Total Productive Maintenance

Introduction

- video

TPM

TPM is a productive maintenance implemented by all employees in an organization.

TPM involves everyone in the organization from operators to senior management in equipment improvement.

TPM in three words:

Total = All individuals in the organization working together.

Productive = production of goods that meet or exceed customer's expectations.

Maintenance = keeping equipment and plant in good condition at all times.

History

- This is an innovative Japanese concept.
- Developed in 1951.
- Nippondenso was the 1st company that implemented TPM in 1960.
- Based on these developments Nippondenso was awarded the distinguished plant prize for developing and implementing TPM, by the Japanese Institute of Plant Engineers (JIPE).
- This Nippondenso became the first company to obtain the TPM certifications.

GOALS :

- Increase production quality.
- Increase job satisfaction.
- Using teams for continuous improvement.

CONTINUOUS PROCESS IMPROVEMENT

- Improve the state of **maintenance**
- Empower employees

Why TPM:

- Avoid wastage in quickly changing economic environment.
- Producing goods with out reducing product quality.
- Reduce cost for production
- Produce a low batch quantity at the earliest time.
- Goods send to the customer must be non defective.

Principles of TPM

- Use Overall Equipment Effectiveness (OEE) as a compass for success.
- Improve existing planned maintenance systems
- Work toward zero losses
- Providing training to upgrade operations and maintenance skills
- Involve everyone and utilize cross-functional teamwork

Types of maintenance

- Breakdown maintenance
- Preventive maintenance

  .periodic maintenance(time based maintenance)
  .Predictive maintenance

- Corrective maintenance
- Maintenance prevention

Breakdown maintenance

- Repairs or replacements performed after a machine has failed to return to its functional state following a malfunction or shutdown.
- e.g., an electric motor of a machine tool will not start, a belt is broken, etc.
- Under such conditions, production department calls on the maintenance department to rectify the defect.
- After removing the fault, maintenance engineers do not attend the equipment again until another failure or breakdown occurs.

Preventive maintenance(1951)

- The primary goal of preventive maintenance is to prevent the failure of equipment before it actually occurs.
- It is designed to preserve and enhance equipment reliability by replacing worn components before they actually fail.
- It is a daily maintenance which includes cleaning, inspection, oiling and re-tightening of equipments.

Long-term benefits of preventive maintenance:

- Improved system reliability.
- Decreased cost of replacement.
- Decreased system downtime.
- Better spares inventory management.

Periodic maintenance (TBM)

- Time based maintenance consists of periodically inspecting, servicing and cleaning equipment and replacing parts to prevent sudden failure and process problems.

Benefits:

- Extended life and use of the equipment.
- Reliable production at the times when machine is needed most.

Predictive maintenance

- This is a method in which the service life of important part is expected based on inspection or diagnosis, in order to use the parts to the limit of their service life.

- Compared to periodic maintenance, predictive maintenance is condition based maintenance.

Benefits of predictive maintenance

- Increased plant readiness due to greater reliability of the equipment.
- Many industries report from two to ten percent productivity increases due to predictive maintenance practices.
- Reduced expenditures for spare parts and labor.
- Reduces the probability of a machine experiencing a disastrous failure, and this results in an improvement in worker safety.

Corrective maintenance (1957)

- Maintenance actions carried out to restore a defective item to a specified condition
- Corrective maintenance is probably the most commonly used approach, but it is easy to see its limitations.
- When equipment fails, it often leads to downtime in production.
- In most cases this is costly business. Also, if the equipment needs to be replaced, the cost of replacing it alone can be important.
- It is also important to consider health, safety and environment (HSE) issues related to malfunctioning equipment.

Maintenance prevention (1960)

- It indicates the design of a new equipment.
- Weakness of current machines are sufficiently studied (on site information leading to failure prevention, easier maintenance and prevents of defects, safety and ease of manufacturing) and are incorporated before commissioning a new equipment.

5S Philosophy

- Based on five Japanese words that begin with ‘S’, the 5S Philosophy focuses on effective work place organization and standardized work procedures.

