OMBU
ENTERPRISES, LLC

3 Forest Ave.
Swanzey, NH 03446
Phone: 603-209-0600
Fax: 603-358-3083
E-mail: OmbuEnterprises@msn.com

Process Metrics

Metrics tell the Process Owner how the process is operating. Well developed metrics include the current level of the process and the target for the same reporting periods.

ISO 9000:2005 defines a *process* is a "set of interrelated or interacting activities which transforms inputs into outputs."[1] In contrast, a *project* is a "unique process consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources."[2]

Characteristics of a Process

A process has three characteristics that help define the metrics and allow us to understand process performance. These important characteristics of a process are effectiveness, efficiency, and adaptability. Correspondingly, we would like our metrics to measure these characteristics.

- An *effective* process is one that delivers the required output.
- An *efficient* process is one that uses few resources to deliver its output.
- An *adaptable* process is flexible in handling changing requirements and special needs.

An effective process delivers its required output and, presumably, satisfies its customer. Effectiveness metrics, therefore, tend to be quality metrics. When looking at attribute data, we often measure the ratio of non-conforming output to total output, *e.g.*, results delivery late/total results delivered.

An efficient process doesn't consume a lot of resources to provide its output. We often describe efficiency metrics as utilization metrics, *i.e.*, kilowatts per widget produced or direct labor hours per case. When the efficiency measure involves human resources, we typically use the term "productivity".

Adaptability metrics are often hard to formulate, because a good process handles exceptions well. So well, in fact, that it is hard to identify exceptional cases. Consequently, we focus on metrics that describe effectiveness and efficiency.

Process Metrics

Process effectiveness metrics are often divided into two types. How often does the product have the desired attributes? How often is the product delivered on time? Consider a fast food

[1] ISO 9000:2005 Clause 3.4.1
[2] ISO 9000:2005 Clause 3.4.3

restaurant as an example. We expect a cup of coffee to be hot and delivered quickly. If I have to wait to 15 minutes and receive a tepid cup of coffee, the restaurant has not satisfied customer expectations.

Typically, a process will have requirements for both product attributes and delivery timeliness. The metrics are often set to meet customer expectations, but the customer may not know them. For instance, in the well known MacDonald's Coffee Case, the company's requirement was to hold coffee between 180° F and 190° F.[3]

Anatomy of a Process Metric

The three types of process metrics have characteristics that help guide the design and development of the metric.

- The *measurand* is the thing we are trying to measure. For example, it might be the number of defects per opportunity, the percentage of people who are satisfied with a service, or the number of people required to deliver a service.

- The *reporting frequency* tells how often the process reports the value.

- The *value* is the result reported for the measurand and represents how well the process is performing. Very often, the value is a ratio of two numbers.

- The *target* is the desired level of performance. Typically, we set the performance target at the end of a period, usually one year. We can also calculate, with the appropriate information, the expected target each time we report the value.

- The *improvement direction* tells us which way we seek improvement, *i.e.,* larger values or smaller values. For example, profit has an improvement direction of up, while defects per opportunity has an improvement direction of down.

- The *improvement ratio* tells the amount of change we expect in the value over time. Take care to select the starting point: sometimes the ratio uses the ending result and other time it is the ending target. In multi-year improvements, the ending target is a better choice. The improvement ratio is often a percentage over one year. For example, make a 10% improvement in the value over the next calendar year. For example, if this process has a target of 90 at the end of last year, and the improvement direction is UP, this year target is 99, as shown in the calculation

$$99 = 90 + (90 \times 0.1)$$

- The *improvement trend* tells how you expect to achieve the result. The most common way is a linear trend, but in some cases, the trend may require a different shape.

- *Stop light rules* provide a quick comparison between the value and the target. Typically, green means the value meets or exceeds the target (considering the improvement direction), yellow means the value has not met the target but is close, and red means the value has not

[3] Wikipedia, Liebeck v. McDonald's Restaurants, retrieved March 16, 2009

met the target and it is not close. The definition of close should consider the natural process variability, but a rule of thumb suggests 10% difference from the target to separate yellow and red.

- A *benchmark* is the value achieved by a comparison process.

Effectiveness Metrics

Effectiveness metrics tell how well the process meets its requirements. When expressed as a ratio, the denominator is the number of times the process delivers its result, while the numerator is the number of times the process successfully delivers its results. Alternately, the numerator could be the number of unsuccessful deliveries. While each approach is acceptable, the improvement direction and stoplight rules change depending on the numerator.

