Measuring Maintenance and Reliability Performance Internationally

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efnms

European Federation of National Maintenance Societies vzw

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- Refineries
  - Operations – 5 years
  - Maintenance – 25 years
- Maintenance Management consultant – 20 years
  - Energy, Paper and Pulping, Mining, Nuclear, Maintenance software
  - Turnaround Project Manager
- EFNMS The European Federation of National Maintenance Societies
  - Member of the GA – 25 years
  - Committee EMAC -23 years
- The Swedish Maintenance Society
  - Board member – 15 years
  - Honorary member – 2 years
- Certified European Maintenance Management Expert 1996
- CEN WG6 Maintenance KPI´s

EMAC – EFNMS Assessment Committee

- Active Since 1998
  - A common language i.e. Standardized terms/structures
    - Thereby providing possibilities to measure and compare
      - National and international view
  - Supporting standardization
    - Initiate, support, promote and disseminate Maintenance standards
    - Members active in standardization organisations
  - Ways to train and learn
    - A three step Workshop program
    - Surveys and guides

GloMe - Global Metricators

Measuring Maintenance and Reliability Performance Internationally

Background

Committee' members from SMRP and EFNMS met in Basel 2006 and discovered the need to challenge the fundamental differences in the definition and use of terms and indicators internationally.

The basis for the European terms is the standard EN 13306 "Maintenance Terminology". The SMRP definitions are contained within each indicator (metric) description and have been compiled in a SMRP Best Practices Glossary

The basis for comparing the Indicators is the EN 15341 and the SMRP Best Practices metrics.

A guidebook published by EFNMS for true global measuring of the Maintenance Function across borders. A guidebook produced by six maintenance experts –from USA, Canada, Hungary, Denmark and Sweden

GMARI published 2008

GloMe published 2020

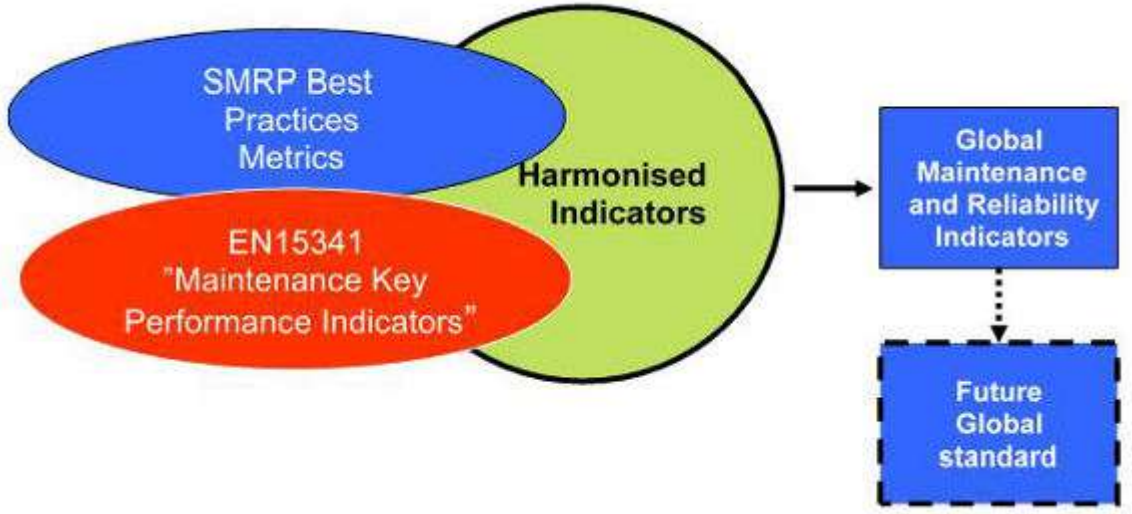
Guidebook Contents

Contents

Harmonisation Effort - The idea

To document and describe the differences and similarities between the EN 15341 Indicators and the SMRP metrics .

