Barriers In TPM Implementation In Industries

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Abstract : - This paper aims to highlight the difficulties faced by organizations in implementing Total Productive Maintenance (TPM). The authors with their experience in TPM and the refinery industry have attempted to understand the factors that hinder implementation of TPM. The paper first explains in brief the concepts of TPM and why TPM is a must for organizations in this complex dynamic business environment. It then takes up the various issues that hamper implementation of TPM in industries. Solutions to overcome the barriers are discussed briefly but will be taken up in detail in another paper with specific reference to refinery scenario.

Index Terms: - Total Productive Maintenance, Organizations, Implementation, Tools, Barriers

1.0 Introduction

Total Productive Maintenance or TPM is a philosophy to enhance an organization's productivity and produce high quality goods by minimizing waste thereby reducing costs. The concept was started by the Japanese in the sixties when they realized that increased demand necessitated more specialized machines which in turn required dedicated maintenance groups. To improve equipment reliability, the TPM strategy was implemented in which the regular daily maintenance was carried out by the operators while the mandate given to the maintenance crew was to carryout specialized maintenance, upgrades and modification jobs to minimize failures thereby increasing machine availability, reducing costs and improving profitability of the organization. The concept looks simple but the practical aspect of implementation is very complex involving various stages each of which requires focused attention else the TPM implementation process is bound to result in failure. Due to this very reason, industries in India and world over have struggled and failed in TPM implementation. TPM is not a quick-fix methodology resulting in instant results; it requires commitment, dedication and perseverance on part of the management and employees over the long run (in terms of years) to deliver noticeable visible results.

2.0 Why Is TPM Necessary?

TPM is necessary from both organizational and individual viewpoints. Let us start with a simple question: Why is an organization in business? – *To make money*. In these times of brutal competition, an organization can succeed, enjoy profits and stay ahead of the competition only by providing faultless service and defect-free high quality products which are easily understood by and useful to customers for a reasonable price.

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expectations. In order to achieve this, they must invest in and adopt TPM as a management tool to maximize profits. The following extract from the book "***Implementing TPM: The North American Experience***", by **Charles Robinson and Andrew Ginder** puts across the requirement for TPM very eloquently – "*In today's global economy, the survival of the company depends on its ability to rapidly innovate and improve. As a result, an unceasing search is on for methods and processes that drive improvements in quality, costs and productivity. In today's fast changing marketplace, slow, steady improvements in manufacturing operations will not guarantee profitability or survival. Companies must improve at a faster rate than their competition if they are to become or remain leaders in their industry."* They go on to say that *"TPM has been identified as a best-in-class manufacturing improvement process."* Coming to the viewpoint from an individual's perspective, the answer lies in linking a few basic and pertinent questions:

- *Why do most of us want to be employed?* To earn money and built a secure future for our family. Which leads us to the second question
- *Which organization would you prefer in order to earn money and built a secure future?* An organization which innovates and is always a step ahead in a complex competitive environment and grows over the future.
- *Now, what should an organization do to be always a step ahead of its competitors?* It should make money.
- *And how does an organization make money?* By improving the top and bottom lines– sales and profits.
- *And finally, how does an organization improve top and bottom lines?* By reducing costs and improving productivity of its employees.

TPM is necessary not only from an organization point of view but from that of an individual also. TPM directly or indirectly leads to a better work-life balance by reducing failures thereby freeing up time for employees to spend more time with their families.

3.0 What Is TPM?

TPM was initially started as a maintenance function which has now evolved into a management function. It as an equipment management program that involves all employees in the company in the maintenance and repair of the company's assets, whether a facility or plant (***Terry Wireman, 1992***). TPM seeks to maximize equipment

effectiveness throughout the life time of the equipment and strives to maintain the equipment in optimum condition in order to prevent unexpected breakdown, speed losses and quality defects occurring from process activities (***Ahuja and Khamba, 2008***). The essence of TPM is encompassed in the three words – Total, Productive and Maintenance.

Total: Involving the commitment of the entire workforce of an organization – the top, middle and lower levels of Management and non-Management personnel. It involves the most important word **OUR** – Our Plant, Our Machines, Our Processes. The Top Management support is crucial for the success of TPM. It acts as a cohesive force to unite all the employees of the Organization. Whole hearted support of all the employees across all streams and disciplines and from the top to the bottom most rung of the organizational hierarchy is a must for successful implementation of TPM. Employees are involved right from the beginning till the very end of the implementation program.

