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Total Productive Maintenance

Agenda

1. TPM: What is it ?
2. TPM purpose and benefits
3. The 8 Pillars (Supporting Activities)
4. Roadmap to TPM
5. TPM Implementation
6. Takeaways

Introduction

What is it ?

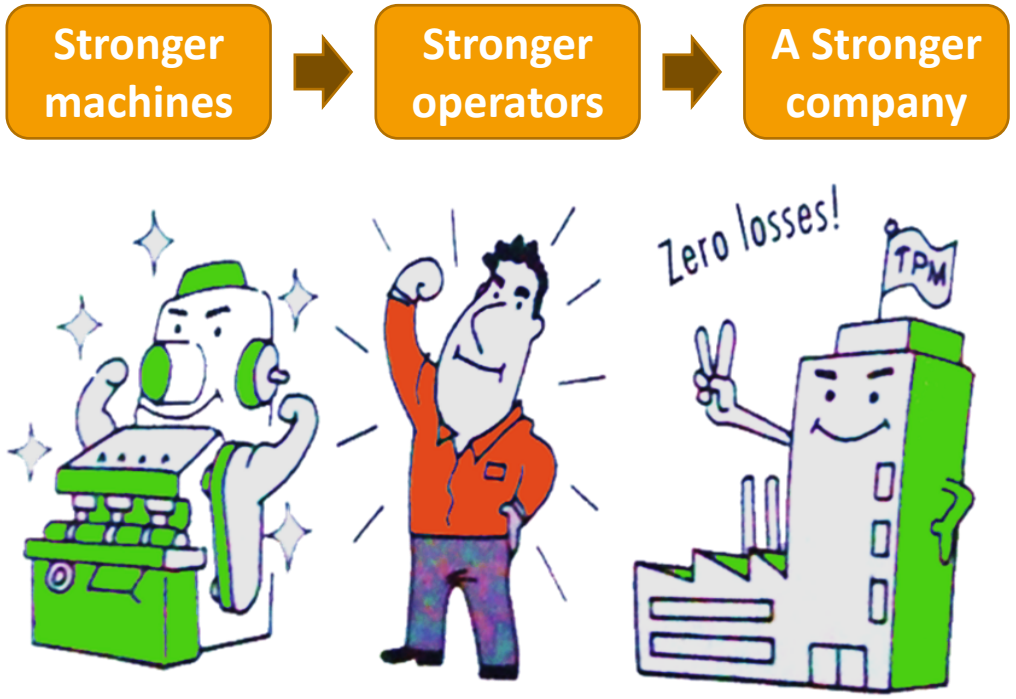
TPM (Total Productive Maintenance) is a **holistic approach** to equipment maintenance that strives to achieve perfect production and safe environment.

Stronger machines → **Stronger operators** → **A Stronger company**

Introduction

Purpose and Benefits

- TPM **emphasizes proactive and preventative maintenance** to maximize the operational efficiency of equipment.
- The implementation of a TPM program creates a **shared responsibility** for equipment that encourages greater involvement by plant floor workers.
- **TPM** can be very effective in improving productivity.



TPM

The 8 TPM Pillars:

1 Autonomous Maintenance

The 8 TPM Pillars:

WHAT IS IT ?	HOW DOES IT HELP ?
Places responsibility for routine maintenance, such as cleaning, lubricating, in the hand of operators.	✓ Gives operators greater “ownership” of their equipment ✓ Increases operators knowledge of their equipment ✓ Ensures equipment is well-cleaned and lubricated ✓ Identifies emergent issues before they become failures ✓ Frees maintenances personnel for higher-level tasks

2 Planned Maintenance

The 8 TPM Pillars:

WHAT IS IT ?	HOW DOES IT HELP ?
Schedules maintenance tasks based on predicted and/or measured failure rates.	✓ Significantly reduces instances of unplanned stop time ✓ Enables most maintenance to be planned for times when equipment is not scheduled for production ✓ Reduces inventory through better control of wear-prone and failure-prone parts

3 Quality Maintenance

The 8 TPM Pillars:

WHAT IS IT ?	HOW DOES IT HELP ?
Design error detection and prevention into production processes. Apply cause-effect analysis to eliminate recurring sources of quality defects.	✓ Specifically targets quality issues with improvement projects focused on removing root sources of defects ✓ Reduces number of defects ✓ Reduces cost by catching defects early (reduces costly inspection checks)

4 Focused Improvement

The 8 TPM Pillars:

WHAT IS IT ?	HOW DOES IT HELP ?
Have small groups of employees work together proactively to achieve regular, incremental improvements in equipment operation.	✓ Recurring problems are identified and resolved by cross-functional teams ✓ Combines the collective talents of a company to create an engine for continuous improvement

