
FACTORS AFFECTING THE LOSSES OF THE TPM IN INDUSTRIES

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ABSTRACT

Total Productive Maintenance (TPM) is a complex, long term process which must be sold to the workforce as a legitimate improvement methodology. For TPM to succeed in any industry, both management and the workforce must address issues strategically while operating in an environment of trust and organization with its sustainable pillars guide will create routines that enable that interaction. The ultimate responsibility of success or failure of the TPM process rests more with management than the plant floor employees. TPM is the key to getting people together to own processes and performance of the machine and builds teamwork on the shop floor, leading to a standard and disciplined work culture, and improved engineering discipline. Industries may be classified in three ways regarding to TPM: the ones that certainly have the structured and working methodology; the ones who say they have it, but they do not have even the structured basic principles; and the ones who had already established the pillars but let this structure to lose serving its fragments only to satisfy the audit. This paper is about this third case, where the main factors that lead to the gradual abandonment of already reached levels of excellence of application of the TPM methodology is presented. For the analysis of the problem operators, maintenance people and managers involved in the productive process were heard. This document was elaborated based on these multiple visions.

Keywords: TPM, Industrial management

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1. INTRODUCTION

TPM is a unique Japanese philosophy, which has been developed based on the productive maintenance concepts and methodologies. This concept was first introduced by M/s Nippon Denso Co. Ltd. of Japan, a supplier of M/s Toyota Motor Company, Japan in the year 1971. Total productive maintenance is an innovative approach to maintenance that optimizes equipment effectiveness, eliminates breakdowns and promotes autonomous maintenance by operators through day-to-day activities involving total workforce (Bhadury, 2000). The manufacturing industry has experienced an unprecedented degree of change in the last three decades, involving drastic changes in management approaches, product and process technologies, customer expectations, supplier attitudes as well as competitive behavior (Ahuja et al., 2006). Now a day there is no place for improvisation when it comes to industrial management matters, being production or maintenance. In a general way, the impact of an inadequate and an inefficient maintenance can define the business profitability and the survival of the company. The use of new technologies and new methods of management have multiplied in companies who try, this way, to keep and broaden their space in the market. The human factor is presented essentially for the success of all this complex process, regardless even to the adopted philosophy. In order to analyze the proposed problem of the lose of TPM in companies, operators, maintenance people and man-agers involved in the productive process were heard. This paper was constructed based on these multiple visions, approaching the main factors involved in the failure of TPM. It is also highlighted, in an explicit way, the key role developed by the collaborators, in all levels, to the success of this methodology. The information ground for the elaboration of this paper is mainly formed by the manufacturing industries of the Metropolitan Region of Faridabad and Gurgoan. According to Rodrigues, TPM is presented in the companies as one of the main tools of management of the industrial maintenance, as shown in the [Figure 1](#).

2. WHERE DOES TOTAL PRODUCTIVE MAINTENANCE COME FROM?

TPM is a unique Japanese philosophy, which has been developed based on the productive maintenance concepts and methodologies. This concept was first introduced by M/s Nippon Denso Co. Ltd. of Japan, a supplier of M/s Toyota Motor Company, Japan in the year 1971. TPM is considered an evolution in preventive maintenance, originally conceived in the United States in the 1950s. The conception of TPM was an answer to the demands of a more and more competitive market that obliged the companies to draw some attitudes, such as: eliminating waste, always obtaining the best performance of the equipment, reducing interruptions or stops of production (breakdowns or interventions), redefining goals. For this TPM distinguishes and attacks six essential sources of diminishing output in the industrial installations, which are presented in [Figure 2](#).