5 S’s

1. Sort :(Seiri)
2. Set In Order:(Seiton)
3. Shine: (Seiso)
4. Standardize: (Seiketsu)
5. Sustain: (Shitsuke)

Sort :(Seiri)

- The first S focuses on **eliminating unnecessary items from the workplace**.
- An effective visual method to identify these unneeded items is called red tagging.
- A red tag is placed on all items not required to complete your job. These items are then moved to a central holding area.
- This process is for evaluation of the red tag items.

Set In Order:(Seiton)

- second S focuses on efficient and effective storage methods and how to **organize the work area.**
- Strategies for effective Set In Order are painting floors, outlining work areas and locations, shadow boards, and modular shelving and cabinets for needed items such as trash cans, brooms, mop and buckets

Shine: (Seiso)

- Once you have eliminated the clutter and junk that has been clogging your work areas and identified the necessary items, the next step is to thoroughly **clean the work area.**
- Workers will also begin to notice changes in equipment and facility location such as air, oil, coolant leaks, fatigue, breakage, and misalignment.
- These changes, if left unattended, could lead to equipment failure and loss of production.

Standardize: (Seiketsu)

- Now the first three S's are implemented.
- **Use standard methods** to keep Sort, Set In Order, and Shine to a condition .
- Allow your employees to participate in the development of such standards.

Sustain: (Shitsuke)

- This is the most difficult S to implement and achieve.
- Maintain through empowerment, commitment, and discipline .
- Sustain focuses on defining a new status quo and standard of work place organization.

Benifits of 5 S's

- Simplifies work environment
- reduces waste
- Improves quality
- Improves safety
- Provide self esteem for everyone in the organization.

