Written by Edwin K. Jones, PE
Friday, 01 September 2000 15:31

The popular benchmarking metric of cost/ERV is a valuable tool for setting long-term goals when used correctly in conjunction with targets for plant reliability. Here is how it is calculated.

Measures of maintenance cost have contributed to the decline of more than a few reliability professionals' careers. From a 35-year career in maintenance and reliability, I have observed that tracking maintenance costs exists in one form or another, even where no other performance measures are in place. As some of you have heard me say (tongue in cheek): "Maintenance managers have always had measures of performance, usually cost and head count. Any other measures are just background noise."

Another basic observation is that if you spend enough time in a manufacturing facility with responsibility for cost and performance, cynicism tends to creep into your philosophical views.

Maintenance costs have been measured, are being measured, and will be measured in the future. The question is, How to do it properly, and how to keep it in balance with other important measures?

Historical measures of maintenance cost

Essentially every manufacturing process has a manufacturing cost sheet to accumulate the costs of manufacturing a product. These costs include variable costs, such as raw materials, utilities, and energy, as well as fixed costs, such as labor, benefits, depreciation, and overhead. Maintenance costs are usually viewed as fixed costs with components of labor, benefits, materials, contractor labor, salaries, and overhead. If no other maintenance cost measures exist, most manufacturing managers can look at manufacturing cost sheets and extract the key components of maintenance cost.

The most basic measure of maintenance cost is a sum of extracted components from a manufacturing cost sheet, and is simply total maintenance cost. This measure can vary greatly by interpretation of what is or is not included.

Perhaps the most commonly calculated form of maintenance cost is the one required annually by the Securities and Exchange Commission (SEC), the so-called 10K filing.

The 10K report has specific definitions for elements of cost, most commonly maintenance, repair, and service. If every company read and interpreted the 10K guidelines the same way, there would be a reasonably consistent basis to compare total maintenance costs with the outside world. My experience suggests that there are wide variances in how 10K costs are reported.

Various organizations have attempted to compare maintenance costs using 10K data for both maintenance cost numbers and historical investment values. Although the cost values are subject to interpretation of the 10K rules, the historical investment values are, perhaps, even more questionable. One organization has tracked and published maintenance costs for an industry sector, using a measure roughly equivalent to 10K Maintenance Cost/Historical Investment. In the 1970s and 1980s, it was basically the only tool available to look at performance.

This concept of measurement has led to various measures of maintenance cost using some form of investment value as a normalizing denominator. Measures of cost in relation to replacement value have emerged as a standard form of cost comparison. Consequently, there is a substantial interest in the methods for calculating estimated replacement values (ERV).

Using plant investment to normalize maintenance costs

Using investment in the calculation of maintenance costs provides a convenient basis for comparing plants of a similar type but which vary in size. Within a reasonable range, using the ERV in the cost calculation (dollar cost/dollar ERV) is a valid mechanism for comparing plants that differ in size. The rationale for using the estimated replacement value, rather than the original cost of the plant is the effect of construction cost escalation over time (inflation). Two relatively new plants built 10 years apart could have original costs that vary by 50 to 100 percent.

Using the maintenance cost/ERV metric

Any manufacturing facility has maintenance costs that vary from month to month. Cost fluctuations may represent scheduled maintenance shutdowns, unexpected shutdowns, seasonal maintenance work, or preventive maintenance tasks. Because some fluctuation in maintenance cost is normal, looking at maintenance costs monthly is best done by comparison with budget. Looking at maintenance cost/estimated replacement value is best done quarterly and annually to ascertain the long-term trend.

In the final analysis, anyone who has responsibility for maintenance and reliability has two primary business contributions: highly reliable equipment and the lowest consistent maintenance cost. Measures for each of these functions tend to be trended over time. The maintenance cost/ERV measure is best considered as a component of a total measurement model, such as the one outlined in the accompanying diagram.

The pitfalls of estimated replacement value

The first basic requirement is to ensure that the maintenance costs you have assembled and the replacement investment value you are using are calculated on the same basis, and that the costs collected represent maintenance expenditures on the investment considered. A potential stumbling block is to discover that the ERV does not agree with an insurance value. In that case, some investigation is in order to establish what was included in the insurance value.

