Total Productive Maintenance

1. TPM definition

Total

- all employees are involved
- it aims to eliminate all accidents, defects and breakdowns

Productive

- actions are performed while production goes on
- troubles for production are minimized

Maintenance

- keep in good condition
- repair, clean, lubricate

1. TPM definition

TPM combines the traditionally American practice of preventive maintenance with Total Quality Control and Total Employee Involvement, to create a culture where operators develop ownership of their equipment, and become full partners with Maintenance, Engineering and Management to assure equipment operates properly everyday.

2. Origins of TPM

Dr. Deming introduced statistical analysis and used the resulting data to control quality during manufacturing (TQM)

Some general concepts of TQM did not work well in the maintenance environment

The need to go further than preventive maintenance was quickly recognized by those companies who were committed to TQM

3. TPM principles

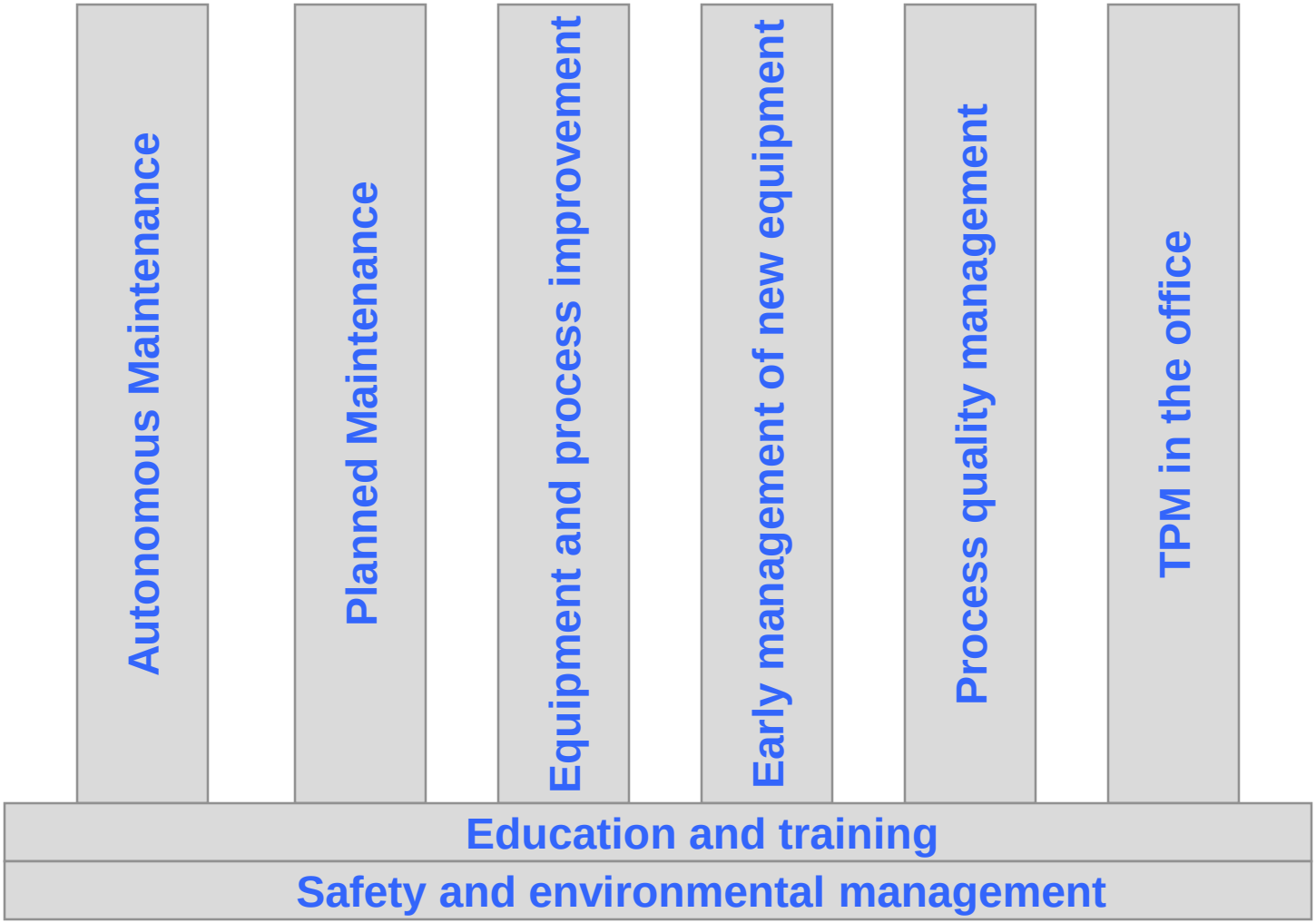
Increase Overall Equipment Effectiveness (OEE)