Effectiveness measures are usually a percentage (multiply the ratio by 100) or parts per million, ppm, (multiply the ratio by 1,000,000). When the metric is nonconforming items, we can also use sigma levels as shown in the table:

Percentage	ppm	Sigma level
10%	100,000	2.78
5%	50,000	3.14
3%	30,000	3.38
1%	10,000	3.83
0.5%	5,000	4.08
0.3%	3,000	4.25

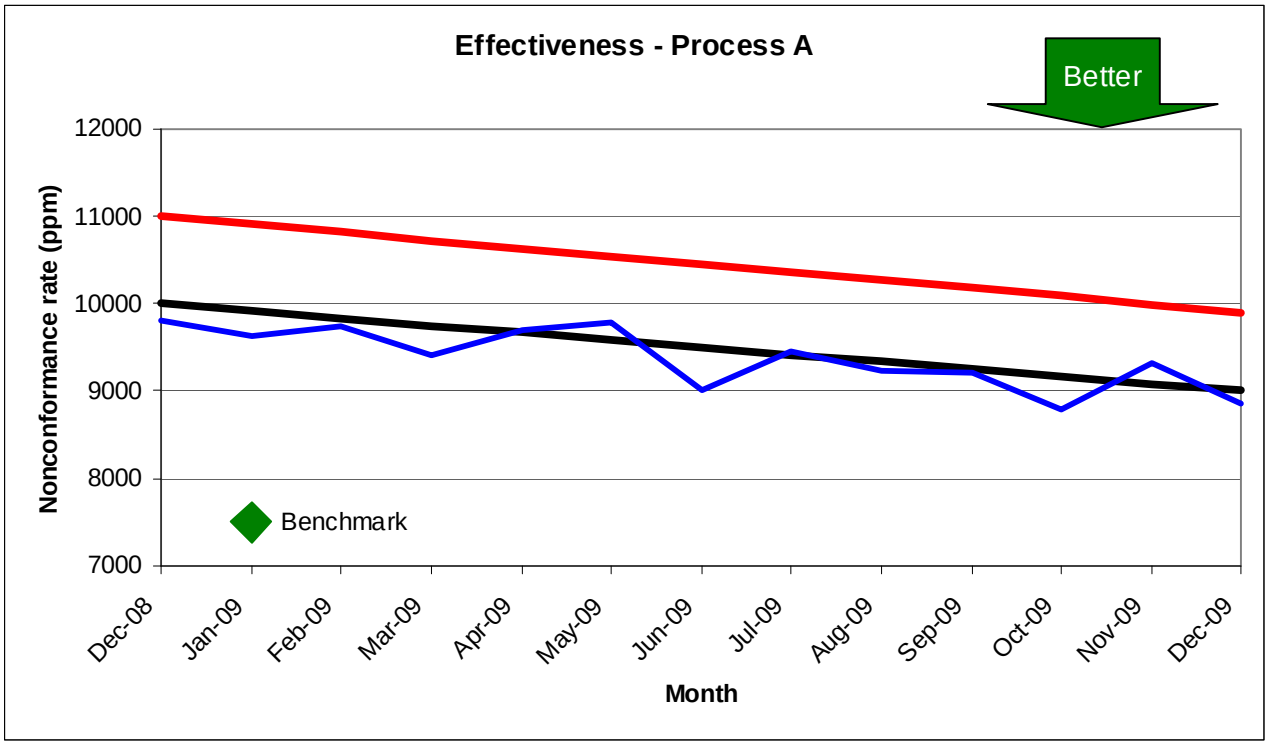
The best way to display an effectiveness metric is a line graph. We will use the items we described above, and then build an illustration.

Items	Value
Measurand	Nonconforming rate
Reporting frequency	Monthly
Values	As determined by the process
2008 target	10,000 ppm
Improvement direction	Down
Improvement ratio	10%
Improvement trend	Linear
2009 target	$10{,}000 \times 0.9 = 9{,}000$ ppm
Stop light rules	10% Green: value $\leq$ target Yellow: target $<$ value $\leq 1.1 \times$ target Red: value $> 1.1 \times$ target
Benchmark	7,500 from the Acme division

Using this example, we can build a graph that shows the results. There are some things to note on this graph.

- The target is a black line.

- There is a red line that shows the stoplight rules. The black target line and the red stoplight line divide the graph into three areas. A value below the black target line is Green. A value between the black target line and the red stoplight line is Yellow. A value above the red stoplight line is Red.
- The process values are shown with a blue line.
- We show the improvement direction as a green arrow.
- We show the benchmark value as a green diamond.
- We use only a few horizontal lines and no vertical lines, to reduce the clutter on the chart.
- The axes are clearly labeled.



Efficiency Metrics

Efficiency metrics tells the resources required to operate the process. When expressed as a ratio the denominator is typically a resource consumed while the numerator is the number of times the process delivers its result. When the resource involves people, it is often termed a productivity measure.

