

A STUDY ON TOTAL PRODUCTIVE MAINTENANCE TO INCREASE THE PRODUC

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Abstract:

In today's industrial scenario huge losses/wastage occur in the manufacturing shop floor. This waste is due to operators, maintenance personal, process, tooling problems and non-availability of components in time etc. Other forms of waste includes idle machines, idle manpower, break down machine, rejected parts etc. are all examples of waste. The quality related waste are of significant importance as they matter the company in terms of time, material and the hard earned reputation of the company. There are also other invisible wastes like operating the machines below the rated speed, startup loss, break down of the machines and bottle necks in process. This project deals in length about this TPM.

Total Productive Maintenance (TPM) is a maintenance program, which involves a newly

defined concept for maintaining plants and equipment. The goal of the TPM program is to increase production while, at the same time, increasing employee morale and job satisfaction. TPM brings maintenance into focus as a necessary and vitally important part of the business. It is no longer regarded as a non-profit activity. Down time for maintenance is scheduled as a part of the manufacturing day and, in some cases, as an integral part of the manufacturing process. The goal is to hold emergency and unscheduled maintenance to a minimum.

TPM was introduced to achieve the following objectives. The important ones are listed below.

- Avoid wastage in a quickly changing economic environment.
- Producing goods without reducing product quality.

- Reduce cost.
- Produce a low batch quantity at the earliest possible time.
- Goods send to the customers must be non-defective.

The TPM program closely resembles the popular Total Quality Management (TQM) program. Many of the tools such as employee empowerment, benchmarking, documentation, etc. used in TQM are used to implement and optimize TPM. Following are the similarities between the two.

1. Total commitment to the program by upper level management is required in both programs.
2. Employees must be empowered to initiate corrective action.

1.2 THEORETICAL BACKGROUND

Introduction:

In today's industrial scenario huge losses/wastage occur in the manufacturing shop floor. This waste is due to operators, maintenance personal, process, tooling problems and non-availability of components in time etc. Other forms

of waste includes idle machines, idle manpower, break down machine, rejected parts etc are all examples of waste. The quality related waste are of significant importance as they matter the company in terms of time, material and the hard earned reputation of the company. There are also other invisible wastes like operating the machines below the rated speed, start up loss, break down of the machines and bottle necks in process. Zero oriented concepts such as zero tolerance for waste, defects, break down and zero accidents are becoming a pre-requisite in the manufacturing and assembly industry. In this situation, a revolutionary concept of TPM has been adopted in many industries across the world to address the above said problems. This project deals in length about this TPM.

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4. Employees must be empowered to initiate corrective action.

5. A long-range outlook must be accepted as TPM may take a year or more to implement and is an on-going process. Changes in employee mind-set toward their job responsibilities must take place as well.

The differences between TQM and TPM are summarized below.

1. In TQM, object is quality while in TPM, equipment is the object.
2. TQM is software oriented while TPM is hardware oriented.

TPM History:

TPM is an innovative Japanese concept. The origin of TPM can be traced back to 1951 when preventive maintenance was introduced in Japan. However the concept of preventive maintenance was taken from USA. Nippondenso was the first company to introduce plant wide preventive maintenance in 1960. Preventive maintenance is the concept wherein, operators produced goods using machines and the maintenance group was dedicated with work of maintaining those machines, however with the automation of Nippondenso, maintenance became a problem, as more maintenance personnel were required. So the management decided that the operators would carry out the routine maintenance of equipment. (This is Autonomous maintenance, one

of the features of TPM). Maintenance group took up only essential maintenance works.

Thus Nippondenso, which already followed preventive maintenance, also added Autonomous maintenance done by production operators. The maintenance crew went in the equipment modification for improving reliability. The modifications were made or incorporated in new equipment. This lead to maintenance prevention. Thus preventive maintenance along with Maintenance prevention and Maintainability Improvement gave birth to **Productive maintenance**. The aim of productive maintenance was to maximize plant and equipment effectiveness. By then Nippon Denso had made quality circles, involving the employee's participation. Thus all employees took part in implementing Productive maintenance. Based on these developments Nippondenso was awarded the distinguished plant prize for developing and implementing TPM, by the Japanese Institute of Plant Engineers (JIPE). Thus Nippondenso of the Toyota group became the first company to obtain the TPM certification.

TPM Target:

1. Obtain Minimum 90% OEE (Overall Equipment Effectiveness)

2. Run the machines even during lunch. (Lunch is for operators and not for machines!)
3. Operate in a manner, so that there are no customer complaints.
4. Reduce the manufacturing cost by 30%.
5. Achieve 100% success in delivering the goods as required by the customer.
6. Maintain an accident free environment.
7. Increase the suggestions from the workers/employees by 3 times. Develop Multi-skilled and flexible workers.