- Differences in terms, structures and indicators
- Indicators that can be used over borders if you know which are:
  - Identical
  - Similar
  - Same performance



Annex A - Metricators
40 indicators – 36 Metrics

This annex contains the SMRP metrics that have been harmonized with EN15341 indicators.
Some examples:

Annex No. – Indicator	SMRP Metric	
A.2. PHA8……	2.2	Availability
A.3. PHA15……	1.3	Maintenance Unit Cost
A.4. M10……	2.3	Uptime
A.7. E3, E7…….	3.1	Systems Covered by Criticality Analysis
A.8. E5……	3.5.1	MTBF
A.9. E9 d)……	3.3	Scheduled Downtime
A.13. O&S8……	5.5.72	Contractor hours
A.14. O&S9……	5.1.2	Corrective Maintenance Hours
A.15. O&S10…….	5.4.1	Reactive Work
A.16. O&S11…….	5.4.2	Proactive Work

Harmonisation classification

- *IDENTICAL*
  - the basis of the indicators is the same although there may be some differences in how they are presented which are detailed in the comments
- *SIMILAR*
  - there are some differences in the indicators that are detailed in the comments. The difference in the two sets of calculations is estimated to affect the result by less than 5%
- *SAME PERFORMANCE*
  - measuring the same performance area but there are significant differences in how the definitions and or calculations which are detailed in the comments

SMRP Metrics used as guidelines

Example Maintenance unit cost

EN 15341 Indicator PHA 15 and SMRP Metric 1.3

DEFINITION

This metric is the measure of the total maintenance cost required for an asset or facility to generate a unit of production.

OBJECTIVES

This metrics allows organizations to quantify the total maintenance cost to produce a standard unit of production over a specified time period (e.g., monthly, quarterly, annually, etc.). It provides a period over period trend of maintenance cost per unit produced. This measure can be applied to a specific asset, a group of assets within a facility, across an entire facility or across multiple facilities.

FORMULA

Maintenance Unit Cost = Total Maintenance Cost / Standard Units Produced

COMPONENT DEFINITIONS

Standard Units Produces

- A typical quantity produced as output. The output has acceptable quality and consistent means to quantify. Examples include: gallons, litres, pounds, kilograms or other standard units of measures.

EN 15341 Indicator PHA 15 and SMRP Metric 1.3
Maintenance unit cost

QUALIFICATIONS (Examples)

Time Basis: Annually - If a shorter interval is used, it should include a weighted portion of planned outages or turnarounds.

The unit maintenance cost on different products can vary significantly even though they have the same units of measure. Exercise care when comparing different products or processes.

SAMPLE CALCULATION

The total maintenance cost for the year was $2,585,000. The total output from the manufacturing site in that same year was 12,227,500 kg.

Maintenance Unit Cost = Total Maintenance Cost / Standard Units Produced

Maintenance Unit Cost = $2,585,000 / 12,227,500 kg

- Maintenance Unit Cost = $0.21 per kg

Harmonizing Similar

EN 15341 Indicator PHA 15	and	SMRP Metric 1.3
PHA15 Impact of Maintenance unit cost		**1.3 Maintenance Unit Cost**
Harmonisation		
EN 15341 Indicator PHA 15 and SMRP Metric 1.3 are similar		

Note 1: The difference is that EN 15341 has a broader definition and includes depreciation of maintenance owned equipment and facilities in "Total Maintenance Cost" " (office, workshop and warehouse)

Note 2: This metricators should only be used for comparable products or services.

Harmonizing Identical

EN 15341 Indicator A&S27	and	SMRP Metric 5.5.33
A&S27 Service level of warehouse		**5.5.33 Stock outs**
Harmonisation		
EN 15341 Indicator A&S 27 and SMRP Metric 5.5.33 are identical		

Note 1: The difference between SMRP metric 5.5.3 and indicator A&S27 is in the way in which the performance is calculated. Indicator A&S27 measures the success rate, while SMRP Metric 5.5.33 measures the "unsuccessful rate".

Note 2: The formula for the calculation of SMRP Metric 5.5.33 based on indicator A&S27 calculation is: 100 % - (Value from A&S 27) = Result for SMRP Metric 5.5.33.