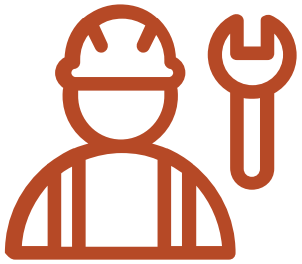
5 Early Equipment Management

The 8 TPM Pillars:

WHAT IS IT ?	HOW DOES IT HELP ?
Directs practical knowledge and understanding of manufacturing equipment gained through TPM towards improving the design of new equipment.	✓ New equipment reaches planned performance levels much faster due to fewer start up issues. ✓ Maintenance is simpler and more robust due to practical review and employee involvement prior to installation

6 Training and Education

The 8 TPM Pillars:



WHAT IS IT ?	HOW DOES IT HELP ?
Fill in knowledge gaps necessary to achieve TPM goals. Applies to operators, maintenance personnel and managers.	✓ Operators develop skills to maintain equipment and identify problems ✓ Maintenance personnel learn techniques for proactive and preventive maintenance ✓ Managers are trained on TPM principles as well as employee coaching and development

The 8 TPM Pillars:

WHAT IS IT ?	HOW DOES IT HELP ?
Maintain safe and healthy working environment.	✓ Eliminates potential health and safety risks, resulting in a safer workplace ✓ Specify targets for accident-free workplace

8 TPM in Administration

The 8 TPM Pillars:

WHAT IS IT ?	HOW DOES IT HELP ?
Apply TPM techniques to administrative functions.	✓ Extends TPM benefits beyond the plant floor by addressing waste in administrative functions ✓ Supports production through improved administrative operations (order processing, procurement, scheduling)

TPM

The Roadmap to TPM:

1 Identify Pilot Area

The Roadmap to TPM:

In this step the target equipment for the pilot TPM program is selected.

There are **three** logical ways to approach this selection:

WHICH EQUIPMENT ?	ADVANTAGES	DISADVANTAGES
Inspection points	✓ Best opportunity for a "Quick-win" ✓ More forgiving of limited TPM experience	✓ Less payback than improving constraint equipment ✓ Does not "test" the TPM process as strongly as the other options
Constraint/Bottleneck	✓ Immediately increases total output ✓ Provides fastest payback	✓ Working on a critical asset as a trial project is a higher risk option ✓ May result in equipment being offline more than desired as it is improved
Most problematic	✓ Improving this equipment will be well-supported by operators ✓ Solving well-known problems will straighten support for the TPM project	✓ Less payback than improving constrain equipment ✓ Unsolved problems are often unsolved for a reason, it may me challenging to get good results

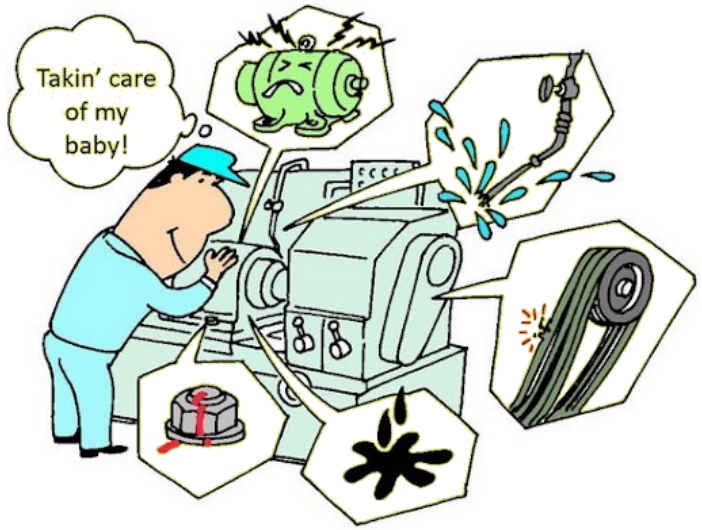
2 Restore Equipment

The Roadmap to TPM:

In this step, the equipment will be cleaned up and otherwise prepped for improved operation.

Two key TPM concepts need to be implemented:

- 5S
- Autonomous Maintenance



3 Measure OEE

The Roadmap to TPM:

Put into place a system to track OEE for the targeted equipment.

This system can be manual or automated (real-time data collection systems), but the scope of the system must include **unplanned stop time reason code tracking**.

4 Address Major Issues

The Roadmap to TPM:

Address the most significant **sources of lost productive time**.

The TPM concept of **Focused Improvement** (also known as **Kaizen**).

