

Total Productive Maintenance (TPM)

WITH REFERENCE TO
MANUFACTURING INDUSTRIES

G M PANDEY

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HINDALCO

Definition

"Total Productive Maintenance (TPM) is a maintenance philosophy that seeks to maximize Overall Equipment Effectiveness (OEE) by preventing breakdowns, defects, and accidents through the participation of all employees."

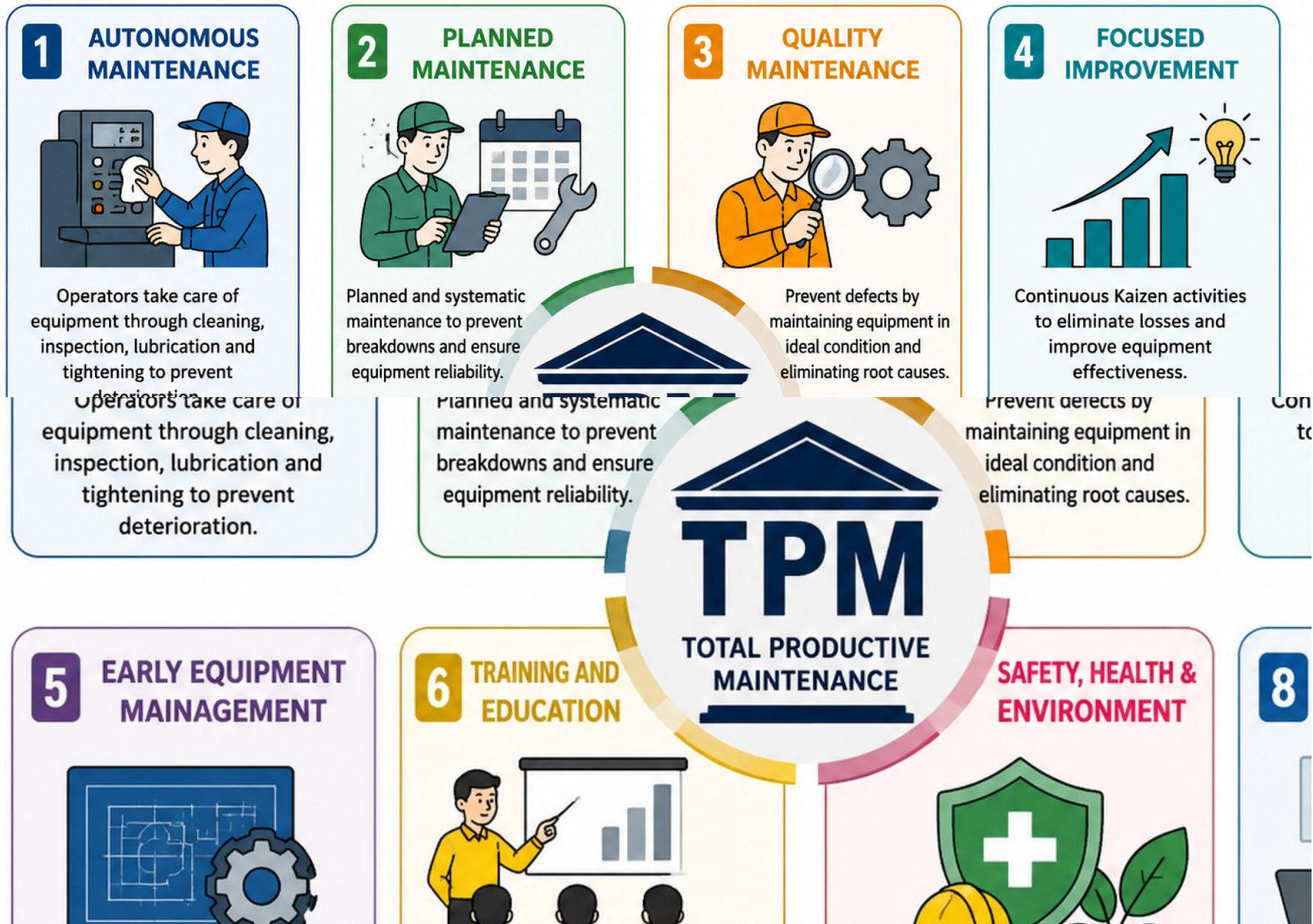
Total Productive Maintenance (TPM) is a comprehensive maintenance approach that aims to maximize equipment effectiveness by involving everyone in an organization—from operators to top management. It focuses on preventing equipment failures, reducing downtime, improving product quality, and increasing productivity.

