

# Improvement in Customer Order Fulfillment of Power Tool Motor Housing

Seenivasan K<sup>1</sup>, Ganapathi. K.N<sup>2</sup> and Raghavendra K<sup>3</sup>

1-MSc Engineering Student, 2- Asst. Professor, 3-Industrial Supervisor Mechanical and Manufacturing Engineering, M.S.Ramaiah School of Advanced Studies, Bangalore.

**Abstract**—This study was carried out to improve the customer order fulfillment of power tool motor housing, since market demand for the power tool has increased more than 50% over the year. Customer order fulfillment for the year 2011-2012 was less than 85% and customer demand was to meet minimum level of 98% from the current level. Further, Customer is planning to introduce some variants from the same model / type of power tool. Since, the supplier is having lot of potential in improving the processes in terms of applying lean techniques to improve the customer order fulfillment. Also, customer is ready to support the supplier by giving more orders and use their potential for new model launch planned in the year 2013 with higher volume. The methodology primarily used in this study was lean techniques, where Total Productive Maintenance, shop floor problem solving techniques. Also, 5S Housekeeping, Kaizen activities were used to eliminate the non value added activities in the supply chain of power tool motor housing production line. Technical problem solving methodology, preventive planning activities in raw material planning, injection moulding processes and mould maintenance activities helped to improve the customer order fulfillment level to meet the customer fixed targeted limit and improvement in customer satisfaction. This study mainly focused on improving the motor housing delivery level from 88% at the beginning of year 2012 to the level of 95% at the end of the year 2012. Also, quality improvement up to 6000 ppm reduction, cost saving or improvement from injection moulding machine and mould maintenance by 1700 INR / month. It is observed that productivity improvement up to 5% after implementing some of the TPM Initiatives. Finally customer satisfaction index improvement of 16 % was achieved in the period between March and November 2012.

**Key words:** TPM, Cause and effect diagram, 8D report

## 1. INTRODUCTION

Power Tool Motor housing is a major part of power tool, which has other sub parts and assemblies are attached within, to make a completely assembled tool. This kind of power tool is used for various kinds of woodworking, hand working, assembly of parts etc. for industrial as well as domestic application including household usage. This is basically an injection moulded thermo plastic part made up of high-grade plastic granules[1]

## 1.1 Customer Satisfaction

Customer satisfaction or exceeding customer satisfaction is one of the key mantra in any business. A satisfied customer tells many more potential customers about the good supplier and business opportunity improves in many folds. Any improvement can be assessed in terms of improvement in market share, improvement in quality rating, satisfaction of level of people and fulfillment or meeting the requirements of customer in major three aspects like quality of the products and services, cost of the products and price revision / reduction given over the years and delivery of products given at right time with right quantity and quality. Refer Fig. 1.1 Supplier and customer layout.[2,3]

There are specified customer satisfaction survey format designed to capture various aspects. Generally once a year customer satisfaction survey is conducted by sending a printed formats and feedback is sought with different rating scale to assess the level of satisfaction in all aspects.

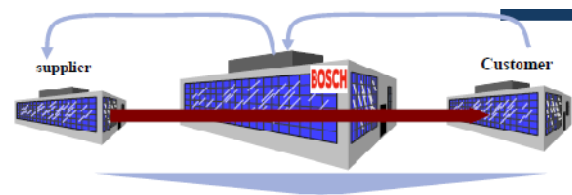


Fig. 1.1: Supplier and customer layout

## 1.2 Customer Order Fulfillment

The current level of customer order fulfillment is low, where as the customer expectation is to meet minimum 98% of their production order, need to be met month on month. This study was carried out to analyze the bottlenecks and problems faced in meeting the customer requirement. Also, analysis of the problem was carried out using Quality tools and methods like Cause and Effect diagram, 5Why analysis and 8D Problem solving tool.

