



# FM

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## Why are These Men Smiling?

*See how maintenance is being transformed.*



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# All Breakdowns Can Be Prevented

**TRANSFORM THAT FILTHY, RUSTY PLANT COVERED IN OIL INTO A WORLD-CLASS ENVIRONMENT THAT IS PLEASANT, SAFE – AND PROFITABLE. HOW? CLEAN TO INSPECT! INSPECT TO DETECT! DETECT TO CORRECT! CORRECT TO PERFECT!**

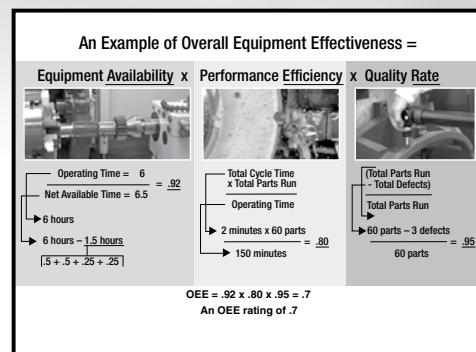
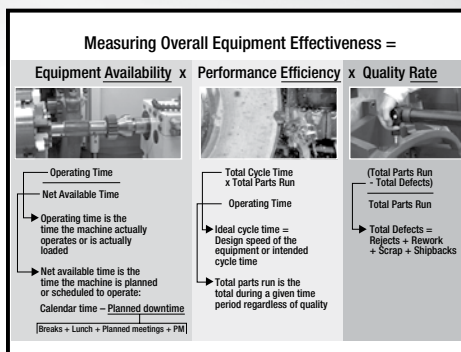
Rick L. Smith,  
Technical Change Associates, Inc.

**B**reakdowns result from undetected or ignored equipment deterioration. 75 percent of all breakdowns are caused by contamination (dirt, waste or foreign objects) or improper lubrication. 75 percent of all equipment deterioration can be detected by a trained operator. The remaining 25 percent can be detected by trained maintenance technicians performing preventive and predictive maintenance.

This means all breakdowns can be prevented, but it requires a significant level of trust and cooperation between employees and management. Total productive maintenance (TPM) promotes zero losses through autonomous small group activities involving all employees that plan, use, and maintain the equipment – from top line managers to front line workers.

## HOW TO ATTACK WASTE

Repairing machinery after it breaks down is ten times more expensive than effective TPM. But TPM is not a short-term fix. It strategically integrates several key strate-

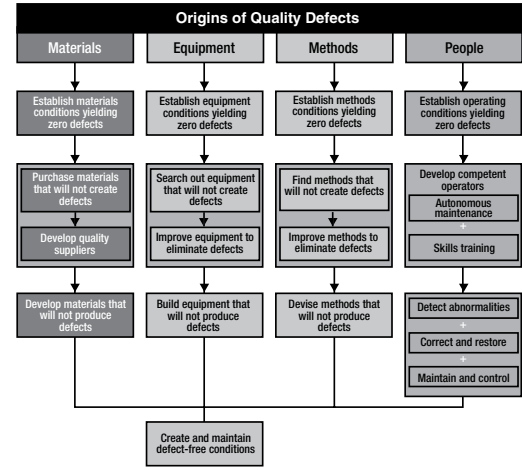


gies that eliminate waste into three systems that must already exist in your plant: a basic preventive maintenance (PM) program, an equipment work order system and an equipment history database. Focused Improvement. Apply comprehensive PM across the life of your machinery to maximize overall equipment effectiveness (OEE) through zero breakdown measures. A strong focus prevents deterioration through regular daily inspections that measure equipment performance and deterioration, detect problems early and correct them sooner.

Daily inspections begin restoring your equipment to spec conditions. They reduce variation in failure intervals by establishing

basic conditions of cleaning, lubrication and tightening. Measure the normal production losses related to equipment down-time during startups, shutdowns, machine set-ups and adjustments. Clarify your equipment operating conditions and stick to the rules – comply with those conditions of use.

This exposes operating abnormalities. Measure abnormal production losses occurring from machine breakdowns, process failures, reprocessing, idling and minor stoppages, operating at reduced speed and producing defective products. Find the cause of each and restore the equipment to its spec condition.



