In May 1995, a company we will call ACME North America to protect its identity, began a focused effort to improve manufacturing performance at one of its major production facilities. Particular attention was given to improving plant reliability and its potential impact on increased uptime and lower maintenance costs.

ACME North America had a respectable profit on sales, and revenues stood at several $100 million. The company was taking prudent action to assure its long-term financial health.

Over the next several months, a number of performance measures were put into place, and specific actions were taken to improve maintenance performance. These included measuring uptime and the causes of lost uptime, as well as implementing certain maintenance improvement tools such as:

- Maintenance planning and scheduling and routine preventive maintenance (PM) activities
- Several predictive maintenance technologies
- More proactive efforts, such as root cause failure analysis and precision alignment and balancing of critical equipment
- Operator PM efforts to improve equipment basic care and to relieve maintenance of several routine tasks
- Assignment of a manufacturing reliability engineer to facilitate the implementation of these practices in a comprehensive manner.

Prior to these efforts, maintaining high uptime had become increasingly difficult, with uptime typically 70 percent or higher, but rarely better than 80 percent. Following the implementation of the reliability program, uptime improved steadily to a peak of 88 percent.

Maintenance costs trended steadily downward after implementing reliability practices, going from $980,000 per month to $480,000 per month.

Reactive maintenance dropped from about 70 percent in mid-1995 to about 30 percent in August 1996. The reduction in reactive maintenance, which typically costs twice that of planned maintenance, was a result of implementing specific preventive (time based) maintenance,

predictive (condition based) maintenance, and proactive (root cause based) maintenance practices in an integrated, comprehensive way. In particular, predictive maintenance was used to confirm the need for scheduled efforts, to trend the condition of equipment, to diagnose the root cause of certain repeated problems, and to balance the need for preventive and proactive maintenance, making it more optimal.

Financial data were normalized by a fixed constant to maintain the confidentiality of the actual data.

Consolidating maintenance contractors

In parallel with the reliability program, the company's purchasing department in the second quarter of 1995 determined that considerable money could be saved by consolidating contractors on site, reducing the administrative and management effort associated with those contractors. It felt this was particularly true for maintenance and related contractors, such as those involved with minor capital and construction projects. The decision was made in June 1996 and the consolidation process began in September.

Simultaneously, at the corporate level, considerable benchmarking led management to conclude that maintenance costs were too high, and that productivity (units of product per employee) was too low. After considerable debate, and apparently unable to wait long enough to realize the full benefit of the improvement process already being established, management decided to cut the number of employees, with maintenance employees being reduced by about half.

Uptime dropped immediately to about 66 percent, then rose gradually to near 86 percent-dropping thereafter for an average of about 75 percent for the period from September 1996 to June 1997. However, it should be highlighted that the immediate drop in uptime in September was related to two specific equipment failure events (a large motor and a heat exchanger), and those specific events should not be attributed to the consolidation effort, or to the downsizing effort. As luck would have it, however, the timing of those failures was very inopportune. And, nonetheless, the plant has had great difficulty recovering to levels of performance exhibited prior to the downsizing and contractor consolidation. Overall, uptime dropped from about 82 percent to 75 percent following these actions.

In the first quarter of maintenance contractor consolidation, maintenance costs soared to more than $1,080,000 by December 1996, over twice August and September's levels, and

significantly above costs a year earlier when the reliability improvement program began.

As of June 1997, maintenance costs were still at $880,000 per month, a comparable level to that of October 1995. In effect, after nearly two years of effort, maintenance costs had not improved, and in fact had increased substantially from about a year earlier.

The level of reactive maintenance had trended downward until August 1996, even continuing downward into November to some 20 percent. However, as consolidated contractor staffing levels and work efforts increased, predictive maintenance was essentially eliminated, giving way to time based or preventive maintenance because the contractor was apparently not familiar with condition based maintenance methods for improving maintenance performance.

Coincidentally, reactive levels also began to rise, peaking in May 1997 at over 40 percent -comparable to levels in early 1996 -and in spite of increased PM. Indeed, some studies indicate a 10-20 percent probability of introducing defects into equipment using a preventive maintenance approach alone.

Stores issues and purchase orders for maintenance parts about doubled from early 1996 levels to some $300,000 per month. Further, purchase order expenses now represented about $150,000 of the total, or about half. This is believed to reflect the contractor's not understanding or using the stores system -preferring the use of purchase orders, stores not having the material required, or some combination of these factors.

The contractor injury rate was initially five times that of employee injury rate, but it has improved to three times the employee rate.

Scheduled maintenance was initially less than 20 percent, but has risen substantially to near 75 percent, although deteriorating in recent months to near 65 percent.

All in all, performance has been substantially worse than expectations by almost any measure -worse than before contractor consolidation, and no better than 1995 when reliability concepts were first introduced by the company.

What happened?