ITEM	DESCRIPTION
Select loss	Based on equipment-specific OEE and stop time data, select one major loss to address. In most cases, the major loss that is selected should be the largest source of unplanned stop time.
Create team	Create a cross-functional team to address the problem This team should include four to six members (from different areas)) with the best equipment, knowledge and experience and that are likely to work well together.
Collect information	Collect detailed information on symptoms of the problem, including observations, physical and photographic evidence. Consider cause-effect diagram at the equipment to collect observations.

4 Address Major Issues

The Roadmap to TPM:

Address the most significant **sources of lost productive time**.

The TPM concept of **Focused Improvement** (also known as **Kaizen**).

ITEM	DESCRIPTION
Organize	Organize a structured problem solving session to: a) Identify probable causes of the problem, b) Evaluate probable causes against the gathered information and c) Identify the most effective fixes.
Schedule	Schedule planned stop time to implement the proposed fixes. If there is an existing change control process, be sure to utilize that process when implementing fixes.
Restart	Restart production and determine the effectiveness of the fixes over an appropriate time period. If sufficiently effective, document any changes to procedures and move to the next major loss. Otherwise, collect additional information and organize another structures problem solving session.

5 Introduce Proactive Maintenance

The Roadmap to TPM:

Integrate proactive maintenance techniques into the maintenance program, thus introducing the TPM.

Identify

Identify all components that are candidates for proactive maintenance.

Establish

Establish initial proactive maintenance intervals.

Feedback

Create feedback for optimizing the maintenance intervals.

Identify

The Roadmap to TPM:

ITEM	DESCRIPTION
Components that wear	Identify and document all components that undergo wear (there should have been established as inspection points in step two). Consider replacing wear components with low-wear or no-wear versions.
Components that fail	Identify and document all components that are known to regularly fail.
Stress points	Consider utilizing thermography and/or vibration analysis to provide additional insights as to equipment stress points.

Establish

The Roadmap to TPM:

ITEM	DESCRIPTION
Wear based	For wear components, establish the current wear level and a baseline replacement interval (in some cases replacement may be triggered early by an AM inspection as established in Step Two).
Predicted failure based	For failure-prone components, establish a baseline (predicted) failure interval.
Time based	Create a baseline Planned Maintenance Schedule that schedules proactive replacement of all wear and failure-prone components. Consider using “Run Time” rather than “Calendar Time” as the interval time base.
Work order based	Create a standard process for generating Work Orders based on the planned Maintenance Schedule.

TPM

Feedback

The Roadmap to TPM:

TPM ACTIVITY	DESCRIPTION
Component log	Create a Component log sheet for each wear and failure-prone component. Record every instance of replacement, along with information about the component condition at the time of replacement (wear amount, “component failed”, “no issue”, etc).
Monthly audit	Performa a monthly planned maintenance audit: a) Verify that the Planned Maintenance Schedule is being followed b) Verify that the Component log sheets are being maintained c) Review all new entries in the Component log and adjust maintenance intervals where appropriate. Keep audits positive and motivational (treat them as training exercise).

Feedback

The Roadmap to TPM:

TPM ACTIVITY	DESCRIPTION
Maintenance interval adjustments	Anytime there is an unscheduled component replacement, consider adjusting the maintenance interval. If the component in not the Planned maintenance Schedule, consider adding it.
Component analysis	Consider plotting data over time from thermography and vibration analysis to expose emerging problems and issues

TPM

Implementation:

- Continuous Improvement
- Visual Management
- Inspection and Monitoring
- Setting Standards
- Eliminating Contamination and Improving Access
- Perform Initial Cleaning and Repairs
- Increase Operator Knowledge

TPM

Implementation:

- The machine's **components**, their **purpose**, and how they **function** (just the basics are often enough)
- **Signs** of deviation from optimum performance
- Which maintenance **actions** they will need to perform
- How to **report** issues to the maintenance team

Increase Operator Knowledge

TPM

Implementation:

- **Deep cleaning** the machines including removal of dust and dirt
- **Lubricating** and **oiling** (for equipment that requires lubrication)
- **Identifying** and **eliminating** signs of deterioration (such as leaks and cracks)
- **Tightening** of any loose nuts and bolts, etc.

