

CHAPTER 1

The History and Impact of Total Productive Maintenance

In order to properly understand the history and impact of total productive maintenance, it is necessary to establish a definition. *Total Productive Maintenance* (TPM) is maintenance activities that are productive and implemented by all employees. TPM involves everyone in the organization from operators to senior management in equipment improvement. It encompasses all departments including:

- Maintenance
- Operations
- Facilities
- Design Engineering
- Project Engineering
- Construction Engineering
- Inventory and Stores
- Purchasing
- Accounting and Finance
- Plant and Site Management

Goals of TPM

TPM has the following five goals (some texts call these pillars):

1. Improving equipment effectiveness
2. Improving maintenance efficiency and effectiveness

3. Early equipment management and maintenance prevention
4. Training to improve the skills of all people involved
5. Involving operators (occupants) in routine maintenance

Improving Equipment Effectiveness

This goal, which insures that the equipment performs to design specifications, is the true focus of TPM. All remaining goals for TPM are valueless unless they support improving equipment effectiveness. The focus must be that nowhere in the world can another company have the same asset and make it produce more than your company can produce. If it does, then it is better at managing its assets than your company and will always be the lower cost producer or provider.

The equipment must operate at its design speed, produce at the design rate, and produce a quality product at these speeds and rates. A major problem occurs because many companies do not know the design speed or rate of production for their equipment. In the absence of knowing the design criteria, management will set arbitrary production quotas. A second major problem develops over time when small problems cause operators to change the rate at which they run equipment. As these problems continue to build, the equipment output may only be half of that for which it was designed. This inefficiency then leads to the investment of additional capital in equipment, trying to meet the required production output.

Improve Maintenance Efficiency and Effectiveness

This goal focuses on insuring that maintenance activities that are carried out on the equipment are performed in a way that is cost effective. Studies have shown that nearly one-third of all maintenance activities are wasted. Therefore, this goal of TPM is important to lowering the cost of maintenance. It is important for all to understand that basic maintenance planning and scheduling are crucial to achieving low-cost maintenance. The goal is to insure lean maintenance, with no waste in the maintenance process.

A secondary goal is to ensure that the maintenance activities are carried out in such a way that they have minimal impact on the up time or unavailability of the equipment. Planning, scheduling, and backlog control are again all important if unnecessary maintenance downtime is to be avoided. At this stage, maintenance and opera-

tions must have excellent communication in order to avoid downtime due to misunderstandings.

Developing an accurate database for each piece of equipment's maintenance history is also the responsibility of the maintenance department. This history will allow the maintenance department to provide accurate data for decisions related to the plant or facility equipment. For example, the maintenance department can provide input to equipment design and purchase decisions, assuring that equipment standardization is considered. This aspect alone can contribute significant financial savings to the company. Standardization reduces inventory levels, training requirements, and start-up times. Accurate equipment histories also helps stores and purchasing not only reduce downtime, but also avoid carrying too much inventory.

Early Equipment Management and Maintenance Prevention

The purpose of this goal is to reduce the amount of maintenance required by the equipment. The analogy that can be used here is the difference in the maintenance requirements for a car built in 1970 compared to a car built in 2000. The 1970 car was tuned up every 3040,000 miles. The 2000 car is guaranteed for the first 100,000 miles. This change was not brought about by accident. The design engineers carefully studied the maintenance and engineering data, allowing changes to be made in the automobile that reduce the amount of maintenance. The same can be true of equipment in a plant or facility.

Unfortunately, most companies do not keep the data necessary to make these changes, either internally or through the equipment vendor. As a result, unnecessary maintenance is performed on the equipment, raising the overall maintenance cost.

Training to Improve the Skills of All People Involved

Employees must have the skills and knowledge necessary to contribute in a TPM environment. This requirement involves not only the maintenance department personnel, but also the operations personnel. Providing the proper level of training insures that the overall equipment effectiveness is not negatively impacted by any employee who did not have the knowledge or skill necessary to perform job duties.

Once employees have the appropriate skills and knowledge,

their input on equipment improvement needs to be solicited by senior management. In most companies, this step only takes the form of a suggestion program. However, it needs to go well beyond that; it should also include a management with an open doors policy. Such a policy indicates that managers from the front line to the top are open and available to listen to and give consideration to employee suggestions. A step further is the response that should be given to each discussion. It is no longer sufficient to say "That won't work" or "We are not considering that now." In order to keep communication flowing freely, reasons must be given. Therefore, managers must develop and utilize good communication and management skills. Otherwise, employee input will be destroyed and the ability to capitalize on the greatest savings generator in the company will be lost.

Involving Operators (Occupants) in Routine Maintenance

This goal finds maintenance tasks related to the equipment that the operators can take ownership of and perform. These tasks may amount to anywhere from 10-40% of the routine maintenance tasks performed on the equipment. Maintenance resources that were formerly engaged in these activities can then be redeployed in more advanced maintenance activities such as predictive maintenance or reliability focused maintenance activities. It must be noted: the focus for the operations involvement is *not* to downsize the maintenance organization. Instead, the focus is to free up maintenance resources for the more technical aspect of TPM.

Cost-Benefit of These Goals

The questions now raised are: Are these goals all worth it? What are the benefits that have been achieved? These questions are answered positively and quickly because results are as follows:

Productivity

- 100-200% increases
- 50-100% increase in rates of operation
- 500% decrease in breakdowns

Quality

- 100% decrease in defects
- 50% decrease in client claims

Costs

50% decrease in labor costs
30% decrease in maintenance
costs 30% decrease in energy
costs

Inventory

50% reduction on inventory
levels 100% increase in inventory
turns

Safety

Elimination of environmental and safety violations

Morale

200% increase in suggestions
Increased participation of employees in small group
meetings

With all of these benefits, it is important for all companies to recognize the importance and value that productive maintenance can bring to the company. Any company trying to achieve World Class status through other programs such as Computer Integrated Manufacturing (CIM), Just in Time (JIT), Total Quality Control (TQC), Total Employee Involvement (TEI), or Lean Manufacturing, will soon find that these programs will not work without total reliability of the company's assets, which is the primary responsibility of the maintenance organization. In particular, Just in Time, Total Quality Control, and Total Productive Maintenance are all essential. Without full utilization of these three programs, the goal of being globally competitive will never be reached.

History of TPM

From where did TPM evolve? What spurred its development? TPM originated in Japan and was an equipment management strategy designed to support the Total Quality Management strategy. The Japanese realized that companies cannot produce a consistent quality product with poorly-maintained equipment.

