CHAPTER 1

INTRODUCTION

Total Productive Maintenance (TPM), Total Quality Management (TQM), Lean Manufacturing (LM) and quality system like ISO 9000 are being practised and followed by different industries. All these are used towards achieving increased productivity, improved quality, improved efficiency, reduction in cost, reduction in time involved, and elimination of wastes.

Many tools are used in the implementation of LM and its subsets namely TPM and TQM. Many of these tools are used in isolation. As a part of this research, initially a study was carried out to find out the impact of TPM in an Indian Industry situated at Chennai, South India. An extensive literature study on TQM and its tools was carried out. Thereafter, Failure Mode and Effects Analysis (FMEA) was carried out at an industry and Lean manufacturing studies were carried out at two industries situated at Chennai, South India.

During the course of the above studies which were carried out on TPM, TQM, LM and FMEA it was realised that certain tools like FMEA and Quality Function Deployment (QFD) have something in common and an attempt was made to combine or fuse these two tools, which may be called as QFD compatible FMEA (QFDCFMEA). Implementation of Lean Manufacturing needs certain steps to be carried out and some of these steps are repeated for the implementation of ISO 9001 quality system. An
integrated systems approach is a must for any organisation. Hence an attempt was made to integrate these two systems and it may be called as Lean compatible ISO 9001 system.

1.1 TOTAL PRODUCTIVE MAINTENANCE

Total Productive Maintenance which was first developed in Japan is a team based productive maintenance programme and involves every level and every function in the organisation, from top executives to the shop floor operators. TPM is used to build a robust enterprise by maximising overall equipment effectiveness (OEE).

Many researchers have earlier made studies about TPM. But as a part of this research, an attempt has been made to study the impact of TPM in an Indian industry situated in Chennai, South India which produces hydraulic brakes and clutch actuation systems for both automotive and non-automotive applications. The study was carried out for five manufacturing units of the industry.

The details pertaining to the calculation of overall equipment effectiveness, productivity, cost of savings in production subsidiary resources, kaizens which were identified and implemented were collected. The summation of losses before implementing TPM and after implementing TPM was collected. The percentage increase in OEE, percentage increase in productivity before TPM and after TPM were calculated and compared. The percentages of OEE improvement for the five manufacturing units were found to be 36.45, 22.73, 32.89, 33.67 and 13.32 and the percentages of productivity improvement for the five manufacturing units were found to be 60.72, 20.73, 43.97, 44.21 and 54.5.
1.2 TOTAL QUALITY MANAGEMENT

Quality is the major preoccupation of business worldwide. Total Quality Management (TQM) has captured the world wide attention in recent years. TQM has become a buzz word for all successful organisations world over. TQM is applicable to a wide range of organisations. Many researchers have already carried out studies with respect to TQM implementation at industries abroad and also in India and identified (i) the reasons for implementing TQM (ii) important TQM elements (iii) obstacles associated with TQM implementation and (iv) barriers of TQM implementation.

1.3 CASE STUDY ON FMEA

Failure Mode and Effects Analysis (FMEA) is one of the vital quality management tool. FMEA is a systematic way of identifying failure modes of a system, item or function and evaluate the effects of the failure modes. The objective of FMEA is to determine the causes for the failure modes and what could be done to eliminate or reduce the chance of failure and ultimately the Risk Priority Number (RPN), which is given by the product of Severity, Occurrence and Detection. FMEA is an effective way to identify component failures or system malfunctions, and to document the system under consideration. As a part of this research, FMEA was carried out at an industry at Chennai which is a leading manufacturer of valves for automobile engines of different kinds and it is presented as a case study on FMEA.

FMEA was carried out for friction welding process used in the manufacture of engine valves. The friction welding machine and the process parameters of friction welding were studied in detail. The frequency of failure was estimated from the failure reports. The causes of each failure was identified through ‘cause and effect diagram’ and brainstorming. The root causes were identified. Design of Experiments (DOE) and ANOVA were
used for optimising the process parameters of the friction welding process. With the proposed process parameters, a batch of valves of passenger car exhaust line were examined and the results of the implemented parameter showed that the weld crack is minimised and the tensile strength was improved. It was found that wear of multi bore collets is the cause for runout and a new collet was specified which helped in reducing the RPN. The process efficiency was improved by implementation of suitable recommended actions which counters the failure modes and the RPN was reduced.

1.4 CASE STUDIES ON LEAN MANUFACTURING

Lean manufacturing is a systematic approach for identifying and eliminating the waste (non-value added activities) through continuous improvement by providing the product at the pull of the customer in pursuit of perfection.

Lean manufacturing principles were applied to the two industries situated around Chennai, India which produce automotive components and they are presented as case studies.

Lean manufacturing principles were applied for the ‘Emergency Locking Reactor’ of the seat belt assembly of a passenger car to ensure shorter lead time, increased productivity, reduced production cost, improved quality and customer satisfaction. Takt time and the non-value added activities were found for the seat belt assembly line. Modification of fixture, implementation of kaizens at various workstations and the necessary layout modifications were carried out. Similar work was carried out for the assembly of rack and housing for steering system of the rack and housing assembly. These studies resulted in benefits such as reduction of rejections, improvement in productivity, prevention of rework, reduction of non-value added time, reduction in process time, effective floor space utilisation,
avoiding wrong operation, and reduction in the time spent for movement by the operator.

1.5 FUSION OF QFD AND FMEA

Based on the case studies on FMEA addressed above, it was felt that it will be worthwhile to explore the possibilities to bring QFD and FMEA in a single window so that the benefits of the two quality tools can together be exploited. QFD is one of the quality tool used for translating customers’ requirements into appropriate requirements at every stage, from research through product design and development to manufacture, distribution, installation, marketing, sales and service. On the other hand, FMEA is a preventive measure to systematically display the causes, effects and possible actions regarding observed failures. Both QFD and FMEA have their own potential usage. Both QFD and FMEA require a process of systematic what/how or cause/effect relationships, and both are assessing the prioritisation of functional requirements through calculations and actions identified to ensure the recommended targets and relevant actions for further testing to be carried out. Both of them require cross-functional and multidiscipline team work to enable their successful implementation. In this part of the research, the fusion of QFD and FMEA was applied to a part called ‘HEBEL’ of a main circuit breaker assembly and this was carried out at an industry situated in Chennai, South India which makes electrical control devices.

1.6 INTEGRATION OF LEAN MANUFACTURING SYSTEM (LMS) AND ISO 9001:2000 (QMS)

Based on a few case studies on Lean Manufacturing, it was felt that an attempt can be made to integrate Lean Manufacturing System and ISO 9001. A thorough comparison of ISO 9001 and LMS with respect to the
various clauses and sub-clauses of ISO 9001 Quality Management System was carried out. As an outcome, an integrated LMS ISO 9001 manual has been prepared. This manual has ISO 9001:2000 requirements listed on one side and the corresponding LMS principles posted against appropriate clauses. This manual will serve as a guide for any new plant that intends to implement ISO 9001 and LMS simultaneously. Such a combined approach avoids the duplication of efforts. This model may be called as the Lean Compatible ISO 9001 (LC ISO 9001).