TPM

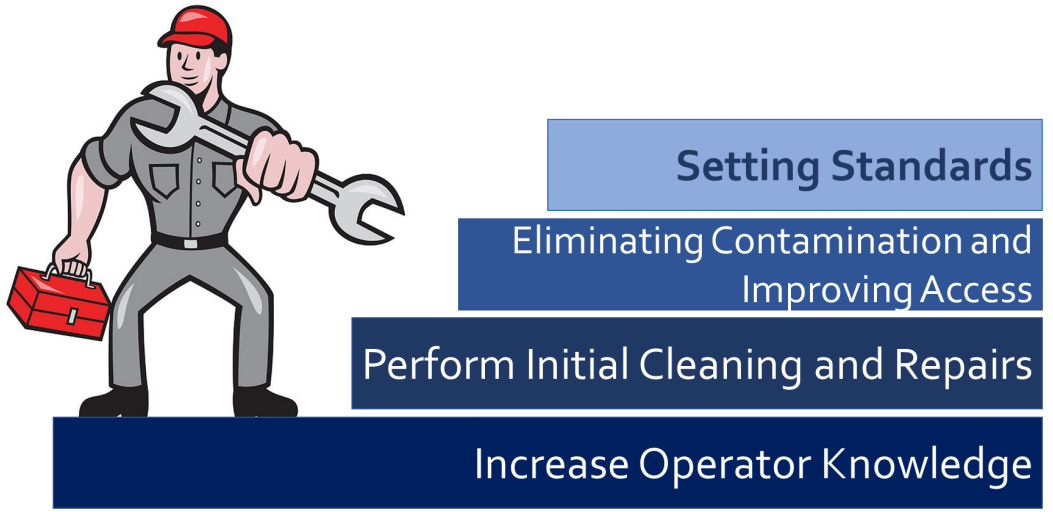
Implementation:

- **Controlling contamination**. This starts by promoting clean habits among the operators. However, it might be necessary to complement their efforts by using high-quality sealing and machine covers.
- **Promoting orderliness.** The area should be clean, neat, and free of dirt and spills. Tools should be stored properly so that operators can reach them quickly when needed.
- **Promoting safe access.** Safe access to maintain and clean a machine is paramount. The lockout/tag out (LOTO) would be a prerequisite.

TPM

Implementation:

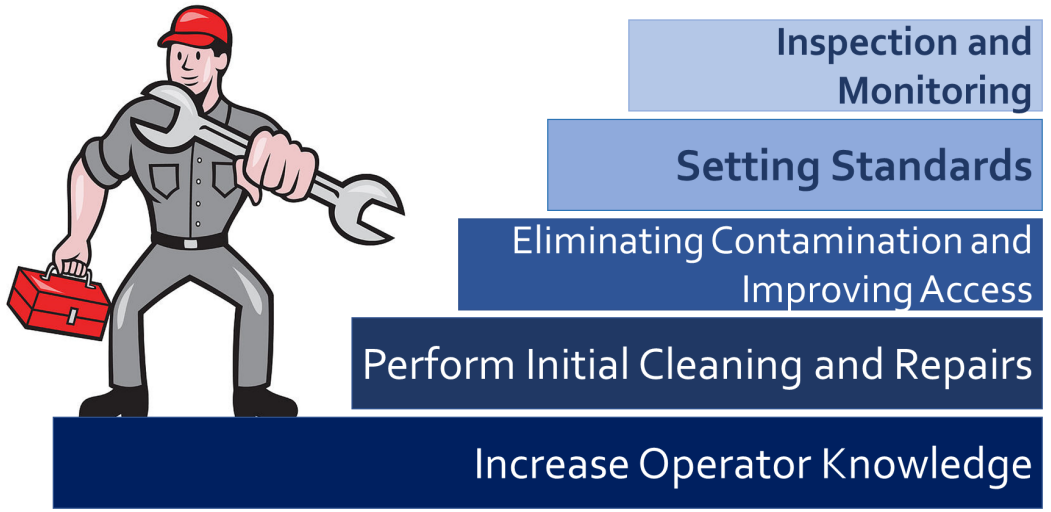
- **What** to clean/lubricate
- **How** to perform those tasks
- **How often** should you perform those tasks
- Other maintenance-related **information** operators might find useful



TPM

Implementation:

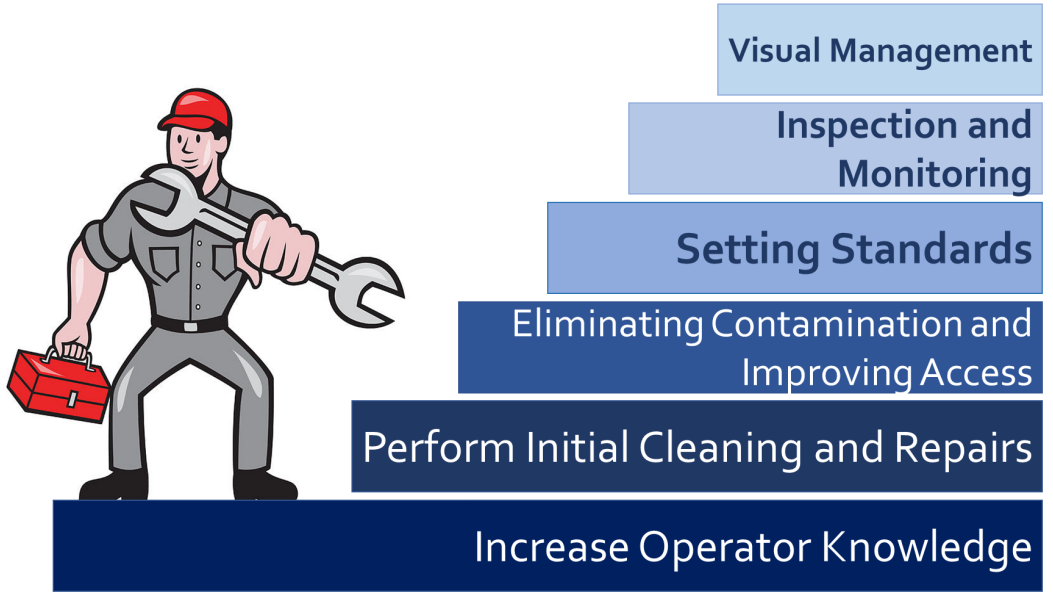
- The **operators** now have the required training and tools to handle the equipment.
- They are **officially in charge** of their machines daily upkeep, and they may adjust their assigned maintenance routines if it improves productivity.



TPM

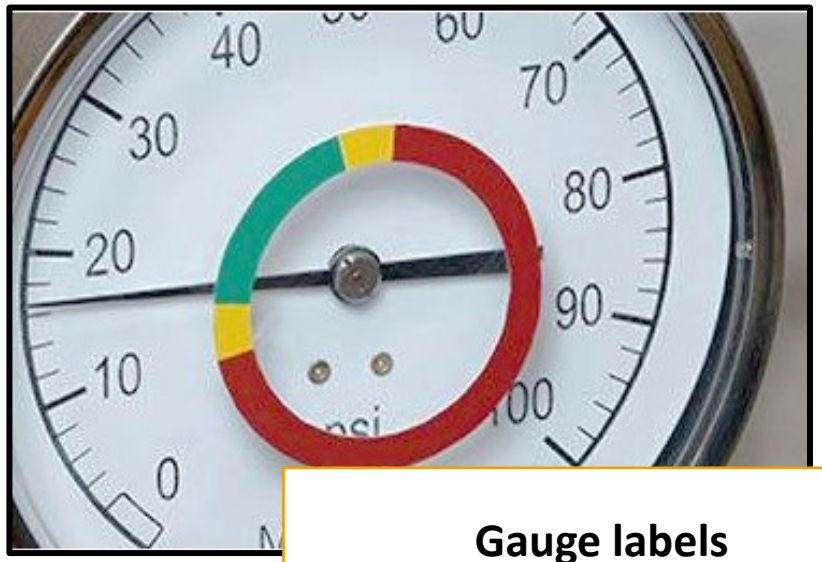
Implementation:

- Visual maintenance management means **making it as obvious as possible** to see whatever is going on with every piece of equipment.
- This helps to maintain each **asset's integrity** because it allows the operators to handle the machinery more confidently.



TPM

Implementation:



Gauge labels
Easily detect abnormalities and if setting is correct

Visual Management

Inspection and Monitoring

Setting Standards

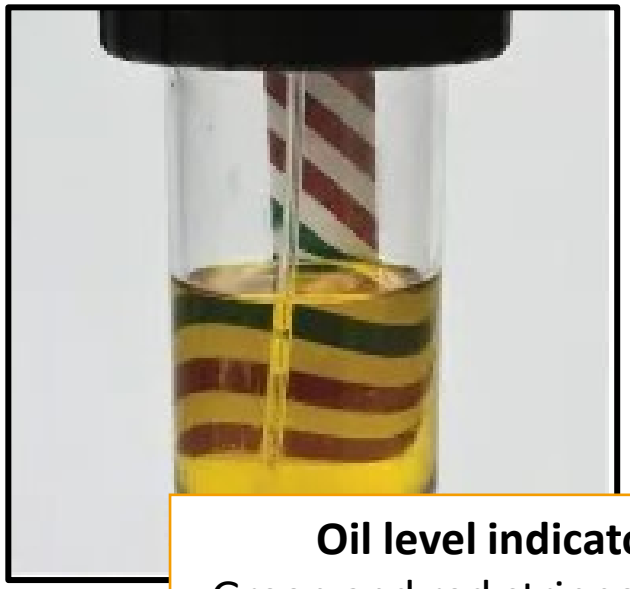
Eliminating Contamination and Improving Access

