Overall Equipment Effectiveness (OEE) as a Quality System Metric

By Ray Harkins

Aside from meeting specific quality system standard requirements—such as those found in ISO 9001 or IATF 16949—well-designed quality system metrics also can serve as meaningful indicators of the strengths and weaknesses of an organization's various processes.

As a quality manager, I often consider how precisely our quality system objectives and other metrics describe the effectiveness of our processes. One metric I started using recently—overall equipment effectiveness (OEE)—has provided our management team with a composite measurable that encompasses three major branches of our operation: maintenance, production and quality.

Over the past three decades—during which standardized quality systems have taken a prominent role in manufacturing—certain metrics have risen to the top as the most common key indicators of performance in each of these three areas.

Consider this simple example to see how common key indicators work together to form OEE:

Machine availability is a commonly used indicator for measuring the effectiveness of an organization's maintenance process. It is calculated as the ratio of a machine's actual run time to its scheduled run time. In some organizations, operator breaks and tardiness can reduce a machine's run time, but unplanned outages because of maintenance problems always reduce availability.

For instance, if a forging machine was scheduled to run for eight hours during a given shift, but it actually ran only 6.1 hours, then its availability was:

$$(6.1 / 8.0) = 76.3\%$$

For production, efficiency is a key metric calculated as a ratio of the number of parts produced in a certain amount of time to the maximum number of parts that could have been produced in the same amount of time.

For instance, if a time study demonstrates that our press can forge 2,500 pieces per hour, and during our example shift it produces 13,000 pieces in the 6.1 hours it ran, then this operation had an efficiency of:

$$(13,000 / 6.1) / 2,500 = 85.2\%$$

Quality is often measured as the ratio of the number of good parts produced to the total number of parts produced. So, if only 12,770 of the 13,000 in our example shift met the customer's specifications, the measure of quality acceptance was:

$$(12,770 / 13,000) = 98.2\%.$$

OEE is then calculated as the product of these three metrics:

$$OEE = \%\ Available \times \%\ Efficient \times \%\ Acceptable$$

So for our example, the OEE is:

$$OEE = 76.3\% \times 85.2\% \times 98.2 = 63.8\%.$$

In his book, *Overall Equipment Effectiveness*, Robert Hansen details the OEE evaluation scale shown in Table 1. According to the scale, the OEE of this process is unacceptable.

Table 1

Hansen's OEE Evaluation Scale

OEE	Comment
< 65%	Unacceptable
65% to 75%	Passable if quarterly trends are improving
75% to 85%	Pretty good
85% to 90%	World class for batch processes
90% to 95%	World class for continuous discrete processes
>95%	World class for continuous stream processes

More importantly than comparing their organization's OEE to a general table like the one shown above, forging professionals can gain better insight into their operation by comparing the OEE metrics of part families, manufacturing facilities, time periods, or other logical groupings. When applied to the bottleneck operation in a process flow, OEE can also provide a powerful indicator of the potential sales lost due to system deficiencies.

Developing and using metrics such as OEE that highlight an organization's best opportunities for improvement have the potential to unlock the next level of profitability.

Reference:

1. *Robert C. Hansen, Overall Equipment Effectiveness: A Powerful Production/ Maintenance Tool for Increased Profits, first edition, Industrial Press Inc., 2011.*

Ray Harkins is the Quality and Technical Manager for Ohio Star Forge in Warren, Ohio. He earned his Master of Science from Rochester Institute of Technology and his Master of Business Administration from Youngstown State University. He also teaches quality, manufacturing, and business-related skills through the online learning platform, Udemy. He can be reached via LinkedIn at linkedin.com/in/ ray-harkins or by email at rharkins@ ohiostar.com.