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Lucky you! There is one KPI that comes close to taking into account almost all variables in a production process. What is it? Read on.

Recapping Parts I-IIIAs we've noted throughout this series, key performance indicators (KPIs) are the metrics that an organization chooses to use as their measures of process performance. They can vary among industries and among individual processes. To begin managing by metrics, an organization must first collect meaningful and pertinent data—*information that is important to the operation of the business*—which is then converted into one or more KPIs. These tools can be used to immediately evaluate the performance of a process variable, as well as provide a means for tracking that variable over time.

We have discussed several KPIs over the course of this series, each of which has measured one or more components in the overall production process. These various metrics have been presented as the tools management can use in measuring the health of portions of the process. Still, the question arises: Is there a single metric that takes into account all of the variables in a given production process? There is one that comes close. It's known as "TEEP," which stands for Total Effective Equipment Productivity.

TEEP is an ideal or best-case benchmark against which a production process is measured. It is the comparison between the theoretical capacity of a machine versus that machine's actual performance. TEEP uses as its litmus test the hypothetical output of a machine if it ran perfectly, all the time.

As an example, suppose you have a machine in your process that is rated to produce one part per hour. TEEP assumes that if it were to run continuously at the capacity determined by the machine manufacturer's OEM specifications, this equipment would produce 24 parts per day, 365 days per year—*and that this benchmark is the number against which your actual*

performance should be measured.

Consider the number to be an absolute (whether it can actually be obtained), like absolute zero or the speed of light. The formula for this calculation is Actual Parts per Unit of Time X Total Time/Theoretical Parts per Unit of Time = TEEP.

Now, don't throw the magazine away and reach for the television remote. It's not as difficult as it sounds. I'll say it in English this time: TEEP is the number of good widgets you are making in a given time period compared to the total number of widgets the machine is capable of making if it ran perfectly at its rated capacity during that same period of time.

Let's look at the machine we just referenced. You have a process that produces widgets, and your primary machine is an old, but well-maintained widget-maker that is rated at one unit per hour. Your plant works two eight-hour shifts each day over a five-day work week, with the weekend being devoted to maintenance efforts. Your process continually achieves uptimes above 90%, and you seldom have any quality issues. Last week, the plant produced a total of 77 widgets at this machine center during your 80 planned production hours.

The TEEP percentage for this rather rosy scenario would be as follows: 77 actual widgets produced X 168 total hours in the week/168 possible widgets = 77%. What does this number tell us? Basically, a TEEP percentage of 77% indicates that 23% of this particular process capacity was unrealized—even though this same process is running exceptionally well when evaluated by less stringent measures. (FYI: a handy TEEP calculator is available to you here.) By the way, if your particular process is achieving a TEEP percentage above 75%, that is an excellent number, and you may take a moment to congratulate yourself.

"But wait," you say. "I don't want to run three shifts, seven days a week. I'm producing between 70 and 80 widgets per week. That's world-class output within my particular industry, especially considering the equipment I have, and that's all the widgets I can sell, anyway. So why would I want to compare myself to a standard that makes no sense for me?"

Why, indeed? TEEP is not for everyone. It's a strategic measure that is used in, among other things, determining the need for capital outlay. Suppose that the giant widget plant down the road—*your main competition, perhaps*—has a big fire or some other issue that causes a

serious curtailment in its ability to turn out product. This leads to a widget shortage, and the price per unit skyrockets. At last, you can sell as many of the things as you can produce—*and pretty much get your own price*. Your unfortunate competitor will be limping along for at least a year, and as you look for ways to take advantage of what could be an extremely profitable time for your business, your eyes might drift to and linger upon the 23% of your unrealized capacity (as determined by your 77% TEEP).

There are several options open to you at this point. You can weed out the few rejects and breakdowns you have and push your TEEP to 80%. You can add a third shift and increase your TEEP or add an extra production day to do the same. You can go to a seven-day/24-hour schedule if you have high confidence in your maintenance program's ability to work around the extra demands you are placing upon the process. You can even attempt to speed up your widget-maker—*if such an action can be undertaken economically, and provided you keep in mind that there are often unforeseen consequences to running a process in excess of its rated capacity.* Regardless of what you do, the TEEP measure is the benchmark that lets you know how much additional production is available without additional capital expenditure (such as adding more machines, replacing older equipment, etc.).

Benchmarking against what?

Since we are on the subject, we should spend a few moments discussing the concept of benchmarks, which are those standards—*sometimes theoretical*—against which we measure and track our own performances. What should these numbers be? What is "world-class?" Who decides?

There is a consensus among maintenance consultants and scholars alike that benchmarks should be challenging but achievable—*and I agree with that guideline*. As for the actual numbers, however, there is little agreement. Benchmarks differ across industries, across plants and across machine centers. Take uptime as an example.

For years, a production uptime percentage above 80% was considered to be a good effort, and 85% was thought to be outstanding. As maintenance practices and machine technology have improved, the best of the best have continued to ease their uptimes in the direction of 88%, then 90% and finally to 95% or higher.

The issue for each plant and for every manager is to benchmark their own processes against

achievable goals—*and to encourage small but steady increments of improvement in their own unique process.* Aspiring to a challenging benchmark should be a positive experience for the entire organization. To illustrate this point, let's go back to the widget industry for a moment.

Suppose you are the production manager for the original widget plant in your organization (the old workhorse), and you have the task of operating technologically obsolete machinery that has been poorly maintained for much of its history. The factory runs uptimes in the mid-70s and makes a small profit. Further assume that upper management has determined that large capital outlays are not in your facility's future. Times are hard, and they'll continue to run the plant as long as it pays to do so. But, if you drop into the red, that may be all she wrote. Under conditions such as these, it is probably not wise to benchmark yourself against the leading plant in your industry—*a brand-new, technological marvel that consistently posts uptime percentages in the mid- to high-90s.*

It's not a case of never being able to get there from here. If you establish a proper PM (preventive maintenance regimen), initiate PdM (predictive maintenance) as budgets allow, do realistic, honest root-cause analyses (RCAs) for every process failure, work safely and begin a conscientious training program, you can wash away most sins over time. There is, however, another component you must consider.

If you are consistently running uptime percentages in the mid-70s and are benchmarking against a goal of 95%, you may find that your rate of improvement drops over time. Specifically, your organization may develop a morale problem, because the goal is perceived as being out of reach. If your process has consistently run uptimes in the 75th percentile and through world-class techniques you are able to raise this average to 80%, you have achieved a huge gain in effectiveness. Conversely, if the new and improved 80% uptime is compared to a 95% goal, it still seems as if the organization has an impossibly long way to go. If, though, the benchmark were 85%, then your people have moved halfway toward their goal—*a goal they perceive as being reasonable and achievable*
. Remember, as goals are reached, new, higher ones can be set. Thus, by making each new goal plateau achievable, you are not limiting the long-term potential of the company, particularly if you reward the attainment of these plateaus as they are reached.

Use your metrics effectively

To manage by metrics, you must first make the conscious decision to gather accurate data that is meaningful to your organization. The accuracy of your data is the critical component of the process. You must then convert the data into KPIs that your organization is capable of

maintaining. Put simply, the gathering and manipulation of data into a useable form is an important job that must be performed by personnel who realize this fact and who are capable of performing the task. Finally, your KPIs should be benchmarked against realistic numbers. You must learn to walk before you can begin to run. **MT**

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