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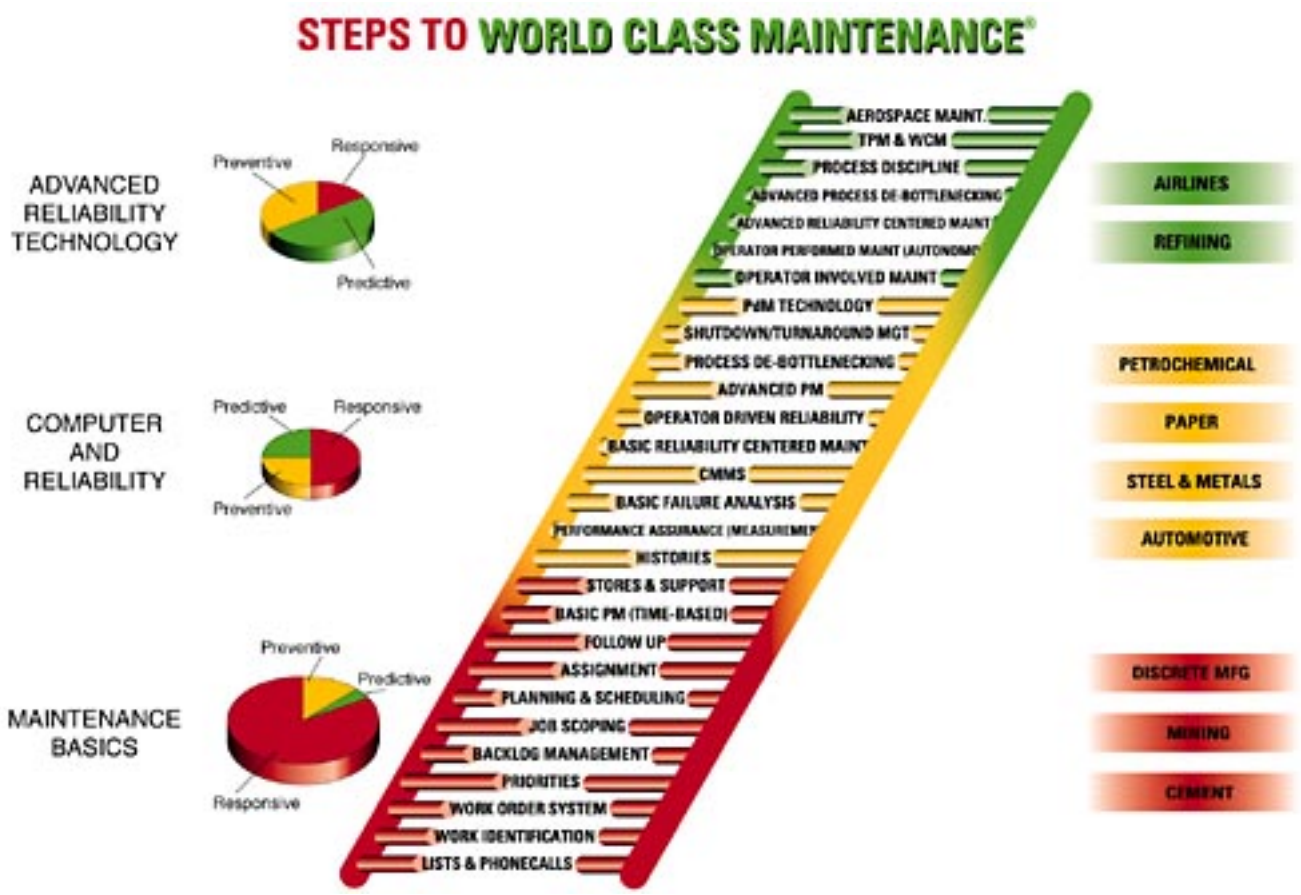
Visual representation of steps necessary to reach top levels of maintenance and reliability performance.

One issue that all companies deal with is what steps are needed to achieve world-class performance in their maintenance departments. HSB Reliability Technologies developed the Reliability Ladder to communicate the steps and changes needed to reach this high level of performance and qualify for certification as such under the company's World Class Maintenance. The Reliability Ladder shown in the accompanying illustration provides corporate and plant personnel with a visual representation of the individual steps and the integration necessary to reach top levels of performance. These steps were developed using a database encompassing a variety of industries. Best practices derived from the database define each "rung." The rungs and ladder, viewed systemically, illustrate the interdependency of various maintenance processes.



The steps do not necessarily have to follow the sequence depicted. For individual organizations, the sequence may vary slightly. In addition, until a comprehensive benchmark is completed and changes are implemented, some rungs may be strong, weak, broken, or not in place. For example, an excellent computerized maintenance management system (CMMS) may be installed but not used (broken rung), or used only partially (weakened rung).

The ladder may be considered to have several major extensions, each supporting those above. The first of these is the maintenance basics section (red rungs) of the ladder. This is followed by the computer and reliability section (yellow rungs), and the advanced reliability technology section (green rungs) in which maintenance requirements are engineered out to a high degree and more technical reliability studies are justified in support of these efforts.

