A Study on Usage of Total Productive Maintenance (TPM) in Selected SMEs

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Abstract. In the present competitive economic environment, it is very much essential for the manufacturing plants to achieve world class operation standards along with high quality and timely delivery of goods. This requires excellent maintenance practices to increase the availability of the machines, to reduce production cost and to produce goods with desired quality level. Total Productive Maintenance (TPM) implementation is an approach to improve the performance of maintenance activities. It aims to maximize the equipment effectiveness by the total participation of all employees. But most of the manufacturing plants are not able to harvest the benefits of TPM practices due to lack of planning and proper awareness. This work is carried out in order to study the usage of TPM in the selected SMEs (Small and Medium sized Enterprises). A total of 50 SMEs involving manufacturing, process and service industries are considered for the study. The primary data is collected through a structured questionnaire consisting of 24 questions related to TPM implementation. The respondents are randomly selected involving chief executives, engineers, managers and supervisors. A five point Likert scale is selected to rate the respondent’s opinion. The results are analysed using simple graphical representations and conclusions are drawn based on the feedback obtained from the respondents. It has been found that 52% of SMEs (26 out of 50) have adopted TPM in their organizations and remaining 48% have not yet implemented TPM. The study helps to find out the extent to which the TPM being used in SMEs and what are the possible reasons for not implementing TPM.

Keywords: TPM, SMEs, Availability, Equipment Effectiveness, Maintenance.

1. Introduction
In the present competitive world, organizations follow different techniques and strategies for their survival and growth. Proper implementation of these techniques and strategies result in cost reductions and meeting the customer requirements [1]. These strategies include those related to manufacturing and maintenance activities. Productivity is considered to be one of the important parameter to measure the growth of the organizations. It states the current status and position of the organization and also identifies the need for improvement [2]. Total Productive Maintenance (TPM) is considered to be a widely accepted strategy for improving the performance of maintenance activities [1,15]. It can be applied in any department of manufacturing, service and process industries to improve their
performance and productivity [3,4,13]. TPM is very much essential from both individual as well as organizational viewpoints. It involves the commitment of all employees of the organization at various levels [4]. It eliminates wastes and the losses in the production process thereby reducing costs and improving productivity [5]. TPM makes the operators to take care of the regular/routine maintenance work of their machines, thus bringing a sense of ownership among them [6,15]. It also maximizes the overall equipment effectiveness by enhancing equipment availability, performance efficiency and quality rate [4,7,14].

More than 60% of the industries in India are falling in the category of Small and Medium Enterprises (SMEs). These SMEs supply a lot of components to the large scale industries, thus are playing a very important role in the modern economy. Increased competition among the SMEs resulted in the survival of those companies which produce high quality products at the reasonable cost. This is possible only when they adopt modern technologies like TPM, RCM, etc. Success of the TPM implementation depends on its pillars and it is not required to implement all the pillars for a particular SME. Hence it is not very difficult to implement some of the TPM pillars in a SME as compared to a large scale industry [8,13].

2. Methodology

This is a quantitative or survey research. The objective is to study the extent to which TPM is being used in the selected SMEs. It also helps to find out the possible reasons for not implementing the TPM in these SMEs. Basic data for this inquiry have been generated by using questionnaire method. A structured questionnaire was prepared consisting of 24 questions. A single questionnaire has been prepared for all the employees. The questionnaire was distributed using Google forms to 50 respondents of different organizations consisting of manufacturing, service and process industries and all 50 responded. The respondents from these organizations were randomly selected involving chief executives, engineers, managers and supervisors. Responses of all 50 respondents were considered for the analysis. The responses are randomly cross verified through the interviews with the respondents. The responses were evaluated on a 5 point Likert scale (1-Strongly Disagree to 5-Strongly Agree). While the primary data was collected through questionnaire, the secondary data was collected by referring books, journals, articles, research papers and related websites.

3. Results and Discussions

The data generated through the survey are analysed using simple graphical representations and interpreted to draw meaningful conclusions. The results of this empirical study are discussed below:

3.1 Awareness of TPM in the selected SMEs

The respondents were asked to state whether the TPM is being used in their organization or not. It was found that 52% (26 out of 50) of the selected organizations have adopted TPM and rest 48% (24 out of 50) have not yet adopted TPM in their organizations. This is represented in the pie chart shown in figure 1. It is necessary to concentrate on these 24 organizations which haven’t implemented TPM yet and study is aimed to find out the possible factors which have hindered the usage of TPM in these 24 organizations.

