



How is TPM Different?

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Reliability-centered maintenance (RCM), enterprise asset management (EAM), or total productive maintenance (TPM)? What is the correct strategy for your company? Are there really any differences among these strategies?

RCM

In the *Certified Plant Maintenance Manager Review Book*, reliability-centered maintenance is defined as, "A method of optimizing the preventive and predictive maintenance programs for an equipment system with the goal of maximizing the equipment's availability and performance at the lowest life-cycle cost."

RCM focuses on ensuring that equipment is capable of performing its designed functions. Within RCM, the preventive maintenance (PM) and predictive maintenance (PDM) programs focus on maintaining equipment's physical integrity so that there is no degradation in its performance that will impact the output required from it. In a sense, RCM is a "balancing act" to optimize the cost of performing the PM and PDM activities so that only necessary activities are carried out -- not too much maintenance, but not too little maintenance, either.

EAM

EAM is management of a company's assets to optimize their use, thereby maximizing the return on investment (ROI) for the assets. According to the Gartner Group, "EAM goes beyond predictive maintenance by including in-process information in asset health analysis to deliver just-in-time maintenance with production impact included in the optimization equation."

EAM focuses on getting the most out of an asset for the life of the asset. Whereas RCM takes a technical approach, EAM blends the technical approach with a financial approach. EAM uses technology for integration of plant systems, eliminating islands of information within a company. This integration is intended to ensure that the company's investments in its assets are maximized.

TPM

TPM blends the best from RCM and EAM while emphasizing *people* and *work culture* issues. This emphasis is seen in the "pillars" or goals of TPM:

1. Improving equipment effectiveness by targeting the major losses
2. Improving maintenance efficiency and effectiveness
3. Life-cycle equipment management and designing for maintenance-prevention

4. Training for everyone involved
5. Involving operators in the daily, routine maintenance of their equipment
6. Winning with teamwork focused on common goals.

Improving equipment effectiveness entails using a blend of management techniques to ensure that equipment performs up to its design capabilities and provides a company with the maximum return on its investment in the equipment. The goal is to make sure that no other company, anywhere in the world, using the same equipment gets better performance from it than you do. If one does, then your company is in “second place” in the competitive market contest.

The benchmark measure for this goal is the overall equipment effectiveness (OEE). This benchmark is calculated by measuring the availability and performance of the equipment and the quality of its output. The goal is to achieve a rating of 85% or higher. This benchmark is very effective, since the measures are not just for maintenance, but also include operations, quality, engineering, and even inventory and purchasing. The OEE focuses on at least 11 kinds of losses in four categories:

A. Planned-shutdown losses

1. Production, breaks, and/or shift changes
2. Planned maintenance

B. Downtime losses

1. Equipment failure or breakdowns
2. Setups and changeovers
3. Tooling or part changes
4. Start-up and adjustment

C. Performance efficiency losses

1. Minor stops (equipment hiccups)
2. Reduced speed or cycle time

D. Quality losses

1. Scrap product/output
2. Defects or rework
3. Yield or process transition losses.

As the list of losses shows, TPM addresses equipment issues that go beyond maintenance and operations. TPM involves the entire company in improving equipment performance. For example, one might exceed the design capacity of equipment by running it “wide open” for a short time, exceeding its design output. However, this action will lower the “availability” component of the OEE formula and prevent any increase in the OEE. In fact, this action could lower the OEE by lowering the quality rate. Without full cooperation of all departments that influence how equipment performs, OEE can never be increased.

Improving maintenance efficiency and effectiveness focuses on optimizing the maintenance organization’s efforts. The goal is to remove all of the waste from the maintenance process. The components of achieving this goal are:

- A good PM program
- Good inventory and purchasing controls and policies
- Effective use of a work order system
- The planning and scheduling of maintenance work
- A computerized maintenance management or enterprise asset management (CMM/EAM) system for data collection and analysis
- Use of appropriate PDM techniques.

The aim is to be as cost effective as possible at managing the maintenance function. However, as several past articles in *Engineer's Digest* have pointed out, most companies struggle with developing a maintenance strategy that encompasses these components. For example, almost one-half of all CMM/EAM systems are either considered failures or still show sub-optimal performance within two years of their purchase.

Life-cycle equipment management and designing for maintenance prevention includes using the data gathered for improving maintenance efficiency and feeding it to design engineers, vendors, and suppliers of equipment to help them make the next generation of equipment more maintainable than the current generation. Such improvements include design changes that either eliminate the need for maintenance or make the equipment easier to maintain, thereby lowering the mean time to repair. Many of the required changes can be identified by analyzing the constraints to increasing OEE. The added capacity of the equipment realized by the changes can then be cost justified by the engineering or management groups.

In addition, since the data is available, life-cycle costing techniques may be used to minimize the financial investment by the company for the entire life of the equipment. This approach avoids the "low bid purchase" scenario that many companies find themselves using today, an approach to capital investments that tends to increase maintenance and operational costs during the equipment's life.