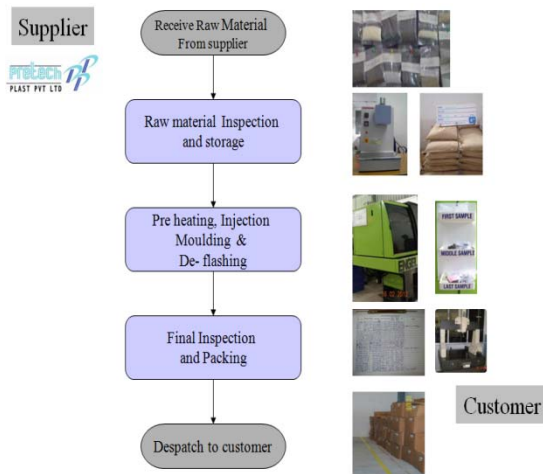
The major focus is to cover the supply chain activities from raw materials procurement, inspection, storage, processing like injection moulding, flash removal, final inspection and packing and dispatch to customer. Supplier is one of the leading plastic injection moulded parts and sub assemblies manufacturer and supplying to various Automotive and Non Automotive Tier1 and Original Equipment (OE) manufacturers[4,5,6]

**2. IDENTIFICATION OF PROBLEM**

Power tool division expects minimum 98% supply fulfillment from child part supplier. Currently, supplier's delivery fulfillment of the power tool motor housing is low, which is not acceptable for the customer. The same was highlighted in their initial customer satisfaction survey.

This study was carried out to address the supply shortage happening due to issues resulting from raw material planning, machine related issues, tool or mould related, manufacturing and quality issues to improve the delivery fulfillment.

Non value added activities were identified in manufacturing related processes and identified issues were addressed by using cause and effect diagram, 5 why analysis and 8D problem solving methods. Top 3 defects were identified through pareto analysis. Process flow chart in Fig. 2.1 highlights the area to be concentrated.[6,7,8]

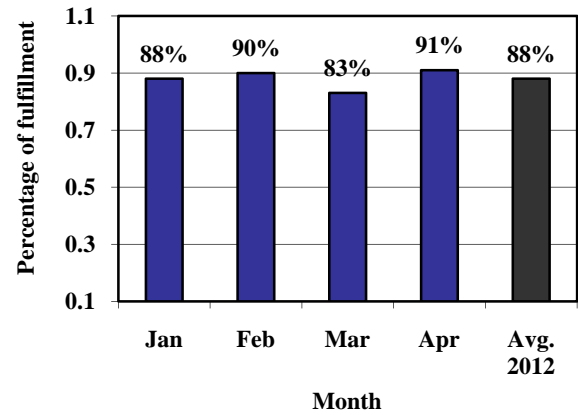


**Fig. 2.1 Process flow chart**

**3. DATA COLLECTION & ANALYSIS**

**3.1 Low Customer Oder Fulfillment**

Power tool motor housing supply data was collected for the first four months of the year 2012, where the average was only 88% as shown in Fig. 3.1. But, customer expectation was minimum 98% to meet increasing market demand.



**Fig. 3.1: Initial customer order fulfilment data**

**3.2 Customer Satisfaction Survey – Initial**

Initial customer satisfaction survey was conducted in the month of March to understand customer's expectations and other requirements. In the survey result it was clearly mentioned by the customer to take care of order fulfillment. This is the trigger for this study.[9,10]

Customer Satisfaction Survey score was 67% as shown in table 3.2 and there were remarks to reduce lead time, improve communication, take initiative for quick actions and visit customer on a fixed frequency for providing solutions.

**Table 3.2: Customer satisfaction survey at the beginning**

PRETECH PLAST PVT LTD.						
GMP 8.2.1.1 R/D Rev - 0						
CUSTOMER SATISFACTION INDEX- March 2012						
Customer : Bosch - Power Tools Division						
Sl no	Elements	Excellent	Very Good	Good	Satisfactory	Poor
1	Quality			★		
2	Delivery			★		
3	Response / Communications				★	
4	Lead Time for new Developments				★	
5	Quality of Documentation			★		
6	Over all performance *			★		

Please tick in the appropriate box

Your suggestions for improvement if any :

- Reduce lead time for tool development and aim for meeting deadlines
- Improve communication between tool room and production shop
- Middle management to take initiative and quick decisions
- Visit customer on a fixed frequency once in two weeks to provide solutions

\* NOTE : TO BE EVALUATED BY CUSTODIAN/ BUYER

Excellent =4 , Very Good =3.5, Good =3, Satisfactory =2 , Poor = 0.

CSI = ( 14 / 24 ) X 100 = 67%

Mr. Jothy - Pretech Plast  
Prepared by :

Bosch Power Tools  
Customer sign

**3.3 Reason for Failures – Pareto Analysis**

Data collected for the first four months were analysed and top three issues were taken for analysing in depth using Cause and effect & 5 Why analysis and actions were initiated.