It was found that 88% (21 out of 24) of the respondents witnessed the availability of computerization in their organizations, which indicates that there is ample opportunity for shifting towards a modern computer based maintenance management system (CMMS). This is represented in the pie chart shown in figure 2.

Also, 80% of the respondents agreed that they know the potential usage of computers which is the indication that they can be easily educated to shift towards modern maintenance strategies like TPM. Analysis of the responses shows that about 46% of the people are heard and aware of TPM strategy. It is also observed that 33% of the people remained neutral when asked about the awareness of TPM and 21% agreed that they have not heard of TPM. These responses related to TPM awareness are shown in
3. It shows that awareness of the respondents about TPM is not much appreciable and hence it is required to educate the people about TPM and its potential benefits.

3.2 Management involvement and motivation in TPM implementation

TPM needs the total involvement of all the employees from management to shop floor level [4,12]. 42% respondents have given neutral response when asked about the management’s support and involvement in TPM implementation in their organization. Same neutral response was obtained for the question ‘TPM increases manpower costs and management may not be ready to accept it’. It shows that they are hesitant to express their views against the management which may affect their job security. A lot of hard work and efforts at the management and employee levels needed to shift from the existing maintenance system to TPM. About 37% respondents expressed that management may not encourage its employees by suitable rewards for their hard work and efforts in bringing out a change in the existing maintenance strategy. It was found that 29% of the people remained neutral as it is a question related to the management. It indicates that employees expect certain rewards and motivation from the management to bring changes in the existing work culture. All the factors related to the management involvement and motivation in TPM implementation and their responses are shown in figure 4.

3.3. Financial factors affecting TPM:

Finance is very important factor in the implementation of TPM in any SME. TPM expects large investments from the management during initial and implementation stages. The potential benefits that can be observed from TPM implementation will definitely mask these investments in the long run.
About 42% of the respondents expressed that financial constraint is not a reason for non-implementing TPM which indicates that their management is financially strong enough to adopt TPM. Training programme is very crucial factor in TPM implementation [15]. It is found that 58% respondents aware that a large amount of money will be spent in training at management, managerial and operator’s level during the TPM process. But they couldn’t express their opinion about the usage of TPM is too expensive or not. Hence it is necessary to create the awareness among the employees about the costs associated with TPM and its implementation.

As stated earlier, TPM needs large investments and they will not yield immediate returns. Once TPM is implemented, it needs minimum three years to stabilize before it starts giving the returns. Hence return on investments from TPM is not immediate which was rightly pointed out by the respondents. The finance related factors affecting TPM are shown in figure 5.

**Figure 4.** Factors related to the management involvement and motivation in TPM implementation

**Figure 5.** Financial factors affecting TPM
3.4 Employee skills and work culture

Normally the employees in an organization will be adjusted to a routine work culture involving a predefined set of rules and procedures. If at all modern strategies like TPM are to be implemented in an organization, people must be in a position to accept the change in the work culture and develop new skills required, without showing any resistance to change. Most of the respondents (46%) expressed that they are not addicted to the current work system and ready to accept the changes. About 33% of the people showed their resistance to change which means that they should be properly motivated by explaining the potential benefits that could be obtained by the TPM implementation. Successful TPM implementation could be achieved by initiating a drastic work culture change and enthusiastic commitment by the top management [11]. 83% of the respondents agree that TPM needs continuous updation and improvement at all levels which is theoretically true.

It is very much necessary to create awareness among the employees about the benefits that could be achieved through TPM implementation. This is because 33% of the respondents were remained neutral when asked about the potential benefits of TPM whereas 50% of the respondents were aware of the benefits of TPM. Supervisory and workforce skills are very important parameters in TPM implementation. According to this study, most of the organizations (50%) do not lack supervisory or workforce skills to implement TPM and about 29% of the respondents felt that their supervisory and workforce skills need to be improved before TPM implementation.

