1. Setting maintenance management objectives and indicators

Any management exercise requires the specification of *objectives* and *indicators* to control performance or, in other words, expressing:

- What do we want? What are the objectives / goals / aims?
- How do we target them? How do we control them?

Objectives express in common language what we want. A set of objectives for maintenance could include:

1. Maintenance management in accordance with established good practices
2. Energy control and optimization
3. Effective preventive maintenance, minimum failures and quick repairs
4. Effort on *improvement maintenance* for better maintainability and energy efficiency
5. Optimized operating costs
6. Good image

To take even more advantage of this article, I highly recommend that you carefully read the EN 15341 standard.

To quantify objectives, we use *indicators* that translate objectives into numbers that enable us to follow their evolution along time and point out problem areas and domains for improvement. According to EN 15341, *indicator is a measured feature of a given phenomenon established by a formula that evaluates its evolution*.

The selection of indicators could start by a simple exercise of good common sense choosing, to the practical extent, some (not too many!) standard indicators described in EN 15341.

Remember that once you select an indicator you should keep the consistency of its formulation – otherwise its evolution and comparisons would be misleading – and use it for long enough so that you learn anything with it.

Another recommendation is not to use too many indicators as data collection and analysis are time consuming matters and it may happen that the more information you have the more confused you can get!

Let us exemplify along the next paragraphs the creation of some performance indicators to interpret the objectives set down above remembering that many other objectives and indicators could be selected.

We shall identify the standard indicators as in the source EN 15341, e.g. T17, E21, by a letter plus a number where the letters E, T and O stand, respectively, for *Economical*, *Technical* and *Organizational*.

Now, regarding those objectives …

1.1. Maintenance according to good practices

Indeed, a broad scope objective.

Good maintenance practice understood as the basic set of rules required to manage it properly involve:

- Maintenance items characterization and preventive maintenance planning
- Maintenance spares and materials characterization and logistics
- Work planning and management of work orders
- Maintenance costing
- Maintenance history build up
- Maintenance analysis and indicator computation

This is more easily accomplished by an easy-to-use computerized maintenance management system (CMMS).

If you introduce some established maintenance indicators and are able to consistently report their evolution that means with great probability that you have a sound maintenance management system. And remember that the crucial issue in working with indicators is not their computation but rather the collection of the necessary information to compute them; you can only collect information consistently if everything above that level is properly organized. A well set management system should be able to produce consistent indicators; an adequate CMMS should produce the indicators without any dedicated effort.

So if you are able to produce reliable indicators you can reasonably conclude that you are managing maintenance according to good practices.

It is interesting to note that some industrial organizations with plants spread over various geographical areas, stipulate that every plant should compute the same set of indicators, naturally based on the same source parameters. This is interesting for benchmarking purposes but the main merit seems to be ensuring that all the plants carry out maintenance according to established good practices. The same applies to buildings.

1.2. Energy control and optimization

Gathering information about the overall energy consumption of the facility is essential.

Further to that overall evaluation, individual energy appraisal of some assets and systems should also be made to get a more detailed picture of the energy consumption, enabling us to eventually identify weak points and elect areas deserving effort for improvement. We will learn a lot about our production facility / building and, in the short term, will be confronted with a lot of possible improvements in individual assets and systems and will probably be introducing particular indicators and targets in this context.

We must remember that energy consumption does not depend only on the performance and efficiency of the equipment. It depends on a great number of factors most of which are not under the direct responsibility of the maintenance department but they can, in most cases, be identified by the maintenance people that should develop a pro-active attitude towards identifying them. Let us enumerate a number of possibilities:

- Drive motor upgrades introducing more economical prime movers
- Checking / calibrating sensors to avoid wrong data inputs
- Improvements in insulation, design and equipment to avoid heat losses

- Eliminating steam, heated or refrigerated water and compressed air leaks
- Improving lubrication
- Early detection of bad condition of bearings
- Inputs for the detection of bad practices concerning waste of energy: operating set points; equipment running when not needed; open windows.
- Inputs for better designs.

Most of these can be positively accomplished by systematic walk-around routines and a basic *obsession* over the energy issue.

1.3. Effective preventive maintenance / minimum failures

Maintenance effectiveness indicators are well served by standardized maintenance indicators.

$$T17 = \frac{\text{Total operating time}}{\text{Number of failures}} \quad \text{Hours}$$

$$T21 = \frac{\text{Total restoration time}}{\text{Number of failures}} \quad \text{Hours}$$

Where:

- Operating time = time during which an item is performing its required function;
- Restoration time = time interval during which an item is in downstate due to a failure (including administrative and logistic delays)
- Number of failures.

T 17 expresses the average operating time between failures; in maintenance conceptual language the so called **MTBF**, *mean time between failures*; T 21, the average time to complete repairs; in maintenance language, an indicator that is *close* to the **MTTR**, *mean time to repair*.

Note that in all indicators numerator and denominator must refer to the *same* maintenance item (the production facility / building as a whole, a system, etc.) and to the *same* time period.

Remember that the crucial matter for the computation of indicators is the reliability of the source information; without these there are no meaningful indicators.

1.4. Effort on improvement

Let us assume that the necessity of improvements had been diagnosed and we wanted some metrics to express effort in this area. Improvement maintenance is frequently identified as an ever present objective in buildings (introduction of energy saving equipment, improving accesses for maintenance, monitoring equipment and the like). A suitable indicator for this could also be selected from the standard referenced above:

$$E19 = \frac{\text{Cost of improvement maintenance}}{\text{Total maintenance cost}} \times 100\%$$

Where:

- Total maintenance cost = wages + social taxes + extra time of personnel + external personnel + materials and spares + contractors + departmental costs (energy, machine tools, depreciation, etc.). It excludes downtime costs.
- Cost of improvement maintenance is the part of the maintenance costs dedicated to the *improvement* type of work

1.5. Optimized operating costs

Operating costs fall in the domain of the operational management. So let the production establish their own indicators. Maintenance should take a good note of those indicators as they are bound to be closely linked to their own, as the major cost issues in a facility, are clearly connected with maintenance and energy issues.

1.6. Good image

Image is also in the domain of operational management. Operational management makes their own indicators and you should try to use or create one or more indicators for maintenance that somehow express what *they* want.

Of course maintenance performance is a great contributor to the overall image of a facility and everybody in the department should be fully aware of that. There are many critical eyes looking around - safety related matters, hygiene, condition of visible maintenance items among many other.

1.7. Maintenance scorecard

It should be stressed that to compute maintenance indicators it is necessary to have implemented a management system that generates consistently and accurately the factors that integrate their formulations. The input of source information is the most critical component to work with indicators and if you are successful in doing so you have an adequate maintenance management system.

If the top management of an organization establishes the requirement of a set of maintenance *Key Performance Indicators* (KPI) for the buildings to be reported it is implicitly specifying the requirement that an adequate management system is in place and that maintenance is conducted according to good practices.

The set of selected KPI normally involve mutual relationships that should be analysed to identify interactions between the indicators helping the manager to better understand the actual tendency of its actions and policies. The set KPIs selected by management to *feel* the organization constitute the *Balanced Scorecard*.

To improve the energy consumption, you may require higher investments in the type of work that we have designated by *improvement maintenance*, therefore, it is reasonable to expect higher figures in the indicators related to the effort in improvement maintenance (E19) 1.4.

Improving availability, as expressed by indicator T21, # 1.3., may penalize maintenance costs.

The analysis of these interactions may suggest improvement measures in a *balanced* way, the expression *Balanced Scorecard* meaning that it should include a set of balanced interacting performance targets.