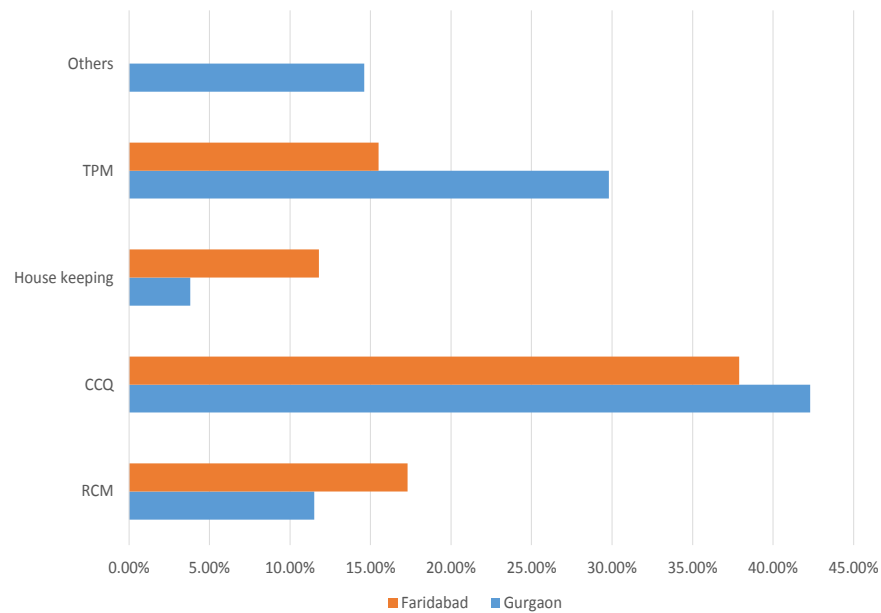


Figure 1. Management tools applied in the maintenance in companies in the region of Faridabad and Gurgaon

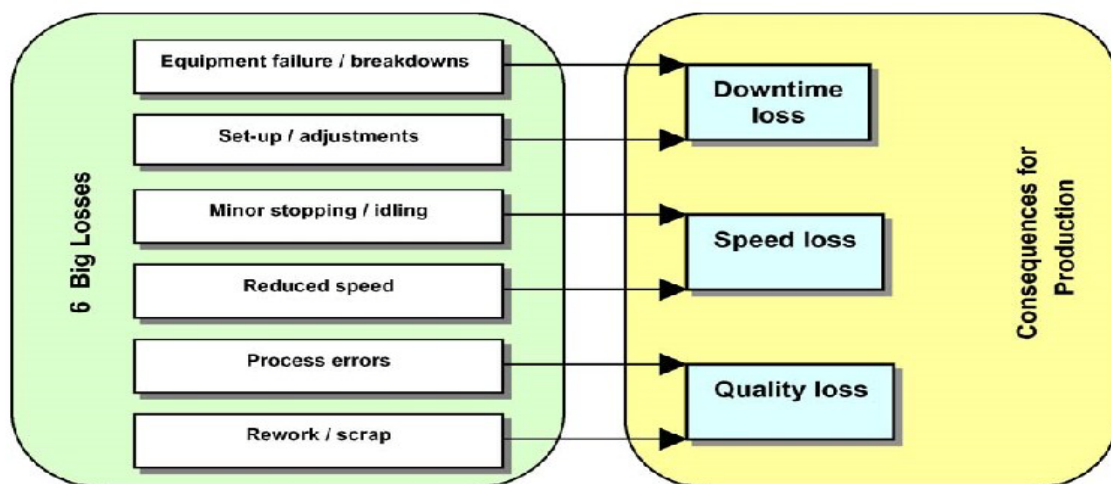


Figure 2. The source of losses according to TPM method

3. TPM PILLARS

The basic practices of TPM are often called the pillars or elements of TPM. The entire edifice of TPM is built and stands, on eight pillars (Sangameshwaran & Jagannathan, 2002). TPM paves way for excellent planning, organizing, monitoring and controlling practices through its unique eight-pillar methodology. TPM initiatives, as suggested and promoted by Japan Institute of Plant Maintenance (JIPM), involve an eight pillar implementation plan that results in substantial increase in labor productivity through controlled maintenance, reduction

in maintenance costs, and reduced production stoppages and downtimes. The core TPM initiatives classified into eight TPM pillars or activities for accomplishing the manufacturing performance improvements include autonomous maintenance; focused maintenance; planned maintenance; quality maintenance; education and training; office TPM; development management; and safety, health and environment (Ireland & Dale, 2001; Shamsuddin et al., 2005; Rodrigues & Hatakeyama, 2006). The detailed maintenance and organizational improvement initiatives and activities associated with the respective TPM are as follows.