Training for everyone involved attempts to ensure in TPM what is often assumed in RCM and EAM. To wit, that the operators and maintenance technicians are skilled. Many of the activities that fall under the first three pillars of TPM can be accomplished by either an RCM or EAM approach, since they too focus on the overall management of the lives of assets. However, TPM moves beyond RCM and EAM with the goal of training to improve the skills of all people involved.



TPM Pillars → Program ↓	Improving equipment effectiveness	Improving maintenance efficiency	Designing for maintenance	Training for everyone	Operator involvement	Winning with teamwork
RCM	✓	✓	✓	?		
EAM	✓	✓	✓	?		
TPM	✓	✓	✓	✓	✓	✓

Table 1. The above table clarifies which pillars or goals of TPM typically are aims of RCM and EAM programs. A check mark (✓) indicates that a pillar is a program's goal. A question mark (?) indicates that a pillar might be a program's goal. Often within an RCM or EAM program, training for everyone is assumed but not carried out.

Realistically, as equipment systems are modernized, the technical skills required to operate and maintain the equipment change. Maximizing OEE requires skilled operators and maintenance technicians. In many companies, there is still the attitude that production runs the equipment and maintenance repairs it. By contrast, TPM exploits the significant benefits to the bottom line that can be achieved when maintenance technicians and operators are trained to improve how the equipment performs.

Earlier articles in *Engineer's Digest* have emphasized the fact that 50% of all plant equipment breakdowns are related to the neglect of basic maintenance practices. Add to this number the percentage of equipment breakdowns that occur due to operator error, and it is quickly apparent that no effort to improve equipment effectiveness will ever be successful without the training of operators as well as maintenance technicians. **Involving operators** in the daily, routine maintenance of their equipment is the fifth pillar of TPM. The goal is to relieve the maintenance department of some of the basic maintenance tasks so that maintenance resources can be re-deployed in higher-level predictive or reliability activities. In most TPM programs, there are eight basic steps for training operators in the care of their equipment. They entail learning how to:

1. Do initial basic cleaning (Cleaning is inspecting.)
2. Address sources of problems (leaks, dirt, grease, etc.)
3. Improve access to hard-to-clean and hard-to-inspect areas
4. Develop cleaning, inspecting, and lubricating standards
5. Master general inspection skills
6. Clean, inspect, and lubricate
7. Organize the workplace
8. Perform full group maintenance and equipment management.

Again, the goal is not to *eliminate* maintenance personnel by involving operators, but rather to allow the



resources to be better used in higher-level diagnostic and problem-solving activities.

Winning with teamwork focused on common goals begins with building a sense of teamwork using common processes for accomplishing tasks and centering on targeted equipment. The team approach is then expanded throughout all areas to improve performance (see the box, "Characteristics of high-performing teams").

Characteristics of high-performing teams

Some of the characteristics of high-performing teamwork include:

Common goals: Daily plans and schedules; weekly plans and schedules; shared daily objectives.

Common processes: Daily morning meetings; weekly meetings; training and practice sessions; checklists for each critical piece of equipment.

Regular feedback: Daily discussions about the prior day's accomplishments; immediate feedback on the performance of the critical equipment and the team's efforts.

Rewards and recognition: Team members sharing in the performance gains; congratulatory messages and tokens of appreciation after each accomplishment.

Focused leadership: Leaders providing a common focus for the team, facilitating timely feedback on individual and collective performance, providing needed resources for accomplishing responsibilities, holding team and individuals accountable for assigned tasks, walking the talk, fostering openness and honesty, and listening, listening, listening.

Individual strengths: General respect for specialized skills and knowledge within the team and continually improved "multi-skill" or shared job roles.

Ownership: A sense of team ownership for everything the team does rather than the singling out of individuals.

Teamwork focused on common goals means regularly communicating the critical measures of performance. High-performing teams can improve only when they track their actual performance, analyze the results, and take corrective action.

Regularly determining the root causes of both poor performances and the best performances helps keep teams focused on common goals. The best teams not only ask why their equipment performed poorly but also why it performed so well. They strive to avoid repeating the same mistakes or having the same problems, and they attempt to repeat the practices that contribute to the highest levels of equipment performance and reliability. The role of "leadership" is most critical in making sure individuals and the entire team is capable of focusing on and achieving the common goals.





TPM Issues

Since it encompasses the best practices in all areas of equipment management, why isn't every company pursuing TPM?

In the past, TPM often was viewed as a "maintenance department" program. This misconception was often because of the name, "total productive *maintenance*." Yet, as noted here, TPM encompasses much more than just maintenance. It involves everyone in the company focusing on improving OEE. Most "failed" TPM initiatives never had this goal. So, those efforts never achieved the results desired, and TPM was dropped in favor of some other "initiative of the month."

While other equipment strategies, e.g., RCM and EAM, may show some benefits, only by involving the entire organization (the people) and changing the work culture can the maximum ROI for equipment be achieved.

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