Improve existing planned maintenance systems

Provide training to upgrade operations and maintenance skills

Involve everyone and utilize cross-functional teamwork

4. Eight major pillars of TPM



4. Eight major pillars of TPM

4.1. 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 deterioration before it affects the process or leads to a failure

4. Eight major pillars of TPM
4.1. Autonomous Maintenance (2)

7 steps are implemented to progressively increase operators knowledge, participation and responsibility for their equipment

1. Perform initial cleaning and inspection
2. Countermeasures for the causes and effects of dirt and dust
3. Establish cleaning and lubrication standards
4. Conduct general inspection training
5. Carry out equipment inspection checks
6. Workplace management and control
7. Continuous improvement

4. Eight major pillars of TPM
4.2. Equipment and process improvement

Objective: maximize efficiency by eliminating waste and manufacturing losses

Manufacturing losses are categorized into 13 big losses:

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

4. Eight major pillars of TPM

4.2. Equipment and process improvement

4.2.1. Equipment losses

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

4. Eight major pillars of TPM

4.2. Equipment and process improvement

4.2.2. Manpower and material losses

Manpower losses

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

Material losses

- Material yield
- Energy losses
- Consumable material losses

4. Eight major pillars of TPM

4.2. Equipment and process improvement

4.2.3 Overall Equipment Effectiveness (OEE)

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

OEE measures the efficiency of the machine during its planned loading time.

4. Eight major pillars of TPM

4.2. Equipment and process improvement

4.2.3 Overall Equipment Effectiveness (OEE)

Overall Equipment Effectiveness = Availability x Performance x Quality Yield	
Availability	Downtime loss
Performance	Speed loss
Quality Yield	Quality loss

4. Eight major pillars of TPM
4.3. Planned maintenance

Objective: establish Preventative and Predictive Maintenance systems for equipment and tooling

Natural life cycle of individual machine elements must be achieved

- Correct operation
- Correct set-up
- Cleaning
- Lubrication
- Retightening
- Feedback and repair of minor defects

4. Eight major pillars of TPM
4.4. Early Management of new equipment

Objective: establish systems to shorten

- new product or equipment development
- start-up, commissioning and stabilization time for quality and efficiency

New equipment needs 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

4. Eight major pillars of TPM
4.5. Process Quality Management

Definition: a process for controlling the condition of equipment components that affect variability in product quality

Objective: to set and maintain conditions to accomplish zero defects

Quality rate has a direct correlation with

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

4. Eight major pillars of TPM

4.6. TPM in administrative and support departments

Administrative and support departments can be seen as process plants whose principal tasks are to collect, process, and distribute information

Process analysis should be applied to streamline information flow

4. Eight major pillars of TPM
4.7. Education and training

TPM is a continuous learning process.

2 major components

- soft skills training: how to work as teams, diversity training and communication skills
- technical training: upgrading problem-solving and equipment- related skills

4. Eight major pillars of TPM

4.8. Safety and environmental management

Assuring safety and preventing adverse environmental impacts are important priorities in any TPM effort

5. TPM implementation

3 requirements for fundamental improvement

Increasing motivation: changing peoples attitudes

Increasing competency and peoples skills

Improving the work environment, so that it supports the establishment of a program for implementing TPM

