

HARMONISATION OF MAINTENANCE PERFORMANCE INDICATORS

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Summary

Globalization process brought the need for a common understanding of the indicators that are used to measure maintenance and availability performance. There have been numerous systems of indicators developed virtually by each larger company or organisation around the world. However, a common set of indicators and definitions would facilitate the ability of an international company to accurately perform benchmarking between facilities in different countries or continents. To resolve this problem, a team comprised of EFNMS and SMRP representatives is working toward a common set of indicators that can be applied globally. This cooperative effort is termed harmonisation.

Keywords: maintenance, key performance indicators, EFNMS, SMRP, harmonisation.

1. INTRODUCTION

Maintenance performance has always been of great interest of both company managers as well as active maintenance staff. The managers always want to know if the money spent on maintenance is spent effectively and is not just wasted. Maintenance staff on the other hand wants to show that they are doing perfect job with top results. The easiest way to show the results is to measure them. But the main obstacle in measuring maintenance performance is in difficulty to find objective criteria or indicators to measure its performance. Unlike production, where outputs can easily be measured in manufactured numbers, tons, etc. per manufacturing costs, it is impossible to give single indicator of maintenance output.

Maintenance process is very complex one and its performance depends on number of factors. Perfect work of maintenance staff quite often brings unsatisfactory results in reliability performance, just because of outdated unreliable machinery. On the other hand reliable advanced equipment may require virtually no maintenance thus resulting in high equipment availability.

Some principal efforts on international level can be recognized in the area of maintenance performance measurement, very often called maintenance benchmarking. Benchmarking uses a set of indicators that can be used for comparison of own results with results being achieved by the others, if possible by the so called world class. In Europe a principal role was played by EFNMS (European Federation of National Maintenance Societies), its working group 7 – Maintenance Benchmarking, which had set up 13 principal indicators in 2002. Later on, this effort was transformed into European standard bringing 71 indicators divided into 3 main categories –

economical, technical and organizational. In parallel, in the North America, a SMRP (Society of Maintenance and Reliability Professionals) has been developing system of maintenance performance metrics, as they called them, but divided into 5 groups – Business and Management, Manufacturing Process Reliability, Equipment Reliability, People Skills and Work Management. As the world is only one and globalization is an ongoing process, in 2006 during the Euromaintenance 2006 /3rd world congress on maintenance, held in Basel, representatives of these groups met and decided to start process of harmonization of both system which should bring a commonly defined and commonly used indicators of maintenance performance.

By the April 2008, seventeen indicators have been harmonized, that is compared and recognized as identical, similar or measure same performance, but using different definitions. Objective the harmonization effort is to bring a common set of indicators and definitions, and thus the ability of an international company to accurately perform benchmarking between facilities in different countries or continents by using a set of indicators that can be applied globally.

2. EUROPEAN SET OF INDICATORS

The European Federation of National Maintenance Societies vzw (EFNMS) is non-profit organization with the objective of improvement of maintenance for the benefit of the peoples of Europe. In 1998, Working Group 7 (WG7) was formed and continually selected a number of benchmark indicators that were regarded as important when measuring maintenance performance [1]. In 2002 they published a set of thirteen indicators.

Members of Working Group 7 actively participated in the standardisation activities of the European Committee for Standardization Technical Committee 319 - Maintenance (CEN/TC 319). The technical committee's efforts resulted in publication of 71 in European Standard EN:15341 Maintenance Key Performance Indicators in early 2007 [2].

The EFNMS Benchmarking Committee (previously called WG 7) utilizes the indicators (selected ones, corresponding to the former 13 EFNMS indicators) in EN: 15341:2007 to conduct workshops through Europe and the Middle East, at which more than 150 participants in twelve countries (among them Slovakia) have been given the opportunity to calculate indicators on their company's maintenance and availability performance, and to gain a deeper understanding in the use of indicator.

The new standard let the users decide which indicators will be utilised, but this on the other hand brings a problem of mutual comparison when companies will not use the same indicators.