Basic Philosophy of Zero Defects. TPM applies lean practices to the maintenance function. Courtesy TCA Associates, Inc

preparing checkpoints and checking intervals, train them in lubrication techniques, and assist in developing lubrication standards. They can deal quickly with deterioration, flaws and deficiencies in basic equipment conditions and provide technical assistance in improvement activities. Maintenance technicians themselves must be trained to become equipment diagnosticians.

Early Equipment Management. Build a predictive maintenance system that introduces ultrasonic, thermographic, spectographic, and linear equipment diagnostics. This enables condition monitoring to be performed, and consolidates improvement activities through failure analysis. Extend equipment life using new materials and technology.

Quality Maintenance. When making a decision to purchase new production equipment, maintenance should be involved to ensure it is easy to use and maintain, highly reliable and well-engineered. Investigate and analyze the existing situation by plotting current work flow. Identify any problems and clarify mechanisms employed to prevent predicted problems. Establish an early management system. Debug system and train personnel to apply comprehensive autonomous maintenance to the new equipment to retain its spec condition.

Abolish any environments causing accelerated deterioration. Eliminate or control major contamination sources. Establish daily checking and lubrication standards.

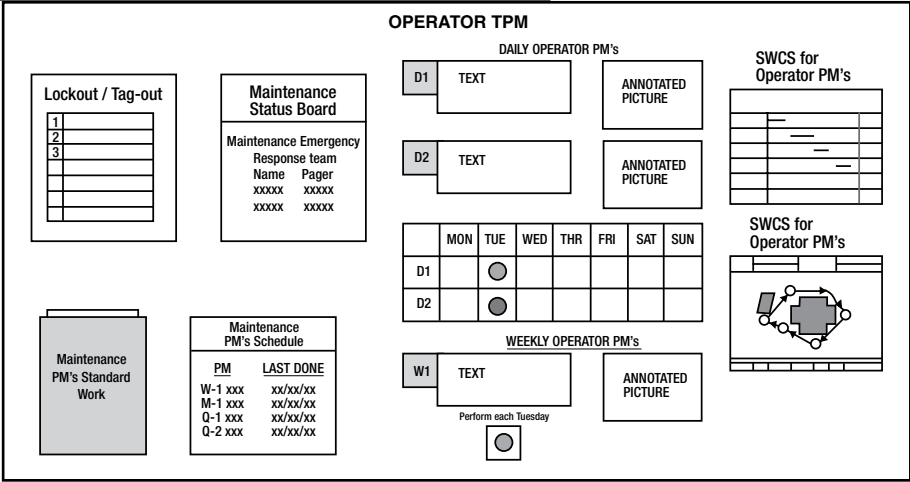
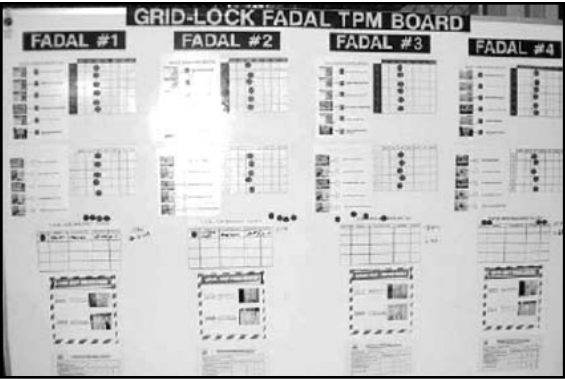
Autonomous Maintenance. Introduce extensive visual controls and begin general inspections to evaluate your equipment and understand the situation. These are activities performed by production personnel that have a maintenance function and are intended to keep the plant operating efficiently.

Their role is to prevent deterioration through correct operation, daily lubrication, adjustment and setting, basic housekeeping, prompt detection of abnormalities, minor

They can also predict deterioration through minor servicing, early prediction and simple parts replacement, prompt reporting of failures and problems, and assisting maintenance in repairing unexpected failures.

All of this builds an information management system to lengthen your equipment life. Rank the failures according to seriousness. Select and prioritize PM items. Prevent major breakdowns from occurring. Correct any equipment design weaknesses. Improve the skills of your machine operators. Prevent operating and repair by upgrading their adjustment and setting skills.