Productive: Oxford Dictionary defines Productive as *"producing or able to produce large amounts of goods, crops or other commodities"*. To produce more, we have to eliminate losses. TPM is all about how to make the processes productive by **eliminating waste and losses** in the processes thereby **reducing costs**. It is an indirect way of saying – How to get the maximum quality work out of the employees? To increase productivity of any process or activity, it is imperative that the employees of the organization are fully involved and the persons with the required competencies are engaged in running the particular process or activity. To ensure the right persons for the right job, extensive training is imparted to the employees of the organization. Waste and loss elimination is taken care by employing pro-active and reliability centered maintenance (in addition to the traditional methods of maintenance) and design modifications wherever required.

Maintenance: The main focus in the Maintenance part of TPM is **fostering sense of ownership** among the operating personnel. In the traditional (and even in the present age) sense, maintenance of equipments is carried out by maintenance group while operation of the equipments is by the operations group. Maintenance engineers get bogged down in routine maintenance jobs and do not have quality time to analyze failures and develop programs to prevent failures in future. There is a rigid barrier between operations and maintenance which needs to be brought down. As per the TPM concept, *operating personnel should take care of routine maintenance of the equipment like greasing, replacement of oil, cleaning etc. and the maintenance personnel should be freed up to carry out modification programs which will result in reliability improvement of the equipment and increased quality of goods produced*. The concept here is that the plant operators who deal with the equipments day in and day out have a feel for the equipments and have the ability and competency to carry out the routine maintenance of the equipments.

Hence TPM can be defined in the following manner:
"Maintenance program in which the field operators look after the routine maintenance and maintenance personnel develop modifications to improve reliability and availability of the equipments, maximize equipment efficiency and productivity of processes by eliminating losses and reducing costs thereby improving quality of the products and ensuring higher top and bottom lines for the organization."

Organizations adopt TPM as a significant process improvement and problem solving approach for enhancing organization's responsiveness for catering to customer needs and affecting cost optimization as part of maintenance strategy to increase market share and maximize profits (***Ahuja and Khamba, 2008***). It is an approach to maintenance that optimizes equipment effectiveness, eliminates breakdown and promotes autonomous maintenance by operators through day-to-day activities involving total workforce (***Bhadury, 2000***).

4.0 Let's Get Started

TPM is not simple; in fact it is a very complex concept. As mentioned earlier, Industries have failed in TPM implementation worldwide. Before we get into the detailed analysis of implementation failure, it is pertinent that we look into the concepts of TPM briefly. The most favored numeral in TPM circles is Zero – **Zero defects, Zero breakdowns and Zero accidents** ***(Nakajima, 1988)***. Failure is just not an option. To achieve this is difficult but not impossible. If an organization has set its sights on high quality, it needs to follow some basic philosophies which built upon one another finally culminating in the goal of high productivity. The most important prerequisite is the **total and absolute involvement of the top management**. A committed top management is a must for implementation of TPM as it is only the top management that can bind together all the departments of the organization. Progress of TPM is directly related to the priority which the management assigns to it (***Peter Willmott and Dennis McCarthy, 2001***). Without top management involvement, TPM implementation will fail. Once the top management is on board, the next step is to **convince the employees and educate them** on TPM concepts, actions needed to be carried out for a successful TPM implementation and the gains that can be accrued once TPM is established. It is very important that the employees are fully aware of the benefits of TPM as they are the main hands-on experts who operate and maintain the machines and equipments. The mechanism for TPM implementation starts here – with the **long term commitment and determination of top management and employees**.