OEE (Overall Equipment Efficiency):

The basic measure associated with Total Productive Maintenance (TPM) is the OEE. This OEE highlights the actual "Hidden capacity" in an organization. OEE is not an exclusive measure of how well the maintenance department works. The design and installation of equipment as well as how it is operated and maintained affect the OEE. It measures both efficiency (doing things right) and effectiveness (doing the right things) with the equipment. It incorporates three basic indicators of equipment performance and reliability. Thus OEE is a function of the three factors mentioned below.

1. Availability or uptime (downtime: planned and unplanned, tool change, tool service, job change etc.)
2. Performance efficiency (actual vs. design capacity)
3. Rate of quality output (Defects and rework)

OEE = A x PE x Q

A - Availability of the machine. Availability is proportion of time machine is actually available out of time it should be available.

Availability = (Planned production time – unscheduled downtime) / Planned production time
Production time = Planned production time – Downtime

Gross available hours for production include 365 days per year, 24 hours per day, and 7 days per week. However this is an ideal condition. Planned downtime includes vacation, holidays, and not enough loads. Availability losses include equipment failures and changeovers indicating situations when the line is not running although it is expected to run.

PE - Performance Efficiency. The second category of OEE is performance. The formula can be expressed in this way:

Performance (Speed) = (Cycle time x Number of products processed) / Production time

Net production time is the time during which the products are actually produced. Speed losses, small stops, idling, and empty positions in the line indicate that the line is running, but it is not providing the quantity it should.

Q - Refers to quality rate. Which is percentage of good parts out of total produced? Sometimes called “yield”. Quality losses refer to the situation when the line is producing, but there are quality losses due to in-progress production and warm up rejects. We can express a formula for quality like this:

Quality (Yield) = (Number of products processed – Number of products rejected) / (Number of products processed)

A simple example on how OEE is calculated is shown below.

- Running 70 percent of the time (in a 24-hour day)
- Operating at 72 percent of design capacity (flow, cycles, units per hour)
- Producing quality output 99 percent of the time

When the three factors are considered together (70% availability x 72% efficiency x 99% quality), the result is an overall equipment effectiveness rating of 49.9 percent.

Stages in TPM implementation:

Step A - PREPARATORY STAGE:

STEP 1 - Announcement by Management to all about TPM introduction in the organization:

Proper understanding, commitment and active involvement of the top management is needed for this step. Senior management should have awareness programmes, after which announcement is made. Decision to implement TPM is published in the in-house magazine, displayed on the notice boards and a letter informing the same is sent to suppliers and customers.

STEP 2 - Initial education and propaganda for TPM:

Training is to be done based on the need. Some need intensive training and some just awareness training based on the knowledge of employees in maintenance.

STEP 3 - Setting up TPM and departmental committees:

TPM includes improvement, autonomous maintenance, quality maintenance etc., as part of it. When committees are set up it should take care of all those needs.

STEP 4 - Establishing the TPM working system and target:

Each area/work station is benchmarked and target is fixed up for achievement.

STEP 5 - A master plan for institutionalizing:

Next step is implementation leading to institutionalizing wherein TPM becomes an organizational culture. Achieving PM award is the proof of reaching a satisfactory level.

STEP B - INTRODUCTION STAGE

A small get-together, which includes our suppliers and customer's participation, is conducted. Suppliers as they should know that we want quality supply from them. People from related companies and affiliated companies who can be our customers, sister concerns etc. are also invited. Some may learn from us and some can help us and customers will get the message from us that we care for quality output, cost and keeping to delivery schedules.

STAGE C - IMPLEMENTATION

In this stage eight activities are carried which are called eight pillars in the development of TPM activity. Of these four activities are for establishing the system for production efficiency, one for initial control system of new products and equipment, one for improving the efficiency of administration and

are for control of safety, sanitation as working environment.

STAGE D - INSTITUTIONALISING STAGE

By now the TPM implementation activities would have reached maturity stage. Now is the time to apply for TPM award. (Following fig shows pillars of TPM

Applications:

2.1 OBJECTIVE OF THE PROJECT

For successful research to be carried out defining of the objective is very important because it makes clear for the researcher the problem & the ways to find out the solution for it. The project is carried out so as to ascertain the importance of TPM among workers.

Main Objectives:

The main objectives include:

- 1> To study of basic concept of TPM.
- 2> To study of worker's perception about TPM.
- 3> To study the effectiveness of TPM on overall productivity of the organization.

