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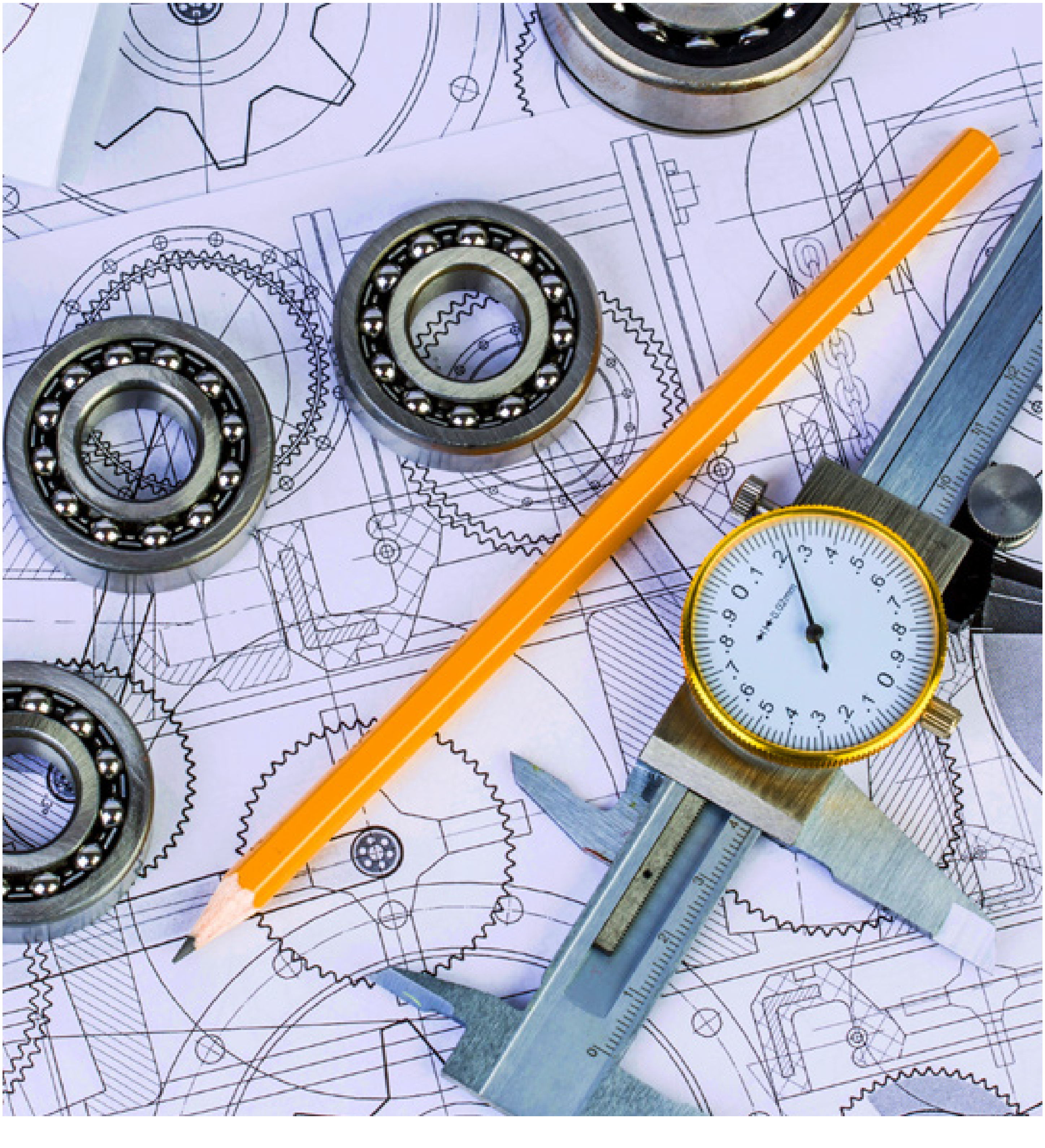

WORK MANAGEMENT

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MEASURING THE RIGHT THINGS THE RIGHT WAY

Victor D. Manriquez, CMRP

Metrics are everyday issues in a maintenance and reliability organization. They can have different values and effects on organizational goals. Examples of metrics that are able to be quantified include: the firing of a boss, the resolution of a contract, the application of a prize or a penalty, and the searching for explanations.