The objective of indicators is to help management to support management in achieving maintenance excellence and utilize technical assets in a competitive manner. Most of the indicators apply to all industrial and supporting facilities.

These indicators should be used to:

- a) measure the status;
- b) compare (internal and external benchmarks);
- c) diagnose (analysis of strengths and weaknesses);
- d) identify objectives and define targets to be reached;
- e) plan improvement actions;
- f) continuously measure changes over time.

To select relevant indicators, the first step is to define the objectives to be reached at each level of the enterprise. At the company level, the requirement is to identify how maintenance can be managed in order to improve global performance (profits, market shares, competitiveness etc). At the systems level and production lines, the maintenance objectives can address some particular performance factors, which have been identified through previous analysis, such as improvement of availability, improvement on cost-effective maintenance, retaining health, safety and environment preservation, improvement in cost-effective management of the value of the maintenance inventory, control of contracted services, etc. At the equipment level, machines or types of machines, better control of reliability costs; maintainability and maintenance supportability, etc may be desirable.

When the objectives have been defined and the performance parameters to be measured have been identified, the next step is to find the indicators that allow measuring these parameters. The system can include capacity of maintaining the equipment, reliability of the equipment, efficiency of the maintenance activities, health, safety and the environment, etc. An indicator is relevant when its

value or its evaluation is correlated with the evaluation of the performance parameter to be measured. A relevant indicator shall be one element of decision making.

It is necessary to precisely define:

- data to be collected to determine the values required for the indicator;
- measurement method (operating mode);
- tools required for the measurement (documents, counters, sensors, analyzers, computerized maintenance management system, etc.).

To make the possible evaluation and comparisons easier, it is necessary that the collected data are in conformity with the standardized definitions (e.g. EN 13306).

It is necessary to predetermine the frequency of the calculation and consider availability and time delay of the relevant data, changes over time and reactivity of the system to the actions undertaken.

Out of the scope of this standard remain definition of score, analysis and adopting required measures. The standard itself comprises a set of indicators, but their analysis will require additional projects.

3. SMRP (USA) METRICS

Society for Maintenance and Reliability Professionals (SMRP) has defined and continually has been developing indicators (metrics as they call them) of the best practices to measure maintenance performance. This process is ongoing and metrics can be found at www.smrp.org. The SMRP is active mostly in the USA and Canada, has over 1500 members of which 150 are executive company members.

Objective of the SMRP committee is to define best practices in maintenance and reliability and gradually create a set of the most frequently used metrics and definitions.

The SMRP best practices committee has selected over 70 metrics that will be gradually defined in the following categories:

- business and management.
- manufacturing process reliability.
- equipment reliability.
- people skills.
- work management.

4. HARMONISATION PROCESS WITH KPI'S

At Euromaintenance 2006 in Basel, Switzerland, key members of the EFNMS WG 7 and the SMRP Best Practices Committee met for the first time. The purpose of the meeting was to exchange information and to explore possible cooperation efforts [3].

It was decided to form a joint EFNMS-SMRP working group to resolve differences between the EN:15341 indicators and those being developed by

the SMRP Best Practices Committee. Side-by-side comparisons were made of both the indicator formulas and definitions of terms. The basis for the European terms was EN:13306:2001 Maintenance Terminology and IEC 60050-191:1990 Dependability and Quality of Service. The SMRP definitions are contained within each indicator (metric) description, and have been compiled in a Glossary of Terms. This resulted in two extensive lists, as there were either terms or formulas that were not common to both sets.

An indicator is determined to be common if it has the same basic formula or could be universally applied. For these common indicators, it is first determined whether any differences can be eliminated. If there are differences that cannot be eliminated, the differences are qualified or explained. This is the essence of the harmonisation process.

It should be noted that the grouping of indicators is different. In EN:15341, the indicators are grouped into economic, technical and organizational sets. The SMRP indicators are categorized in accordance with the five pillars of the SMRP Body of Knowledge: Business and Management, Manufacturing Process Reliability, Equipment Reliability, People Skills and Work Management.

