SLOVENSKI STANDARD
oSIST prEN 17007:2016

01-julij-2016

Proces vzdrževanja in s tem povezanih kazalnikov

Maintenance process and associated indicators

Instandhaltungsprozess

Processus de maintenance et indicateurs associés

Ta slovenski standard je istoveten z: **prEN 17007**

ICS:

03.080.10	Vzdrževalne storitve. Upravljanje objektov	Maintenance services. Facilities management

oSIST prEN 17007:2016 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 17007

June 2016

ICS 03.080.10

English Version

Maintenance process and associated indicators

Processus de maintenance

Instandhaltungsprozess

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 319.

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COMITÉ EUROPÉEN DE NORMALISATION
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Ref. No. prEN 17007:2016 E

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European foreword

This document (prEN 17007:2016) has been prepared by Technical Committee CEN/TC 319 “Maintenance”, the secretariat of which is held by UNI.

This document is currently submitted to the CEN Enquiry.

According to EN ISO 9001, maintenance is a process since it consists of organized, coordinated tasks using resources and performed by various stakeholders to obtain a given result. Terminology standard EN 13306 defines it as the “combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function.”

It seemed appropriate to formalize the maintenance process through a breakdown into processes that provides the following advantages:

— it makes it possible to clearly indicate the activities to be carried out with a relevant level of detail;

— it indicates the inputs/outputs of each sub-process and defines all the links that join them together and allow the realization of the overall process;

— it provides the ability to define indicators for measuring the realization of each process and monitoring its effectiveness.

The aim of this document is to allow an understanding of the actions and interactions between processes. It provides maintenance managers with a management tool by giving them a way to compare their organization to the generic representation described and to detect insufficient actions, unassigned responsibilities and/or poorly established links. It gives information to define indicators, dedicated to specific processes, allowing the creation of scorecards that are appropriate for monitoring activities and measuring performance.

1 Scope

This European Standard provides a generic description of the maintenance process. It applies to all maintenance systems and all organisations. Therefore, it has been established without a particular organization in mind and does not aim to propose one.

The purpose of the breakdown into processes and the representation of their inter-relationships[1] is to help maintenance personnel, and particularly management at different levels, to:

— clearly identify the actions to be taken in order to meet the overall objectives set by Management in terms of maintenance;

— delegate responsibilities that ensure the realization of the actions with the required performance levels;

— for each process, clearly determine:

  — the necessary inputs and their origin;

  — the required results and their intended uses;

— monitor and quantitatively assess the performance obtained at various levels of the breakdown into processes.

— improve the collection and the distribution of data.

This description should be adapted based on the type of organization chosen to perform the maintenance, the complexity of the systems maintained and the scope of the external contracted services.

This standard does not cover software maintenance itself, but applies to items containing software.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13306:2010, *Maintenance - Maintenance terminology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13306 as well as the following terms and definitions apply.

3.1
activity
set of tasks organised within a process

3.2
indicator
measured characteristic (or a set of characteristics) of a phenomenon, according to a given formula, which assess the evolution

[SOURCE: EN 15341:2007, 3.1]

Note 1 to entry: Indicators are related to objectives

[1] Relationships between several elements or members of the same unit or group.

3.3
exceptional maintenance
preventive maintenance which is infrequent and has a significant impact in terms of total life cycle costs

[SOURCE: prEN 13306:2015]

Note 1 to entry: exceptional maintenance includes large maintenance actions that may be:

unavoidable and planned, thereby leading to the development of alternative strategies (e.g. life extension)

unexpected, as a result of design, manufacturing, installation, operation or maintenance errors or accidental situations (fire, flood, etc.)

Note 2 to entry: the cost of exceptional maintenance is generally accounted as capital investment

Note 3 to entry: exceptional maintenance is sometimes called replacement investments.

3.4
maintenance budget
determination of the maintenance expenditures over a given period in the future to ensure the availability of the necessary financial resources

3.5
maintenance documentation
set of documents including:

— work order;

— technical instructions;

— list of necessary resources;

— plans;

— schedule;

— any other document needed to perform the operation

3.6
maintenance history
part of maintenance documentation which contains the history of all maintenance related data for an item

[SOURCE: prEN 13306:2015, 10.5]

Note 1 to entry: The history may contain records of all failures, faults, costs, item availability, up time and any other relevant data.