Note 3: The SMRP metric is calculated on an annual basis, whereas indicator O&S28 can be calculated for on any given time frame

Harmonizing Same performance

EN 15341 Indicator O&S9	and	SMRP Metric 5.1.2
O&S9 Proportion of corrective maintenance		**5.1.2 Corrective Maintenance Hours**
Harmonisation		
EN 15341 Indicator O&S9 and SMRP Metric 5.1.2 have the same performance		

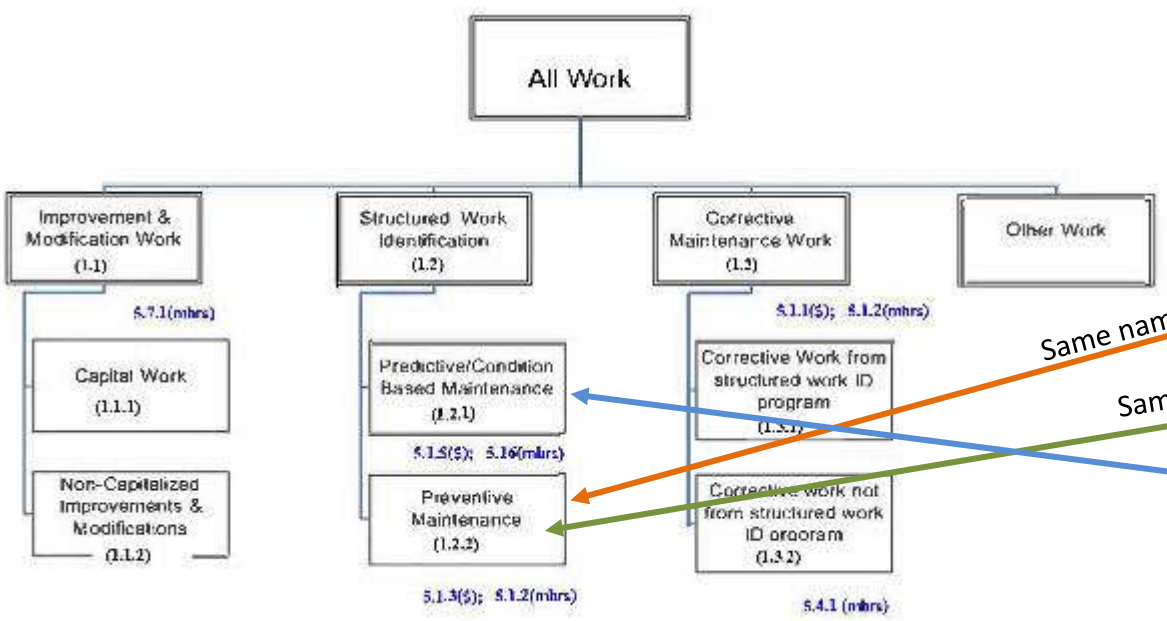
Note 1: The SMRP component definition for corrective maintenance "is the hours/cost to restore equipment to a functional state after a failure or when a failure is imminent." This is similar to the EN 13306 definition, "maintenance carried out after fault recognition and intended to put an item into a state in which it can perform a required function."