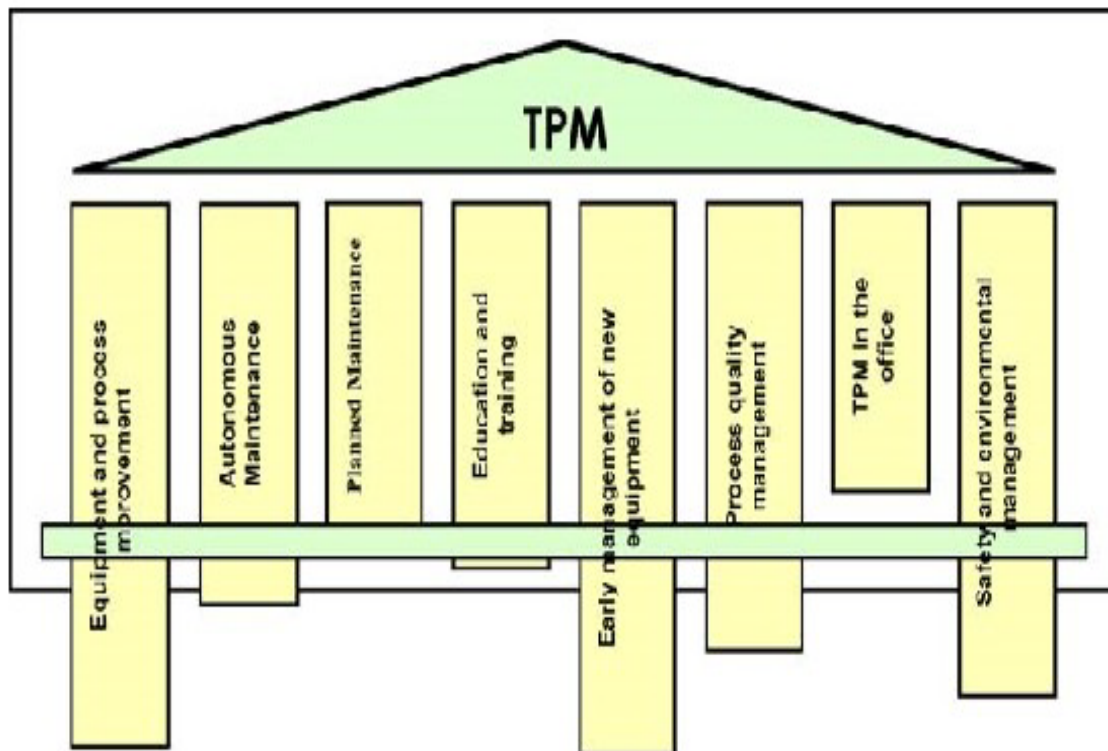


Figure 3. The pillars of TPM

Pillar 1- 5S: TPM starts with 5S. It is a systematic process of housekeeping to achieve a serene environment in the work place involving the employees with a commitment to sincerely implement and practice housekeeping. Problems cannot be clearly seen when the work place is unorganized. Cleaning and organizing the workplace helps the team to uncover problems. Making problems visible is the first step of improvement. 5S is a foundation program before the implementation of TPM. If this 5S is not taken up seriously, then it leads to 5D (delays, defects, dissatisfied customers, declining profits, and demoralized employees). This 5S implementation has to be carried out in phased manner. First the current situation of the workplace has to be studied by conducting a 5S audit. This audit uses check sheets to evaluate the current situation. This check sheet consists of various parameters to be rated say on a 5-point basis for each 'S'. The ratings give the current situation. The each of the above-mentioned 5S is implemented and audit is conducted at regular intervals to monitor the progress and evaluate the success of implementation. After the completion of implementation of 5S random audits could be conducted using company check sheets to ensure that it is observed in true spirits by every one in the work place. Table 1 depicts the key activities to be holistically deployed for effective 5S implementation at the workplace.