3.7
maintenance plan
structured and documented set of tasks that include the activities, procedures, resources and the time scale required to carry out maintenance

[SOURCE: prEN 13306:2015, 2.5]

3.8
maintenance policy
general approach to the provision of maintenance and maintenance support based on the objectives and policies of owners, users and customers

[SOURCE: EN 60300-3-14:2004, 3.1.12]

Note 1 to entry: (except EN 60300–3-14) The maintenance policy entails establishing the direction (method, programme, budget, etc.) based on the goals and objectives set by the company's Management.

The management focus in the policy statement can be:

— availability and useful life of the item;

— safety of the items and individuals, product quality, environmental protection;

— optimization of maintenance costs, etc.

In particular, the maintenance policy give guidance to maintenance strategy that leads to choices being made between:

— planning corrective and/or preventive, predetermined or condition-based maintenance;

— insourced and/or outsourced maintenance.

3.9
maintenance procedure
document that describes in detail preventive and corrective maintenance tasks

Note 1 to entry: These procedures indicate the dismantling and reassembly actions (with the help of diagrams, expanded views, etc.) and give the time periods of the tasks, permissible wear-out rates, the various faults that may occur, and their diagnosis.

Note 2 to entry: Maintenance procedures also include the company's health and safety rules as well as the regulatory aspects (environment, safety, etc.).

3.10
maintenance strategy
management method used in order to achieve the maintenance objectives

[SOURCE: prEN 13306:2015, 2.4]

Note 1 to entry: Examples could be outsourcing of maintenance, allocation of resources, etc.

3.11
maintenance support equipment
set of equipment needed to perform the maintenance tasks based on the recommended procedures

Note 1 to entry: These resources include:

— tools;

— measuring and control equipment;

— computer equipment;

— handling equipment (slings, fork-lift trucks, hoists, etc.);

— means of access (scaffolding, ladders, platforms, etc.);

— individual and collective protective equipment;

— environmental protection equipment;

— etc.

3.12
process
set of interrelated or interacting activities which transforms inputs into outputs

[SOURCE: EN ISO 9000]

3.13
spare part
item intended to replace a corresponding item in order to retain or maintain the original required function of the item

[SOURCE: prEN 13306:2015, 3.5]

Note 1 to entry: The original item may be subsequently repaired.

4 Principles of maintenance process breakdown

4.1 Process families

To more easily identify processes, it is helpful to classify them into three main families

a) Management process

This includes determining the objectives and the policy to be implemented in order to achieve them, deploying the company's means and allocating the resources. It ensures the coherence of the realization and support processes. It includes measuring and monitoring the process system and using the results to improve performance.

b) Realization processes

These contribute directly to achieving the expected result and are designed to ensure that the need expressed by the customer is satisfied. They encompass all activities related to the realization cycle of the product or service.

c) Support processes

These are essential to the functioning of the other processes (realization processes, other support processes, management process) as they provide them with the necessary resources.

They include activities related to:

— human resources;

— financial resources;

— material resources and their maintenance (premises, equipment, software, etc.);

— information processing.

4.2 Breakdown into levels

Level 1 of the breakdown is an overall mapping that identifies the processes and classifies them into each of the families based on the diagram shown in Figure 1.