2.1.1 SEVEN PILLARS OF TPM

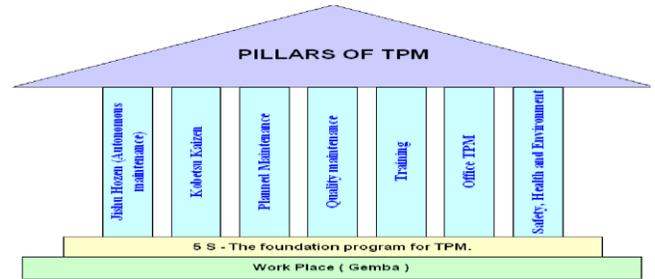


Fig.Seven Pillars of TPM

Above fig shows the major pillars of TPM on which it is based mainly. All these pillars are explained briefly as follows.

Autonomous maintenance:

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.

Policy:

1. Uninterrupted operation of equipment's.
2. Flexible operators to operate and maintain other equipment's.
3. Eliminating the defects at source through active employee participation.

Steps in AM (JISHU HOZEN):

1. Preparation of employees.
2. Initial cleanup of machines.
3. Take counter measures
4. Fix tentative JH standards
5. General inspection
6. Autonomous inspection
7. Standardization and

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.

Planned Maintenance:

It is aimed to have trouble free machines and equipment's producing defect free products for total customer satisfaction. This breaks maintenance down into four "families" or groups, which was defined earlier.

1. Preventive Maintenance
2. Breakdown Maintenance
3. Corrective Maintenance
4. Maintenance Prevention

Quality Maintenance:

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).

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.

Office TPM:

Office TPM should be started after activating four other pillars of TPM (JH, Kaizen, QM, and PM). 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

1. Processing loss
2. Cost loss including in areas such as procurement, accounts, marketing, sales leading to high inventories
3. Communication loss
4. Idle loss
5. Set-up loss
6. Accuracy loss
7. Office equipment breakdown
8. Communication channel breakdown, telephone and fax lines
9. Time spent on retrieval of information
10. Non availability of correct on line stock status
11. Customer complaints due to logistics
12. Expenses on emergency dispatches/purchases.

Safety Health & Environment:

Target:

1. Zero accident,
2. Zero health damage
3. Zero fires.

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. A committee is constituted for this pillar, which comprises representative of officers as well as workers. Senior vice President (Technical) heads the committee. Utmost importance to Safety is given in the plant. Manager (Safety) is looking 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.

TPM training program was conducted recently & implemented subsequently by the management of PTL. They were keen to know the feedback from the workers & the outcome of TPM.

Therefore the project is conducted in which the feedback is taken directly from all the workers of following different units which are directly involved in the manufacturing process of the gear boxes.

- Production unit
- Welding unit

- Assembly unit
- Paint unit
- Quality control unit

As TPM is continuous process it is not one time program, it should be evaluated on regular basis. TPM can be applied at each & every sphere of organization functioning, but this project deals with TPM implementation of above mentioned units. Following are the basic reasons for selecting the topic for the project.

- To know the concept of TPM.
- To understand the TPM implementation process.
- To know the outcome of TPM implementation.
- To know the extent in which TPM has been understood by workers.
- To know whether TPM has been implemented properly & to know the scope for its further improvement.

2.2 5S Of TPM:

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, hence in the above figure, 5s has been positioned in the base. **If this 5S is not taken up seriously, then it leads to 5D. They are Delays, Defects, Dissatisfied customers, declining profits and Demoralized employees.**

Japanese Term	English Translation	E
<i>Seiri</i>	Organization	S
<i>Seiton</i>	Tidiness	S
<i>Seiso</i>	Cleaning	S
<i>Seiketsu</i>	Standardization	S
<i>Shitsuke</i>	Discipline	S

2.3 Research Design for the Project:

A research design is simply the framework or the plan for study that is used in collecting & analyzing the data. For the project carried out at PTL, following are the research design parameters.

Research Approach: Direct/Descriptive

Element: Workers

Data Collection Method:

Secondary Data:

The secondary data was collected from company data bank and company catalogue, Journals

and company files. The data was also collected through internet and other sources.

Primary data:

The primary data was collected through a structured questionnaire and by taking interview of all the workers.

2.3 Limitations of the study:

The major limitation of the project is that TPM is continuous non ending activity it takes several years to understand & implement it cannot be judged instantly. Following are some of the major limitations.