5.0 TPM Implementation

Now that the top management and employees are on the same boat, the first thing to do is to establish a team that will coordinate the activities of TPM. **The team should necessarily consist of employees from all the levels of the organization right down to the operator level**. This team – the TPM team will be responsible **for identifying the goals and laying down strategies and outlining resources** required to achieve the goals. These goals should be very specific and quantifiable with all the

members having a clear idea of what to achieve. The goals are then broken down to **sub-goals** specific to areas in the organization and to achieve these sub-goals, **small teams having expertise in these specific areas are formed**. These teams are given the responsibility of identifying and rectifying issues in the equipments to which they are assigned and developing master plan for failure prevention.
Once the sub-teams are formed and have identified the equipments they would work on, the first set of activities to be carried out is grouped under what is called as **5S** (developed by **Hiroyuki Hirano**) which in a nut-shell is nothing but being systematic or in other words **removing the clutter** by sorting out the required items as critical / not critical and required / not required from the items present in the workplace (*Seiri*), systematically arranging the required items at their designated places (*Seiton*), cleaning the workplace and keeping it spic and span (*Seiso*), implementing and maintaining standards for orderliness in the work place, environment and equipments (*Seiketsu*) and having self-discipline and commitment to practice 5S as a way of life (*Shitsuke*). The next task, once the area is cleared and in order, is to convince and persuade the operations personnel especially the **operators to carry out the routine maintenance activities and inspection and to prepare work instructions for the machines under their control and responsibility**. The most important requirement for operators is to have ability to detect abnormalities in the working of the equipment with respect to operation and quality of output, based on a sense that there is something wrong (***A. K. Sharma et al. 2012, K. Shiroze, 1996***). Some of the activities may be - regular cleaning of machines, checking the operating parameters, greasing, general inspection for any abnormalities like increased sound, dripping of lubrication oil or grease, disconnection of machine earthing etc. This attitude can be developed only if machines are allocated to each of the operators to inculcate a sense of belonging among the operators. This is the concept of **autonomous maintenance**. Routine maintenance and inspection once taken care of, the maintenance group is left with the task of developing maintenance programs, tools and schedules to eliminate failures and losses in the equipments thereby maximizing machine availability, effectiveness and utilization. When using TPM, the operator and maintenance staff become partners in seeking to improve equipment performance while the maintenance staff and engineers become partners in designing equipment for enhanced performance (***Frendall et al, 1997***).

Some of the tools used in eliminating failures are

1. **Small improvements carried out on a continuous basis**. The Japanese call it **Kaizen** and it was proved by them that Kaizen eliminated losses and yielded better results than big-bang improvements (intermittent large scale improvements). The rationale was that carrying out improvements on a continuous basis helped the employees to detect areas requiring improvements faster and better. Continuous improvement basically involves identifying benchmarks of excellent practice and instilling a sense of employee ownership in the process (***Krajewski and Ritzman, 2002***). According to ***James A Leflar (Practical TPM: Successful Equipment Management At Agilent Technologies, 2001***), continuous improvement activities can produce desired results only if the organization is competitive and the improvement activities are focused on the most important few items than the trivial many.

2. **Maintenance schedules involving preventive, predictive and corrective maintenance**. Preventive maintenance (PM) involves developing maintenance schedule on a time bound or criticality based schedule and carrying out maintenance as per the jobs listed out in the activity list. The maintenance activities are carried out on a fixed schedule irrespective of whether the equipment needs the maintenance or not. Predictive maintenance (PD) involves monitoring of equipments and based on the read-outs, carrying out maintenance on the equipments. For example: greasing of motors based on vibration readings. The monitoring can be continuous on-line for highly critical equipments like Power Plant generators or taken at fixed intervals for equipments like pumps and motors. Industries normally have both preventive and predictive maintenance programs. PM and PD programs constitute the foundation for Reliability Centered Maintenance (RCM) where-in the historical and probable failures are analyzed and maintenance action is implemented to prevent these failures. Corrective maintenance involves changing the design in the machines to eliminate the root cause of failures.

3. **Producing defect free products** by maintaining defect free manufacturing process and removing non-conformances in processes and products, having strict quality control programs and by adopting measures to implement modifications based on customer feedback.

6.0 Barriers in TPM Implementation

Having understood the basics of TPM, we will now discuss the barriers in TPM implementation. As mentioned earlier, TPM implementation though easy on paper, is difficult to achieve and this is mainly due to reluctance by the organization to understand and implement the concepts of TPM and failure to realize the benefits obtained by implementation of TPM. Let us look at the various factors:

1. **Lack of top management commitment**: TPM programs can be effective if and only if the top management is totally committed and involved. The top management drives TPM. It is the responsibility of the top management to distill the benefits of TPM down the organizational levels. Management commitment for TPM implementation comes in the form of operator's time and a short term investment of dollars that brings equipment into condition (***Robert Jostes and Marilyn Helms, 1994***). Without top management support, the TPM program will suffer a premature death.

