CHAPTER 7

RESULTS AND DISCUSSION

7.1 INTRODUCTION

The main contribution of the work presented in this thesis is FTFMEA model. Its practical viability was investigated by implementing it in two different foundries. In reality, the organisations find the need of expertise and time as the hindrance factor in implementing FTFMEA model. In order to overcome this hindrance and meet the needs of the organisations, the KBFTFMEA was developed. The KBFTFMEA was checked for its performance appraisal by feeding the required information which was gathered from the implementation of FTFMEA model in the Foundry-1. These studies were done based on the literature survey results. The results also revealed that foundry area was not being considered holistically for any continuous process and quality improvement techniques.

The experience of the practical implementation process reported in the previous three chapters, revealed the practical compatibility of FTFMEA model for any type of foundry. The results are expressed in qualitative, quantitative terms and the calculation of loss is in terms of money value. The qualitative and quantitative measurements are expressed by keeping roadmap as the benchmark. In case of qualitative appraisal the implementation experience are benchmarked by using the statement like complete, partial and little. In the case of quantitative analysis, the implementation experience are analysed by using a numerical percentage of implementation by keeping
roadmap as the benchmark. The issues and the implementation results are presented and discussed in this chapter.

7.2 RESULTS

The results of investigating the implementation of FTFMEA model through 8 steps are briefly described in the following subsections:

7.2.1 FTFMEA Awareness Creation

For the implementation process it is vital to get the permission from the management to conduct the case study. The task was carried out by explaining the advantages and the solutions that can be derived to reduce the failure and increase the quality of product. In both the Foundry-1 and Foundry-2 this task was successfully carried out. In both Foundry-1 and Foundry-2 the author of this thesis was recognised as the coordinator of the FTFMEA implementation programme. This enabled the coordinator to coordinate the entire proceeding of the FTFMEA model implementation. The model was then presented to the managerial personnel’s and supervisors to create awareness. On the whole the performance of the awareness creation programme was complete in all aspects both in Foundry-1 and Foundry-2. The qualitative assessment is that, the conduct of awareness programme on FTFMEA model was complete in all respects. The quantitative assessment in both Foundry-1 and Foundry-2 was 100% in comparison to that is envisaged in the roadmap.

7.2.2 FTFMEA Team Formation

After the completion of the awareness creation programme, the FTFMEA team formation is the major and most important aspect in the FTFMEA model. In Foundry-1, the members are selected by the coordinator with discussion with the management from the list of interested employees
who has more than five year of experience. In the Foundry-2, even though the list of interested employees was collected and shortlisted by the coordinator before submitting it to the management, the management gave their list of FTFMEA team members to the coordinator and asked to work with them. The members of both teams were intensively trained by exposing them to the FTFMEA model. They were given a set of rules, to which they are strictly advised to follow. It is estimated by the coordinator, that the second stage of model could be implemented to 100% at both Foundry-1 and Foundry-2. The qualitative assessment was that the implementation was complete at both Foundry-1 and Foundry-2 with respect to the task specified in the roadmap.

7.2.3 Identification of the Associated Department and Listing out the Source of Failure Data

According to the roadmap, the coordinator was required to initiate the identification of the source data of failures. By conducting meeting in both Foundry-1 and Foundry-2, the coordinator along with the team, devised a mechanism of collecting various defects in their respective departments. A methodology was also devised to identify the interrelationship between departments for a particular defect. It was decided to identify the defects with consultation of the workers.

At the end, the various departments under which the defects and process failures are to be collected and tabulated are decided. In the estimation of the coordinator the implementation of FTFMEA model was 100% in both Foundry-1 and Foundry-2. The qualitative assessment was that the coordinator could implement the third step to a complete extent with respect to the task specified in the roadmap.
7.2.4 FTFMEA Data Collection

As decided in the earlier process and with respect to the activities specified under the step four in the roadmap, the defects according to the departments were collected from the workers and supervisors. Each defect, along with the association of that defect to the other interrelated departments was also collected. The entire process took a week to complete and the help of the quality department played an important role in collecting these data. In the Foundry-1 and Foundry-2 this process was not able to be implemented to a greater extent. In the estimation of the coordinator the implementation of the FTFMEA was around 95% in Foundry-1 and it was 90% in Foundry-2. The quantitative assessment was that the coordinator could implement this fourth step to little less than complete with respect to these tasks specified in the roadmap.