- ✓ Typically people show strong resistance to interview or questionnaire.
- Assembly unit (15 Workers per shift)
- Paint unit (5 Workers per shift)
- Quality control unit (2 Workers per shift)

As PTL operates in three shifts in all 45 workers per shift, i.e. $45 * 3 = 135$ workers were asked questions & interviewed simultaneously.

4.1 OBSERVATIONS & FINDINGS

Observations:

- ✓ Many people treat it just another “Program of the month” without paying any focus and also doubt about the effectiveness.
- ✓ Insufficient understanding of the methodology and philosophy of TPM.
- ✓ Many people considered TPM activities as additional work/threat.

3.1 DATA COLLECTION & DATA ANALYSIS

Questionnaire was prepared at PTL, Chinchwad, Pune & census method was adopted for data collection for below units only.

- Production unit (20 Workers per shift)
- Welding unit (3 Workers per shift)

- ✓ It has been observed that majority of the worker are in favor with TPM implementation.

- ✓ Majority of the worker think that top management must be involved in the TPM implementation.
- ✓ Majority of the worker are busy in working cannot give sufficient time for the interview or questionnaire.
- ✓ The worker which is working since long time found bias.

Findings:

- ✓ 80% workers are aware of TPM implementation program by management & 20% are not.
- ✓ 73% workers think that they have received sufficient TPM knowledge thro' training program arranged by PTL, 27% don't think so.
- ✓ 69% of the workers of the opinion that TPM committee has been set up by PTL, remaining workers having opposite opinion.
- ✓ 66% workers are satisfied with the basic needs provided which are required to follow TPM while 34% is not satisfied with it.
- ✓ According to 44% workers TPM master plan has been prepared, 56% workers are not agree with this.
- ✓ 81% workers said target has been set thro' TPM plan, 19% do not agree with this.
- ✓ 69% workers think that productivity has increased considerably, 60% said that reduction in customer complaint, 41% said reduced accidents, 79% said about workplace, 83% said reduced machine failures & 73% think that boosted work satisfaction as outcome of TPM
- ✓ 70% of the workers said good about productivity, 8% said it is very good; balance workers are not satisfied with the productivity post TPM.
- ✓ 58% workers of the opinion that TPM assessment takes place on regular basis, 42% don't think so.
- ✓ 47% said that appreciation of their work takes place balance workers are not agree with this.
- ✓ 57% workers think that TPM made considerable changes in the working condition while balance 43% workers are not agreeing with this.
- ✓ 75% workers rates TPM as very good, 9% think it is excellent, balance are just ok with TPM implementation.
- ✓ As per 65% workers top management should be involved actively in TPM implementation, 55% think TPM training content should be enriched, 69% think that committee members need to be proactive, 75% agrees that master plan has to be there, 71% are not ok with

assessment & 83% think that after successfully following TPM their efforts should be appreciated.

These are all major observations & findings.

4.2 CONCLUSION

In the era of advanced technology, organizations have to keep updating themselves to face the competition. There are various programs which are required to implement so that the organizations can survive. TPM is one of the effective tools available with the management. In PTL, recently TPM training was conducted & implemented subsequently. The project studies the post TPM implementation scenario so that effectiveness of TPM can be understood. Worker's point view is studied in this project which focuses mainly on **training content, basic needs, participation from top management, TPM planning, assessment & appreciation related to TPM.**

It can be concluded that workers are definitely interested to make their work place better so that along with their personal goals, professional goals can be achieved. If everyone involved in TPM program does his/her job seriously, high rate of return is guaranteed. Though there are difficulties in

implementing TPM initially with the active participation of workers & management it can be resolved. TPM is continuous process it can't be judged instantly, the assessment has to take place on regular basis. The project tries to find out the post TPM implementation scenario, so that management can understand the effectiveness of TPM & worker's view or stand on TPM.

One of the major advantages of TPM is that work satisfaction & increase in the morale of the workers, major limitation is that the philosophy of TPM needs to be understood correctly. Not only on shop floor but also in all functioning of the organization such as purchasing, logistics, TPM can be applied effectively so that each & every employee of the organization can take advantage of TPM making organization better place to work.

4.3 SUGGESTIONS

- ✓ PTL has to improve the training content of TPM.
- ✓ Basic needs of the workers which are required to follow TPM should be satisfied.
- ✓ Along with top management, TPM committee members need active participation in TPM activities.

- ✓ Effective TPM planning is essential for the success of the organization.
- ✓ Assessment & appreciation need to carry out effectively.
- ✓ Though majority of the workers gives good rating to TPM, in order to make it 100%, the problems faced by other workers need to be resolved.

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