Maintenance basics phase

Maintenance basics are the support structure upon which the more-advanced practices rest. One of the major problems identified in benchmarking plants is that companies initiate advanced reliability technologies without first having a firm basic infrastructure in place. This probably stems from management's technical orientation. Hence, technical solutions are sought for what often are behavioral problems in how work is performed. Therefore, excellent predictive maintenance tools such as vibration analysis, oil particle analysis, infrared thermography, and eddy current inspection are employed without fully achieving expected gains. The full benefits of the technology can accrue only to those who have the basic infrastructure (red rungs) in place and in use.

As an example, consider a situation in which vibration analysis identifies an impending failure, and the basic maintenance system has not identified, planned, scheduled, prioritized work, and ordered parts for nonemergency items that should be completed when the equipment is down. In this case, opportunities to reduce costs and improve reliability will be lost. Work may not be performed; resources may be wasted on last-minute rushing to get parts; or, worse yet, start-up is delayed because equipment or parts are not available. Clearly, the investment in the technology, even though preventing consequential damages, does not provide full benefits in reducing downtime.

Similar problems occur in attempts to employ Reliability Centered Maintenance. These concepts assume the availability of proper information in useful form. Equipment histories, mean time between failure, and the other data that good maintenance basics provide are necessary for proper analysis and decision making. This is particularly important in repair vs. replace decisions and in evaluating the total cost of equipment across expected life cycle.

Computer and reliability phase

Once the maintenance basics are in place, the steps upward on the ladder become easier. A good set of performance assurance metrics, equipment histories, and a failure analysis discipline are prerequisites to move into the computer and reliability phase.

In this "yellow rung" area, we consistently find that organizations have acquired a powerful CMMS that is used to only a fraction of its potential. The causes: lack of the maintenance basics, failure to establish disciplines in computer use, and inadequate hands-on training. There is a tendency to assume that the CMMS will be a panacea not requiring attention to all of the basics. The result is that many CMMS systems fall into disuse. In fact, most are not being used to their potential as powerful tools in reliability improvement. The majority of plants can profit greatly by an assessment of their CMMS utilization and a plan to improve the processes to take advantage of the tool.

Another step up the ladder is operator-performed maintenance. In most industries, studies indicate approximately 30 percent of operator time can be used to perform minor maintenance. In addition, companies often struggle in negotiations to obtain labor agreements permitting multi-skilling and operator-performed maintenance.

Once they obtain agreements, they have difficulty implementing the concepts. They never get the benefits because they attempt to move directly to operator-performed maintenance without going through three logical and required steps:

1. The first step is to achieve operator-driven maintenance, which is independent of labor contract restrictions and is available to almost every organization. It involves having the equipment operators take "ownership" of their equipment. This includes such things as writing accurate, meaningful work orders; having equipment clean and ready to work on when maintenance people arrive; and communicating with mechanics as to equipment symptoms and condition.

2. The next step is operator-involved maintenance, where operators provide job set-up help and good equipment performance information, and assist in simple maintenance work.

3. The third step is operator-performed maintenance or the autonomous feature of Total Productive Maintenance (TPM), which requires steps 1 and 2. It also requires a training program in maintenance procedures for operators. In short, operator-performed maintenance means establishing a team of operators and maintenance people with the common goal of keeping the equipment running at rated speed, at top quality, and at maximum uptime. These are the three elements of overall equipment effectiveness (OEE), a performance measure with roots in TPM.

Advanced reliability technology phase

As an organization moves further up the ladder, a reallocation of maintenance resources occurs. With the shift away from reactive maintenance to more preventive/predictive maintenance, there will be a reduction in the overall amount of maintenance to be done. The pie charts that accompany the Reliability Ladder illustration show the mix of reactive, preventive, and predictive maintenance that typically exists in the three phases of the climb up the ladder. The pie is considerably larger at the lower end of the ladder where reactive "fix it when it breaks" maintenance prevails because the total cost of maintenance (driven by reactive practices) is greater. The pie also gets larger at the top of the ladder where multiple redundancies and high levels of engineering are required by the safety needs of industries such as aerospace.

At higher positions on the ladder, a greater amount of process de-bottlenecking will occur with maintenance being avoided through engineered process improvements, condition monitoring, system redundancies, etc. For any industrial facility, there is a point at which risk and cost factors establish a practical limit. It is important to know where you are on the ladder. A good set of metrics is essential.

Where industries stand

Average positions of various industries are shown along the ladder. These are relative rankings. Obviously there are companies within industries that perform at the high and low ends of a bell shaped curve peaking approximately where their industry is shown.

Corporations or plants can use the ladder as a model for comparison of their reliability and maintenance practices. Take a realistic look at your maintenance/reliability practices in comparison to the steps shown. Typically, such a look shows the strong, weak, missing, and broken rungs that exist. What does your ladder look like? If it were a real ladder in your garage, would you use it to paint your house? Would it give an OSHA inspector fits?

The comparison will provide an initial assessment of the strengths upon which to build and the improvement opportunities that exist. Through a detailed benchmarking study and implementation of the changes recommended, corporations and plants can make each rung as strong as required for their operations; they can climb up the ladder to world-class performance; and they can optimize production, reliability, and flexibility to meet strategic goals. **MT**

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