Table 1. Key Activities for Effective 5S Implementation at the Workplace.

Japanese nomenclature (English 5S/5C):Features
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Seiri (Sort/Clear): Sort out unnecessary items from the workplace and discard them
Seiton (Set in order/Configure): Arrange necessary items in good order so that they can be easily picked up for use
Seisio (Shine/Clean and check): Clean the workplace completely to make it free from dust, dirt and clutter
Seiketsu (Standardize/Conformity): Maintain high standard of housekeeping and workplace organization
Shitsuke (Sustain/Custom and practice): Train and motivate people to follow good housekeeping disciplines autonomously

Pillar 2-Autonomous Maintenance(AM): This pillar is geared towards developing operators to be able to take care of small maintenance tasks, thus freeing up the skilled maintenance people to spend time on more value added activity and technical repairs. The operators are responsible for upkeep of their equipment to prevent it from deteriorating. By use of this pillar, the aim is to maintain the machine in new condition. The activities involved are very simple nature. This includes cleaning, lubricating, visual inspection, tightening of loosened bolts etc. AM policy are-uninterrupted operation of equipments, flexible operators to operate and maintain other equipments, and eliminating the defects at source through active employee participation. Steps in AM are preparation of employees, initial cleanup of machines, take counter measures, fix tentative AM (JISHU HOZEN) standards, general inspection, autonomous inspection, and standardization.

Pillar 3-Kaizen: “Kai” means change, and “Zen” means good (for the better). Basically kaizen is for small improvements, but carried out on a continual basis and involve all people in the organization. Kaizen is opposite to big spectacular innovations. Kaizen requires no or little investment. The principle behind is that “a very large number of small improvements are more effective in an organizational environment than a few improvements of large value”. This pillar is aimed at reducing losses in the workplace that affect our efficiencies. By using a detailed and thorough procedure we eliminate losses in a systematic method using various kaizen tools. These activities are not limited to production areas and can be implemented in administrative areas as well. Kaizen policy are practice concepts of zero losses in every sphere of activity, relentless pursuit to achieve cost reduction targets in all resources, relentless pursuit to improve over all plant equipment effectiveness, extensive use of PM analysis as a tool for eliminating losses, and focus of easy handling of operators. Kaizen target are achieve and sustain zero loses with respect to minor stops, measurement and adjustments, defects and unavoidable downtimes. It also aims to achieve 30% manufacturing cost reduction. Tools used in kaizen are Why-Why analysis, Poka-Yoke (Poka-Yoke is Japanese term, which in English means ‘mistake proofing’ or ‘error prevention’), summary of losses, kaizen register, and kaizen summary sheet. Six losses in the work place: The objective of TPM is maximization of equipment effectiveness. TPM aims at maximization of machine utilization and not merely machine availability maximization. As one of the pillars of TPM activities, kaizen pursues efficient equipment, operator and material and energy utilization that is extremes of productivity and aims at achieving substantial effects. Kaizen activities try to thoroughly eliminate losses. Six major losses that were identified are-equipment failure, set-up and adjustments, small stops, speed losses during production, and losses during warm-up (Nakajima, 1988).

Pillar 4-Planned Maintenance (PM): It is aimed to have trouble free machines and equipments producing defect free products for total Customer satisfaction. This breaks maintenance down into four “families” or groups, viz., preventive maintenance, breakdown maintenance, corrective maintenance, and maintenance prevention. With PM we evolve our efforts from a reactive to a proactive method and use trained maintenance staff to help train the operators to better maintain their equipment. In PM policy are achieve and sustain availability of machines, optimum maintenance cost, reduces spares inventory, and improve reliability and maintainability of machines. PM targets are zero equipment failure and break down, improve reliability and maintainability by 50 percent, reduce maintenance cost by 20 percent, and ensure availability of spares all the time. Six steps in planned maintenance are equipment evaluation and recoding present status; restore deterioration and improve weakness; building up information management system; prepare time based information system; select equipment, parts and members and map out plan; prepare predictive maintenance system by introducing equipment diagnostic techniques; and evaluation of planned maintenance.