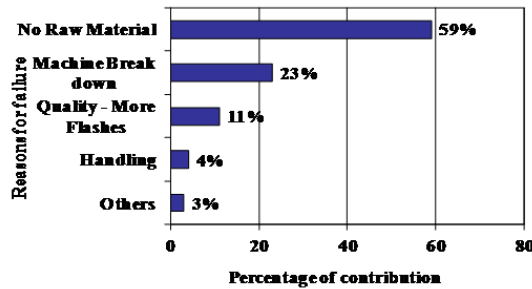


Fig. 3.3: Pareto analysis of failure reasons

4. PROBLEM SOLVING

4.1. No Raw Material

Raw material being not available for production was the key issues and contributes 59% of reasons for failure as shown in Fig. 3.3.

4.1.1 Cause & Effect Diagram – No Raw material

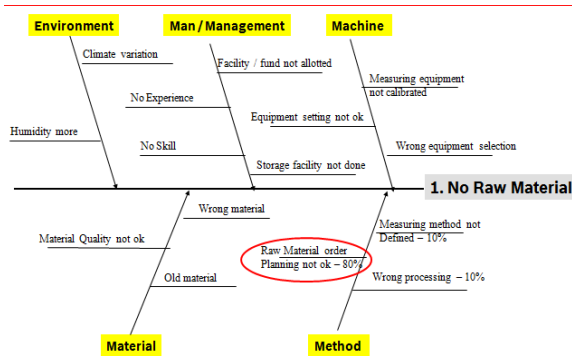


Fig. 4.1: Cause and Effect Analysis for No raw material

Cause and effect diagram as shown in Fig. 4.1 was made to analyse the reason for the failure of raw materials were not available for production. There were many cause based on the method, management, machine, material and environment aspects.

4.1.2 5- Why Analysis – No Raw material

After the cause and effect diagram analysis, the identified main cause was taken for 5 why analysis. Basically, said 5-Why analysis was taken for identifying the real root cause for raw materials not available at the time of manufacturing as shown in Fig. 4.2. It was finally identified that no direct

interactions with raw materials supplier’s marketing department and its person resulted in delay of getting the raw materials and further delay in storing and issuing to the shop floor for continuous manufacturing.

Problem : 1. Raw Material order planning not ok.

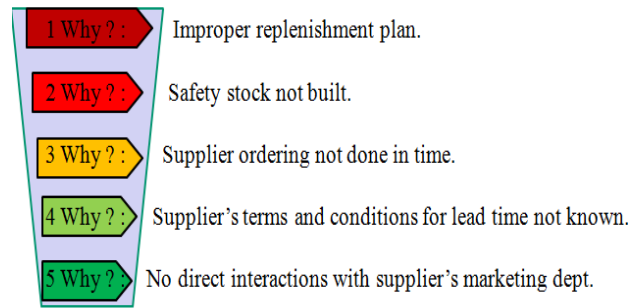


Fig. 4.2: 5 - Why Analysis for No raw material

4.1.3 8D Formats and problem solving - No Raw material

Shop floor 8D Problem solving methodology is used to record the complaint in a systematic way, compile the problem statement, initiate containment actions, find out root causes, initiate corrective actions, plan for preventive actions, monitor the effectiveness and close loop actions by proper closing meeting.

**Problem : 1. Raw Material order Planning not ok.**

**D1: Problem Statement**  
 Problem: 1. Raw Material order Planning not ok. - 80%  
 Customer: Bosch India Pvt. Ltd. Bangalore  
 Date: 18.08.2012

**D2: Problem Description**  
 Customer: Bosch India Pvt. Ltd. Bangalore  
 Date: 18.08.2012

**D3: Problem Definition**  
 Customer: Bosch India Pvt. Ltd. Bangalore  
 Date: 18.08.2012

**D4: Problem Impact**  
 Customer: Bosch India Pvt. Ltd. Bangalore  
 Date: 18.08.2012

**D5: Root Cause**  
 Customer: Bosch India Pvt. Ltd. Bangalore  
 Date: 18.08.2012

**D6: Introduction of corrective actions and tracking of effectiveness**  
 Customer agreement at: Bangalore by: Mr. Jothy  
 Description of the action(s):  
 Establish / Introduce direct interaction with supplier marketing department for getting material in time.  
 Resp. Mr. Henry pl. introduction on: August, 2012 introduced on: effective from: August, 2012  
 Re establish safety stock for ordering - including the delay from supplier  
 Resp. Mr. Henry pl. introduction on: August, 2012 introduced on: effective from: August, 2012