TPM thus began in the 1950s and focused primarily on the preventive maintenance. As new equipment was installed, the focus was on implementing the preventive maintenance recommendations by the equipment manufacturer. A high value was placed on equipment that operated at designed specifications with no breakdowns. During these same years, a research group was formed

which later became the Japanese Institute of Plant Management (JIPM).

During the 1960s, TPM focused on productive maintenance, recognizing the importance of reliability, maintenance, and economic efficiency in plant design. This focus took much of the data collected about equipment during the 1950s and fed it back into the design, procurement, and construction phases of equipment management. By the end of the 1960s, JIPM had established and awarded a PM prize to companies that excelled in maintenance activities.

Then in the 1970s, TPM evolved to a strategy focused on achieving PM efficiency through a comprehensive system based on respect for individuals and total employee participation. It was at this time that "Total" was added to productive maintenance. By the mid-1970s, the Japanese began to teach TPM strategies internationally and were recognized for their results.

This process was an evolutionary one that took time, not because it was technically difficult to produce the results, but because of the efforts to change the organizational culture so that it valued the "Total" concept.

Today the international focus on TPM is intensifying. This interest is expressed to support a company's full utilization of its assets. For example, one of the prevalent strategies today is the concept of Lean Manufacturing. It is based on the Toyota production system and is designed to drive out waste from an organization. Lean Manufacturing strategies have yet to produce the true benefits possible because they assume full asset utilization. Furthermore, the full utilization of assets will never occur without an effective TPM strategy. Therefore, are Lean Manufacturing strategies effective today? The answer is no. A quick review of the current state of maintenance in the United States indicates that changes are required if companies want to achieve the benefits of Lean Manufacturing.

Maintenance Costs

Various financial studies showed U.S. companies were spending over 600 billion dollars on maintenance and related expenditures in 1990. Of this huge amount, approximately one-third was unnecessary or wasted. This waste provides a cost advantage that companies can ill afford to give to their international competitors.

Where are the wastes? They are in the ineffective use and con-

trol of maintenance resources, labor, and materials. For example, what is the percentage of time that a maintenance technician is involved in actual hands-on activities? Is it two hours out of eight? Three hours? In companies where reactive or emergency types of maintenance make up 50% or more of the maintenance workload, technicians average only 2-3 hours of hands-on activities per day. During the rest of their time, they are engaged in non-productive activities such as looking for parts, drawings, instructions, or authorization.

What about inventory wastes? The cost of having too many spares is paid, not only in capital investments, but also in carrying costs, storage costs and labor costs. Still other costs include spoilage costs, pilferage costs, and the costs of damage caused by materials being stored and moved frequently.

A recent survey of maintenance and maintenance-related personnel showed organizational issues that were impacting maintenance efficiency and effectiveness. These areas include:

- Maintenance scheduling

- Hiring and training maintenance technicians

- Too much emergency or breakdown

- maintenance Lack of controls over

- maintenance spares

- Lack of upper management support and understanding

Each of these problems are difficult to solve, but when combined provide any manager with a formidable task. However, organizations that have these problems will have an almost impossible task trying to implement a TPM program. The right step is to solve some of these basic problems first, before tackling the task of implementing TPM. Later in the text, a methodology is presented showing how to solve these problems.

Maintenance Budgets

Maintenance budgeting is also another problem for organizations. Many methods are used to budget and monitor maintenance. While some work well, others are burdens to the maintenance departments. An extreme case occurs when maintenance is responsible for all maintenance-incurred expenses, whether these expenses are requested or approved by maintenance or operations. In such cases, maintenance may or may not be in control of the moneys be-

ing spent. At the opposite end of the spectrum is the organization with a zero maintenance budget. All charges, including an overhead multiplier, are billed directly to the department requesting the work or which owns the equipment. In this case, the operations or facility organization will want to keep the maintenance costs as low as possible, and will defer repairs, improvements, and refurbishes that should have been performed. In either case, the primary consideration, which is the condition of the company's capital assets (the equipment or facility), is pushed into the background. Total Productive Maintenance's focus on the equipment and / facility pays tremendous benefits to the company.

Figure 1-1 highlights the cost and payback for maintenance verses the company cost. Maintenance costs are between 15% and 40% of the total cost of production in typical manufacturing. The average is approximately 28%, an amount that is too high. When maintenance costs are reduced, even by as little as 10%, any cost avoidance is transformed directly into pre-tax profit. Some companies are able to save as much as 50% of their maintenance budget without sacrificing efficiency or quality of the maintenance work completed. Such savings, which increase pre-tax profit considerably, allow companies to be even more competitive in their respective markets. The comparative savings is highlighted in Figure 1-2.

These savings are enough of an enticement for some companies, but the true cost savings is yet to come. Consider which is

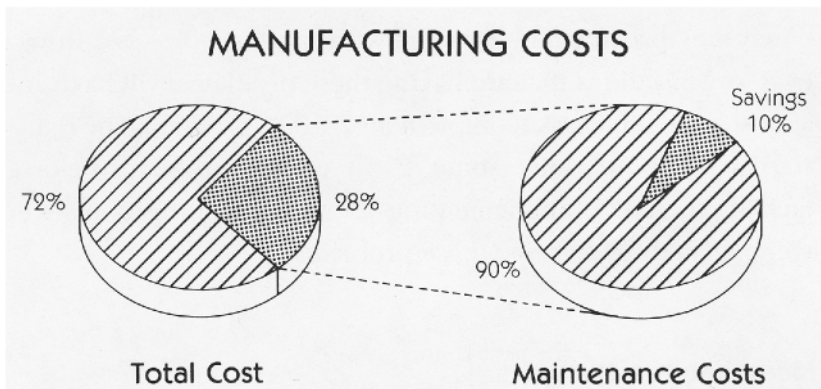


Figure 1-1 Reducing maintenance costs by 10% can produce an increase in pre-tax profit of almost 36%.

more: The maintenance cost of a repair or the cost of lost production? One survey showed that this costs ranges from 2:1 to as high as 15:1, as shown in Figure 1-3. Therefore, if the maintenance cost for a repair is \$10,000, the true cost to the company of not having the maintenance work performed ranges from \$30,000 to \$160,000. It is critical that companies examine the true cost of maintenance versus non-maintenance if they are ever to be successful in improving maintenance and implementing TPM.