6. TPM Benefits

Increased equipment productivity

Reduced equipment downtime

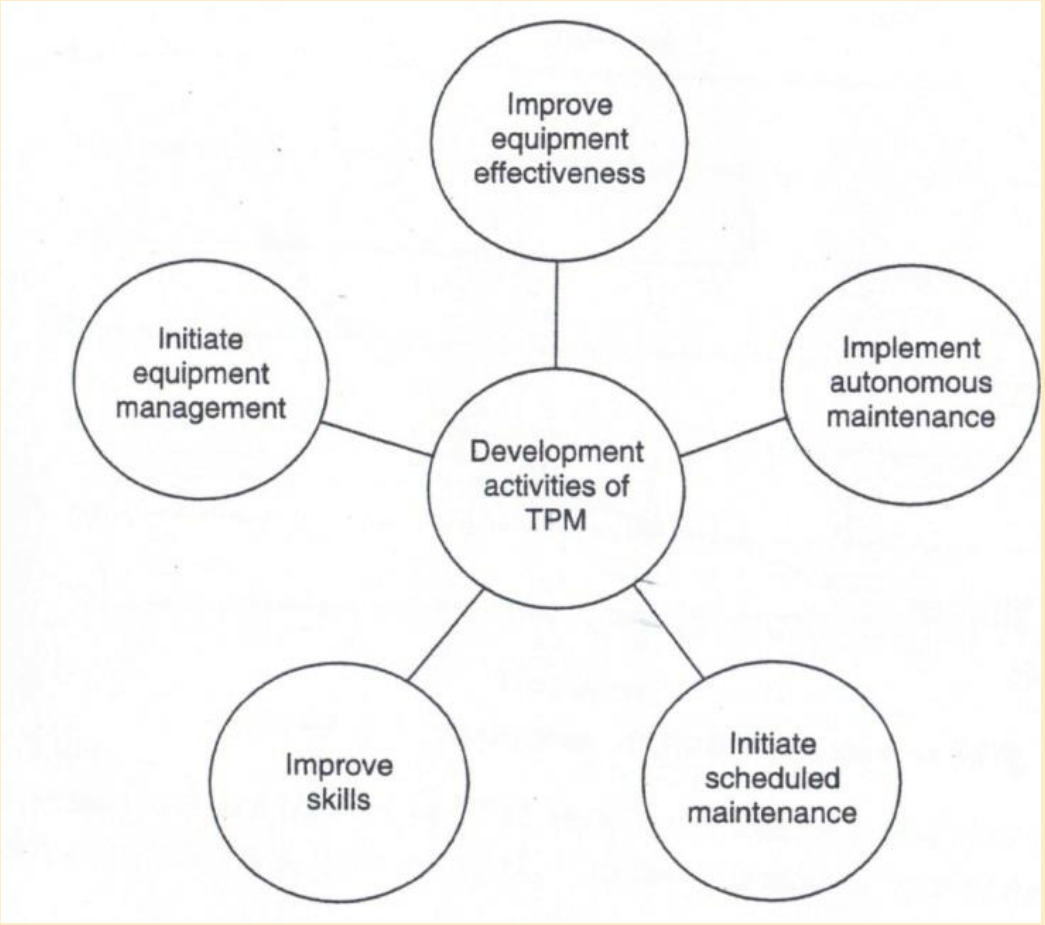
Lower maintenance and production costs

Approaching zero equipment-caused defects

Enhanced job satisfaction

Increased Return On Investment

THE BASIC CONDITION APPLICABLE FOR TPM SUCESS



IMPROVE EQUIPMENT EFFECTIVENESS

It is not the available time but the actual time a machine is productive. If the equipment effectiveness is less, then it creates maximum waste.

Causes for losses in equipment available time are:

- Planned maintenance time
- Unplanned machine time
- High set up time
- Poor performance efficiency
- First time pass rate

Overall equipment effectiveness

Machine	Drill and tap centre	Shop	Water pump line
Shift time-minutes	480	planned production/shift	200
Planned maintenance time	25	Actual production	160
Downtime (average/shift)	35	Performance efficiency	80%
Average setup time	30	First-time pass rate	99%
Available time	390		
Availability %	= 390/480 = 81.25%		
Overall equipment effectiveness	= 0.81 x 0.99 x 0.80		64%

IMPROVE EQUIPMENT EFFECTIVENESS

- If the equipment effectiveness is more than 85 percent, then it is close to the world class.