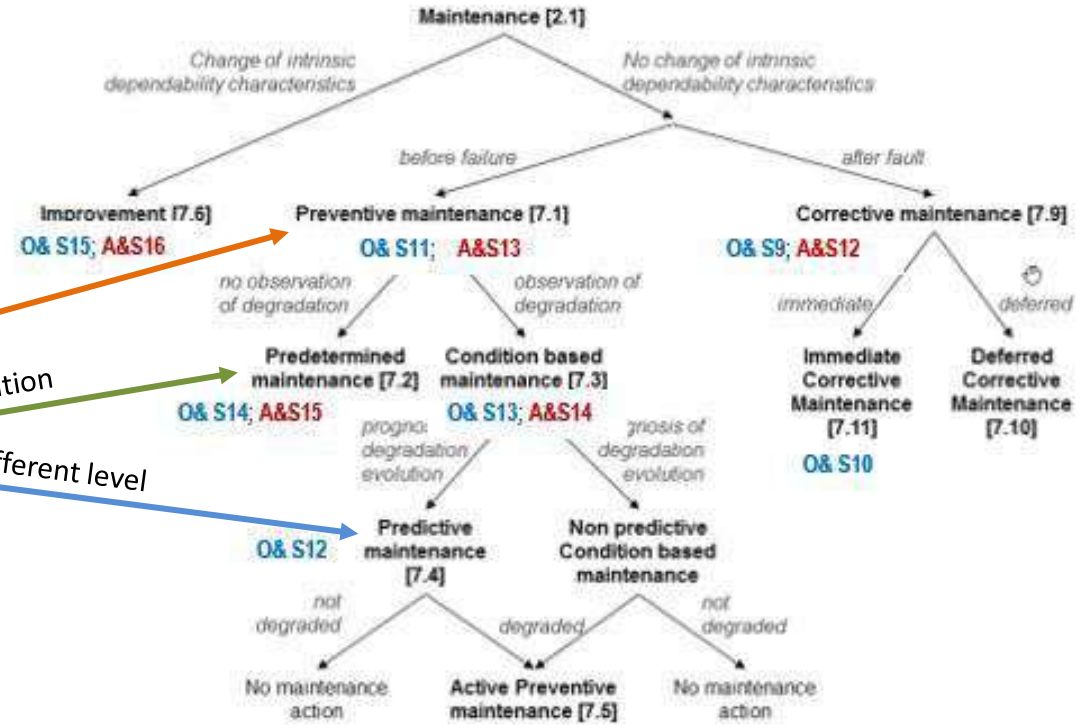
Note 2: Corrective maintenance consists of deferred maintenance and immediate/breakdown maintenance.

Note 3: *SMRP includes part of work identified during condition-based maintenance (CBM) and preventive maintenance (PM) in the corrective maintenance definition*. In the EN 15341 definition for condition-based maintenance any work identified during CBM activities is included in the CBM indicators.

Note 4: Depending on the application of the metric, care should be taken when making comparisons of indictor O&S9 and SMRP metric 5.1.2, since calculating the indicator based on the SMRP metric will give a higher number than by indictor O&S9. This is because part of the findings from CBM and preventive maintenance are classified as corrective maintenance in the SMRP metric.