Objectives of TPM

- Maximize Overall Equipment Effectiveness (OEE)**
- Eliminate equipment breakdowns and defects**
- Reduce production losses and downtime**
- Improve workplace safety**
- Increase employee involvement and ownership of equipment**



8 PILLARS OF TPM



• **Autonomous Maintenance (Jishu Hozen)** – Operators perform routine cleaning, inspection, lubrication, and minor maintenance.

• **Planned Maintenance** – Preventive and predictive maintenance to minimize breakdowns.

Quality Maintenance – Prevent defects by maintaining equipment in optimal condition.

• **Focused Improvement (Kaizen)** – Small, continuous improvements to eliminate losses.

• **Early Equipment Management** – Design and install new equipment with maintainability and reliability in mind.

• **Training and Education** – Develop employees' technical and problem-solving skills

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• **Safety, Health, and Environment** – Ensure a safe and environmentally friendly workplace.

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• **Office TPM** – Improve administrative and support processes to enhance productivity

Benefits of TPM

- **Increased equipment availability**
- **Higher productivity**
- **Reduced maintenance costs**
- **Improved product quality**
- **Fewer accidents and safer workplaces**
- **Greater employee engagement and teamwork**

Overall Equipment Effectiveness

$$\text{OEE} = \text{Availability} \times \text{Performance} \times \text{Quality}$$

Factor	Meaning	Formula
Availability	How much of the planned production time the machine is actually running	$\text{Operating Time} \div \text{Planned Production Time}$
Performance	How fast the machine runs compared with its ideal speed	$(\text{Ideal Cycle Time} \times \text{Total Units}) \div \text{Operating Time}$
Quality	Percentage of good products produced	$\text{Good Units} \div \text{Total Units}$

AUTONOMOUS MAINTENANCE (JISHU HOZEN)

- **A Pillar of Total Productive Maintenance (TPM)**
- **Presented by:**
Name: _____
Organization: _____
- **Image Suggestions:**
- Operator inspecting a machine
- TPM wheel

What is Autonomous Maintenance?

Definition

Autonomous Maintenance (AM) is a TPM pillar where machine operators perform routine maintenance activities to keep equipment in optimal condition.

Objectives

- Improve equipment reliability
- Prevent breakdowns
- Increase operator ownership
- Enhance workplace safety
- Improve product quality

Why Autonomous Maintenance?

Benefits

- ✓ Reduces breakdowns
- ✓ Detects abnormalities early
- ✓ Increases equipment life
- ✓ Improves OEE
- ✓ Reduces maintenance costs
- ✓ Improves safety
- ✓ Better teamwork

Objectives of Autonomous Maintenance

Main Objectives

- Prevent equipment deterioration
- Develop operator skills
- Eliminate minor stoppages
- Improve productivity
- Maintain basic machine conditions
- Support Zero Breakdown and Zero Defect goals

The Seven Steps of Autonomous Maintenance

1. Initial Cleaning ↓
2. Eliminate Sources of Contamination ↓
3. Establish Cleaning & Lubrication Standards
4. General Inspection ↓
5. Autonomous Inspection ↓
6. Standardization ↓
7. Continuous Improvement

What is Planned Maintenance?

Definition

Planned Maintenance is a systematic approach to maintaining equipment through scheduled inspections, servicing, repairs, and replacement of parts before failures occur.