Perform Initial Cleaning and Repairs

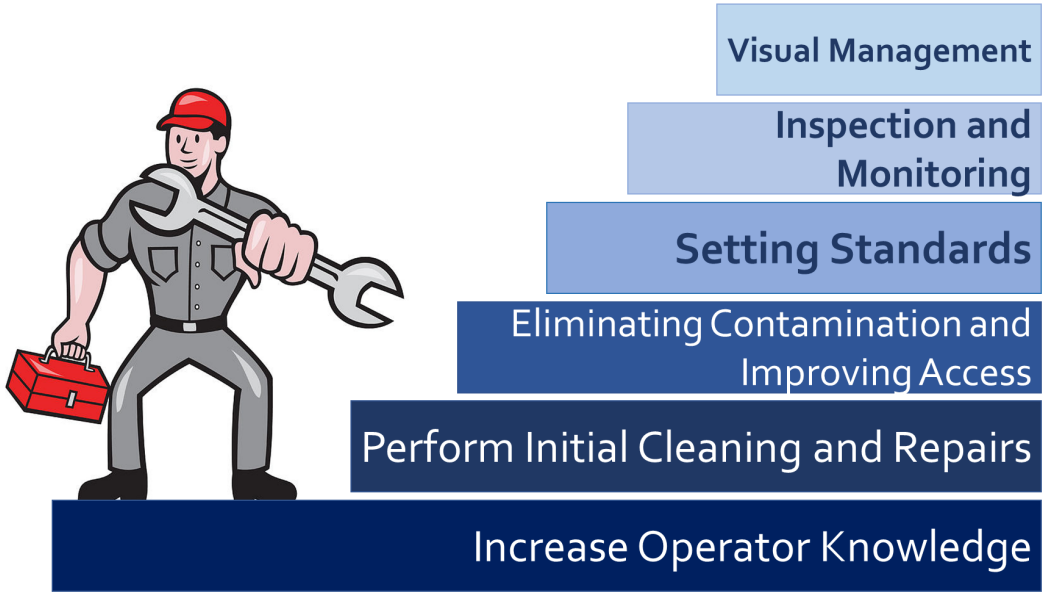
Increase Operator Knowledge

TPM

Implementation:

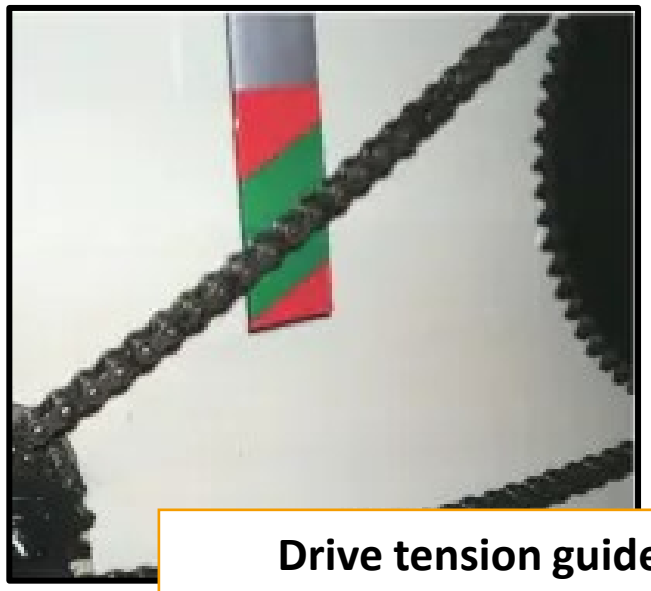


Oil level indicator
Green and red stripped label to detect the required optimal oil level