Structures – Work Types





Same name

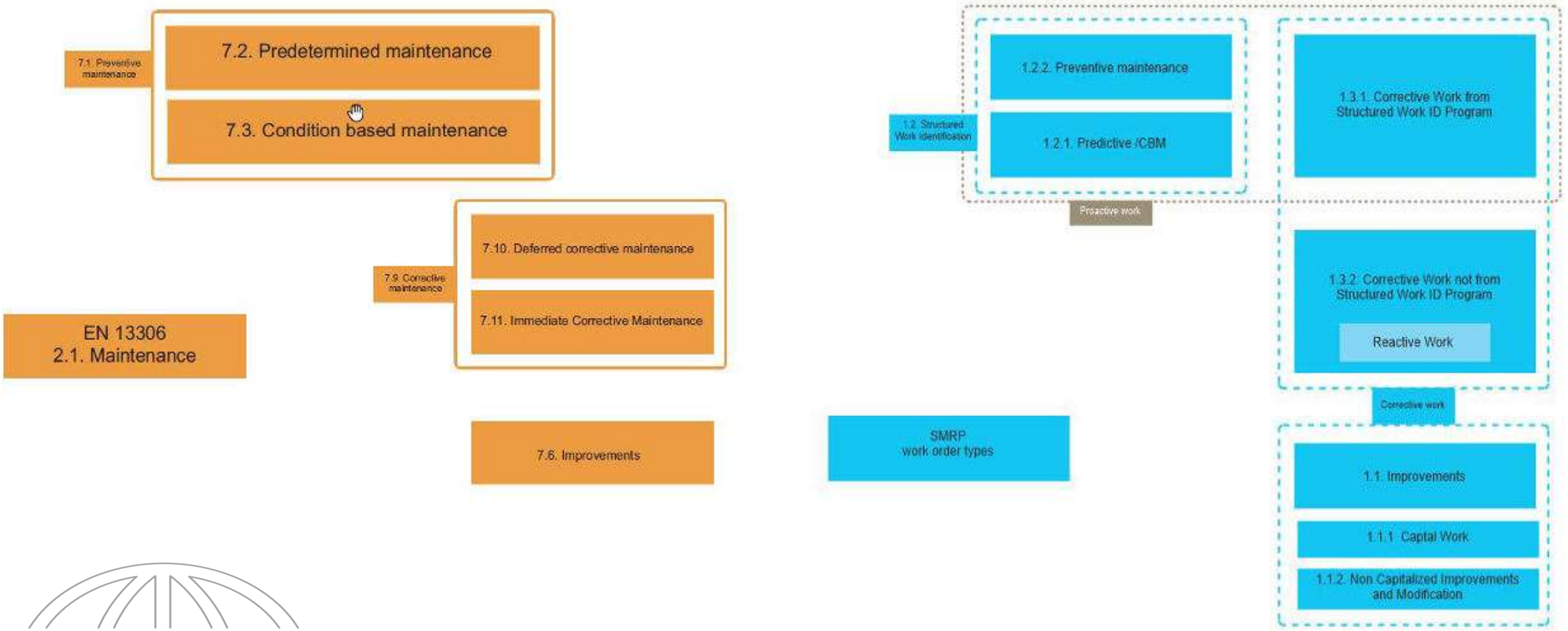
Same definition

Different level

Maintenance Work Types Defined by the SMRP

Maintenance Work Types Defined by EN 13306

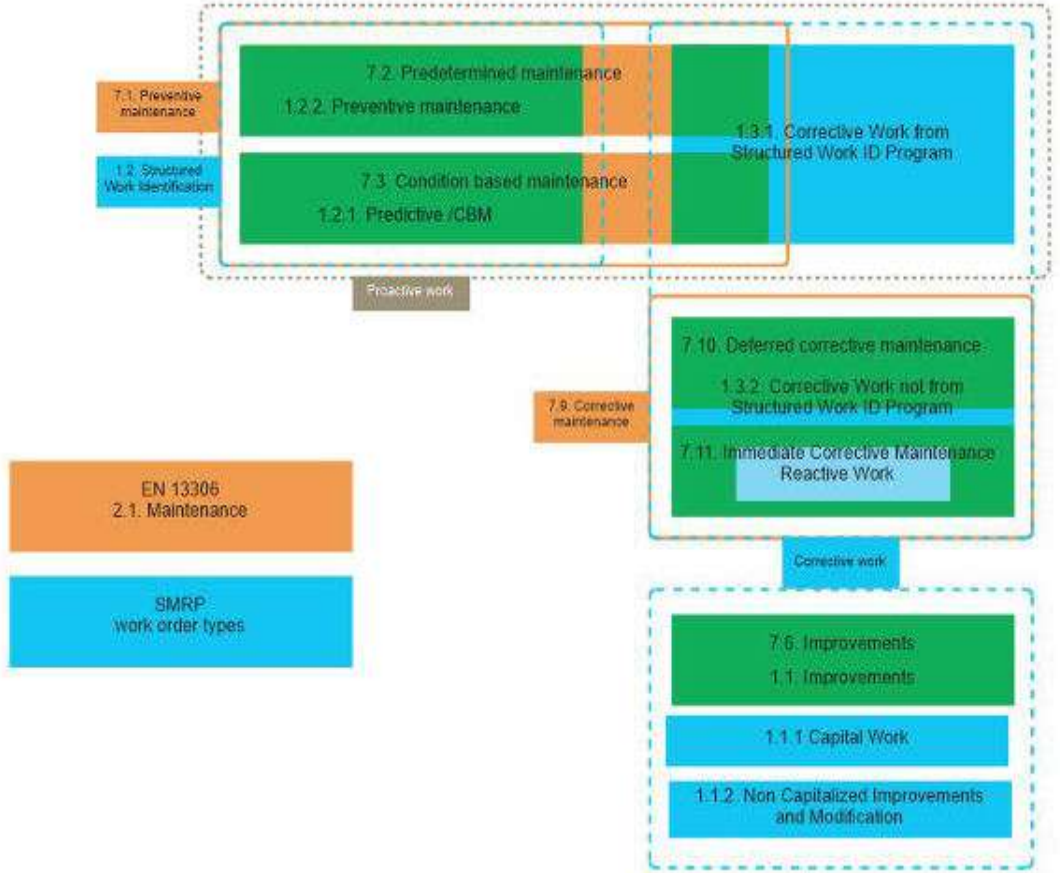
Work Types


7.1. Preventive maintenance
7.2. Predetermined maintenance
7.3. Condition based maintenance
7.9. Corrective maintenance
7.10. Deferred corrective maintenance
7.11. Immediate Corrective Maintenance
EN 13306
2.1. Maintenance
7.6. Improvements
SMRP
work order types
1.2. Structured Work identification
1.2.2. Preventive maintenance
1.2.1. Predictive /CBM
Proactive work
1.3.1. Corrective Work from Structured Work ID Program
1.3.2. Corrective Work not from Structured Work ID Program
Reactive Work
Corrective work
1.1. Improvements
1.1.1. Captal Work
1.1.2. Non Capitalized Improvements and Modification

Work Types

Table 7.1 – SMRP and CEN Maintenance Work Type Equivalents

SMRP	CEN Standards
1.1 Improvement & Modification Work	7.6 Improvement
1.2 Structured Work ID Program = 1.2.1 Predictive Maintenance + 1.2.2 Preventive maintenance	7.1 Preventive maintenance = 7.3 Condition Based Maintenance + 7.2 Predetermined Maintenance
1.3 Corrective maintenance= 1.3.1 Corrective Work from Structured Work ID Program + 1.3.2 Corrective Work Not from Structured Work ID Program	7.9 Corrective Maintenance= 7.10 Deferred Corrective maintenance + 7.11 Immediate Corrective Maintenance
Proactive philosophy-driven work	
1.2.1. Predictive maintenance	7.3 Condition Based Maintenance
1.2.2. Preventive maintenance	7.2 Predetermined Maintenance