An additional problem is the control of the maintenance budgeting process. In over half of the sites, the plant manager or the plant engineer controls the maintenance budget, preventing the maintenance managers from controlling the departments they are responsible and held accountable for managing (see Figure 1-4). Unless managers are allowed to control their department budgets, they cannot be responsible for effectiveness. Total Productive Maintenance places responsibility and control for the job functions with the correct managers.

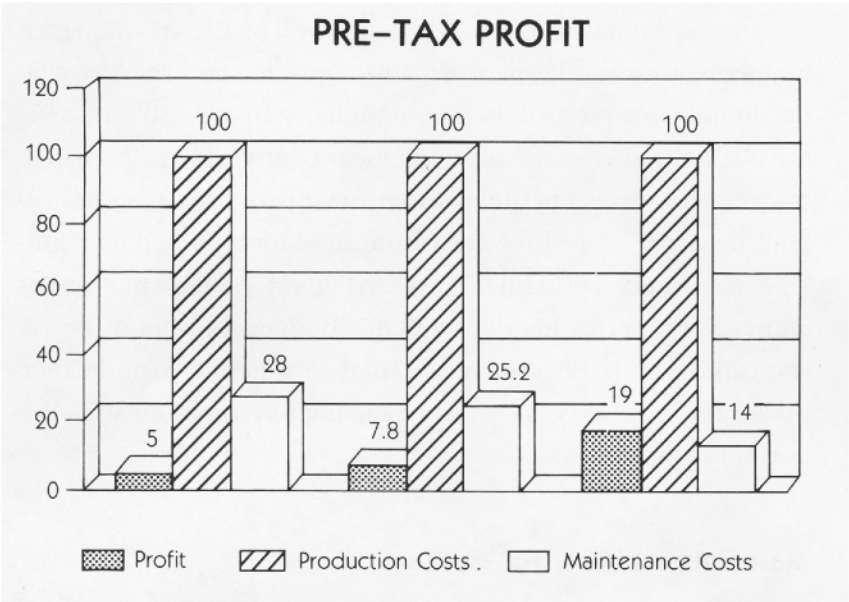


Figure 1-2 The relationship between reduced maintenance costs an increase in pretax profit.

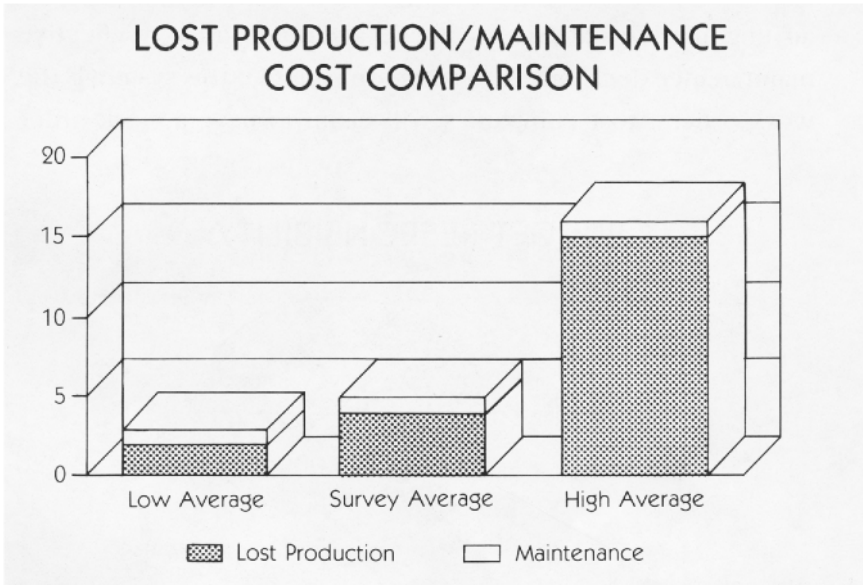
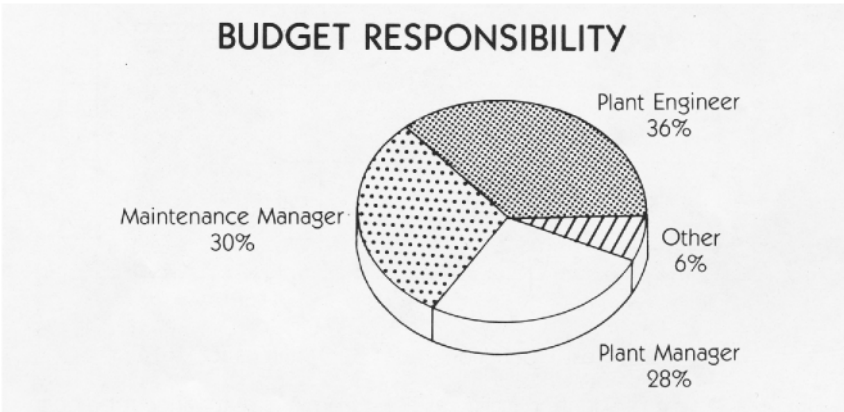


Figure 1-3 Lost production costs resulting from a maintenance repair can vary greatly in different companies.

Figure 1-4 In only 30% of all sites does the maintenance manager control the



maintenance budgeting process.

Maintenance Control Systems

This problem area contributes to all aspects of maintenance and is a key component of a successful TPM program. It is the system used by maintenance to gather information and provide an engineering database to make accurate and cost effective maintenance decisions. The more common name for this system is the work order. Most companies claim to have a work order system. However, only a minority of the companies are satisfied with their information, a point highlighted in Figure 1-5, which shows that the basic information-gathering function in most maintenance organizations is not functioning properly. If the information is not being gathered properly, one must question the accuracy of the decisions that are being made based on this information.

Companies that accurately gather information on work order systems still fail to use it correctly, showing a lack of performance monitoring and information analysis (see Figure 1-6). Thus, even when companies do gather the information, they fail to use it to find and implement cost effective asset management decisions.

Beyond the asset management issue, consider maintenance staff sizes. The size of a maintenance workforce is determined by the amount of work that it has to perform. This amount, commonly called the craft backlog, is the accumulated total of all estimated la

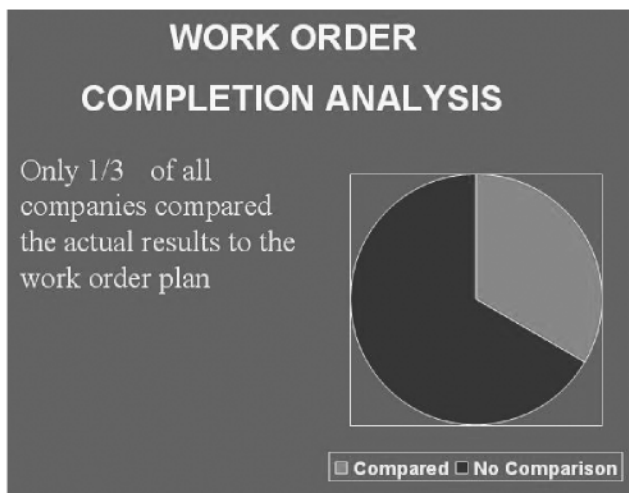


Figure 1-5 Work order system analysis.