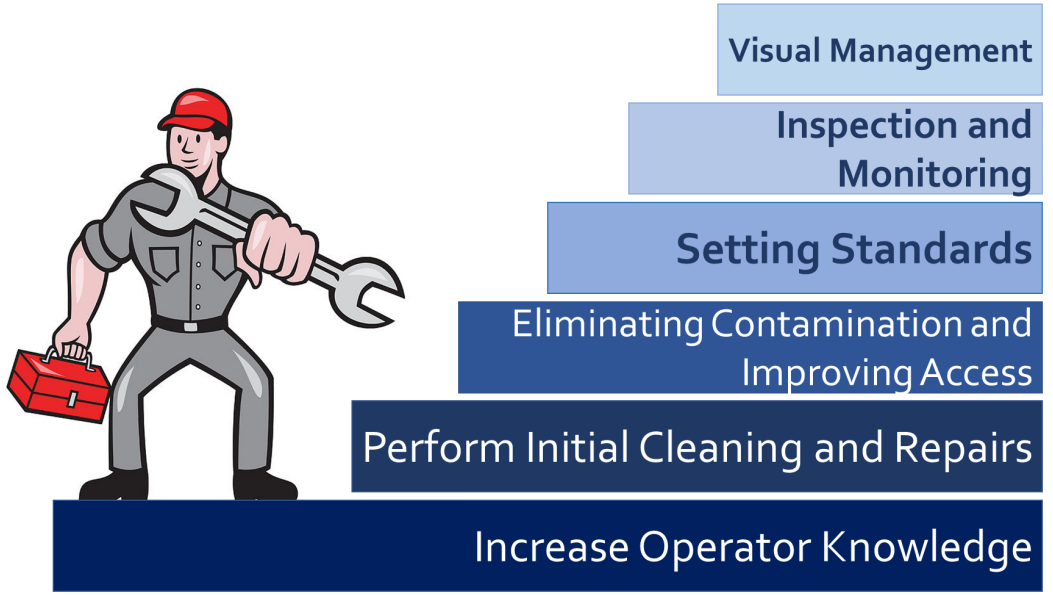


TPM

Implementation:



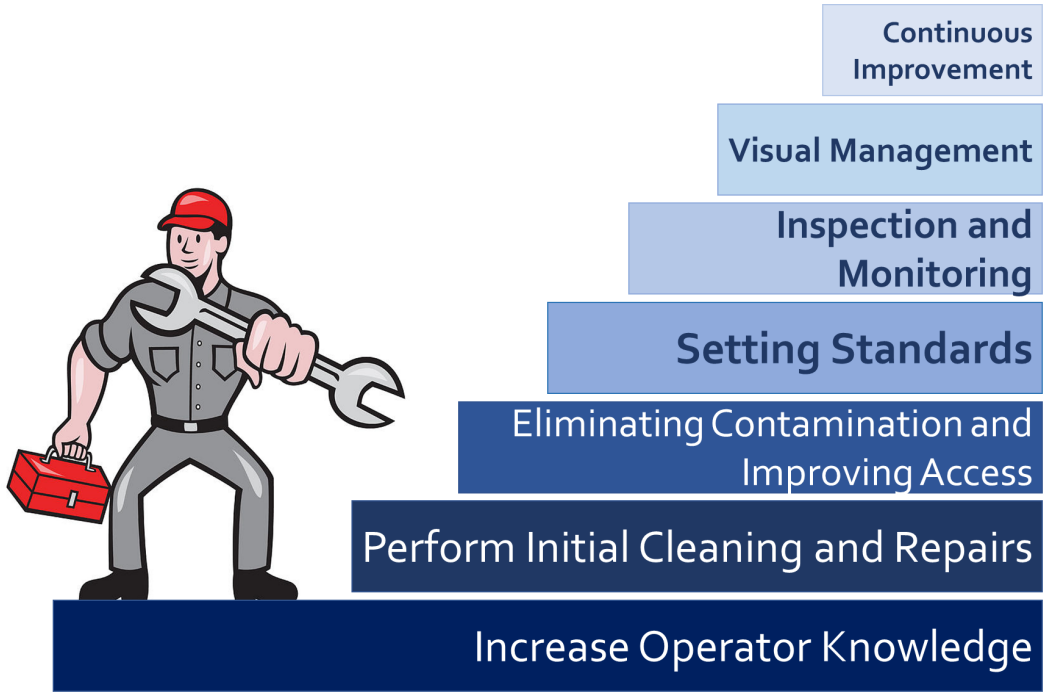
Drive tension guides
Inspect proper tension on drive system and the need for tighten or replacement



TPM

Implementation:

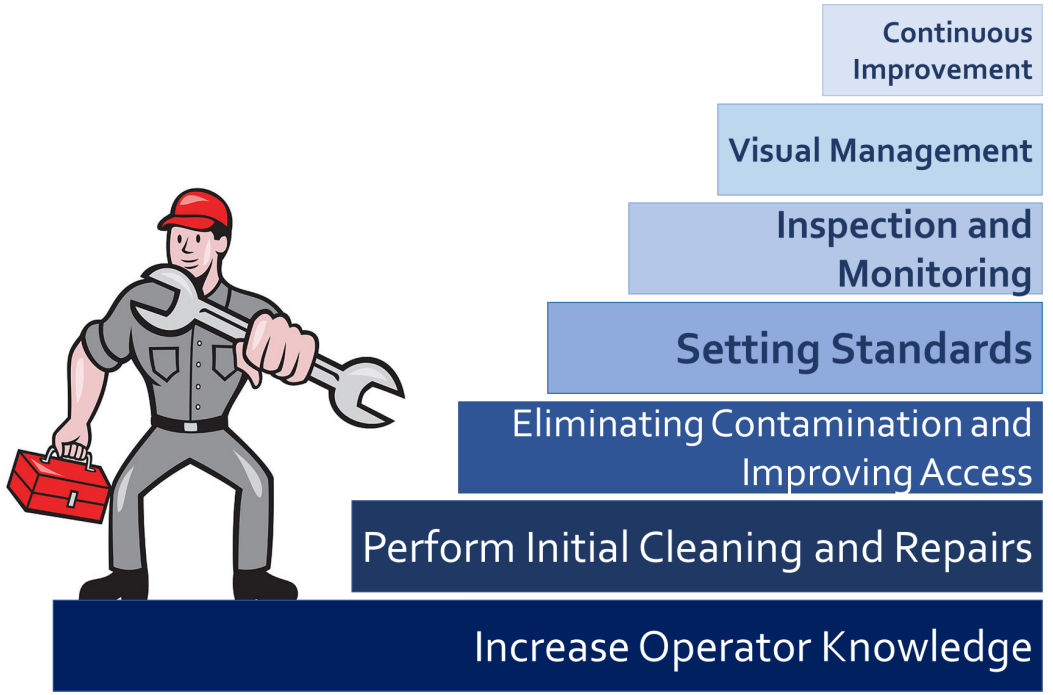
1. **When** was the last time we reviewed our processes?
2. Are our process documents **up to date**?
3. Are operators still complying with established **standards** and **procedures**?
4. In which areas are we **struggling** the most?
5. Are there **new technologies** that can make maintenance tasks easier or faster?