1.3.1 Corrective work from Structured work ID	7.10 Deferred Corrective maintenance
Proactive Work	7.1 Preventive Maintenance
Reactive philosophy-driven work	
Reactive work – (component of 1.3.2 Corrective Work Not from Structured Work ID Program)	7.11 Immediate Corrective Maintenance



Terminology - Why discuss this?

The authors have studied some of the most basic terms like:

- Required Function
- Availability
- Uptime; Downtime
- Restore time
- Workorder
- Standby; Idle

These are used and defined in many standards like in the table.

Not wrong- not right - but different

Term	EN 15341 2019	EN 13306 2017	SMRP Glossary	SMRP Benchmarks	ISO 14224 2016
Personnel					
Direct Contract Maintenance Personnel			Defined	Used in 5.5.3	
Direct Maintenance Personnel	O&S 3		Defined	Used in 5.5.3	
Indirect Contract Maintenance Personnel			Defined	Used in 5.5.3	
Time					
Maintenance man-hours					3.53
Uptime		9.1	used	2.3	3.97
Total Downtime			used	3.2	
Down time		9.2			3.16
Availability					
Availability		4.7	2.2	Used in 2.1.1 , 2.1.2 , 2.2	3.3 ; C2.1
Operational availability			Ao	Used in 2.2 , 2.1.1 2.1.2	C.2.3.1 a
Availability based on operating time	M11				
Economy					
Total Maintenance Cost	M17		Defined		KPI 31
Cost	used	used	used		used
Basic terms					
Spare part	used	3.5	used	used	used
Required function	used	2.6	used	used	3.83
Work terms					
Work order	3.8		used	used	used

Terminology examples

8.2 Required Function

The most common definition in standards is: **"Functions of an item which are considered necessary to fulfil a given requirement"**