Fig. 4.3: 8D Format for No raw material

A big shop floor problem solving sheet was displayed in the shop floor like the Fig. 4.3 and with the guidance of the team leaders, the above said complete set of document were filled with complete details including due date and person responsible for completing the activities.[11,12]

**4.1.4 Solution Procedure –Action Plan for no raw material**

All the three top problems analysed using 8D Formats to find out root causes, actions planned for corrections and preventions. All these actions related to planning, machine maintenance and mould maintenance were listed out problem wise and actions were tracked.

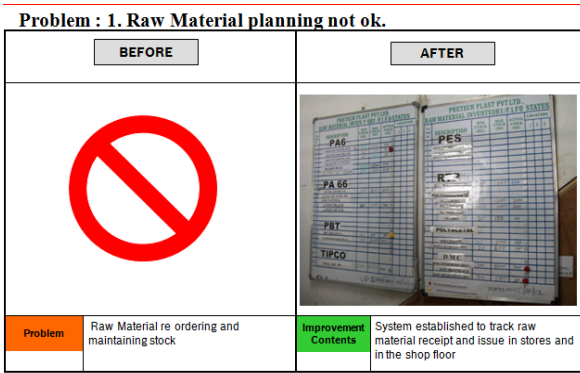
**Table 4.4: Major Action for No raw material**

Sl. No.	Complaint/ Issues	Cause	Actions	Resp./Due date
1.1	Raw material not available for production	No direct interaction with supplier's marketing department.	Establish/introduce direct interaction with supplier's marketing department for getting Raw materials in time.	Mr. Henry, August, 2012 September, 2012
1.2	Raw material not available for production	No alert indication was established for raw material re ordering.	Re establish safety stock for ordering including the delay from Raw materials supplier.	Mr. Seenivasan Mr. Henry, August, 2012 October, 2012

The said action plan as per Table 4.4 for the major issue of no raw material helped to track the material availability across the supply chain helped to get and make available for any time as per the requirement of customer demand.

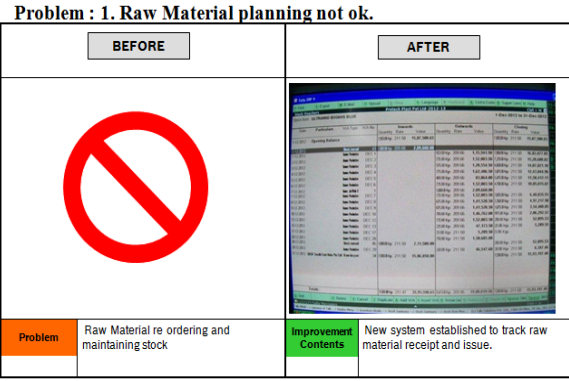
**4.2 Solution Implementation**

All the planned actions were initiated and implemented in the shop floor. New actions were listed and implementations were recorded in the shop floor for effective monitoring. All these three category actions too listed in the form of before and after format. Also, problem and improvement contents were mentioned for each action.



**Fig. 4.5: Action Implementation for no raw material**

The action implementation as shown in Fig. 4.5 and 4.6 represents that, earlier there was no system tracked in the stores, where the actual storage, issue and balance of stock of materials type and location wise not displayed and it was not known to the store in-charge and helpers to verify in the system and board.



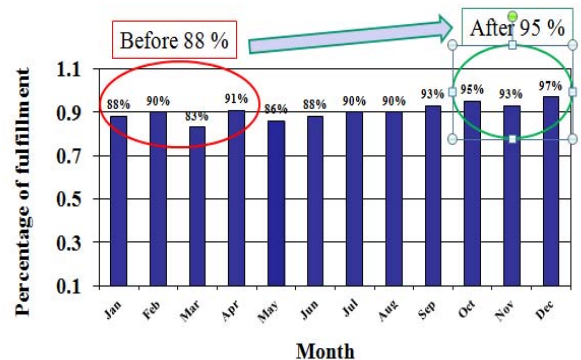
**Fig. 4.6: Action Implementation for no raw material**

Earlier there was no system in the stores and it was recorded in note book or simple excel sheet to track the raw materials. Now, there is a tally system introduced to take care of the complete raw material issue / stock control.