2. **Organization resistance to change**: This is a direct off-shoot from the lack of top management commitment. An organization changes if and only if its top management is willing to change. To adopt a complex ideology, the organization needs to be fearless and should be able to adapt and change as per the environment. In this world of cut-throat competition and globalization, to stay ahead, innovation is the key. A majority of the organizations once set in a particular path, believes it to be too risky to alter its course and hence finds it difficult to implement TPM.

3. **Unwillingness to commit resources**: TPM implementation requires investment by the top management in terms of resources (man, materials, money and time). In majority of the cases, management considers TPM as an unnecessary expenditure and drain on its resources, thereby resisting calls for implementation of the same and finding out ways and means not to allocate budget for its implementation. They fail to see the larger picture and the effect of TPM in improving profits. As mentioned earlier in this paper, TPM implementation takes time and the top management should be willing to show patience in achieving the desired results.

4. **Work culture**: "*Keep the distance*" is practiced in many organizations. Boundaries between management and non-management staff impede flow of communication and foster indifference among employees. All employees should be involved in the decision making process. The same is true among the various departments of the organization. For example – maintenance does not fully trust operations to carry out autonomous maintenance. **Jack Welch**, former Chairman and CEO of General Electric espoused the philosophy of "*boundaryless*" where-in all barriers were removed among engineering, manufacturing, marketing and the other functions which would open the organization up to the best ideas and practices and finding a better way every day.

5. **Resistance by employees**: A common comment in Indian organizations is *"This is not my job"*. When the work culture promotes distinction and boundaries, employees view themselves as belonging to the departments in which they work and not to the organization that employ them. A narrow sense of vision hinders growth of an organization. It is the task of the management to align employees to the organization's vision and goals.

6. **Long term commitment of management and employees**: Human resource assets are to be treated with care and management should go the extra distance to make them feel at home. Remuneration and employee benefits and facilities should be at par with global levels. Employees should feel wanted in the organization and be motivated to overcome all obstacles in TPM implementation.

7. **Manpower costs**: Organizations opt for minimum manpower to cut costs. Manpower recruitment has to be done in line with the requirements the processes demand. Unfortunately, as TPM implementation is not considered a core requirement, it is not considered when manpower allocation is carried out.

8. **Non-Involvement of non-management staff**: All organizations in India have unionized staff of appreciable strength. The actual job of running the machines is done by the operators who belong to the workers union. To get TPM started, management must find time to sit with the union, take them into confidence and convince them about the benefits of TPM. The operators and lower level workers are key constituents of TPM programs. Without their involvement, TPM implementation will definitely fail.

9. **Lack of a suitable reward mechanism**: TPM implementation is unlike the normal routine activities carried out by the employees of an organization. It is a specialized job demanding specific skill sets. Employees whole heartedly invest their time and knowledge for a successful implementation and for this reason they should be publicly appreciated by the management for their efforts. A suitable reward mechanism should be instated to encourage a sense of inclusiveness to the employees.

10. **Lack of knowledge of TPM**: Many organizations are not able to successfully implement TPM due to insufficient knowledge on TPM. Before announcing and implementing TPM programs, it is imperative that organizations send senior personnel to industries where TPM has been successfully implemented to learn the nuts and bolts of TPM implementation. The failure of organizations to successfully institutionalize effective TPM implementation program is due to lack of support system to facilitate learning and transform learning into effective diffusion of the practices of TPM (***Ahuja and Khamba, 2008***). The organization's success in fully achieving the benefits of TPM through effective implementation of maintenance strategies is reliant upon the competencies of the workforce (***M. Panneerselvam, 2012).***

11. **Need for training**: To impart knowledge on TPM, extensive training schedule needs to be developed by the organization. An organization should identify the specific knowledge, skills and management abilities that it wants its employees to have and then design suitable training to achieve to develop the skills (***Suzuki T., 1994***). Organizations should be willing to spend on

training, educating and developing its employees on TPM implementation and its benefits. When compared to the benefits achieved through TPM implementation, the costs incurred on training are very minimal.