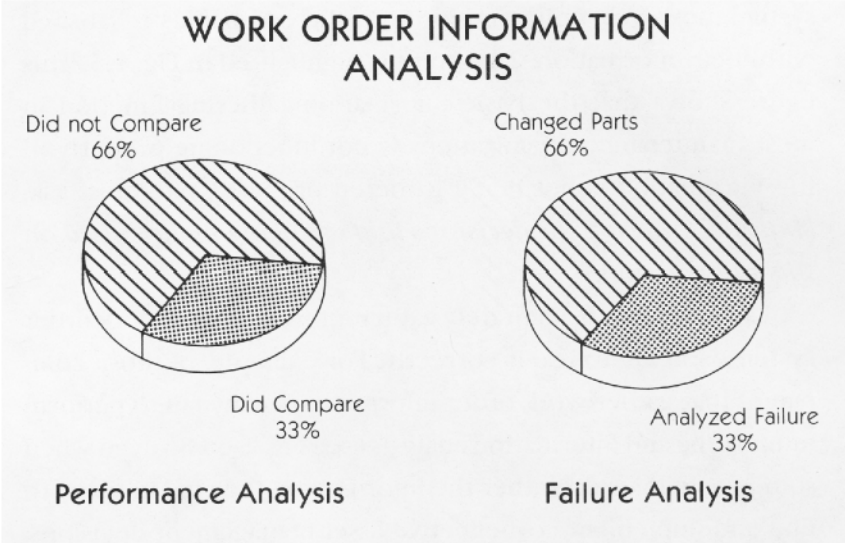
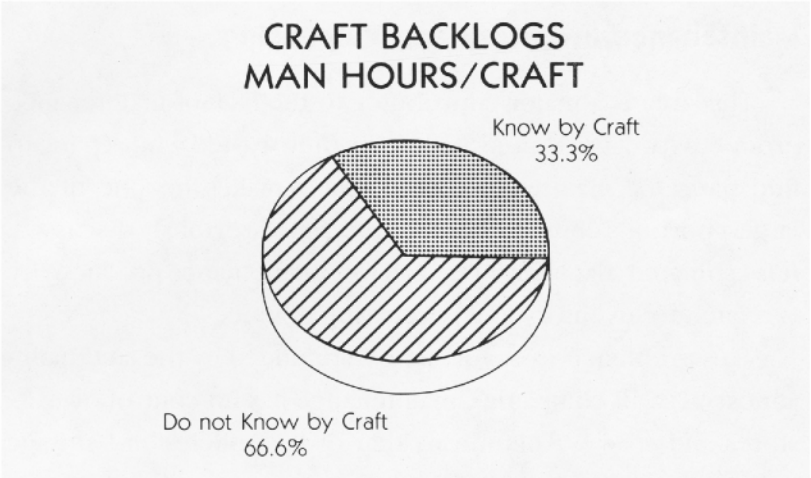


Figure 1-6 Even though almost 77% of all companies use work orders, many of them fail to analyze the information they provide.

Figure 1-7 Many companies fail to plan and estimate existing work orders.



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bor requirements on work orders waiting to be performed. Because many companies do not plan and estimate work orders, they do not know the size of their maintenance backlogs (see Figure 1-7). How do they then make justifiable decisions on maintenance staffing levels? It would be unimaginable for a production department to be managed in the same manner. You would either have operators standing around or equipment setting idle without an operator. This area must be controlled if optimum use of resources is to be realized.

Preventive Maintenance

Preventive maintenance is another major area that must be investigated during a TPM development plan. How do U.S. companies perform preventive maintenance? Almost 80% of the companies are not satisfied that their programs work or are cost effective (see Figure 1-8). The main reasons for these failures and the solutions will be discussed in Chapter 6. However, the largest reason for the failure of preventive and predictive maintenance programs is the lack of understanding and support for the program by upper management. Total Productive Maintenance programs ensure this support. Preventive maintenance under a TPM program will be successful if they are properly designed and implemented.

Maintenance Inventory and Purchasing

This area is a major contributor to the lack of maintenance productivity in the United States. The time wasted while trying to find parts for maintenance technicians makes up one of the largest por

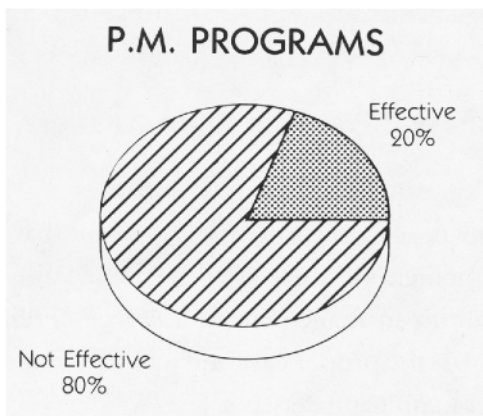


Figure 1-8 About 80% of all companies are not satisfied with their existing preventive maintenance programs.

tions of the lost productive time already discussed. Estimates suggest that over 50% of all lost maintenance productivity is related to inventory and purchasing practices.

This problem is even further compounded by the fact that in almost half of all companies, maintenance has no control, or even input, over its inventory and purchasing policies. Therefore, order policies and storage policies are made by individuals who may not understand how maintenance inventory is different from operations or production inventory. This lack of understanding creates stockouts and overstocks, both of which are unnecessary expenses that weaken an organizations competitive position. While a stockout is considered a nuisance to maintenance, what is its true cost? What is the cost of downtime or lost production that is caused by a stockout? This cost can be considerable, yet it is rarely a factor considered in stocking decisions — a major flaw in many company's maintenance inventory and purchasing functions.

Is There Only One TPM Methodology?

Many companies are asking themselves if there is more than one way to approach TPM. Experts from around the world acknowledge problems implementing a cookbook-style TPM in any company due, in part, to factors such as:

- Skill of the workforce
- Age of the workforce
- Complexity of the equipment
- Age of the equipment
- Company culture
- Current status of the maintenance program

Remember that the primary focus of TPM is the constant improvement in the overall equipment effectiveness (OEE) of the company's equipment and capital assets.