Objective

- Eliminate unexpected breakdowns
- Increase equipment **reliability**
- **Reduce maintenance costs**
- **Improve production efficiency**

Objectives of Planned Maintenance

Main Objectives

- Achieve Zero Breakdown
- Improve Equipment Availability
- Reduce Maintenance Cost
- Extend Equipment Life
- Improve Product Quality
- Ensure Safe Operations

Need for Planned Maintenance

Problems Without Planned Maintenance

- ✗ Frequent breakdowns
- ✗ High repair costs
- ✗ Production delays
- ✗ Safety hazards
- ✗ Poor product quality

Benefits

- ✓ Continuous production
- ✓ Better machine performance
- ✓ Reduced downtime
- ✓ Longer equipment life

TYPE

DESCRIPTION

Preventive Maintenance

Maintenance performed at scheduled intervals

Predictive Maintenance

Maintenance based on equipment condition

Corrective Maintenance

Planned repair after detecting defects

Shutdown Maintenance

Maintenance during planned shutdown

Overhaul Maintenance

Complete restoration of equipment

Benefits of Planned Maintenance Operational Benefits

- ✓ Reduced downtime
- ✓ Higher productivity
- ✓ Better product quality
- ✓ Lower maintenance costs
- ✓ Increased equipment reliability
- ✓ Improved workplace safety

What is Quality Maintenance?

Definition

Quality Maintenance is a TPM pillar that aims to **prevent defects by maintaining ideal equipment conditions.**

Objectives

- Produce Zero Defects
- Improve Product Quality
- Reduce Rework and Scrap
- Increase Customer Satisfaction

Objectives of Quality Maintenance

Main Goals

- ✓ Zero Customer Complaints
- ✓ Zero Quality Defects
- ✓ Stable Manufacturing Process
- ✓ Improve Process Capability
- ✓ Reduce Production Cost
- ✓ Increase Customer Confidence

Why Quality Maintenance?

Common Problems

- Equipment Wear
- Loose Components
- Poor Calibration
- Dirty Sensors
- Tool Wear
- Process Variation

Principles of Quality Maintenance

Quality is Built into the Process

Instead of:

Inspecting defects after production

We:

Prevent defects before production

Focus Areas

- Equipment Condition
- Process Parameters
- Material Quality
- Human Skills

Benefits of Quality Maintenance

Benefits

- ✓ Zero Defects
- ✓ Reduced Scrap
- ✓ Lower Rework
- ✓ Higher Productivity
- ✓ Better Equipment Reliability
- ✓ Improved Customer Satisfaction
- ✓ Lower Manufacturing Cost

What is Focused Improvement?

Definition

Focused Improvement (Kobetsu Kaizen) is a systematic approach used in TPM to eliminate losses, improve productivity, reduce costs, and increase equipment effectiveness through continuous small improvements.

Objectives

- Eliminate chronic losses
- Increase productivity
- Improve quality
- Reduce operating costs
- Enhance workplace safety

Why Focused Improvement?

Common Manufacturing Losses

- Equipment breakdowns
- Minor stoppages
- Speed losses
- Defects and rework
- Matter
- Excess one

Benefits

- Increased production output
- Lower maintenance costs
- Better equipment reliability
- Higher employee involvement

Loss Category

Breakdowns

Setup & Adjustment

Minor Stops

Reduced Speed

Process Defects

Startup Losses

Examples

Machine failure

Changeover

Sense

Slow machine operation

Scrap

Initial rejects

Kaizen Methodology

PDCA Cycle

Plan

- Identify losses



Do

- Implement improvements



Check

- Measure results



Act

- Standardize improvements

1. PLAN

Identify a problem or improvement opportunity and develop a plan.

- Define the problem
- Analyze the root cause
- Set measurable objectives
- Develop an action plan

DO

Implement the planned solution on a small scale or in a controlled manner.

- Execute the action plan
- Train employees
- Collect data
- Record observations

CHECK

Evaluate the results and compare them with the target.