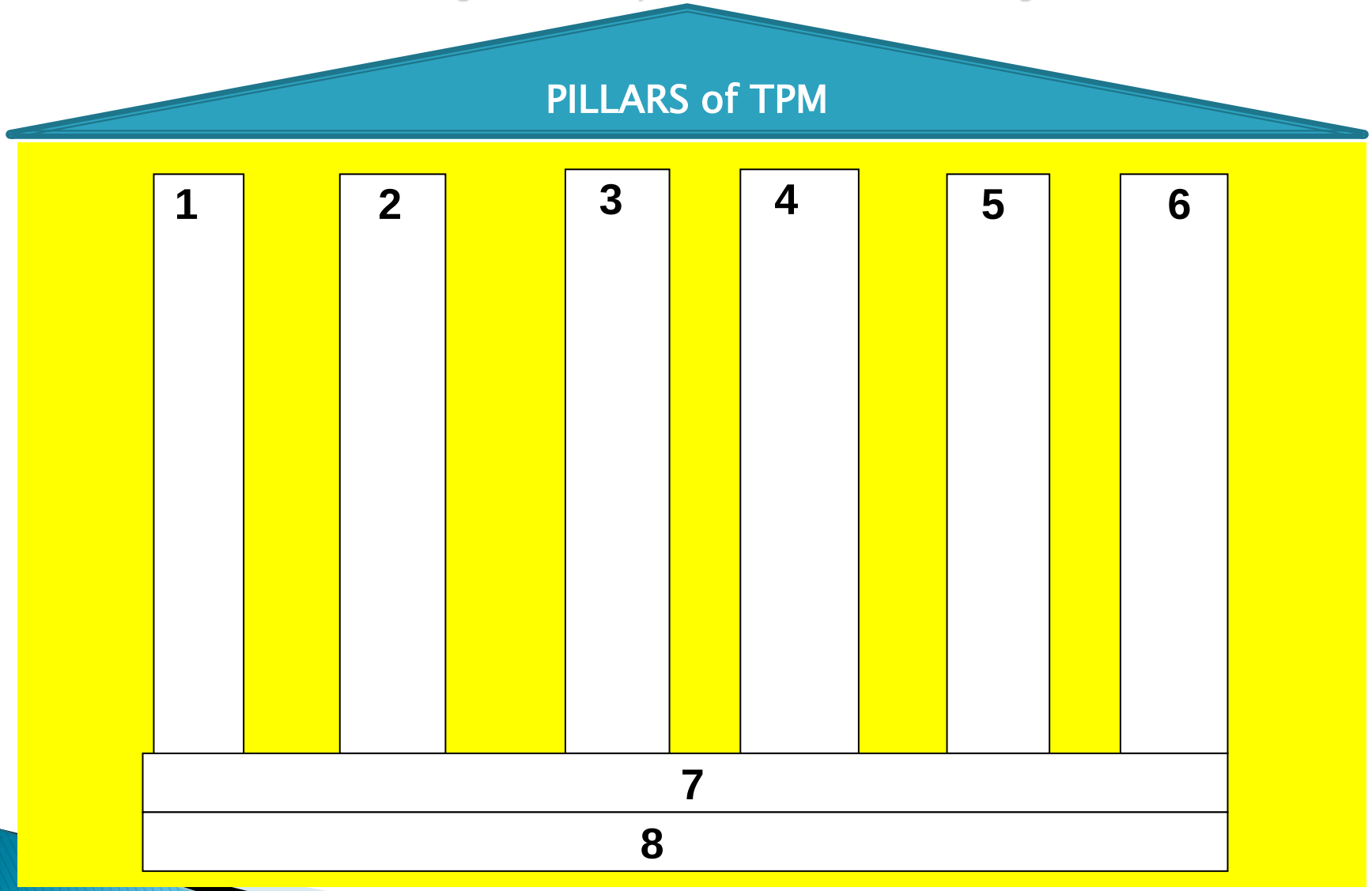
Similarities b/w TQM & TPM

- Total commitment to the program by upper level management is required in both programs.
- Employees must be empowered to initiate corrective action, and
- A long range outlook must be accepted, as TPM may take a year or more to implement.
- It is an on-going process which is a continuous process improvement.

Differences between TQM and TPM

Category	TQM	TPM
Object	Quality (Output and effects)	Equipment (Input and cause)
Mains of attaining goal	Systematize the management. It is software oriented	Employees participation and it is hardware oriented
Target	Quality for PPM	Elimination of losses and wastes.

1.Autonomous maintains 2.Planned maintains 3. Equipment and process improvement 4.Early management of new equipment 5.process quality management 6.TPM in the office 7.education and training 8.saftey and environmental management.



Autonomous Maintenance (1)

- Train the operators to close the gap between them and the maintenance staff, making it easier for both to work as one team
- Change the equipment so the operator can identify any abnormal conditions and measure before it affects the process or leads to a failure

Autonomous Maintenance (2)

- Seven (7) steps are implemented to progressively increase operators knowledge, participation and responsibility for the equipment.
- 1. perform initial cleaning and inspection
- 2.Countermeasures for the causes and effects of dirt and dust
- 3.Eastblish cleaning and lubrication standards
- 4.Counducting general inspection training
- 5.Carry out equipment inspection checks
- 6.workplace management and controls
- 7.Continious improvement

Equipment and process improvement (3)

- Objectives: Maximize efficiency by eliminating waste and manufacturing loss
- Manufacturing losses are categorized into 13 bid losses:

- Equipment losses (6)
- Manpower losses (4)
- Material losses (3)

Equipment losses

- DOWNTIME LOSS
  - Equipment failure / breakdowns
  - Set-up / adjustments
- Speed loss
  - Minor stopping
  - Reduced speed
- Quality loss
  - Process errors
  - Rework / scrap

Manpower and material losses

Manpower losses

- Cleaning and checking
- Waiting materials
- Waiting instructions
- Waiting quality confirmation

Material losses

- Material yield
- Energy losses

Overall Equipment Effectiveness

- OEE figures are determined by combining the availability and
  performance of your equipment with the quality of parts made

- OEE measures the efficiency of the machine during its loading time.
  Planned downtime does not effect the OEE figure

Overall Equipment Effectiveness (OEE)

Overall equipment effectiveness = Availability * performance * Quality yield

Availability	Downtime loss
Performance	Speed loss
Quality Yield	Quality loss

Overall Equipment Effectiveness (OEE)