There were many factors at work; some were beyond the control of the contractor. The decision to use the new contractor was driven by a need to consolidate contractors, as well as a perception that labor costs for contractors were cheaper than in-house labor. In fact, costs actually increased following consolidation of contractors. Some of the factors associated with the performance shortfall include:

- Contractor experience. The contractor's staff had limited experience with the equipment they were maintaining. As a result, a substantial learning curve was necessary to become familiar with the plant, including its equipment, policies, procedures, and practices. Further, the contractor had limited experience with condition monitoring (predictive maintenance) to help optimize time based maintenance. Thus it relied primarily on a time based approach to maintenance, which is typically not optimal in and of itself. This is evidenced by the concurrent increase in reactive maintenance levels, in spite of a substantial increase in time based maintenance. Finally, many of the contractor's staff were taken from the construction ranks, where different work processes and methods are used, resulting in a more-difficult transition into an operating plant.
- Displaced contractors. Existing contractors, who were in effect being eliminated, remained on the job for about three months after the new firm started. These existing contractor charges increased substantially during this transition period prior to their departure. While a transition period may be prudent, better management may have helped mitigate these costs.
- Shutdown impact. Just prior to the new contractor's arrival, the entire plant had been shut down for extensive maintenance efforts and bringing on line a major new production process. The start up was difficult and time consuming, leaving few resources to manage the integration of the new maintenance contractor. Morale problems were inherent in the concurrent shift of maintenance functions to the contractor. Confusion was substantial, and morale and productivity were low.
- Transition process. The process for introducing and integrating the contractor with the plant's work management practices was poor. There was little understanding of the work order process used at the plant, of the planning and scheduling process, and of the maintenance information software currently in use. There was insufficient management interface, because of the shutdown and startup efforts, to allow adequate communication and management of the integration effort.
- Loss of key management staff. Concurrent with the arrival of the contractor, two key managers at the plant were transferred, exacerbating the difficulties in providing overall management and integration of the contractor.
- Loss of skilled staff. Many, if not most, of the employees skilled in maintaining plant equipment began to leave just as the new contractor arrived. Some were laid off; others went on early retirement. Morale was quite low, and the enthusiasm for "training" the contractor coming in was essentially nonexistent.

Current situation
At this point it is too late to return to the way things were. The plant has gone through the pain of bringing in, training, and integrating a consolidated contractor, whose staff is now familiar enough with the equipment and work processes to perform in a reasonably effective manner. However, costs are still substantially above what they should be for world-class performance, and indeed are above what they were when the contractor arrived.

Given this, and that almost all operating units will (and should) continue to use the contractor to support world-class performance, it is appropriate to meet with the contractor on a regular basis to improve the relationship and to create clear expectations.

Path forward
Making the contractor an integral part of the operation is a necessity, not an option; establishing expectations and measures associated with world-class performance also is a necessity, not an option.

The guiding principle behind performance measures is that the contractor must deliver an effect, not simply supply a service for a fee. Desired effects include improved equipment life, higher availability and uptime, lower maintenance costs per unit of contractor supply (for example, normalized to account for issues such as assets under their care or total product produced), and excellent safety performance. In other words, the contractor will be held to the same high standards as the balance of the organization, and become a genuine partner in the plant's success. Some of the measures of effect might include those in the section "Measures of Performance."

A fresh look will be taken at the plant's operation, and firm leadership will be exercised, particularly regarding expectations for contractor performance. Maintenance excellence is not an option, it is a requirement. To achieve excellence, which is not simply doing a lot of PM, a balanced maintenance program will be reestablished including greater application of predictive and proactive methods. More teamwork between maintenance and operations also will be required to eliminate losses from the ideal. Too much is at stake for the success of the business. Therefore, the plant, in cooperation with the contractor, will assure the following:

1. A strong predictive, or condition based, maintenance program, including operator input of equipment and process condition, is re-established.

2. Existing PM tactics are reviewed with the intent to optimize them. Maintenance planning and scheduling will be tempered with good condition monitoring, and the quality of the maintenance effort will be validated with a commissioning process.

3. Operations personnel will become much more involved in operational reliability and what they can do to improve performance, including operator PM as appropriate. Operational excellence is also a requirement, not an option.

This case study of ACME North America produced a number of lessons for management, staff, and the work force. They are summarized in the section "Lessons Learned at ACME North America."

Even in the best of circumstances, major changes to any "system" will always result in transitory effects -the system will generally get worse before it gets better. This, too, is a cost which should be considered by management.

It is hoped this case study provides an order of magnitude estimate of the cost effects which could occur, and will help avoid those costs. Perhaps the best policy would be to avoid the costs in the first place. Simply replacing one set of warm bodies with another will not necessarily deliver the effect desired.

The processes which result in improved performance must be put in place. In this instance, that was being done, but was interrupted by the introduction of a consolidated contractor through decisions made at the corporate level. The goal of consolidating contractors to improve administrative and management costs would have worked, but it was disrupted by several events not the least of which was a major downsizing.

(A future article will discuss issues related to effective use of maintenance contractors.) **MT**

Ron Moore is president and managing partner of The RM Group, Inc., 12024 Broadwood Dr., Knoxville, TN 37922; telephone (423) 675-7647; e-mail ronsrmgp@aol.com.