The joint working group made very good progress, announcing the first harmonisation results in January 2007.

To date, the seventeen indicators listed in Table 1 have been harmonized. An additional eleven indicators have been identified for harmonisation. Each is classified as:

- IDENTICAL – the bases of the indicators are the same, although there may be some differences in how they are presented. The differences are detailed in the comments.
- SIMILAR – there are some differences in the differences that are detailed in the comments.
- SAME PERFORMANCE – the indicators measure the same performance area, but there are significant differences in the definitions or calculations that are detailed in the comments.

When an indicator is harmonized, a statement declaring this fact is added to the SMRP metric description.

Furthermore, the SMRP metric is recommended for use by EFNMS as a guideline or supporting document for the European Indicator.

The harmonised indicators were used in the first world's SMRP-EFNMS Benchmarking Workshop held at Euromaintenance 2008 in Brussels.

The harmonisation work will continue until the list of SMRP indicators currently under development has been exhausted. It is desired to initiate similar harmonisation efforts with other international maintenance organizations, such as COPIMAN (Technical Committee on Maintenance of the Pan American Federation of Engineering Societies) or MESA (Maintenance Engineering Society of Australia).

It is also desired to promulgate the use of these indicators as accepted standards. Discussions are ongoing with CEN/TC 319 to consider proposing the harmonized metrics as global standards or guidelines.

Table 1 – EFNMS-SMRP Harmonized Indicators

SMRP Metrics		EN 15341 Indicators	
Metric No.	Metric name	Indicator No	Indicator Ratio
5.5.33	Stock outs	O26	Number of the spare parts supplied by the warehouse as requested x 100/ Total number of spare parts required by maintenance
1.4	Stores value/RAV	E7	Average inventory value of maintenance materials x 100/ Asset Replacement Value
1.5	Annual maintenance cost per RAV	E1	Total Maintenance Cost x 100/ Assets Replacement Value
3.5.1	MTBF	T17	Total operating time x 100/ Number of failures
3.5.2	MTTR	T21	Total time to restore x 100/ Number of failures
4.2.1	Maintenance training costs	E21	Cost of training for maintenance/ Number of maintenance personnel
4.2.2.	Maintenance Training hours	O23	Number of maintenance internal personnel man-hours for training x 100/ Total internal maintenance man-hours
5.4.1	Reactive work	O17	Immediate Corrective maintenance man-hours x 100/ Total maintenance man-hours
5.4.2	Proactive Work	O18	Preventive maintenance man hours x 100/ Total maintenance man hours

5.7.1	Continious improvement hours	O8	Man-hours used for continuous improvement x 100/ Total maintenance personnel man-hours
5.5. 71	Contractor maintenance cost	E10	Total contractor cost x 100/ Total maintenance cost
5.5.8	Overtime maintenance hours	O21	Overtime internal maintenance man hours x 100/ Total internal maintenance man hours
5.1.1	Corrective maintenance cost	E15	Corrective maintenance cost x 100/ Total Maintenance Cost
5.1.2	Corrective maintenance hours	O16	Corrective maintenance man hours x 100/ Total maintenance man hours
5.4.4	Work orders performed as scheduled	O22	Number of work orders performed as scheduled x 100/ Total number of scheduled work orders
5.5.6	Craft workers on shift ratio	O10	Direct maintenance personnel on shift x 100 Total direct maintenance personnel
5.5.31	Stores Inventory Turns	E12	Total cost of maintenance materials x 100 Average inventory value of Maintenance materials Warehouse turnover

5. SUMMARY

Although much has been done in the field of KPIs, there are some weaknesses in the area of structuring and hierarchical composition of these KPIs. Another problem is definition of “top” or leading indicators, which was discussed in [4]. Frequently used OEE is only partly affected by maintenance and maintenance costs do not characterize quality of work performed (not considering age and inherent reliability of equipment). And none of these systems, although declaring technical indicators, have nothing to say about technical basis or diagnostics used in maintenance process, which is a fundamental for the maintenance.

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