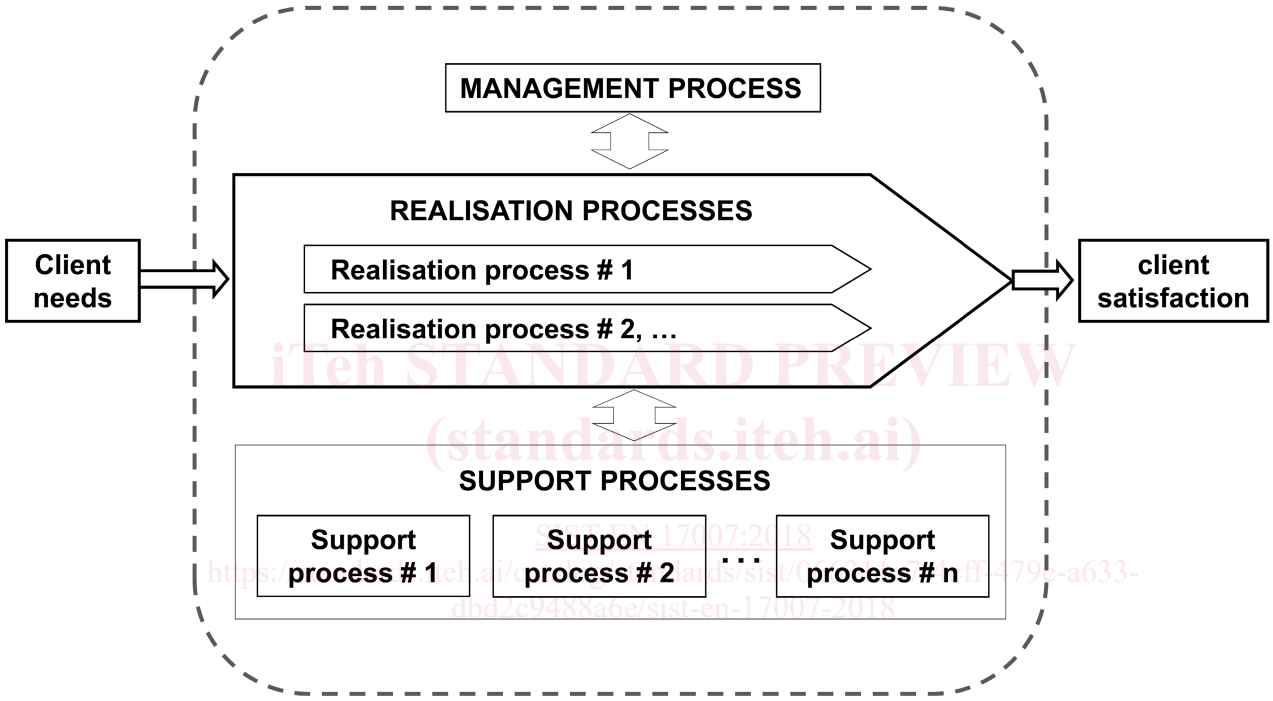


Figure 1 — Level 1 of the process mapping

Each level 1 process is in turn broken down into level 2 processes. In addition to the component processes, this level shows the input and output data of each process as well as its origins and destinations.

This provides a sequenced representation of the level 2 processes that contribute to the realization of the level 1 process (see Figure 2).