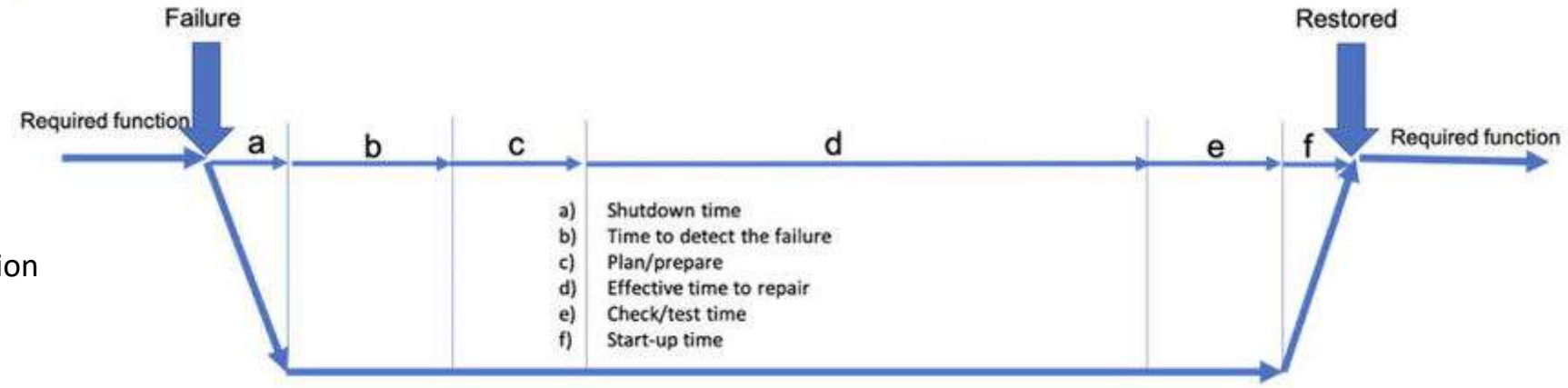
Comments and Discussion

"Required Function" is perhaps the most important term to understand and agree on. Since many of the indicators relate to this term, it is a must to have the definition clarified. In the most basic sense, it is what the owner wants an item to do.

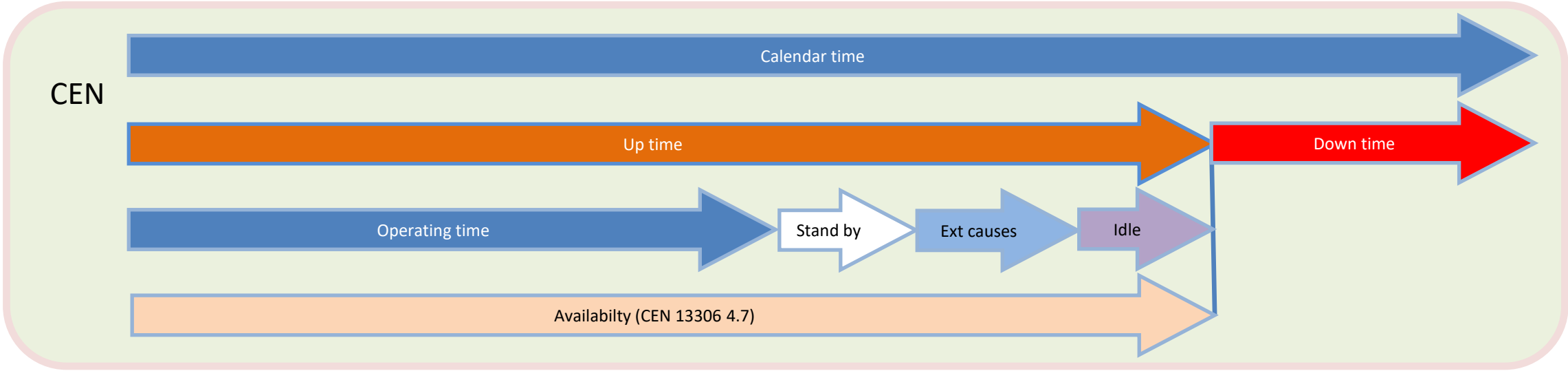
It is also associated with a performance level of the item. For example, the function of a pump is to pump, but it must have a pressure-flow characteristic with a tolerance level on that characteristic. Within the tolerance zone, the requirements are satisfied. Outside the zone, the required function is not performed, and the item is faulty.

Most of the functional requirements can be found in the design documents. However, there are also other internal documents that describe requirements for safety, integrity, health, production rate and time, product quality, environment, etc. These are internal agreements on when and how the requirements are to be met.

