the distance saved is 13 kilometers on one side but effectively the distance in kilometers saved is 26 kilometers. This means by in-sourcing the operation of hot air leveling the company has saved on transportation cost as well as it has saved on follow up, co-ordination and communication cost.

FINDINGS

1) It is found that as number of tiers in a process increases rejection increases
2) It is observed that the average rejection combined together for all the tiers is much higher than the permissible limit in terms of PPM.
3) It is observed that as the number of tier increases the distance traveled by the component between the processes also increases.
4) It is observed that when the facility was made available in house it has reduced rework and rejection drastically.
5) It is revealed as the facility was made available in house the cost of transportation for carrying the material is also reduced drastically.
CONCLUSION

It can be concluded that as more number of tiers are involved the rework and rejection increases it can also be concluded that due to multi-layer outsourcing cost of follow up with the supplier increases and also the transportation cost increases due to the movement between the processes. It can also be concluded that as phenomenal growth of the automobile sector has increased the strength of the giants. This has led to increase in the number of SSI units supplying materials to these giants. Even the giants have shown interest in starting such a venture. The work load was such heavy that these vendors (i.e. SSI units) have further proceeded for sub-vendor ship. This has led to the creation of multi-layer production process for the production of one unit/part of the unit. But it is recommended that while outsourcing any operation the company should assess its capacity and quality standards and then decide about outsourcing.

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