- Analyze performance data
- Compare actual vs. planned results
- Identify gaps
- Verify whether the solution worked

ACT

Standardize successful improvements or take corrective action if the target is not achieved.

- Standardize the successful method
- Update procedures
- Share best practices

Start a new PDCA cycle for further improvement

PDCA in TPM

**Problem → Plan → Implement → Measure →
Standardize → Continuous Improvement**

Focused Improv

Step-by-Step

1. Identify loss
2. Collect data
3. Analyze root causes
4. Develop improvement ideas
5. Implement solutions
6. Measure improvements
7. Standardize best practice

Root Cause Analysis Tools

Common Kaizen Tools

- Fishbone Diagram
- 5 Why
- Pareto Chart
- Brainstorming
- Check Sheets
- Histogram
- Scatter Diagram

Benefits of Focused Improvement

- Increased productivity
- Reduced breakdowns
- Improved equipment life
- Lower maintenance cost
- Better product quality
- Improved safety
- Employee participation
- Continuous improvement culture

Real Industrial Examples

Automobile Industry

- Reduced changeover time by 40%

Steel Industry

- Improved rolling mill availability

Power Plants

- Reduced boiler down Time

Cement Industry

- Improved kiln reliability

Food Industry

- Reduced packaging defects

Conclusion

Focused Improvement (Kaizen)

- ✓ Eliminates equipment losses
- ✓ Improves OEE
- ✓ Reduces production costs
- ✓ Increases employee participation
- ✓ Creates a cult

**"Small Improvements Every
Day Lead to Big Results
Tomorrow."**

Six Big Losses

- • Breakdowns
- Setup & Adjustment
- Minor Stops
- Reduced Speed
- Defects
- Startup Losses

Benefits

- • Higher productivity
- Lower costs
- Better quality
- Safer workplace

FOCUSED IMPROVEMENT (KAIZEN) – Pillar 4 of

4 FOCUSED IMPROVEMENT (KAIZEN)

Focused Improvement (Kaizen) aims at eliminating losses, improving equipment effectiveness and achieving higher productivity through small, continuous and systematic improvements.



OBJECTIVES

- ✓ Eliminate losses (waste) in equipment, processes and systems.
- ✓ Improve Overall Equipment Effectiveness (OEE).
- ✓ Improve quality, productivity and safety.
- ✓ Reduce cost.
- ✓ Create a culture of continuous improvement in the organization.



WHAT IS KAIZEN?

Kaizen is a Japanese word meaning "Change for the Better". It focuses on continuous, incremental improvements in processes, equipment and people.

改善

KAIZEN

"Change for the Better"

TYPES OF KAIZEN

1. SMALL KAIZEN

Small, daily improvements done by everyone at the workplace.



Examples:
5S, cleaning, minor adjustment, eliminating small losses.

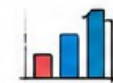
2. BIG KAIZEN

Major improvements requiring more planning, resources and cross-functional teams.



Examples:
Process redesign, layout change, automation, major cost reduction.

TOOLS & TECH



Pareto Analysis



Cause and Effect Diagram



Check Sheet



Flowchart

EXAMPLES OF FOCUSED IMPROVEMENT (KAIZEN)

Reduce Changeover Time



Reduce Minor Stops



Reduce Cycle Time



Reduce Defects



Improve Safety



BENEFITS



What is Gemba Kaizen?

Gemba = actual
workplace

Kaizen = continuous
improvement

Observe, identify waste,
improve.

Objective

Improve quality

Reduce cost

Increase productivity

Enhance safety

Principles

Go to Gemba

Observe

Find root cause

Standardize

Continuous improvement

Five Golden Rules

Go to Gemba

Check actual object

Temporary action

Find root cause

Standardize

8 Wastes

Overproduction

Waiting

Transport

Overprocessing

Inventory

Motion

Defects

Unused talent

Tools

5S

PDCA

5 Why

Fishbone

VSM

OEE

Conclusion

Small continuous improvements
create lasting results

5S Facilitator's Guide