# Setup Reduction and TPM Basics

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Like pit crews in auto racing, manufacturing crews rely on speed and efficiency in making changeovers. A carefully planned setup reduction process can bring a manufacturer to the lowest-cost finish line first. As described by Robert K. Hall, vice president of InterMetro Industries Corporation, the benefits of setup reduction include significant changeover time reductions, quicker response time to schedule changes, greater production flexibility, and simplified work flow. This article offers setup reduction and Total Productive Maintenance (TPM) tips shared by Hall during a recent AME seminar, "Setup Reduction and TPM," in Rosemont, IL.

### Setup Reduction Teamwork

Hall described setup reduction as "a systematic process of minimizing equipment downtime during product, material, or tooling changeovers by involving employees in making improvements." He described how employees at American National Can facilities, for example, cut setup times through 100 Corrective Action Teams (CATs). A typical CAT included five to seven members (mostly hourly workers) with a non-hourly team leader and an industrial engineer as facilitator.

Once a setup reduction CAT was created, team members videotaped their own setup reduction process. By doing so, they were able to identify all of the steps involved in completing a changeover. All changeover elements were then identified as internal or external. Internal elements are activities which must be done while the machine is shut down. External elements can take place while the machine operates. The more internal elements can be switched to external, the more successful a setup reduction project can be, Hall said.

Changeover elements can further be classified as adjustment, preparation, installation, or removal. Installation and removal elements generally are internal, while preparation and adjustments are external. The CATs found that adjustment activity sometimes con-

sumes up to 95 percent of the changeover time. By installing a changeover correctly the first time, team members found that machine adjustments could be eliminated, reducing downtime and scrap.

Up to 30 percent of setup time involves preparation and the search for tools, parts, supplies, or materials, according to Hall. Better housekeeping and planning can eliminate preparation time.

Hall also noted that changeover elements can be eliminated, combined with other elements, re-sequenced, or done in parallel to save time in a limitless number of ways. After changeover elements are identified and analyzed, CATs developed action item lists to track streamlining opportunities, improvement ideas presented, who was responsible for testing particular improvement suggestions, and the current status of ideas (data collected on effectiveness).

During several weeks, CAT members identified several specific changes in their setup reduction processes which saved time and other resources. Through a formalized design process, they worked with management to develop changeover plans incorporating the new approaches. Their work was not finished, however. Setup reduction is a continuous process with major gains achievable on the third or fourth generation. Like pit crews relentlessly looking for ways to improve speed and reach the winners circle, setup reduction teams should continue to look for ways to trim setup times.

### TPM to Improve Overall Equipment Effectiveness

Total Productive Maintenance (TPM) is an improvement approach aimed at reducing breakdowns and improving quality through the elimination of waste caused by production equipment. At American National Can, for instance, TPM improvements were achieved through 40 CATs and a continuous improvement approach toward maximizing overall equipment effectiveness (OEE). OEE is best with high levels of equipment availability, efficiency, and quality, or in other terms, when downtime, setup losses, spoilage, and rework are minimized.

Autonomous maintenance distinguishes TPM from traditional maintenance programs. It includes daily activities such as cleaning, lubricating, checking the tightness of bolts, etc. This routine process transfers "ownership" from maintenance employees to operators. Problem solving tools which support TPM include Pareto analysis, problem analysis, "ask why analysis" — asking "why" a problem occurs several times to uncover root causes of major equipment breakdowns, etc.

Two important aspects of the TPM approach are preventive and predictive maintenance practices. At DuPont, preventive and predictive maintenance play important roles in the company's strategic TPM approach. Operators at many of its facilities gauge conditions of the machines they are running, predict when and why the machines will break down, and apply preventive maintenance techniques to "fix" breakdowns before they occur. DuPont estimates that its proactive approach reduces maintenance costs by as much as 15 percent, or $300 million annually.

**Predictive maintenance** uses "modern measurement and signal processing techniques to accurately diagnose the condition of equipment during operation and determine when maintenance is required," Hall said. It is essentially the use of sensing equipment to forecast when a breakdown might occur; Hall said it is relatively easy to train shop floor personnel in the use of these technologies. Not all equipment should be targeted for predictive maintenance. Good candidates include equipment that is expensive to repair or causes serious losses if it fails.

Vibration analysis, infrared, oil ferrography, lubricant and fiber optic monitoring techniques are used to diagnose the health of equipment. They employ diagnostic techniques to:

- Monitor the continuous change of machine conditions
- Measure stress, deterioration, strength, and performance without dismantling the equipment
- Predict equipment reliability and capacity
- Identify the cause, location, and extent of a malfunction
- Indicate the method of repair.

**Preventive maintenance** is "periodic inspection of equipment to detect conditions that might cause breakdowns or deterioration and to reverse such conditions," Hall said. **Establishing maintenance standards** in terms of inspection, servicing, and repair which assure consistency and efficiency is one of the first steps your company can take in beginning a preventive maintenance system.

**Spare parts control** can help a company promote part reliability, assure the availability of spare parts, and reduce inventories and costs. **Maintenance cost control** can help to decrease maintenance costs by moving subcontracting work in-house, extending equipment life, and reducing energy and resource use. **Lubrication control** can prevent leakage and contamination, and prolong machinery life, Hall said.

Finally, **maintenance planning** can create a structured approach to carrying out the above preventive techniques. It involves the creation of annual and monthly maintenance plans which, at the very least, rank equipment priorities and map out major maintenance projects.

*Suggested readings about TPM:*
*Equipment Planning for TPM; Maintenance Prevention Design* by Fumio Gotoh, originally published by the Japan Institute for Plant Maintenance; *TPM for America; What It Is and Why You Need It* by Herbert R. Steinbacher and Norma L. Steinbacher; *TPM for Operators*, compiled by Productivity Press, Kunio Shirose, advisory editor; *The TPM Development Book* by Seichi Nakajima; all published by Productivity Press, 800/394-5632.

The articles, "TPM: Total Productive Maintenance" and "Setup Reduction," are available from Robert K. Hall by writing him at InterMetro Industries Corporation, 651 N. Washington Street, Wilkes-Barre, PA 18705; or by phone at 717/825-2741.

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