ABSTRACT

Over the past four decades, both researchers and practitioners have been striving to enable modern manufacturing organizations to perform at world class manufacturing (WCM) level. As a result, modern organizations have been adopting various WCM strategies. One of them is total productive maintenance (TPM). When TPM was propagated by Nakajima during 1980s, its scope was restricted to improving quality in maintenance. Over the years, the scope of TPM has been extended from improving maintenance quality to achieving performance improvement of the organizations. TPM links maintenance strategies with total quality management (TQM) using many tools and techniques. Some of those techniques instilled in TPM are 5S, kaizen and suggestion scheme. However, one of the prominent techniques of TQM namely quality function deployment (QFD) does not find adequate application in TPM programs. This deficiency is noticed despite the fact that, the technical languages evolved by the QFD technique are useful to achieve WCM performance through the application of TPM.

Choosing of the technical languages evolved by the QFD technique requires tactical decision making. Such kind of decisions can be made through the application of analytic hierarchy process (AHP) technique. This observation reveals the need of integrating QFD and AHP with TPM. In order to fulfill this need, the doctoral work reported in this thesis was carried out. In the beginning of this doctoral work, a literature survey involving the study of TPM, QFD and AHP was carried out. The findings of this literature survey were used to design a model called analytic maintenance quality function deployment (AMQFD).
AMQFD model has been designed to encompass three primary components namely house of quality (HoQ) of QFD, 8 - pillars of TPM concept and AHP technique. The application of AMQFD begins by the formation of HoQ. The HoQ reveals the technical languages. These technical languages are exposed to top management who will make strategic decisions. According to their appropriateness, these decisions are passed through the following 8 - pillars of TPM namely autonomous maintenance, focused maintenance, planned maintenance, quality maintenance, education and training, safety, health and environment, office TPM and development management.

After building the TPM pillars, the actions to be implemented are pinpointed. These are subjected to AHP which passes through the following three steps namely discretization hierarchy, sensitivity analysis and priority analysis. In this discretization hierarchy, four levels are top level (referred to as goal), the intermediate levels (referred to as criteria and sub-criteria) and lowest level (referred to as alternatives). After conducting sensitivity analysis by referring to this discretization hierarchy, the actions are ranked and thus prioritized. These prioritized actions are implemented and their performance is measured using the following continuous maintenance quality improvement parameters namely overall equipment effectiveness (OEE), mean time between failures (MTBF), mean time to repair (MTTR), mean down time (MDT) and availability.

The values of continuous maintenance quality improvement parameters are compared with set targets. These values are revealed after the completion of one cycle of implementing AMQFD model. Finally the corporate performance at world class level is measured using the following performance indicators namely zero breakdowns, zero accidents, improved profit, improved core proficiency, enhanced goodwill, improved productivity,
market leadership, improvement in the life of plant and equipment, reliability improvement and continuous maintenance quality improvement. These corporate performance indicators are compared with set targets. Then the strategies for achieving continuous maintenance quality improvement are evolved. These strategies are exposed to the top management for making strategic decisions.

In order to investigate the practical implementation aspects of AMQFD, several companies were considered. Based upon the background history like implementation of TPM and TQM tools, three companies were chosen. Subsequently, a 14 steps procedure for implementing AMQFD was devised and its implementation aspects were investigated in these three companies. In the first company, sugar is manufactured. In the second company, automotive accessories are manufactured. In third company, multiple products like pneumatic values, hydraulic values and automobile accessories are manufactured. Due to the lack of awareness about implementing approaches like TPM and TQM in these companies, a few steps of AMQFD implementation procedure could not be implemented in these companies. However, the results of conducting this investigation revealed the practical feasibility of implementing AMQFD in modern manufacturing companies.

In order to examine the feasibility of implementing AMQFD in engineering educational scenario, an implementation study was conducted in engineering educational institution (EEI). While certain changes had to be made to make it compatible for application in EEI, the investigation conducted in the direction of studying the practical implementation aspects revealed that, AMQFD model would be a vehicle to make EEIs to make journey for performing at world class level. Particularly it was found that, AMQFD would facilitate the gathering of the information about the
requirements of stakeholders of the EEIs. By making use of this information, AMQFD model facilitates the identification of technical descriptors which are required to enable the EEIs to improve its performance. Further, in order to prioritize the implementation of these technical descriptors through the building of TPM pillars, it is suggested to apply AHP. By making use of the results of AHP, the exact activities to be carried out for enabling EEIs to perform at world class level was identified. After implementing these activities, the performance of EEIs is measured using parameters namely higher accreditation score, ISO 9001 certification, attaining world class level and improved core proficiency, all-round skill improvement for students, enhanced goodwill, beneficial to the society, educational leadership, improvement in the field of research and development, increased surplus fund and continuous maintenance quality improvements.

During the doctoral work reported in this thesis, the top management leadership could not be availed to lead the implementation of AMQFD model. In this situation, the reactions of the competent personnel about the implementation of AMQFD model were gathered. These reactions indicated the practical compatibility and capability of AMQFD model in triggering the modern organizations to make journey at faster pace towards performing at world class level. On the whole, the way of effectively translating the customer voices into maintenance based technical languages and deploying them by making multi-criteria decisions has been made possible in the doctoral work reported in this thesis through the contribution of AMQFD model.