Planned Maintenance. The maintenance staff must construct a system that periodically services and inspects machinery, improves major contamination sources, resolves problems in inaccessible places, and focuses on recurrence prevention and failure analysis. They should establish formal work standards, control spares and equipment



Courtesy TCA Associates, Inc.

improvements to contamination sources, and keeping maintenance records. They should also measure deterioration through daily inspection (patrol checks and five senses checks during operation), periodic inspection during plant shutdown, or shutdown maintenance.

data, computerize maintenance information processing abnormalities early, and deal with abnormalities correctly.

Training. Maintenance personnel should instruct production employees in inspection skills, assist them in

## GET TO WORK


All breakdowns can be prevented –but it takes a team effort. TPM accomplishes this by involving and empowering employees with closed-loop measurements of results that drive continuous and rapid improvements in your manufacturing process.

Eliminate raw material losses and energy wastes in maintenance. Get rid of excessive maintenance materials, wasteful human labor

spent inspecting/reporting on faulty equipment, cleaning losses wasted on dust and spills, management losses wasted on layout and scheduling, and unnecessary tests and analysis of losses.

Transform that filthy, rusty plant covered in oil into a world-class environment that is pleasant, safe – and profitable. There's no other way to compete in the global economy. Now's the time to get to work. Clean to Inspect! Inspect to Detect!

Detect to Correct! Correct to Perfect!

Rick L. Smith is vice president and general manager for Technical Change Associates, Inc., 606 Washington Blvd., Suite 100, Ogden, Utah 84404, 801-621-8980, fax: 801-334-0877, [rsmith@technicalchange.com](mailto:rsmith@technicalchange.com). 

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	Reactive Maintenance	Preventive Maintenance	Predictive Maintenance	Maintenance Prevention
System Description	1. Maintenance department responds to equipment malfunctions and breakdowns	1. Periodic adjustments and checks 2. Periodic replacements of wear parts 3. Periodic overhaul	1. Periodic measurement and tending of equipment and process parameters	1. Equipment design is based upon minimal maintenance requirements
Characteristics	1. Inefficient maintenance department 2. Unpredictable equipment operation 3. All maintenance work is unplanned	1. More predictable operation 2. More efficient maintenance department	1. Predictable maintenance requirements 2. Planned and scheduled equipment repairs	1. Close relationship with equipment suppliers
Examples	1. Light bulb replacement	1. Changing oil and filters	1. Vibration analysis	1. Sealed bearings in small electric motors
Results	1. Steady degradation of equipment performance	1. Maintain level of equipment performance	1. Maintain equipment performance with minimal disruption to production	1. Continually improving equipment designs
Maintenance Department Responsibilities	1. Respond to emergencies 2. Get production back on line	1. Keep machines running by checking, replacing, and overhauling 2. Perform checks during down times	1. Log equipment parameters 2. Trend data 3. Predict equipment repair cycle	1. Input to equipment design 2. Minimize and eliminate maintenance requirements

Phase	1 Stabilize Failure Intervals	2 Lengthen Equipment Life	3 Periodically Restore Deterioration	4 Predict Equipment Life
Autonomous Maintenance	Step 1: Perform initial cleaning Step 2: Improve contamination sources and inaccessible places Step 3: Establish cleaning and checking standards	Step 4: Perform general equipment inspection	Step 5: Perform general process inspection	Step 6: Systemize autonomous maintenance Step 7: Practice full self-management
Specialized Maintenance	Step 1: Evaluate equipment and understand situation	Step 6: Evaluate the planned maintenance system		
	Step 2: Restore deterioration and correct weakness (support autonomous maintenance and prevent recurrences)	Establish as corrective maintenance		
	Step 3: Build an information management system	Establish as periodic maintenance		
		Step 4: Build a periodic maintenance system		
			Step 5: Build a predictive maintenance system	

*Six Steps to Building a Planned Maintenance System.*  
Courtesy TCA Associates, Inc.

*Planned Maintenance Transition. As more employees get involved, maintenance moves from firefighting to prevention.*  
Courtesy TCA Associates, Inc.