TPM

Implementation:

6. Are we encouraging **feedback**? When last did we get feedback from an operator?
7. Is there any structure for **recognizing/encouraging staff** that contributes the most to positive change?
8. Where have we **succeeded** the most?
9. Where have we **failed** the most?



Takeaways

- **Equipment downtime** is one of the highest downtime causes in manufacturing. Is paramount to implement a **TPM before Lean transformations**.
- Use the **8 Pillars** (support Activities) to build and sustain TPM programs.
- Use the **roadmap** to gradually test the waters and guide the teams into a formal TPM implementation.
- TPM is **lengthy** and **requires heavy investment**, build the case to justify the savings and facilitate the buy-in from upper management/directors.

Thank You

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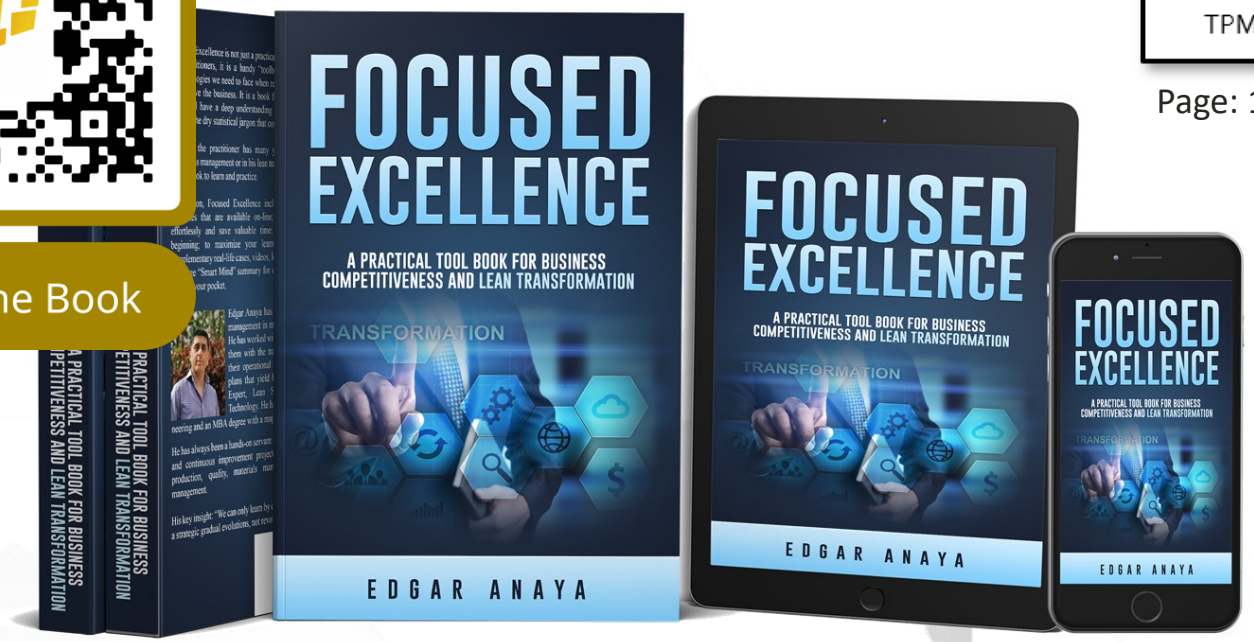
Get the Book



TOPIC

TPM

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Reference: Focused Excellence
by Edgar Anaya

A Practical Tool Book for
Business Competitiveness and
Lean Transformation