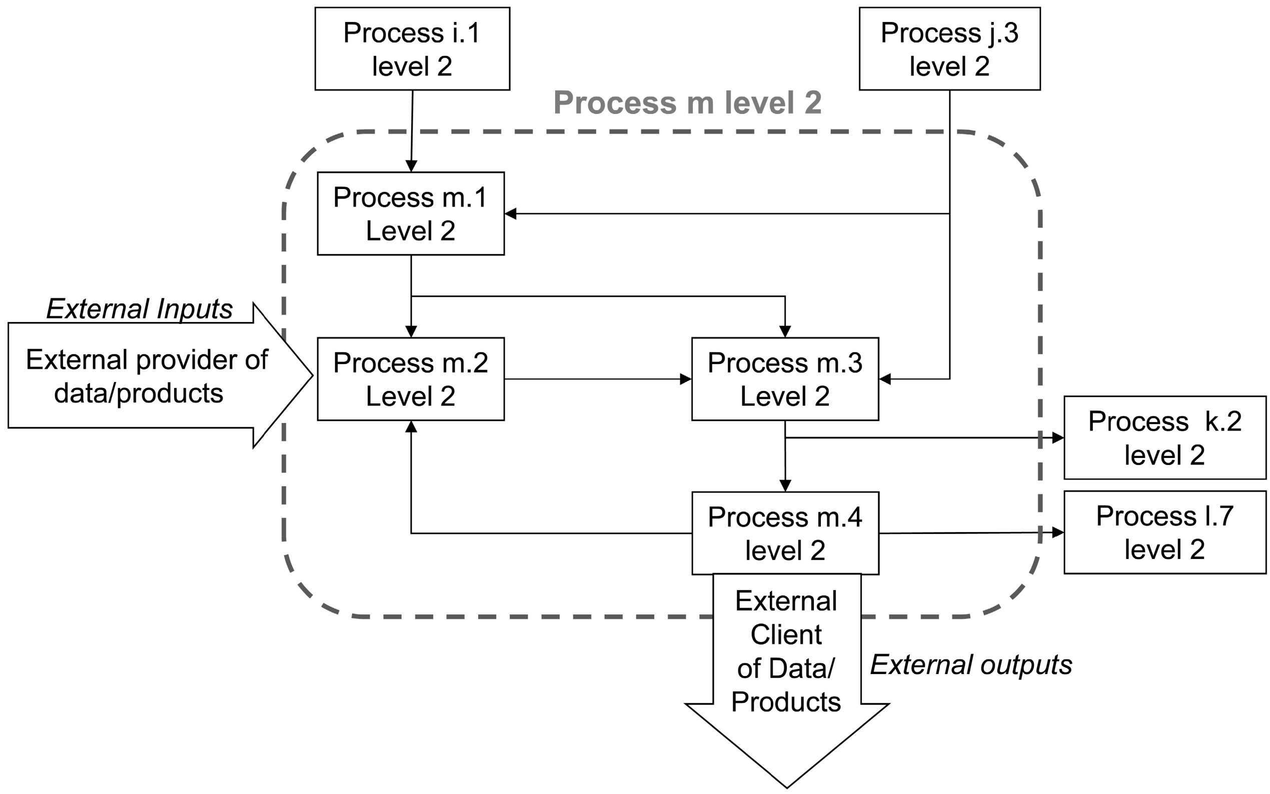


Figure 2 — Level 2 of the process mapping — Example

Some input data are output data from processes outside the process broken down or is supplied by entities outside the maintenance process. The same may be true for output destinations. These external origins and destinations are indicated on the diagram.

A third level may be described, where necessary, to further clarify the actions, but this level is not discussed in this standard.

A profile is drawn up for each level 2 process. It includes:

— the **name of the process**;

— the **purpose(s) of the process**, which is expressed in terms of action(s) with clearly stated goals;

— the **activities that comprise the process**. These activities constitute level 3 of the breakdown, which is not shown in the form of a diagram in this document;

— the **input data and products** which are needed to realize the process. They come from either other level 2 processes, other level 1 processes or entities outside the maintenance process;

— the **output data and products** which are created or modified by the process and are intended for either other level 2 processes, other level 1 processes or entities outside the maintenance process;

— regardless of the level of the process, the **stakeholders** are: the person who requested the process, the process manager, the customer, the beneficiary of the process and input data suppliers. These stakeholders are relative to the company's **organization** and can therefore not be generic. As a result, information about them is not provided in this standard and it is up to each company to do so. This makes it possible to clearly identify the players' responsibilities, detect any insufficiencies and assign each stakeholder's tasks, customers, objectives and suppliers;

— the **interfaces with the other processes** summarize all the related processes. These can be data or product suppliers or customers of the output data or products;

— the **constraints** related to realization of the process are a way to specify certain requirements or situations. They shall be taken into account by the process;

— the **potential related indicators** are used either to measure the performance of the process, which makes it possible to assess its effectiveness and attainment of the targets assigned to it, or to monitor the realization of the actions taken to ensure their progress and adherence to timeframes.

4.3 Use of the Maintenance process breakdown

The representation of the maintenance process, established according to the aforementioned principles, is provided in Clauses 5 and 6. It is generic, which means that it is not based on any particular organization and draws on best practices generally implemented in the maintenance sector. It is then up to each company to use this breakdown to build or update its organization.

This can be achieved by identifying, within its own organization, the structural entities that realize the various processes defined. It is then necessary to ensure that:

— each process exists and is managed,

— each process is unique,

— the inputs/outputs are clearly defined (products, data, timeframes, etc.),

— the suppliers and customers of the inputs/outputs are clearly designated by name,

— the responsible persons for the processes (process owners) has been defined,

— the indicators are regularly analysed and published in order to monitor the progress of the actions and measure the effectiveness of the processes and their ability to achieve the assigned objectives.

This task offers many advantages:

— the result obtained provides a basis for understanding how the company's maintenance process is performed and improves the confidence of the customer into the ability of the maintenance provider;

— each entity of the organization clearly sees its position in relation to the others and the importance of its actions within the maintenance process. Each person's work is more easily recognized thanks to a greater ability to communicate the results obtained;

— responsibilities are defined without overlaps or ambiguities and objectives are established and quantified;

— the players have a better understanding of the objectives, which improves synergy and teamwork;

— management of the processes is significantly easier. Management shall have the means to detect malfunctions, measure non-conformities and any deviations from the objectives and take appropriate measures to correct or update the processes in question (e.g. it provides framework for assessment and benchmarking);

— formalization of the processes is a tool for training the various job profiles and developing the company's knowledge and facilitates changes through a better understanding of their consequences;

— Formalizing the sequencing of actions and using indicators to detect deviations helps to ensure the continuous improvement of the maintenance process.

— Provides a framework for systematic Information System support.

It should be noted that each company shall adapt the various processes according to its field of activity and economic, geographic, political, cultural and other contexts.