As the SMRP Body of Knowledge (BoK) indicates in the first pillar, "measure performance" refers us to the performance monitoring and reminds us that:

1. The chosen KPI should be related to the organizational objectives
2. Measuring the right things the right way is a key to any successful maintenance and reliability process.
3. Each KPI should be the result of multiple dimensions that check for quantity as well as quality.

In Pillar 5, it teaches us to "measure work management performance (establish performance indicators, report schedule compliance and rework, etc.)" while recommending that we:

1. Demonstrate the understanding of maintenance performance metrics.
2. Ensure we are measuring what should be managed.
3. Select appropriate and achievable metrics to support the need of the business.

In this article I will refer to three cases where the incorrect measurement of the metric can lead to bad decisions. I will also speak on another case where the metric selection was not suited.

CASE 1

In a company of outsourced maintenance services, the planner delivers the monthly information to the reliability analyst (for the backlog calculation) as outlined in the work flow of this process. The analyst performs the calculation and obtains the backlog values with the formula:

$$\text{Backlog} = \frac{\text{(Ready Work)}}{\text{(Crew Capacity)}} \text{ (weeks)}$$

With the information received from planning, the calculation value for this metric was never greater than one; it was between 0.6 and 0.8 weeks. The analyst decided to look for information about what it is the best value in its class for this metric and found that it is between two and four weeks! (SMRP Guide for Metric 5.4.9 Ready Backlog).

The backlog value for maintenance work in this service was better than world-class. The analyst doubted this value because another metric being used in the process that was the "Schedule Compliance Hours" did not overcome the 50 percent average for a best value in its class of 90 percent. On one hand, how do we understand that the backlog showed pending work for execution was so low and, by the other hand, the scheduled work showed so little compliance?

The next step was to review the backlog definition. SMRP presents definitions for two types of backlog, the "Ready Backlog" and the "Planned Backlog". Ready Backlog is the "classical" definition and stands for:

"The metric is the quantity of work that has been fully prepared for execution, but has not yet been executed. It is work for which all planning has been done and materials have been procured. However, work is awaiting assigned labor for execution."

From this definition, we understand that the backlog is not only the pending work from the previous week, which was not completed due to the scarcity of man power, but also the work that is scheduled for the upcoming week. Additionally, the planner only included the work not performed in the last month, ignoring the previous months. Finally, the works were computed over the work orders' (WO) chronological hours, instead of the man hours of the personnel assigned. These three distortions, or "nonconformance", were the ones that produced the mistakes in backlog calculation, and for that reason it showed the low values that did not correspond with the real maintenance work.

After the corrections were made, the backlog value became five weeks, a value according to the work scheduling status in this service.

To summarize, the mistakes in calculations in this case were:

- Not including the hours of the actual week in the "ready work".
- Limiting the work orders not performed to only the previous month.
- Using chronological hours instead of man hours from WOs.
- Misconceptions about definitions and elements involved in backlog calculation.

CASE 2

As with the previous case, I was consulted for a backlog situation in an outsourced maintenance service. This time the backlog value was great – in the order from five to seven weeks. This was motive for the client's claim to the contractor. This delay in the work compliance, which was showed in the backlog, implied that the service contractor should provide additional personnel at its cost to perform the work in the backlog.

According to what was established in the contract, the client´s personnel emitted the WO, which the contractor's personnel would plan and schedule. We took a sample of WO that was sent to schedule and to be reviewed and found that these WOs were far from being planned work in the SMRP definition for "planned work", which states:

"Jobs in which all labor, materials, tools, safety considerations and coordination with the asset owner have been estimated and communicated prior to the commencement of work."