The steps necessary to develop a TPM program must be determined for each company individually. These steps must be adjusted to fit individual requirements because the types of industry/ service/facility, production methods, service activities, equipment conditions, special needs, problems, techniques, and levels of sophistication of maintenance vary dramatically from organization to organization.

Thus, there is no one right answer. The focus of any TPM program is the achievement of the five basic goals discussed earlier in this chapter as well as any others that may be identified by your the particular organization. Although there is no one fixed methodology for implementing TPM, some guidelines can be examined from a technical perspective. These guidelines are presented in a flowchart format in the next section.

TPM Decision Tree

Good, sound maintenance practices are essential for effective TPM. But what exactly are good, sound maintenance practices?" The following discussion explains each block of the TPM decision tree (see Figure 1-9) designed to assist in the development of a TPM implementation methodology. These activities are not intended to be a cookbook, but rather to serve as a general model. If a clear understanding of the model is developed before attempting to implement TPM, then the implementation process will take less time and fewer resources.

1. PM Program Development.

Preventive maintenance is the core of any equipment maintenance process improvement strategy. All plant equipment, including special back up or redundant equipment, must be covered by a complete, cost-effective preventive maintenance program. The preventive maintenance program is designed to eliminate all un-planned equipment failures.

2. Evaluate the PM Program.

Evaluating the preventive maintenance program insures proper coverage of the critical equipment of the plant or facility. The program should include a good cross section of the following:

- Inspections
- Adjustments
- Lubrication
- Proactive replacements of worn components

The program should support the goal of no unplanned equipment downtime. This topic will be discussed further in Chapter 6.

3. Is it Effective? Less Than 20% Reactive Work Performed

The effectiveness of the preventive maintenance program is determined by the level of unplanned equipment maintenance that is performed. Unplanned equipment maintenance is defined as any maintenance activity that is performed with less than one week of advanced planning. Unplanned equipment maintenance is commonly referred to as reactive maintenance.

An effective preventive maintenance program will reduce the amount of unplanned work to less than 80% of the total labor expended for all equipment maintenance activities. If more time is being spent on unplanned activities, then a reevaluation of the preventive maintenance program is required. It will be difficult to make progress in any of the following areas unless the preventive maintenance program is effective enough for the equipment maintenance to meet the 80% / 20% rule.

4. Review the Maintenance Stores.

Once the preventive maintenance program is effective, the equipment spares, inventory, and purchasing systems must be analyzed. The equipment spares and inventory should be organized, with all of the spares identified and tagged, then stored in an identified location, with accurate on-hand and usage data. The purchasing system must allow for procurement of all necessary spare parts to meet the maintenance schedules. All data necessary to track the cost and usage of all spare parts must be complete and accurate. This topic will be discussed further in Chapter 7.

5. Are the Stores Effective? (Greater Than 95% Service Level)

Simply defined, the service level measures the percent of time that a part or in stock when it is requested. The spare parts must be on hand at least 95% of the time for the stores and purchasing systems to support equipment maintenance activities. Unless maintenance activities are proactive (less than 20% unplanned weekly), the stores and purchasing groups cannot be cost effective in meeting equipment maintenance spare parts demands. However, the inventory and purchasing functions must achieve at least a 95% service level before effective work order utilization can occur.

6. Review the Work Order System.

The work order system is designed to track all equipment maintenance activities. The activities can be anything from inspections and adjustments to major overhauls. Any maintenance that is performed without being recorded in the work order system will be lost. In turn, lost or unrecorded data makes it impossible to perform any analysis of equipment problems. All activities performed on equipment must be recorded to a work order by the responsible individual. This step highlights the point that maintenance, operations, and engineering will be extremely involved in utilizing work orders.

7. Are Work Orders Fully Utilized? (100% Coverage)

This question should be answered by performing an evaluation of the equipment maintenance data. The evaluation can be as simple as answering the following questions:

How complete is the data?

How accurate is the data?

How timely is the data?

How usable is the data?

If the data is not complete, it will be impossible to perform any meaningful analysis of the equipment's historical and current condition. If the data is not accurate, it will be impossible to correctly identify the root cause of any equipment problems. If the data is not timely, then it is impossible to correct equipment problems before they cause equipment failures. If the data is not usable, it will be impossible to format it in a manner that allows for any meaningful analysis. Unless the work order system provides data that passes this evaluation, further progress will be impossible.

For example, consider team problem-solving activities that are focused on improving overall equipment effectiveness. The teams always look for the root causes of problems that impact the OEE. Without accurate data from the work order, how can they perform a root cause analysis? How can they identify the top ten problems that cause downtime on the equipment? How would they know which modifications have been done to the equipment in the past that could have caused the current problem? Without data, all decisions about the equipment become subjective.

8. Review Planning and Scheduling.

This review examines the planning and scheduling policies and practices for equipment maintenance. The goal of planning and scheduling is to optimize any resources expended on equipment maintenance activities, while minimizing the interruption the activities have on the production schedule. The goal of planning and scheduling is to insure that all equipment maintenance activities occur like a pit stop in a NASCAR race. This insures optimum equipment uptime, with quality equipment maintenance activities being performed. Planning and scheduling pulls together all of the activities (maintenance, operations, and engineering), and focuses them on obtaining maximum quality results in a minimum amount of time.

9. Are Planning and Scheduling Effective? (Greater Than 80% Weekly)

While this step is similar to Step 3, its focus is on the effectiveness of the activities performed in the 80% planned mode. An effective planning and scheduling program will insure maximum productivity from those employees performing any equipment maintenance activities. Delays, such as looking for parts, rental equipment, drawings, or tools, or waiting while equipment is shut down, will all be eliminated. If these delays are not eliminated through planning and scheduling, then optimizing equipment utilization will be impossible. It will be equivalent to a NASCAR pit crew taking too long for a pit stop; the race is lost by not keeping the car on the track. Equipment utilization is lost by not properly keeping the equipment in service. Maintenance planning and scheduling is discussed further in Chapter 8.

10. Investigate the Computerization of the Work Order System.

A considerable volume of data is generated and tracked to properly utilize the work order system and to plan and schedule effectively. If the data becomes difficult to manage using manual methods, it may be necessary to computerize the work order system. If the workforce is burdened with excessive paper work or is accumulating file cabinets of equipment data that no one has time to look at, then it is best to computerize the work order system. However, if the number of pieces of equipment is relatively small and data tracking and analysis are not a burden, then it may be best to maintain the manual work order system.