7.2.5 FTFMEA Table Consolidation

The coordinator along with team members sat for a brain storming session in order to consolidate various defects, failures causing these defects and the interacting departments. The coordinator also trained the members in the preparation of the tables. They were also asked to enter these information’s in the FTFMEA Tables along with the present control mechanism which is used to eliminate or reduce these failures. After consulting with the management the tables were formed. In both the Foundry-1 and Foundry-2 this activity was carried out to the extent of 100%. The qualitative assessment is that the implementation of this fifth step of FTFMEA model was complete in both the Foundry-1 and Foundry-2 with respect to the activities specified under the same step of roadmap.
7.2.6 FTFMEA Analysis

After consolidating the tables in the above step the members and coordinator sat for another brainstorming discussion. The coordinator introduced and trained the members in why – why analysis and in cause and effect analysis. After which the members in both the Foundry-1 and Foundry-2 decided to use the why – why analysis. By using the why – why analysis the causes of failures and their effects were decided. The coordinator induced the Linkert’s scale for rating the various failures. After deliberating the members rated these failures. The ratings of the inter department are done after a thorough consolidation within members and the coordinator. In both the Foundry-1 and Foundry-2, these exercises could be carried out only to a partial extent, as the exercise needed time and multiple sessions for discussion. This happened so as the coordinator could not be in regular contact with the FTFMEA team members because the members were preoccupied with their work. In the estimation of the coordinator, the sixth stage of FTFMEA model could be implemented to the extent of 75% at Foundry-1 and it was 70% at Foundry-2 with reference to these stipulated in the same step of the roadmap. The qualitative assessment was that the step was implemented partially in both the Foundry-1 and Foundry-2 with reference to the roadmap.

7.2.7 Implementation of FTFMEA Recommended Actions

In this step of FTFMEA model, implementation based on the recommendations of the FTFMEA Table developed by the team members is to be started in a full - fledged manner. The recommended actions which have higher ratings can be implemented very easily than the failures with lower rating values. So the management was requested to implement these recommended actions to prevent, reduce or eliminate failures based on the ratings. The management was also requested to implement those actions as a
group of 4 or 5 recommendations to eliminate failures. After studying the result of those implementation processes, the management could implement other recommendation to eliminate failures. In case of Foundry-1, a partial implementation of a few recommended actions were taken and implemented, but a full – fledged implementation of the recommended actions was yet to commence. So the results of the FTFMEA model can only be observed by using questionnaires to get the response of these personnel’s and were quantified. In case of Foundry-2, the recommended actions were implemented to a greater extent. The recommendations of failures with higher ratings are implemented and the failures with lower ratings are only partially implemented with the financial constrains in mind. In the opinion of the coordinator the seventh step of the FTFMEA model has been carried out at the extent of 30% at the Foundry-1 and it is carried out to an 85% extent at Foundry-2. The qualitative assessment is that the seventh steps of the FTFMEA model can be implemented to the little extent at Foundry-1 and it is partial in Foundry-2.

7.2.8 Evaluate the Performance of FTFMEA Implementation Actions

In the last step of FTFMEA model implementation it is used to evaluate the implemented actions of FTFMEA model. As the FTFMEA model, is a closed loop system, the deviations in the results obtained and implementation process can be corrected to increase the effectiveness of the model. In the Foundry-1 and Foundry-2 whatever recommended actions were implemented to eliminate failures were evaluated at constant intervals to find the effectiveness of the implemented actions. If the results are not satisfactory the team members sit together to find out the corrective actions needed to be taken to rectify the deviations in the results obtained. In both the Foundry-1 and Foundry-2, the coordinator noted that the activity carried out to the extent of 100%. The Foundry-2 implemented this step of the recommended actions to the FTFMEA model, which they have implemented. The qualitative
assessment of the FTFMEA model could be implemented to the complete extent at Foundry-1 and Foundry-2 as specified under the roadmap.

As mentioned in the above eight sub sections, most of the steps of FTFMEA model implementation could be carried out to the extent of 100% in both the Foundry-1 and Foundry-2. However, in the case of implementing a few critical steps of FTFMEA model, the implementation could not be carried out to the complete extent. These deficient steps of FTFMEA model implementation is discussed in the next session.

7.3 RESULT DISCUSSIONS

The implementation of FTFMEA model at Foundry-1 and Foundry-2 is discussed in this section by drawing the experience described in the previous section. In order to aid this discussion, the quantitative and qualitative assessment of the FTFMEA implementation at Foundry-1 and Foundry-2 with respect to roadmap are summarised in Table 7.1.

Table 7.1 Extent of implementation of FTFMEA model at Foundry-1 and Foundry-2 with respect to roadmap

<table>
<thead>
<tr>
<th>Step No</th>
<th>Title of the step of FTFMEA models implementation</th>
<th>Extent of implementation with reference to roadmap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Quantitative Foundry-1</td>
</tr>
<tr>
<td>1</td>
<td>7.2.1</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>7.2.2</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>7.2.3</td>
<td>100%</td>
</tr>
<tr>
<td>4*</td>
<td>7.2.4</td>
<td>95%</td>
</tr>
<tr>
<td>5</td>
<td>7.2.5</td>
<td>100%</td>
</tr>
<tr>
<td>6*</td>
<td>7.2.6</td>
<td>75%</td>
</tr>
<tr>
<td>7*</td>
<td>7.2.7</td>
<td>30%</td>
</tr>
<tr>
<td>8</td>
<td>7.2.8</td>
<td>100%</td>
</tr>
</tbody>
</table>
After presenting the information, the steps in which the implementation of FTFMEA model is incomplete in either Foundry-1 or Foundry-2 or both is indicated by using asterisk (*) mark.