Another pitfall is discovering that not all corporations use the same indexes when calculating inflation factors. Some use Bureau of Labor Statistics factors (Construction Cost Index or other); some use the Marshall-Swift index; some large corporations have established their own factors, based on corporate construction history. For older plants, these factors can present substantially different views of replacement value. And when a plant is bought or sold, its current value may be established as the purchase price, rather than an indexed original cost.

Finally, some tax rules allow depreciation of a plant to the value in use. So the real trap is that a plant's actual value, original or current, may be a mystery. When the plant's investment books are clouded by some of the pitfalls mentioned previously, I tend to rely on the insurance value as the best available estimate of a plant's current value.

What is included in calculation of maintenance costs?

Simply stated, maintenance costs include direct labor with benefits, materials, labor by contractors, and salaries and overhead. The sum of these components should be considered total maintenance cost. Each of these components has a definition that should be consistently applied. The safest approach is to use the definitions required in the SEC 10K report.

How to calculate replacement value

Once you have established that the original equipment investment figures reasonably

agree with equipment actually in use (and being maintained), the next step is to identify clusters of equipment by the year in which they were acquired. This activity will allow you to consider each cluster of investment and escalate it to a current value, using the selected index. Your company may already use a preferred index, or you may choose the index protocol you believe to be most accurate. I prefer to use the Bureau of Labor Statistics Construction Cost Index (BLS CCI). There are variations in index methods, and the variations become magnified with older plant and equipment.

The next step is to sum the indexed clusters of investment to get a total current value of plant and equipment. It is a good idea, at this stage, to compare the indexed value of the plant with other plants recently built, adjusting for size and available insurance values.

Even when a company is self-insured, there is normally an established "insurance value" to help define the financial exposure the company risks. These values are typically prepared by an insurance underwriter, even if the plant is self-insured. Underwriters follow a procedure very similar to the one described.

What are the merits of tracking cost/ERV?

Looking at maintenance costs per investment dollar recognizes that costs go up with increasing amounts of equipment. Using ERV in the denominator helps to place the amount of equipment in consistent terms, that is, today's dollars.

By normalizing size and age of plant, it is possible to compare performance with a much wider base of data. The adage that an older plant will cost more to maintain is not supported by data, at least over the first 25 or 30 years of its life. A poorly maintained 10-year-old plant may be in much worse shape and cost more to maintain than a properly maintained 25-year-old plant. The cost versus age curve is far from a linear relationship. If maintained properly over time, a plant is continually being restored to as-new condition, a basic tenet of the total productive maintenance philosophy.

Maintenance cost/estimated replacement value is a standard barometer of maintenance performance. For all its limitations, it is a useful and widely accepted measure.

Limitations of the cost/ERV metric

Aside from the difficulties of determining the original cost and selecting an appropriate index protocol, there are other problems and stigmas attached to the use of ERV.

It is a measure that has often been used to browbeat maintenance managers. It may steal focus from reliability issues or total cost of manufacture (for example, cost per pound). It may become the only measure managers look at—versus a balanced set of measures.

Basic tenets of benchmarking

There are some very basic and standard warnings in benchmarking:

- Never, never use a single metric to draw conclusions. It takes sets of three or four metrics to produce a sound conclusion.
- Look at cost, but also look at equipment reliability, staffing, basic practices in use, and stores and spare parts management.
- Benchmark across similar and dissimilar industries, but look more closely at those in similar industries. You can learn from both.
- Use benchmarking as a method to highlight opportunities for improvement, not as an end in itself. Be prepared to use the results to create or reshape a strategic plan.

- Use many measures for benchmarking. Use a focused, abbreviated set of measures for performance tracking. Some of the measures will be the same; some will differ.

Maintenance cost/ERV. Use it or not?

I say yes. Understand the limitations, understand the implications, and measure cost/ERV consistently. Use cost/ERV to set long-term goals, along with targets for plant reliability. Cost/ERV is one of the most widely used metrics available. World-class plants tend to fall in the range of 1 to 2.5 percent **MT**

Edwin K. Jones, P.E., is a consultant based in Newark, DE. He can be contacted at (302) 234-3438; e-mail jjones1432@aol.com .