5 Breakdown of the maintenance process and process profiles

5.1 Maintenance process

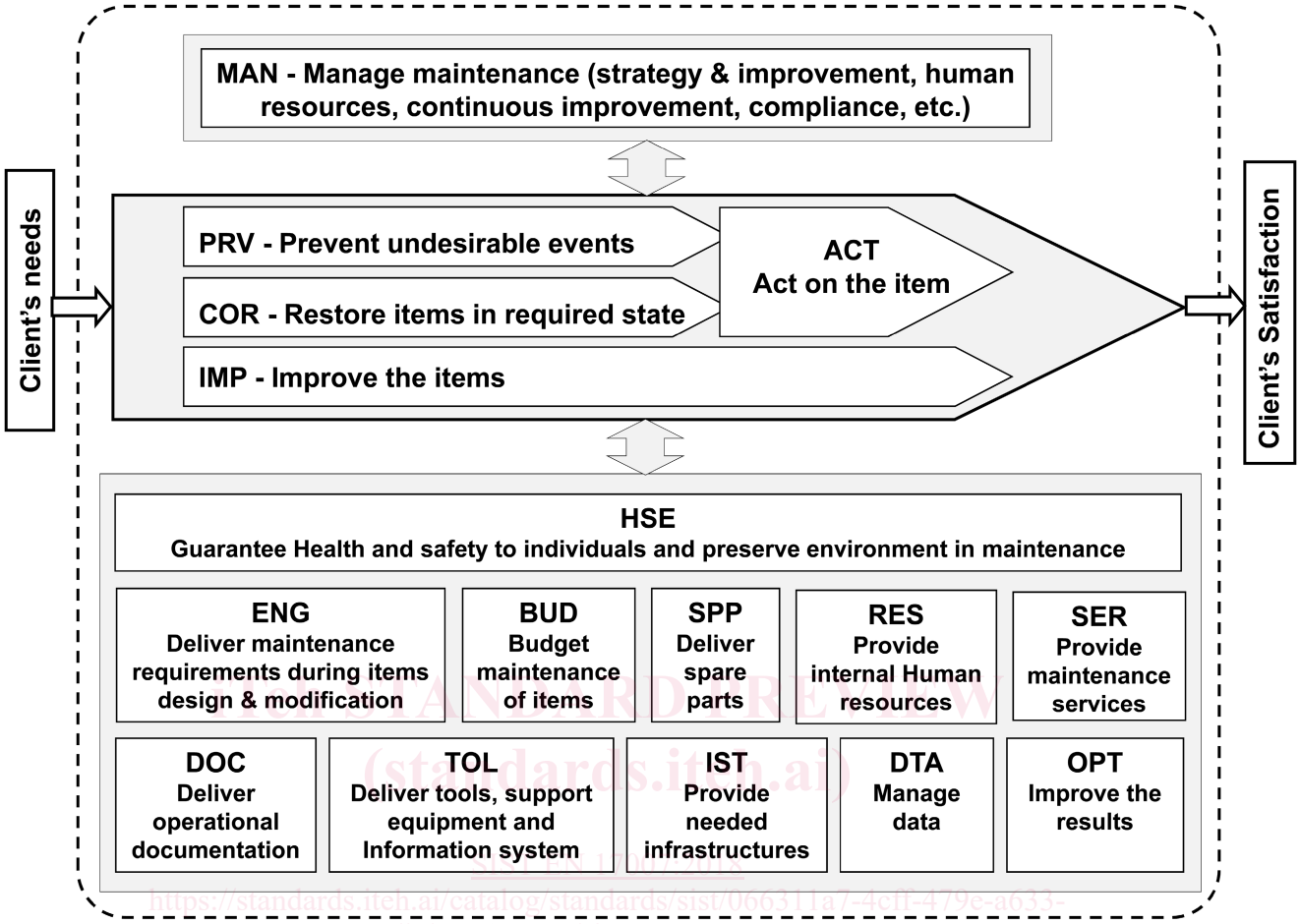


Figure 3 — Maintenance process (level 1 of the mapping)

The maintenance process consists of the following processes:

a) the management process:

— MAN: Manage maintenance (strategy and improvement, human resources, continuous improvement, compliance, etc.);

b) the realization processes:

— PRV: Prevent undesirable events;

— COR: Restore the items in required state;

— IMP: Improve the items;

c) the support processes:

— HSE: Ensure personal health and safety to individuals and preserve environment in maintenance;

— BUD: Budget maintenance of items;

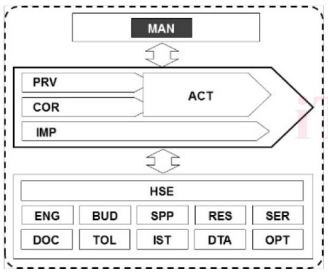
— DOC: Deliver the operational documentation;

- DTA: Manage data;
- ENG: Deliver maintenance requirements during items design and modification;
- OPT: Improve the results;
- TOL: Deliver the tools, support equipment and information system;
- SPP: Deliver spare parts;
- RES: Provide internal human resources;
- SER: Provide maintenance services;
- IST: Provide the needed infrastructures.