We can use an efficiency measure to illustrate another kind of improvement trend, a step function. Assume we measure the number of kilowatts per widget. At the beginning of June 2009, we plan to install a more efficient machine that reduces the energy conception by 25%. Our table shows for this metric is shown below.

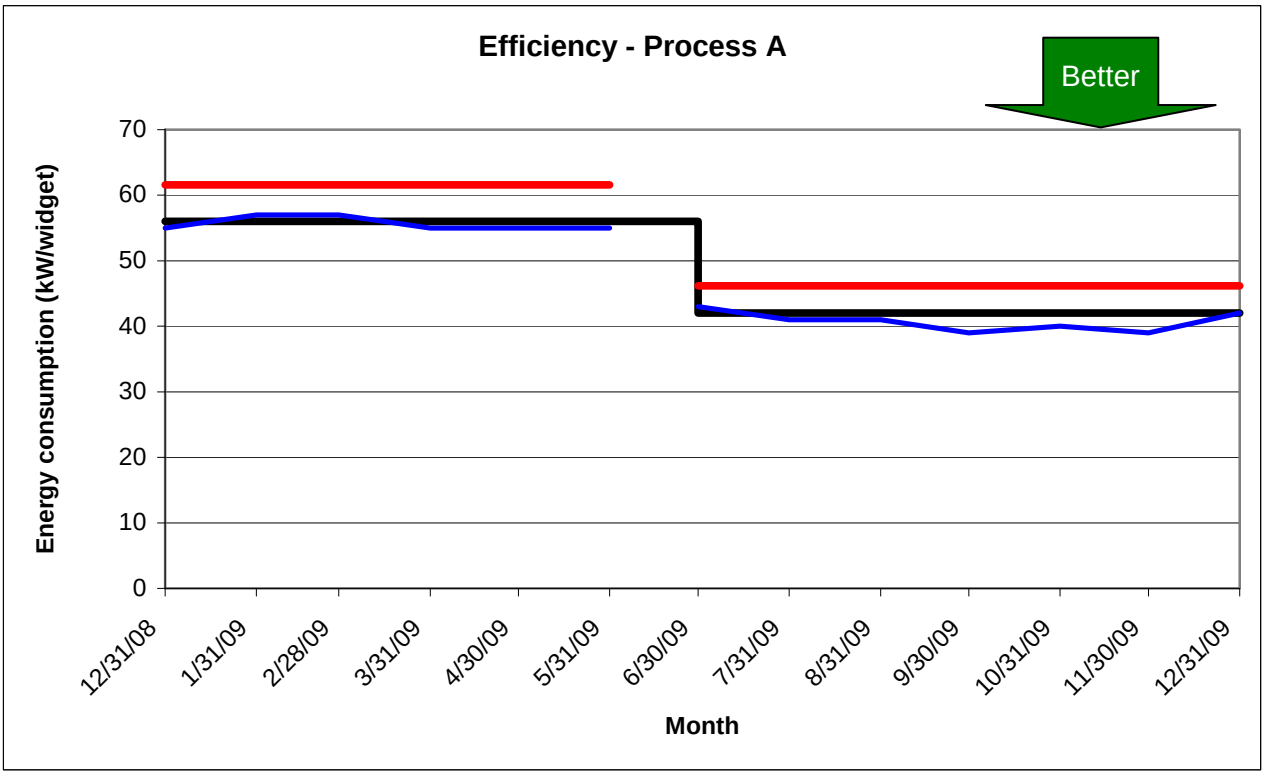
Items	Value
Measurand	kilowatts per widget
Reporting frequency	Monthly

Items	Value
Values	As determined by the process
2008 target	56 kW/widget
Improvement direction	Down
Improvement ratio	25%
Improvement trend	Step function in June
2009 target	56 × 0.75 = 42 kW/widget
Stop light rules	10% Green: value ≤ target Yellow: target < value ≤ 1.1 × target Red: value > 1.1 × target
Benchmark	None available

Some of the features for this graph are noted below.

- The target and stoplight lines are a step, showing the new machine was installed at the beginning of June. The June results represent the whole month.

- We don't have a benchmark for this metric, so we didn't include it.



Summary

A good metric is easy to define, as long you pay attention to all of the elements. There are a few things to think about, however.

- Notice that is the improvement is down, the stoplight line is above the target. This also works the other way. If the improvement is up, the stoplight line is below the target.

- The most common trend line is linear, but other kinds of lines are also used. Consider, for example, when you know most of the improvement will happen in the beginning of the year. You wouldn't want a linear target line is this case.
- Sometimes the process is being maintained, with no planned improvement. In this case, set the improvement percent at 0% and the improvement trend as linear. The target will be a horizontal line on the graph.