Time to restore
A graphical presentation



CEN availability - related to calendar time



$$\text{CEN 13306 4.7} = \frac{\text{Up time}}{\text{Up time} + \text{Down time}}$$

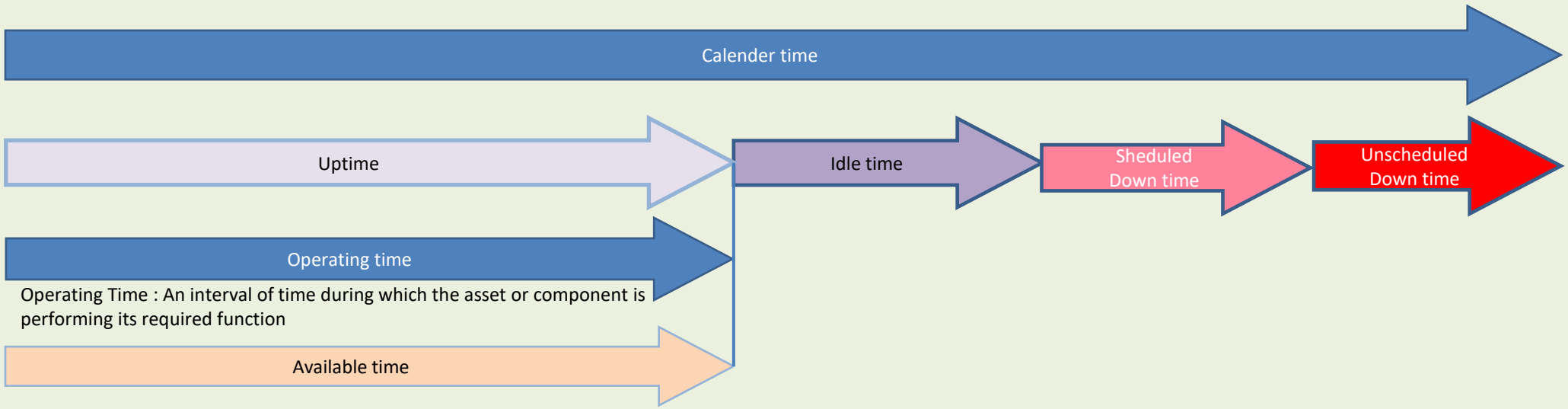
EN 13306 4.7 Time based Availability

$$\text{CEN 15341 PHA8} = \frac{\text{Operating time}}{\text{Operating time} + \text{Down time}}$$

EN 15341 PHA 8 Operational Availability due to Maintenance

Note: *Down time and idle time have different definitions in CEN and SMRP*

SMRP relation Uptime/Operating time(available time



Using Indicators with EN17007

- For each process and component process, a set of elements needed to define indicators which can be used to measure the effectiveness of the process is provided.
- In many instances, the indicators defined in EN 15341 can be used as well.
- A Table in GloMe lists the harmonised EN15341 indicators which can be utilized for the EN 17007 processes.

ACT	Implement preventive and/or corrective actions on the item
IMP	Improve the items
MAN	Manage maintenance
OPT	Improve the results
PRV	Prevent undesirable results by avoiding failures and faults
RES	Provide internal human resources
SER	Provide external maintenance services
SPP	Deliver spare parts

Indicators and Maintenance process

- PHA15 Impact of maintenance on standard technical output
  - In process "MAN", element i3man (maintenance cost) is the numerator of indicator PHA15
- P19 Proportion of training and education man hours
  - Indicator P19 can be used for the component process "RES.3". The applicable element is i6res (training time in relation to actual maintenance work time).
- O&S8 Intensity of works by external maintenance
  - The numerator of indicator O&S8 can be used for the component process “MAN”. The applicable element is i7man (maintenance assigned to a service provider).
- A&S12 Contribution of corrective maintenance cost
  - Indicator A&S12 can be used for the processes "MAN" . The applicable element is i4man (corrective maintenance costs).

Summing up

- By identifying the similarities or the differences between the two approaches, the aim and the way of calculating each KPI becomes clearer.
- The examples for the calculation of the KPIs are, as always, an important assistance for the maintenance managers.
- GloMe provides maintenance professionals with an easy-to- use guide for understanding of the indicators, and of the components included or excluded in the calculation of each indicator.

Thank you for your time
Questions?