In the case of the fourth step of implementation of FTFMEA model, the identification of the source of failures data was evasive. This task could not be carried out to the complete extent because the workers couldn’t be involved in the process. The workers who were working in most of the department were daily labourers from northern states are mostly not well educated and don’t have the understanding and dedication towards their work. There was also communication barrier between the workers and the team members. These workers do not work at a work place for long duration as they keep changing their place of work. This was the case in both Foundry-1 and Foundry-2, with the effort of the coordinator and some of the team members, this step of FTFMEA model implementation could be implemented to the extent nearing 100%. This kind of hurdle can be overcome by making these workers permanent and by training and educating them in the each and every step in the foundry process and FTFMEA model this hurdle can be overcome to a greater extent.

In the sixth step of FTFMEA model, implementing the FTFMEA analysis can be exercised only to the extent of 75% in Foundry-1 and 70% in Foundry-2. This is due to the fact that the time and cost involved in making the team members dedicate their time in FTFMEA team meetings during their working hours. The members were not interested to work after hours due to their personal reasons. Some of the team members were afraid and evasive in suggesting the recommended action against a failure thinking that they were suggesting recommendation against the management. The Foundry-1 and
Foundry-2 management were not ready to allocate time for the team members to go for a meeting during the working hours as they considered it as waste of time and money and they consider that any production problems will go unnoticed and productivity will be lost due to the unproductive man hours. This could not be rectified by the coordinator.

In the seventh step of FTFMEA model, implementation the process could be exercised only to the extent of 30% in Foundry-1 and 85% in Foundry-2. In Foundry-1, the management is yet to implement the recommended actions of FTFMEA model during the doctoral work being reported in this thesis to reduce or eliminate failures and improve the quality. They implement only six recommended actions which are very easily implementable. Hence, these personal were requested to assume that these recommended actions were implemented to reduce failure and respond to these questionnaire. In Foundry-2 the management implemented all the recommended actions which have very high rating of reducing the failures. It implemented 85% of the recommended actions. The need of financial implication may have made the management to evade the rest of the recommended actions to reduce failure.

Another important characteristic of FTFMEA model is that, it facilitates the calculation of loss in terms of money value. Since money is the language of business, this aspect will be useful for the top management to view the loss that could be saved from the financial point of view. In the case of Foundry-1 and Foundry-2, the loss incurred was found to reduce after the implementation of FTFMEA model which is summarised in Table 7.2.
Table 7.2 Results of implementation of FTFMEA model

<table>
<thead>
<tr>
<th>S.No</th>
<th>Details</th>
<th>Results of implementing FTFMEA model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Foundry-1</td>
</tr>
<tr>
<td>1</td>
<td>Money saved</td>
<td>Rs. 12,98,490 / month</td>
</tr>
<tr>
<td>2</td>
<td>Percentage of reduction</td>
<td>8%</td>
</tr>
</tbody>
</table>

Though FTFMEA model was not implemented completely in Foundry-1, the management allowed the coordinator to implement the KBFTFMEA in the company with the help of the data collected for FTFMEA model implementation. The working of the KBFTFMEA was found to be smooth when the data and information gathered by conducting the FTFMEA investigations were entered. This KBFTFMEA system was extensively used by the Foundry-1 to enter and modify FTFMEA Tables, to take the print out of the FTFMEA Table and FTFMEA drawings and to deliberate about the various failures and defects that occur during the production processes along with their corrective actions. The FTFMEA drawing and tables are displayed at each processing stage of foundry casting production for creating awareness to prevent, reduce or eliminate failure.

On the whole, the experience of implementing FTFMEA model at Foundry-1 and Foundry-2 indicated that it is a practically compatible model. This claim is made as the quantitative and qualitative assessment indicates that nearly 90% can be implemented quantitatively and qualitatively. All the assessment is above the region of partial and complete, to enhance the quality and prevent, reduce the failures in the foundry industry.
7.4 CONCLUSION

The results of the Foundry -1 indicated that FTFMEA is a model which is practically implementable to prevent, reduce and overcome failures in Foundry-1 and thereby improves the quality, productivity with improved profits margin of about 8% which accounts to a sum of ₹ 12,98,490 monthly.

In the Foundry- 2, the Percentage rejection of castings after implementation of recommendation is 70% and the Percentage rejection of rejections after implementation of recommendation is 30% and the cost savings by implementing the FTFMEA model is Rs.8,25,005 per month.

The application of FTFMEA model in the Foundry-1 and Foundry-2 revealed its practicality and processes to reduce failures, improve quality continuously and thereby reducing the financial loss incurred in the foundry due to failures. The application of KBFTFMEA will facilitate the foundry industries to carry out streamlined implementation of FTFMEA model. The speed at which the stages of FTFMEA model are implemented depends on the management interest in infusing continuous improvement in the industry. As the FTFMEA model and KBFTFMEA is not developed for a particular foundry, it can be used by any type of foundry producing any type or size of castings.