Pillar 5-Quality Maintenance (QM): It is aimed towards customer delight through highest quality through defect free manufacturing. Focus is on eliminating non-conformances in a systematic manner, much like focused improvement. We gain understanding of what parts of the equipment affect product quality and begin to eliminate current quality concerns, and then move to potential quality concerns. Transition is from reactive to proactive (quality control to quality assurance). QM activities are to set equipment conditions that preclude quality defects, based on the basic concept of maintaining perfect equipment to maintain perfect quality of products. The condition is checked and measure in time series to very that measure values are within standard values to prevent defects. The transition of measured values is watched to predict possibilities of defects occurring and to take counter measures before hand. In QM policy are defect free conditions and control of equipments, quality maintenance activities to support quality assurance, focus of prevention of defects at source, focus on Poka-Yoke (fool proof system), in-line detection and segregation of defects, and effective implementation of operator quality assurance. QM targets are achieve and sustain customer complaints at zero, reduce in-process defects by 50 percent, and reduce cost of quality by 50 percent.

Pillar 6-Training: It is aimed to have multi-skilled revitalized employees whose morale is high and who has eager to come to work and perform all required functions effectively and independently. Education is given to operators to upgrade their skill. It is not sufficient know only “Know-How” by they should also learn “Know-Why”. By experience they gain, “Know-How” to overcome a problem what to be done. This they do train them on knowing “Know-why”. The employees should be trained to achieve the four phases of skill. The goal is to create a factory full of experts. The different phase of skills is phase 1-do not know, phase 2-know the theory but cannot do, phase 3-can do but cannot teach, and phase 4-can do and also teach. Training policy’s are focus on improvement of knowledge, skills and techniques, creating a training environment for self-learning based on felt needs, training curriculum including tools/assessment etc. conducive to employee revitalization, and training to remove employee fatigue and make, work enjoyable. Training target are achieve and sustain downtime due to want men at zero on critical machines, achieve and sustain zero losses due to lack of knowledge/skills/techniques, and aim for 100 percent participation in suggestion scheme. Steps in educating and training activities are setting policies and priorities

and checking present status of education and training, establish of training system for operation and maintenance skill up gradation, training the employees for upgrading the operation and maintenance skills, preparation of training calendar, kick-off of the system for training, and evaluation of activities and study of future approach.

Pillar 7-Office TPM: Office TPM should be started after activating four other pillars of TPM (AM, Kaizen, PM, and QM). Office TPM must be followed to improve productivity, efficiency in the administrative functions and identify and eliminate losses. This includes analyzing processes and procedures towards increased office automation. Office TPM addresses twelve major losses, they are processing loss; cost loss including in areas such as procurement, accounts, marketing, sales leading to high inventories; communication loss; idle loss; set-up loss; accuracy loss; office equipment breakdown; communication channel breakdown, telephone and fax lines; time spent on retrieval of information; non availability of correct on line stock status; customer complaints due to logistics; and expenses on emergency dispatches/purchases.

Office TPM and its benefits are involvement of all people in support functions for focusing on better plant performance, better utilized work area, reduce repetitive work, reduced administrative costs, reduced inventory carrying cost, reduction in number of files, productivity of people in support functions, reduction in breakdown of office equipment, reduction of customer complaints due to logistics, reduction in expenses due to emergency dispatches/purchases, reduced manpower, and clean and pleasant work environment.

Pillar 8-Safety, Health and Environment: In this area focus is on to create a safe workplace and a surrounding area that is not damaged by our process or procedures. This pillar will play an active role in each of the other pillars on a regular basis. Safety, health and environment target are zero accident, zero health damage, and zero fires. A committee is constituted for this pillar, which comprises representative of officers as well as workers.