Each of these processes is broken down at level 2 in the following figures.

Elements (variables, quantities, characteristics, etc.) to define indicators are provided for each process. Each organization can adapt them to its own requirements.

5.2 MAN process: Manage maintenance



See Figure 4.

Purpose(s) of the Process

The aim of this process is to manage maintenance in order to achieve the objectives set by the company's management.

Key activities / elementary processes

- **MAN.1 – Establish the maintenance policy, strategy and development actions**

Based on the company's missions, values, regulations compliance and general objectives, the policy establishes the direction, which gives priority to:

- safety of individuals and items, product quality, environmental protection;
- availability and useful life of the items;
- optimization of maintenance costs, etc.

The maintenance strategy, which results from the maintenance policy, requires that choices be made for:

- developing, adapting or implementing maintenance methods;
- organizing the internal resources (maintenance teams, stocks of spare parts and consumables, documentation, tools, etc.);
- insourcing and/or outsourcing and/or contracting some or all of the maintenance tasks;
- studying the economic impact of item modifications or improvements.

The development of maintenance processes according to the strategy and the process to determine and prioritize improvements are defined and decided.

- **MAN.2 – Identify the internal or external activities (carried out by the staff of the user company or participating companies)**

The maintenance policy and strategy make it possible to clearly identify the activities carried out internally and those assigned to participating companies. In connection to budgeting this identification leads to choosing between “making” and “buying” and specifying the required skills.

— **MAN.3 – Determine the organization, job profiles and responsibilities**

Based on the direction and choices expressed in the policy and strategy, an organization is set up to realize the maintenance processes. Tasks and job profiles are established as well as possible needs to update present skills. Responsibilities are defined and assigned to the company's personnel.

— **MAN.4 – Prepare and negotiate the budgets**

Economic plans (Budgets) are approved and adjusted by Management based on the budgeting process (BUD).

— **MAN.5 – Oversee the actions**

All the actions included in the maintenance process are coordinated, supervised and, if applicable, decided on by Management in order to achieve the goals and objectives defined in terms of safety, availability, costs, environment, quality, etc.

— **MAN.6 – Define, select, analyse and communicate the information**

The technical, organisational, economic and social information that shall be communicated internally and/or externally is defined, selected, analysed and made available to the relevant entities.

— **MAN.7 – Define policy and strategy areas of improvement**

All information (technical, organisational, economic and social) is analysed in order to continuously adjust and improve the maintenance policy and strategy.

Input data/products	**Output data/products**
— the company's missions, values, general objectives, rules, knowledge about asset portfolio, asset systems, assets, operating profiles, operating constraints and conditions — laws, decrees, codes, regulations and standards external to the company — external constraints (user of the item, owner, etc.) — Initial Preventive Maintenance Plans (ENG.9) — documentation (DOC.6) — required skills or training needs (ENG.11) — maintenance budget (BUD.5) — notice of conformity (ENG.8) — contribution of maintenance to development of prevention and Safety Plan (HSE.4) — information regarding activities carried out (DTA.11, OPT.2, RES.4, SER.4) — budget estimates for maintenance during operation and for exceptional maintenance and analysis of projected-actual deviations (BUD.5) — indicators, best practices, scorecards (OPT.4) — improvements to be made (OPT.2,3,4,5,6,7)	— company's maintenance policy, strategy, operational objectives, directions, choices, improvements — internal and external activities to be carried out, organization, job profiles, responsibilities — maintenance budgets — information obtained from the process for the purpose of other processes, scorecard, best practices
Stakeholders To be completed by the organization in order to answer the questions: — who is realizing the process? — who is the customer of the process?	**Interfaces with other processes** All processes

Constraints related to realization of the process

The large amount of diversified data that shall be collected, formatted and analysed on a regular basis requires an efficient information management system.

Indications of elements to define indicators related to the process