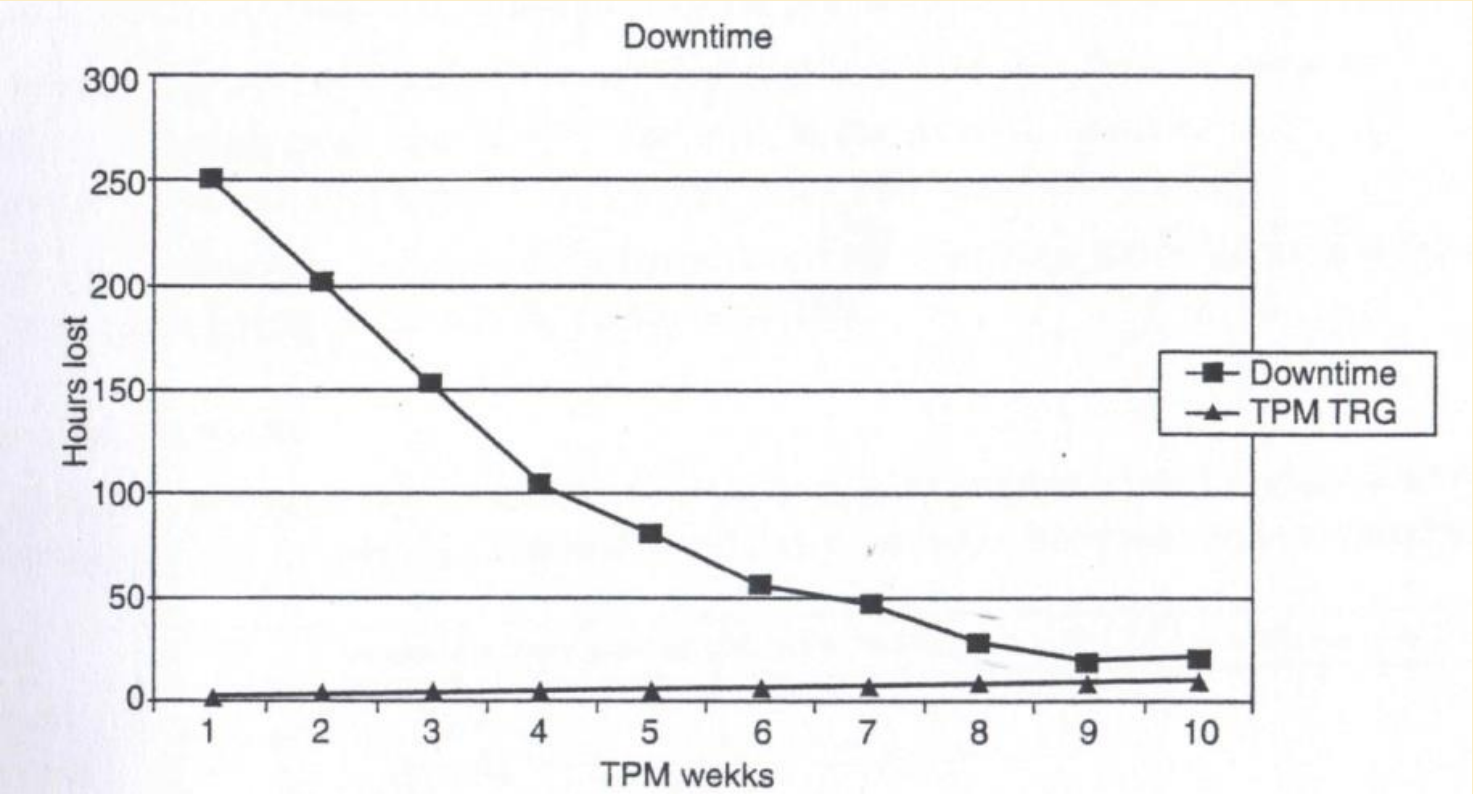
IMPLEMENT AUTONOMOUS MAINTENANCE

- Clean the machine/ equipment thoroughly
- Identify the reason for dirt/ dust
- Create standards for lubrication with specific area and time
- Identify if there are any abnormalities in air pressure, lubrication, tightness of bolts and nuts, electrics, create hydraulics and moving parts
- Establish appropriate standards to be followed but the operator
- Make sure the operators are trained in the standards and they follow strictly

IMPLEMENT SCHEDULED MAINTENANCE

- The scheduled maintenance should be performed on a planned date in consultation with shop.
- In addition to preventive maintenance, weekly and monthly maintenance need to be planned and executed.

Improve skills



Improve skills

- The operators operational and maintenance skills to be improved.
- The operators should be given intense training on various aspects of machine maintenance.
- TPM aims at: achieve optimal equipment conditions and achieve optimal human performance.

Initiate equipment management

- It is necessary to initiate history cards for the machines and record all the actions taken.
- Maintenance dept should share all vital maintenance data with shop managers.
- Required spares are to be planned and ordered along with the machine.

TPM implementation process

- Announce the top management decision to implement TPM
- Establish vision and strategies
- Formulate a master plan
- Form cross functional team
- Training to employee of the organization
- Hold TPM kick off event
- Identify/ calculate equipment effectiveness
- Prepare process maps for preventive maintenance
- Prepare revised procedure for preventive maintenance
- Develop scheduled maintenance program
- Standardize the process/procedure
- Continuously improve the process