10a. Establish a Manual Equipment Maintenance System.

A manual system can be as simple as a cardex file with cards for each equipment item, and with notations of all repairs and services on the cards. Other methods include a visual white board with markers and spaces for notations or a magnetic board with tags that can be moved as each service is complete. Still another method is a log book, which may simply be a three-ring binder, with pages for notations of each service or repair that is performed on the equipment. It does not matter which method is used, but rather that the equipment data is complete and in a format that can be analyzed.

10b. Is the Manual System Effective?

The manual system should meet the equipment management information requirements of the organization. Some of these requirements include:

Complete tracking of all repairs and service

The ability to develop reports, for

example: *Top ten equipment problems*

Most costly equipment to maintain

Percent reactive vs. proactive maintenance

Cost tracking of all parts and costs

If the manual system does not produce this level of data, then it needs to be re-evaluated. (If it is effective, then go to Step 13.)

10c. Evaluate the Manual Work Order Process.

The goal of reevaluating the manual work order system is to determine where the weaknesses are in the system so that they can be corrected and good equipment data can be collected. Several questions for consideration include:

Is the data we are collecting complete and accurate?

Is the data collection effort burdening the work force?

Do we need to change the methods we use to manage the data?

Do we need to re-evaluate the computerization decision?

Once problems are corrected and the equipment management information system is working, then constant monitoring for problems and solutions must be put into effect. (Go to Step 13.)

11. Purchase and Implement a CMMS (EMIS).

The computerized maintenance management system (CMMS), also known at times as an Equipment Management Information System (EMIS), is a computerized version of a manual system. There are currently over 200 commercially produced CMMSs in the North American market. Finding the correct one may take some time, but through the use of lists, surveys, and word of mouth, and by evaluating the vendor's financial status, it should take no more than three to six months for any organization to select a CMMS. Once the right CMMS is selected, it must then be implemented. CMMS implementation may take from three months for smaller organizations to as long as 18 months for larger organizations to implement.

Companies can spend much time and energy addressing CMMS selection and implementation. Keep in mind that CMMS is only a tool to be used in the improvement process; it is not the goal of the process. Losing sight of this fact can curtail the effectiveness of any organization's path to continuous improvement.

12. Is the CMMS Usage Effective?

If the correct CMMS is selected, then it makes the equipment data collection faster and easier. It should also make the analysis of the data faster and easier. The CMMS should assist in enforcing World Class maintenance disciplines, such as planning and scheduling and effective stores controls. The CMMS should provide employees with usable data with which to make equipment management decisions. If the CMMS is not improving these efforts, then the effective usage of the CMMS needs to be evaluated. Some of the problems encountered with CMMS include:

Failure to fully implement the CMMS

Incomplete utilization of the CMMS

Inaccurate data input into the CMMS

Failure to use the data once it is in the CMMS

CMMS will receive further consideration in Chapter 9.

13. Investigate Operator Involvement.

As the equipment management system (CMMS, EMIS) becomes effective, it is time to investigate whether operator involve-

ment is possible in some of the equipment management activities. There are many issues that need to be explored, including the types of equipment being operated, the operators to equipment ratios, the skill levels of the operators, and contractual issues with the employees' union. In most cases, there is some level of activity at which the operators can be involved within their areas. If there are no obvious activities for operator involvement, then a reevaluation of the activities will be necessary.

14. Identify the Activities.

The activities in which the operators may be involved can be either basic or complex. The complexity is determined partially by their current operational job requirements. Some of the more common tasks for operators include, but are not necessarily limited to:

A. Equipment Cleaning

This activity may be as simple as wiping off the equipment when starting it up or shutting it down.

B. Equipment Inspecting

This activity may range from a visual inspection while wiping down equipment to a maintenance inspections checklist utilized while making operational checks.

C. Initiating Work Requests

Operators may prepare work requests for any problems (either current or developing) on their equipment. They pass these requests on to maintenance for entry into the work order system. Some operators will directly input work requests into a CMMS.

D. Visual Systems

Operators may use visual control techniques to inspect their equipment and to make it easier determine its condition.

Whatever the level, operator involvement should contribute to the improvement of the equipment effectiveness.

15. Are the Operators Certified to Perform the Activities?

Once the activities in which the operations personnel are to be involved have been determined, the operators' skills to perform

these activities need to be evaluated. The operators should be properly trained to perform any assigned tasks. The training should be developed in both written and visual formats. Once the operators are trained, copies of the materials should be given to the operators for their future reference. These materials will contribute to the commonality required in order for operators to be effective while performing these tasks. In addition, certain regulatory organizations require documented and certified training for all employees (e.g., Lock Out Tag Out). Training for personnel involved in TPM will be discussed further in chapter 10.

16. Begin Operator Involvement.

Once the operators are trained and certified, they can begin performing their newly-assigned tasks. The operators must be coached for a short time to insure they have the full understanding of all aspects of the new tasks. Some companies have made this coaching more effective by having the maintenance personnel assist with it. Background knowledge can then be transferred to the operators— information that they may not have received otherwise during the more formal training.

17. Is Predictive Maintenance Being Performed?

Once the operators have begun performing some of their new tasks, maintenance resources may become available for other activities. One area that should be explored is predictive maintenance. Fundamental predictive maintenance techniques include:

Vibration Analysis
Oil Analysis
Thermography
Sonics

Plant equipment should be examined to see if any of these techniques will help reduce downtime and improve service. Predictive technologies should not be utilized because they are technically advanced, but only when they contribute to improving the equipment effectiveness. The correct technology should be used to trend or solve the equipment problems encountered.

18. Investigate Reliability Engineering.

Reliability Engineering is a broad term that includes many engineering tools and techniques. Some common tools are:

Life Cycle Costing. This technique allows companies to know the cost of their equipment from when it was designed to the time of disposal.

RCM. Reliability Centered Maintenance is used to track the types of maintenance activities performed on equipment to insure that they are the correct activities to be performed.

FEMA. Failure and Effects Mode Analysis examines the way the equipment is operated as well as any failures incurred during the operation in order to find methods of eliminating or reducing the numbers of failures in the future.

Early Equipment Management and Design. This technique takes information on equipment and feeds it back into the design process to insure that any new equipment is designed for maintainability and operability.

Using these and other reliability engineering techniques improves equipment performance and reliability and, in turn, helps to insure competitiveness.

