ABSTRACT

With an increase in the interest in automation and mechanization, the machine maintenance in manufacturing field has become more important than ever. The attainment of higher degree of quality maintenance ensures the quality of the product. Whenever machines fail to attain maintenance standard, the risk of producing defective products increases. This phenomenon demonstrates the existence of a strong link between machine maintenance and product quality. At the same time, excessive maintenance would result in unnecessary expenditures, whereas poor maintenance would lead to defectives and breakdowns. Hence, it is essential to carry out maintenance engineering activities effectively at minimum cost and at the same time without compromising the quality of the product. In this context, maintenance engineering in manufacturing field was selected as a broad area of research work. This research work was carried out with the scope of improving the performance of production machines through the reduction of failures and associated losses.

During this research, literature survey was conducted to investigate the research works already carried out in maintenance engineering area with the focus on cost reduction. Deficiencies in the previous research works in this field were identified and defined as the research problem. Thrust

activities in maintenance engineering area which influence the scope of the research were identified for investigation. A maintenance model named Responsive Maintenance Model (RMM) encompassing quality, maintenance, risk management and engineering principles was designed. Case studies were conducted in thrust activities by applying the RMM.

RMM facilitates to minimize losses due to failures of machine parts and spare parts. RMM was incorporated with a scheme to estimate the losses associated with failures and risk management principles to identify the causes of failures. In a nutshell, RMM is a diagnosis and decision based framework for enabling continuous improvement through the reduction and prevention of failures and losses.

Failures of machine parts and spare parts were investigated in two manufacturing companies through the application of RMM. In the first case study, RMM was applied to minimize the losses associated with the failure of plastic injection moulding machine parts. In this, Taguchi's loss function on preventive maintenance (PM) was used as a measurement tool for assessing the losses, and risk management technique was used as a failure analysis tool. After investigating the root causes of failure, corrective measures were evolved and implemented. Further, condition based maintenance was performed to avoid machine deterioration and subsequent failures. Though there was a marginal increase in the maintenance cost, considerable reduction in failure loss was realized.

In another case study, RMM was applied to minimize losses due to the failure of spare parts used in a special purpose machine engaged in radiator manufacturing. In that, unit cost method was used for assessing the losses, and risk management technique was used as a failure analysis tool. After investigating the root causes of failures, corrective measures were evolved and implemented. Further, PM was performed to control the process for avoiding failure of spare parts. Significant reduction in failure loss was established with a marginal increase in recurring expenditure for process improvement and PM.

Difficulties associated with record-keeping of paper based maintenance records were controlled with the development of Computerized Data Support System (CDSS). A case study was conducted in one of these companies to evaluate the usefulness of CDSS for the organization of failure data to be used in RMM. The results of the case study have indicated that CDSS is a useful tool for the organization of failure data to be used in RMM.

Studies conducted on the needs of business organizations emphasized the motivation and skill development of employees for minimizing the losses incurred due to their improper working. In this context, the appropriateness of training for improving the performance of employees, processes and machines was evaluated by training a few operators in one of these two companies. The proficiency level of operators along with

production losses was evaluated before and after imparting training. Results of the case study justified the necessity of training for improving the performance of the employees.

The RMM designed with the objective of improving the performance of machines through the reduction of failures was found to be appropriate for meeting the scope of the research work. The results of investigations indicated that organizations enjoyed significant benefits by implementing the RMM.