Overall Equipment Effectiveness = Availability *performance * Quality yield

Availability = $\frac{\text{Time available for production -- Downtime}}{\text{Time available in production}}$

Performance = $\frac{\text{Ideal cycle time * number of parts produced}}{\text{Operating time}}$

Quality Yield = $\frac{\text{total number of parts produced – defect number}}{\text{Total number of parts produced}}$

Planned maintains

- Objectives : Establish preventative and predictive maintenance system for equipment and tooling
- Natural life cycle of individual machine elements must be achieved
- correct operation
- correct set-up
- cleaning
- lubrication
- feedback and repair of minor defects
- quality spare parts

Early management of new equipments

- Objective: establish system to shorter
- new production or equipment development
- start-up, commissioning and stabilization time for quality and efficiency
- New equipment need to be :
- easy to operate
- easy to clean
- easy to maintain and reliable
- have quick set-up times
- operate at the lowest life cycle cost

Process quality management

- Definition: a process for controlling the condition of equipment components that affect variability in product quality
- Objectives: to set and maintain condition to accomplish zero definition
- Quality rate has direct correlation with

- material condition
- equipment precision
- production methods
- process parameters

TPM in administration and support department

- Administration and support departments can be seen as process plans whose principles tasks are to collect, process and distribute information.
- Process analysis should be applied to streaming information flow

Education and training

- TPM is a continuous learning process
- Two major components :
- soft skills training : how to work as a team, diversity training and communication skills
- Technical training : upgrading problem-solving and equipment-related skills

Safety and environmental management

- Assuring safety and preventing adverse environment impacts are important priority in ant TPM effort

Requirement and fundamental improvements

- Increasing motivation: changing people attitudes
- Increasing competency and people skills
- Improving the work environment, so that it support the establishment of a program for implementing TPM

TPM Implementation

preparation	Announcement to TQM introduction Introductory education campaign for workforce TPM promotion Establish basic TPM policies and goals Preparation and formulation of a master plan
Kick-off	Invite customers, attitude companies and subcontractors
implementation	Develop an equipment management program Develop a plan maintenance program Develop a Autonomous maintenance program Increasing skills of production and maintenance personals Develop early equipment management program
Stabilization	Perfect TPM implementation and raise TPM levels

Announce top management decision to introduce TPM

- State TPM objectives in a company newsletter
- Place articles on TPM in a company newspaper

Introductory education campaign

- Seminars for managers
- Slide presentation for all employs

TPM Promotion

- Special committees at every level to promote TPM
- Newsletter
- Articles
- Videos
- Posters

Establishing basic TPM policies and goals

- Analyze existing conditions
- Set goals
- Predicting results

Preparation and Formulation of a master plan

- A master plan lays out your goals, what you will do to achieve them and when you will achieve them
- Detailed plans for each pillar have to be prepared

TPM Kick-off

- The main kick-off to TPM should take the form of a formal presentation with all the employees attending
- This opportunity can be used to gain the full support of the employees
- Invite external customers, affiliation and subcontracting companies

Develop an equipment management program

- The principle of designing for maintenance prevention can be new products, and to new existing machines
- New products: must be designed so that they can be easily produced on new existing machines
- New machines : must be designed for easier operation, changeover and maintenance
- Existing machines:
- Determine how to eliminate the problem and reduce maintenance through an equipment design change or by changing the process

TPM Benefits

- Increase equipment productivity
- Reduced equipment downtime
- Increased plan capacity
- Lower maintenance and production cost
- Approaching zero equipment-caused defects
- Enhance job satisfaction
- Increase return on investment

Human knot activity:

- **Instructions**
- Step1
- Stand in a circle with a group of at least four people.
- Step2
- Use your right hand to grab the right hand of the person directly across from you.
- Step3
- Use your left hand to grab the left hand of the person to the right of the person holding your other hand.
- Step4
- Untangle, as a group, back into one open circle, without letting go of hands or dislocating any joints.

Focus on Change

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conclusion

- TPM may be the only thing that stands between success and total failure for some companies.
- It can be adapted to work not only in industrial plants, but in construction, building maintenance, transportation, and in a variety of other situations.