As stated earlier, TPM needs cooperation and coordination between all employees at various levels involving different skills [10]. In other words, TPM totally works on a network strategy to which 54% of the respondents agreed. 46% of the respondents were remained neutral indicating the need of awareness to be created among them. The factors related to employee skills and work culture which affect TPM are shown in figure 6.

![Employee skills and work culture in TPM](image)

3.5 Other factors affecting TPM implementation

One of the main requirements of TPM is bringing together employees at various levels to meet the objectives of the organization. This is in fact a very tedious job as it is very difficult to unite people with different skills, experience, age, qualifications, specializations, payment levels, etc. This
empirical study also reveals the same. As TPM is an advanced and modern maintenance strategy, it requires maximum use of computers in planning, scheduling, developing and documenting maintenance activities. The data which are saved in computers can be easily retrieved for future use in maintenance planning activities. This study also stresses the need for a very strong computer maintenance management system (CMMS) in TPM. Also, it is necessary to maintain the records of maintenance activities which will be very useful in determining performance effectiveness of equipments. Computers, maintenance log books, etc, play an important role in recording the maintenance data. In this empirical study, 71% of the respondents expressed that they have proper maintenance records in their organization.

It is well understood that success of TPM depends upon its pillars or tools [10,15]. Many tools are available to improve the performance of a machine. It is not required to implement all pillars on a particular machine. Based on the calculated equipment effectiveness and condition of the machine one or two pillars may be implemented to improve the performance [8,13]. Many organizations find it difficult to implement TPM due to the insufficient knowledge in understanding the interconnections between pillars of TPM [9]. In our survey, most of the respondents are not aware of the selection of TPM tools and remained neutral in responding to it, thus indicating the need of proper training in this area.

It is also observed that 46% of the respondents expressed that TPM is beneficial only to large scale industries, not to SMEs. This is expressed in a view that large scale industries have enough potential to invest huge amounts for maintenance activities whereas SMEs are not. But their performance will be definitely enhanced when they adopt a few TPM pillars [8]. It is also found that 54% of the respondents felt that TPM is not the ultimate and it may not do everything in an organization. These 6 factors described above are shown in the figure 7.

At the end of the questionnaire, two questions were added to know whether TPM is currently in progress in the organization or not and any future plans to implement TPM in the organization. Two respondents out of 24 SMEs (8%) stated that TPM implementation is currently in progress in their organization. This is shown in figure 8. Also, 10 respondents (42%) have expressed that they are going to implement TPM in future, which is represented in figure 9. This indicates that slowly the organizations are getting the awareness of TPM and its benefits in the long run. Success stories of the organizations after TPM implementation, information from articles, journal papers, conferences, etc, are creating awareness of TPM and motivate the organizations to move towards TPM.

![Figure 7. Other factors which affect TPM implementation in SMEs](image-url)
4. Conclusions
TPM is a maintenance strategy which improves productivity, safety and employee morale and integrates maintenance and production personnel. It requires a strong backup from top management and also requires total employee commitment.

It was found that out of 50 selected SMEs, only 26 SMEs have implemented TPM and remaining 24 SMEs have yet to implement TPM indicating that there is a need to motivate these SMEs by creating awareness about TPM and its potential benefits in the long run. According to this survey, the factors which mainly affect the usage of TPM in the selected SMEs are: management’s involvement and support, employees resistance to change from the existing work system, belief that TPM is only beneficial to large scale industries, difficulty in achieving total involvement of the workforce, lack of reward system for the employees, need of a strong CMMS for TPM, need for continuous updation of skills and improvement, slower return on investments, greater financial support from management.

TPM concepts are not fully implemented in Indian manufacturing industries. The industries are not able to harvest the benefits of TPM practices due to lack of planning and proper awareness. Some of the organizations are giving less priority to maintenance function and consider it as a profitless activity. The SMEs must respond at a faster rate to the changing demands of the customer and they must be flexible. In order to compete and survive in the continuously changing environment, SMEs must adopt modern maintenance management techniques such as TPM. TPM implementation is a continuous journey and its benefits are not suddenly visible. SMEs can implement TPM by initiating a drastic culture change and enthusiastic commitment by the top management.

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