12. **Non-implementation of pilot study**: Organization wide implementation should be done only after implementing a pilot study on a specific area of requirement. This is a must to bring out the difficulties and finding solutions to the problems uncovered in the pilot study. A pilot study is very important from the view point of uncovering productivity related issues. TPM implementation should always be structured and planned with a well design pilot study.

13. **Improper constitution of teams**: Teams are integral to TPM implementation strategy. The "Team" concept on which TPM is based on should involve all departments including engineering, operations and maintenance (***B. S. Blanchard et al., 1995***). If the teams are not constituted properly, problems in the equipments cannot be detected and rectification and modification actions cannot be initiated. A team consisting of only management staff or only non-management staff or personnel from one department does not add any value. The teams should consist of personnel from the cross-section of the organization spanning all the levels and departments.

14. **Attitude towards manufacturing / production process**: This is directly related to work culture in an organization where-in frequent breakdowns are tolerated and not analyzed, processes are inefficient, product quality is not checked and customer feedback not monitored. Operators have to become involved in routine maintenance and improvement activities that halt accelerated deterioration, control contamination and help prevent equipment problems ***(Suzuki T., 1994)***.

15. **Repair driven maintenance**: This is an offshoot of attitude towards manufacturing process. In a large number of organizations, instead of carrying out maintenance jobs to avoid failure and repair, focus is on carrying out immediate repair and bringing the machine back on line as fast as possible. The focus should really be on reliability centered maintenance which implies that the function must concentrate on assuring maximum reliability in production equipment and not on quick repair time (***R. Moore, 1997***).

16. **Inability to plan design change or replacement maintenance**: In many organizations, sufficient time for maintenance of equipments is not given, pushing the maintenance crew to carry out the minimum maintenance required to restart the equipment and keep it running to meet the daily requirements. If equipment requires design change or planned replacement, it should be taken out of service for as much time as required for the maintenance activity so that it does not fail in future. The ultimate goal of the maintenance department is maintenance prevention.

17. **Maintenance management process**: To implement TPM, management and employees should embrace technology. Maintenance management process should be computerized to have ready access to the schedules and failure analysis reports, which should be uploaded on to the organization's Local Area Network. Organizations should develop preventive, predictive and corrective maintenance programs to achieve the goal of maintenance prevention.

18. **Issues in design modification**: There is a general feeling that the design given by the Original Equipment Manufacturer (OEM) is considered sacrosanct. This need not always be the case. The design would be suited for a particular process but when the process is changed to enhance efficiency and productivity, the original design need to be modified to suit the new requirement.

19. **Non-availability of Standard Operating Procedures**: SOP is a set of clearly written down instructions that document any activity followed by an organization. They document the way activities are to be performed to facilitate consistent conformance to technical and quality system requirements and assist an organization to maintain quality control and quality assurance processes (***United States Environmental Protection Agency, 2007***). Clearly written down procedures ensure that the equipments are run properly and the probability of failure is minimal.

20. **Tools and instruments**: Organizations should invest in latest state-of-the-art tools and measuring instruments for faster identification and rectification of problems arising in manufacturing processes. This will help in considerably reducing failures and breakdowns of equipments and machines.

21. **Holding large inventory**: In order to ensure that processes do not get affected due to unavailability of resources and raw materials, organizations hold enormous inventory leading to large holding and storage costs which adversely affects profits. Production planning should be done in a manner that the raw materials are available just-in-time for the process and a ready customer is available for the products.

7.0 Conclusion

As said earlier, TPM implementation is not easy. But its payoff is huge. Management has to invest in time, money and resources for a successful implementation. The organization as a whole should be dedicated and committed to TPM. This requires transformation of work culture from "*It's not my job but yours*" to "*It's our job*".

There should be free flow of communication and information both horizontally and vertically transcending all levels within an organization. Processes need to standardized and maintenance need to be planned. Routine maintenance activities require to be carried out by operators to allow maintenance personnel to schedule modification and maintenance programs. Extensive training has to be given throughout the organization on TPM and its benefits. Successful implementation of TPM initiatives can be rationally actualized in Indian manufacturing industries through a radical culture change and a zealous commitment by the top management (***M. Panneerselvam, 2012***). TPM implementation is a continuous journey and it will take years for the benefits to be visible. But the effort is worth the pain experienced in the implementation process.

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