**5. RESULTS AND DISCUSSIONS**

**5.1 Results Comparison**

Customer order fulfillment data collected in the initial four months were having an average of 88%. This problem is taken for a study and month on month fulfillment were continuously collected and recorded. During the problem study, analysis, action implementation stages also data were plotted. After analysis, actions implemented for these problems and after each action completion, the collected data compared with before condition to confirm final effectiveness. The last 3 months data, where all actions were implemented having an average of 95 %. This last quarter data compared with first quarter data and there was a change of 7% result in fulfillment, which is close the targeted 98% fulfillment as shown in Fig. 5.1



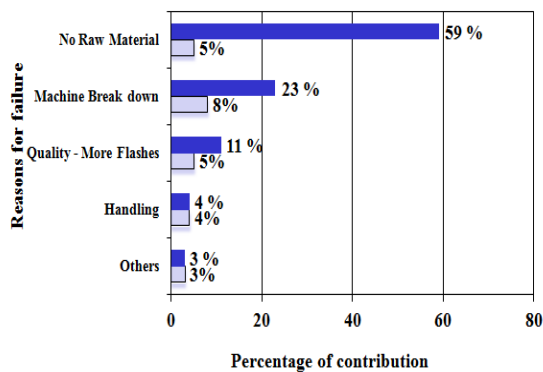
**Fig. 5.1: Year end customer order fulfillment trend graph**



**5.2 Improved Results**

Three major problems and its actions resulted in 7% improvement in overall delivery fulfillment. The final three months data were analysed and once again compared with initial Pareto and found that the first problem of raw material planning and procurement resulted 54 % improvement compared to first quarter result as shown in Fig. 5.2.

The results of second and third issues were also encouraging but still the effectiveness is getting monitored. It is expected that in a month or two the horizontal deployment of actions in to various identified area will result into good level of satisfactions, which is acceptable to the customer.



**Fig. 5.2: Comparison of Pareto before and after**

**Table 5.3: Customer satisfaction survey at the year end**

PRETECH PLAST PVT LTD.						
GMP 8.2.1.1 R/D Rev - 0						
CUSTOMER SATISFACTION INDEX- December, 2012						
Customer :		Bosch - Power Tools Division				
Sl no	Elements	Excellent	Very Good	Good	Satisfactory	Poor
1	Quality		★			
2	Delivery		★			
3	Response / Communications			★		
4	Lead Time for new Developments			★		
5	Quality of Documentation		★			
6	Over all performance *		★			

Please tick  the appropriate BOX

Your suggestions for improvement if any :  
 Address the packing and handling issues  
 Plan for two Bin system for supporting BPS implementation

\* NOTE : TO BE EVALUATED BY CUSTODIAN/ BUYER

Excellent =4 , Very Good =3.5, Good =3, Satisfactory =2 , Poor = 0.

CSI = ( 20 / 24 ) X 100 = 83%

Mr. Jothy - Prettech Plast  
 Prepared by :

Bosch Power Tools  
 Customer sign

The final customer satisfaction survey as shown in Table 5.3 highlights various improvements achieved. There is an improvement of 16% as per customer satisfaction surveys conducted from March to December, 2012.

**6. CONCLUSIONS**

The results were compared as shown in Fig. 6.1, where customer has given target on the following criteria

Sl No	Topic	Before Jan, 2012	After Nov, 2012	Improvement
1	Quality	15000 ppm	9000 ppm	6000 ppm reduction
2	Cost (Machine & Mould Maintenance )	5600 INR	3900 INR	1700 INR / Month
3	Delivery	88%	95%	7 % Improvement
4	Productivity (First pass Yield)	78%	83%	5 % Improvement
5	Customer Satisfaction	67 % (2011)	83% (2012)	16 % Improvement

**Fig. 6.1: Summary of improvement**

- Final customer satisfaction on over all supplier performance.
- TPM is one of the major aspects, which helped to improve the customer order fulfillment
- Shop floor Problem Solving - 8D Methodology helps involvement of Cross Functional Team Members for effective problem solving
- 5S and Kaizen initiatives across the plant helped ownership among associates to keep the plant with improvements & easy accessibility for necessary tools and equipments

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