The sample of WOs reviewed showed a high percentage of them that didn't include materials, others with materials not required, or included materials out of stock in the warehouse. Estimated planned hours were underestimated. In other words, WOs were sent to scheduling without having been completely planned. This situation drove these WOs to a point where they were condemned to the backlog since the moment they were scheduled.

Additionally, because of the missing WO data not stored in the CMMS, it used an ad hoc algorithm to obtain the WOs' man power. This time, the mistakes in calculation were:

- Scheduling work orders that had been not properly planned with all the resources.
- Use of an arbitrary calculation for estimating man hours of ready work instead of the man hours from the WO.

CASE 3

A reliability engineer that worked in a plastic film production plant told me they measured the mean time between failures (MTBF) for each production line. The values were really low. In particular, the previous month they had registered an MTBF of 48 hours for one of the lines.

The formula for MTBF calculation is:

$$\text{MTBF} = \frac{\text{(Operating Time (Hours))}}{\text{(Number of Failures)}} \text{ (Hours)}$$

With the operating time, there was no confusion; it was counted by the odometer installed in the line. The difference was in the number of failures. When we reviewed the list of events for non-scheduled stops (from 15 events registered) 10 of them indicated that an alarm had been shown in the control panel, but the production line had neither stopped nor reduced its production rate. The alarm signal had been reset, and the production went on without downtime or loss.

As the definition of failure in the standard ISO 14224:2006, item 3.15 states, it is a "termination of the ability of an item to perform a required function". The same concept is included in the SMRP Guide 3.4.1: "When an asset is unable to perform its required function".

According to these definitions, those 10 events that the alarm signaled, but didn't stop production, didn't qualify as failures because the production line did not lose its ability to perform the required function.

For the MTBF calculation, they should have only taken in consideration the five events that produced the stop of the production line when it "was unable to perform the required function". The MTBF value after the correction was 144 hours.

Of course the cause or causes for the alarm signals, without stop, should be investigated, assessed and corrected in a scheduled maintenance.

The error in the MTBF calculation was:

- Including events that don't qualify as failures according to the standard definition. This increases the denominator in the formula with the consequent decrease in the MTBF value.

CASE 4

In a cement production facility, the "reliability and continuing improvement engineer" commented that the main indicator of the maintenance performance, the MTBF, was calculated over all of the equipment in the plant – meaning not the MTBF for all the equipment considered individually, but a MTBF for all the failures mixed as a "Global MTBF". This was justified by management by stating "if the maintenance in all equipment improves, this will be reflected in all the plant and improve this "Global MTBF".

This could be right if what you want is only a number to show in meetings. A more important question is will this metric help us to take preventive or corrective actions and improve our maintenance performance?

The MTBF is linked to the number of failures, which are related to the failure modes. In the end, these affect the corresponding equipment. By that reason, the MTBF is better used at the level of assets and components to compare the reliability of similar type of assets. Like it was used in this case, MTBF is an indicator for a plant that includes a diversity of equipment like crushers, mills, furnaces, cyclones, centrifugal fans and belt conveyors, among others.

The mess in this situation stemmed from the indicator selection stage, where the indicator chosen (MTBF) is not the most adequate indicator to align with the objectives of the area.

CONCLUSION

When selecting the metrics to measure and monitor the maintenance and reliability management, we should consider:

1. Defining the objectives we are looking for with our maintenance and reliability management. Using objectives of the SMART type is a good option. SMART is the acronym for Specific, Measurable, Attainable, Relevant and Time based.
2. Choosing the metrics that align themselves better with the objectives that we predict will be reached by the organization.
3. Using standardized metrics, like the ones in the SMRP guides (67 metrics organized by BoK Pillars) or from the European standard EN 15341:2007 (71 metrics organized in three groups: technical, economical and organizational ones).
4. Establishing internal procedures or instructions where the formulas and considerations for metrics calculation must be precise.
5. Training the responsible personnel in the collection, processing and calculations of the data in order to minimize the non-conformities.