The committee is headed by senior vice president (technical). Utmost importance to safety is given in the plant. Manager (safety) looks after functions related to safety. To create awareness among employees various competitions like safety slogans, quiz, drama, posters, etc. related to safety can be organized at regular intervals.

4. FACTORS THAT DAMAGE TPM SUCCESS

Success of a TPM program is closely connected to the way of managing people, because the focus of the proposed work in this methodology is the human being. As it happens in all management process, it is necessary to create indicators for the evaluation of performance indicators of the program. In this context the indicators used to verify and control TPM are:

- Productivity.
- Costs.
- Supply, levels and circulation.
- Quality can achieve zero defects.
- Safety, almost total eliminating of violations.
- Morale, suggestions and participation of all employees in the small group meetings.

Even with these established indicators, one can notice that a large part of them is constructed in the companies only to satisfy the audit process (internal and external). With this attitude, one

ends up with a superficial management of the whole process, where the manager does not get the benefits that a real interaction between maintenance and production, offered by TPM, could bring to the company. In other words, the lack of commitment by managers leads to ruining the already established structure. The main factors, indicated by the maintenance people and production, that directly influence the lose in TPM pattern inside companies, are presented. One notices that several factors mentioned refer to the overload of the work imposed on the operators. This overload is due to many factors, some internals and other externals to the company. It is important to highlight that independent of the source of this overload, it is not only the machines that exhaust (enhancing the probability of failure), but also mainly the people. With this pressure one apparently gains in productivity, but in a short time the losses begin to show up together with the increase in costs. In many companies, one notices the overload in work on the production people, preventing this way that the operator effectively participates in TPM process, limiting him, when it happens, to the putting of “TPM Cards”, so that maintenance makes its intervention. This is a negative factor when it comes to the question of the professional development of the operator, because in the beginning of TPM process he is stimulated, encouraged and appreciated for being capable of making small maintenance and adjustments in the equipment. When this activity is diminished due to overload in production activities, he gets professionally frustrated. Another not motivating factor for the production people is when their ideas, suggestions are not “heard”, discussed or they do not have feedback. These cases there are problems of communication in the decisions taken by the managers and the way they are communicated to the people involved. In the first time a suggestion is not made, in a second time his suggestion is not taken seriously either, or is blocked by the financial sector (without an explanation for the shop floor), in this rhythm, probably there will not be a third suggestion, losing this way this important channel for improvement possibilities.



Figure 4. Main actors in TPM process

Other negative facts that occur in companies are:

- problems of purchase of replacement material, preventing the performance of planned maintenance;
- budget cuts without reasonable explanation for the team involved with TPM;
- incorrect dimensioning of the maintenance team to deal with the programmed activities;
- no follow-up of maintenance backlog;
- impediment of liberation of machines for maintenance in planned date;
- constant change in schedule;
- non-systematic accomplishment of maintenance planning giving a feeling of non-credit to it;
- the collaborators' non-commitment;

-the return to the maintenance team of the feeling of “firemen extinguishing the fire”.

In order to attack the exposed factors, that are very common in our industries, it is necessary synergy and willing of the actors presented in Figure 4.

The interaction of each one of these actors as presented in Figure 4, performing their functions inside their responsibilities is what will make TPM process continuous. Any other attempt outside this global vision will always have a palliative effect.

5. CONCLUSION

In accordance to what has been presented, we go back to the great issue, that unfortunately many managers have not noticed yet, that the great asset of the companies is their collaborators. And the big responsibility for non-success is due to the managers of the process and the top administration of the companies. Because, even though several resources are invested for the implementation of a TPM system in the beginning of the process, what one notices in most cases, is that the organization as a whole (operators, maintenance people, managers, top administration—Figure 4) is not always really inserted in TPM philosophy. The periodical performance of audit with respective evaluations and feedback in the system still present one of the most positive procedures for the maintenance and improvement of the structure. TPM is an excellent work philosophy that really produces gains in the productive process. An important question for all is: “Does my company think it has TPM, or does it really have it?”

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