19. Investigate Financial Optimization.

Once the equipment is correctly engineered, the next step is to understand how the equipment or process impacts the financial aspects of the company's business. Financial optimization considers all costs impacted when equipment decisions are made. For example, when calculating the timing to perform a preventive maintenance task, are the cost of lost production or downtime considered? Are wasted energy costs considered when cleaning heat ex-changers or coolers? In this step, the equipment data collected by the company are examined in the context of the financial impact they have on the company's profitability.

20. Are the Tools and the Data Available for Financial Optimization?

While financial optimization is not a new technique, most companies do not properly utilize it because they do not have the data necessary to make the technique effective. Some of the data required includes:

MTBF (Mean Time Between Failure) for the equipment
MTTR (Mean Time To Repair) for the equipment
Downtime or lost production costs per hour
A Pareto of the failure causes for the equipment
Initial cost of the equipment
Replacement costs for the equipment
Complete and accurate work order history for the equipment

Without this data, financial optimization cannot be properly conducted on equipment. Without the information systems in place to collect this data, a company will never have the accurate data necessary to perform financial optimization. We will look more closely at financial optimization in Chapter 11.

21. Use Financial Optimization.

If the data exists and the information systems are in place to continue to collect the data, then financial optimization should be utilized. With this tool, equipment teams will be able to financially manage their equipment and processes.

22. Evaluate the Success of the TPM Program.

Are the results achieved by maintenance reaching the goals that were set for the improvement program when it was started? If not, then the maintenance improvement program needs to be examined for gaps in performance or deficiencies in existing parts of the process. Once weaknesses are found, then steps should be taken to correct or improve these areas.

23. Strive for Continuous Improvement.

Continuous improvement means never getting complacent. It calls for constant self-examination with the focus on how to become the best in the world at the company's business.

This implementation flow focuses on the "technical" flow to TPM. Meanwhile, there is a complementary flow chart that examines the "people" side of TPM. This flow chart, developed by Robert Williamson of Strategic Work Systems, is available by contacting him at www.swspitcrew.com

