CHAPTER 9

CONCLUSION

9.1 TPM

Due to the implementation of TPM, the following results were obtained.

(i) The percentage of OEE improvement for the actuation unit, wheel cylinder unit, process shop, press shop and drum brake unit are 36.45%, 22.37%, 32.89%, 33.67% and 13.29% respectively.

(ii) Savings achieved by eliminating/combining/reducing the production subsidiary resources, per annum in lakhs of rupees for the actuation unit, wheel cylinder unit, process shop, press shop and drum brake unit are 2.32, 1.80, 11.72, 1.62 and 1.22 respectively.

Hence it is concluded that implementation of TPM leads to

(i) increase in OEE and production per hour

(ii) increase in the participation of all in the operation and maintenance through the circle meetings and JH activities.

(iii) improved employees’ morale which leads to increase in number of kaizens
(iv) easy maintenance of machines due to improved cleaning, lubrication and inspection standards and visual controls.

(v) reduction in cost of maintenance

(vi) reduction in number of quality defects.

However it should be noted that the improvement in OEE and production per hour and the success of TPM will depend on

(i) the completion and progress of all the steps of JH activities
(ii) training given to the operator
(iii) skill and knowledge level of the operator
(iv) the number of kaizens that are implemented.

9.2 CASE STUDY ON FMEA

Due to the FMEA that was carried out for friction welding in the manufacture of engine valves, the RPN for the different failure modes were reduced and are shown below.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Failure Mode</th>
<th>Initial RPN</th>
<th>Improved RPN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low Tensile strength</td>
<td>160</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>Weld crack</td>
<td>120</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>Run out</td>
<td>108</td>
<td>72</td>
</tr>
</tbody>
</table>

Hence the following conclusions are drawn.

(i) FMEA needs many other tools and techniques which includes why why analysis, cause and effect diagram, prioritisation matrices, Nominal group techniques, brain
storming, statistical charts, Design of Experiments to be employed.

(ii) FMEA may call for change of design/material/testing procedure/Tool design etc., to the extent required to reduce the RPN.

(iii) The benefits of FMEA can be exploited well, if poka-yoke solutions and kaizens are employed wherever necessary and possible.

(iv) FMEA not only reduces the RPN but also it leads to many other benefits like optimisation of process parameters which is known as parameter design or robust design, improved customer satisfaction during the course of reduction of RPN.

(v) FMEA is a practical tool which can reduce the RPN of a product/process which in turn will ensure the safety and reliability during the use or service of a product.

### 9.3 CASE STUDIES ON LEAN MANUFACTURING

The studies on Lean Manufacturing reveal that Lean Manufacturing is very vital which leads to

(i) elimination of wastes

(ii) elimination of non-value added activities and thereby reduction in process time

(iii) increase in productivity

(iv) reduction in rejection rate
(v) reduction in floor space requirements and operator movement and

(vi) Kaizens play an important role for the success of Lean Manufacturing.

(vii) Lean Manufacturing will make use of all the tools that are used in TQM/TPM and TQM /TPM are the subsets of Lean Manufacturing.

9.4 QFDCFMEA

The common features of QFD and FMEA which were highlighted in chapter 6.2 are the driving points towards the fusion of QFD and FMEA and such fusion is called as QFD Compatible FMEA (QFDCFMEA).

QFDCFMEA was arrived at by linking the phases in the order of QFD (Material selection) – Design FMEA – QFD Process selection – Process FMEA.

The advantage of such an approach is that the outcomes of QFD can be properly used to carry out the FMEA. It can be carried out by a single team and will result in reduction of time.

It is to be noted that the QFDCFMEA which was carried out is tailor made for this application and is not a comprehensive one. However such tailor made QFDCFMEA can be applied case by case following the concept which was developed in this research.

9.5 INTEGRATION OF QMS AND LMS

The reasons to go in for the integration of QMS and LMS were discussed and presented in Chapter 6.4.
From the clause wise analysis that was made, it is found that there are fifty one sub-clauses of ISO 9001:2000 of which thirty two sub-clauses have the possibility for linkage with LMS.

Hence it is realised that integration of these two systems is possible and essential.

For any organisation which plans for implementation of QMS and implementation of LMS, it will be beneficial to carry out as an integrated system to avoid repeated activities and save cost.

The possibilities for linkages between QMS and LMS that were explored in this research will serve as a manual for implementation of an integrated QMS/LMS and such a system may be called as Lean Compatible Quality Management System (LCQMS) which will take care of the quality management as well as lean manufacturing principles and requirements.

9.6 SCOPE FOR FURTHER WORK

(i) The concept of QFDCFMEA that was developed in this research which was a tailor-made one, can be taken up for further research to create and develop such tailor-made Fusion depending on the scenarios.

(ii) A study on the implementation of the concept of LCQMS in an industry can be made to realise the benefits and also for further research.

(iii) Further studies may be made to look for fusion of a few of the other Quality Management Tools.