Robert M. Williamson, Strategic Work Systems, Inc. Equipment performance and reliability has become a major concern as businesses reorganize, downsize, and aggressively pursue "lean" principles. Is your equipment doing what it is supposed to do, first time, every time? What are the causes of poor performance? What should you focus on?

Measuring and improving equipment performance is becoming a hot topic in many facilities and plants. So, what do you know about your overall equipment effectiveness? The basic measure associated with Total Productive Maintenance (TPM) has been overall equipment effectiveness (OEE). It incorporates three basic indicators of equipment performance and reliability:

- Availability or uptime (downtime: planned and unplanned)
- Performance efficiency (actual vs. design capacity)
- Rate of quality output

OEE is not an exclusive measure of how well the maintenance department works. The design and installation of equipment as well as how it is operated and maintained affect OEE. It measures both "efficiency" (doing things right) and "effectiveness" (doing the right things) with your equipment.

Here is an example on how OEE is figured for a critical piece of equipment that is running 70 percent of the time (in a 24-hr day), operating at 72 percent of design capacity (flow, cycles, units per hour), and producing quality output 99 percent of the time.

When you factor the three together (70 percent availability x 72 percent efficiency x 99 percent quality), the result is an OEE rating of 49.9 percent. The OEE rating reflects how well the equipment is loaded and doing what it is supposed to—in this case less than 50 percent. Running at 55 percent OEE meets plant requirements.

Given the OEE data we then can determine the "cost of unreliability" or poor equipment performance. For example, a 5 percent decline in OEE may have led to 500,000 units not produced in a year. At a sales price of $12 per unit the cost of unreliability is $6 million of lost sales (revenues). This helps make a strong business case for improving the care and upkeep of critical equipment.

The OEE rating for critical equipment provides a relative comparison or "report card" on equipment performance and how well our maintenance and operations improvement activities are doing. The real use of OEE comes by using the factors (availability x efficiency x quality) and actual losses to determine root cause and corrective action.

What caused the 5 percent decline in OEE in the example above? What changed? This is where the factors of OEE become more important than the percent OEE itself. By tracking and trending the factors of OEE (data) one can quickly spot whether the machine experienced more downtime (planned or unplanned), or was running at a slower pace or minor stops, or produced more defects. Improper or inefficient operation can cause lower availability (setups, tool, or part changing) as can improper maintenance (breakdowns). Root cause analysis begins by focusing on the type and extent of loss, not the OEE percentage rating.

Here are some additional ways to think about OEE in a variety of settings:

Individual machine: The performance of the machine is compared only to itself over time (historical trending).

Integrated manufacturing cell: Regardless of individual machine performance, the entire multi-machine cell must function as a single unit. OEE for the cell is a good relative

performance comparison.

Discreet manufacturing: Individual machines and integrated cells must function in a variety of combinations to produce many different types and sizes of products. OEE can be misleading. However, the factors of OEE become indicators of where and what type of improvements should be made.

Process plants: A process stream must perform as a whole, similar to an integrated manufacturing cell. OEE, or "overall process effectiveness" (OPE), is a good relative performance comparison. The factors of OEE should be tracked and trended to observe changes in performance of critical equipment in the process stream.

Facilities: Utility systems in schools, hospitals, and commercial buildings typically function as individual machines or processes in support of a facility, and possibly other machines. In these cases OEE ratings on critical machines should be tracked and trended to observe changes in performance. **MT**