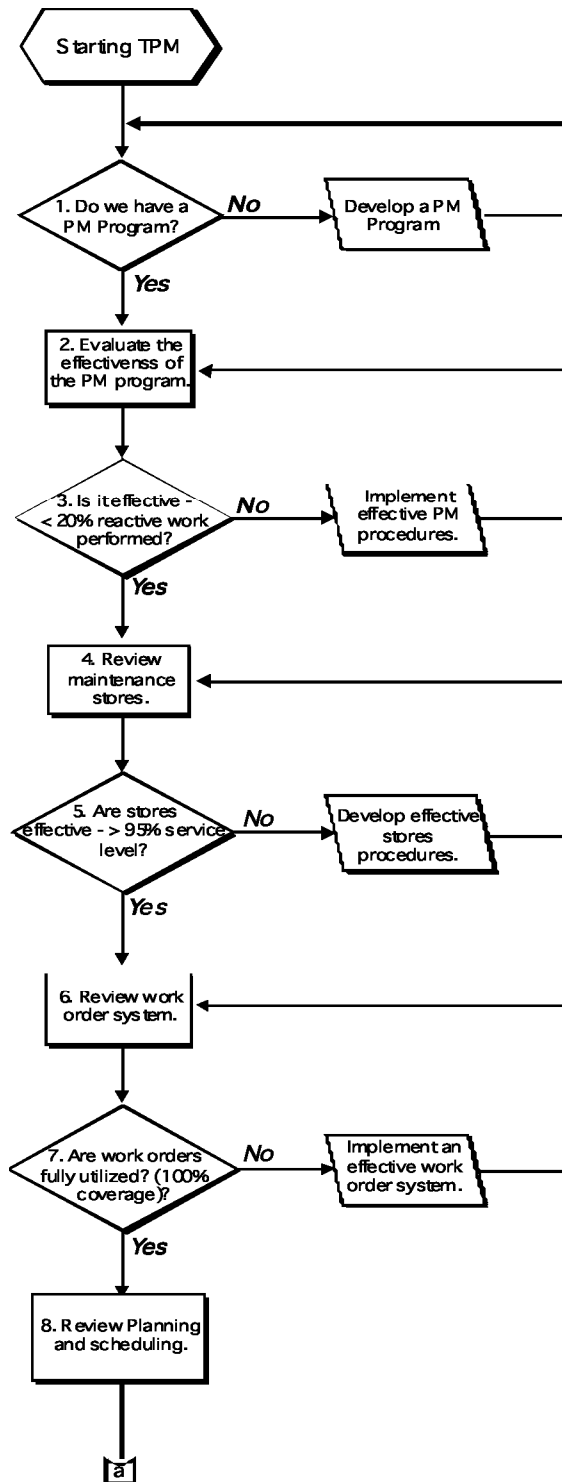


Figure 1-9 a

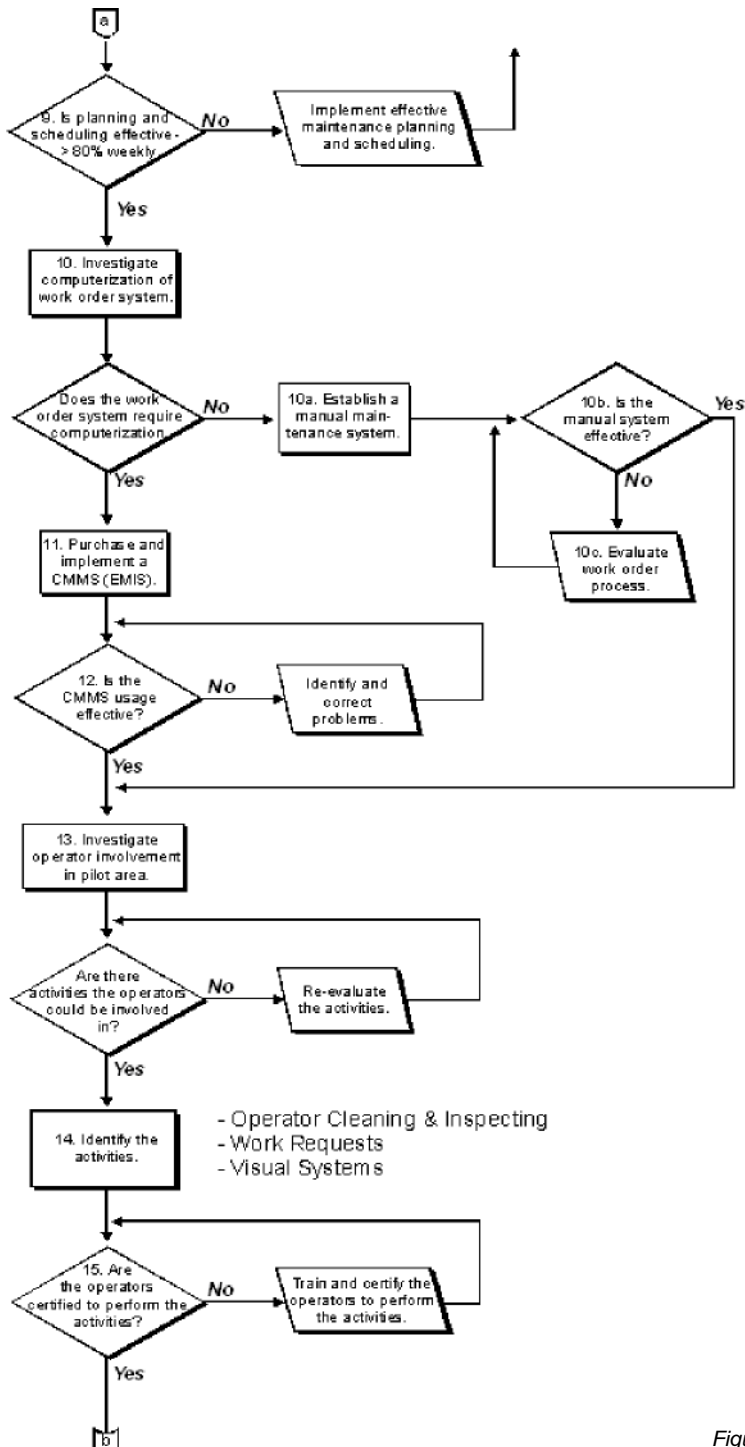


Figure 1-9 b

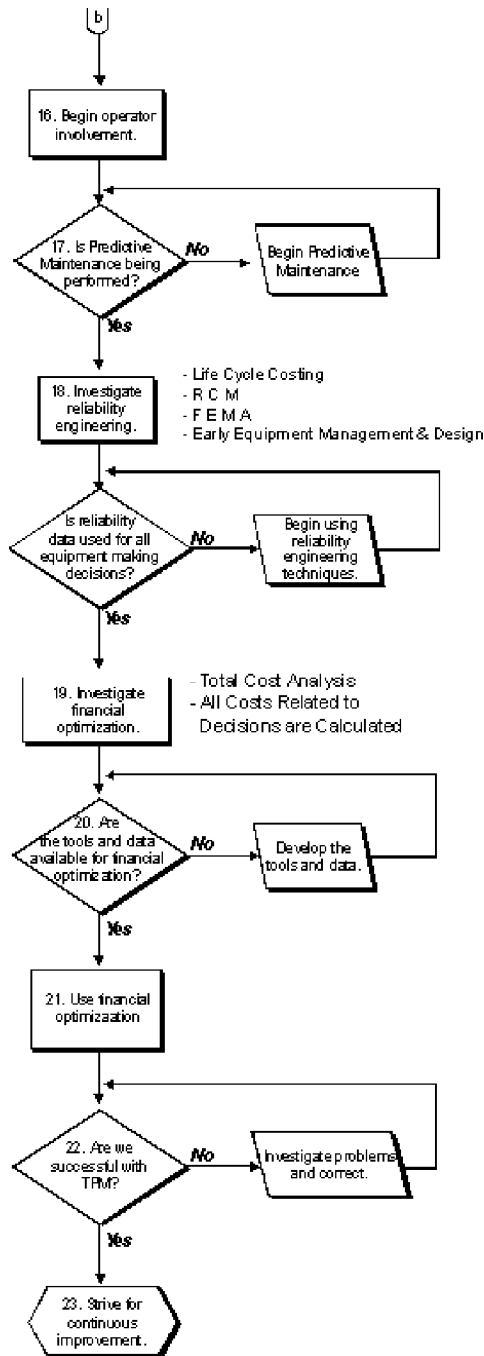


Figure 1-9 c

Pitfalls for TPM

While the TPM flow appears to be easy to follow, there are hidden pitfalls when trying to implement TPM. Two will be considered now, with these and others receiving additional consideration in Chapter 15.

Organizational Downsizing

In the business environment of the early 2000s, much of management focus is spent on headcount reductions or downsizing of the workforce. This practice is detrimental to the employee involvement required by TPM. In some companies, TPM starts as a middle management activity. The line employees buy in to the common sense approach to TPM and begin to contribute ideas that increase productivity. Because senior management has never been properly educated about the process, they use the increase in productivity (output) to focus on reducing expenses to further increase profits. When this occurs, the employee involvement required by TPM diminishes and the TPM strategy fails.

In the January 14, 1995 issue of the Economist, it was stated that, “Even the 1980s’ most ardent adherents of quality are finding that TQM does not readily blend with wave after wave of restructuring, downsizing, and re-engineering”. The article stated further “the snag is downsizing undermines a cornerstone of TQM: Employee Motivation.” If you change the acronym from TQM to TPM, you have an equally true statement. Unless the entire organization from senior management to the line employees understand the true focus of TPM—which is improving equipment effectiveness—the TPM effort will be destined to failure.

Senior executives today need to realize that there are two ways to decrease cost per unit.

1. Make the same number of units and reduce expenses.
2. Hold the line on expenses and make more units.

TPM, while doing both, focuses more on increasing equipment utilization and eliminating waste (reducing expenses) rather than focusing on headcount reductions. Unless this is clearly understood throughout the organization, companies will continue to struggle to implement TPM strategies.

Lack of Focus on Results

Many consulting organizations that teach TPM focus on its esoteric aspects. They have their clients start by cleaning their equipment, forming teams to discuss theoretical improvements, and creating visual systems to make the plant look better. Although these activities are a part of the overall TPM strategy, they are implemented without any tangible results. Therefore, the companies spend their physical and financial resources with little, if any, financial return on investment.

Unless all of the initiatives in TPM are tied to financial benefits or improvements, senior management support wanes over time. When the company has a particularly tight quarter financially, senior management eliminates support for strategies that are not providing an immediate return on investment. When this occurs, the plug is too easily pulled on the TPM strategies. However, in companies where all TPM initiatives are tracked and financially justified, the overall TPM strategy is supported by senior management even in the most difficult of times.

TPM is not a difficult strategy to execute. As long as it has a focus and financial justification, it will be successful. This theme will continue to be developed throughout the remainder of this text.

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