
**Systems and software engineering —
Lifecycle profiles for Very Small
Entities (VSEs) —**

**Part 3-1:
Process assessment guidelines**

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see <http://patents.iec.ch>).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and systems engineering*.

This second edition cancels and replaces the first edition (ISO/IEC/TR 29110-3-1:2015), which has been technically revised.

The main changes compared to the previous edition are as follows:

- [Annex A](#) has been reworked and split to distinguish measurement framework and exemplar process assessment model; exemplar process assessment model for system life cycle processes has been added;
- main concepts for VSE profiles, i.e. maturity levels and process capability levels, have been added;
- structure of the process assessment model has been reworked and mapped to VSE profiles and processes dimensions;
- process assessment indicators description has been reworked;
- software project management and software implementation process base practices indicators and work product characteristics have been aligned with the latest editions of ISO/IEC 29110-4-1, ISO/IEC/TR 29110-5-1-2 and ISO/IEC/TR 29110-5-2-1;
- software process performance indicators for organizational profile group have been added;
- software process capability levels and process attributes indicators (PA.1 to PA.4) have been added;
- rules to derive VSE profiles from process capability levels have been added;
- subclauses on conformity of the exemplar process assessment model have been added.

A list of all parts in the ISO/IEC 29110 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Very Small Entities (VSEs) around the world are creating valuable products and services. For the purpose of the ISO/IEC 29110 series, a Very Small Entity (VSE) is an enterprise, an organization, a department or a project having up to 25 people. Since many VSEs develop and/or maintain system and software components used in systems, either as independent products or incorporated in larger systems, recognition of VSEs as suppliers of high quality products is required.

According to the Organization for Economic Co-operation and Development (OECD) SME and Entrepreneurship Outlook 2019 report, 'Small and medium-sized enterprises (SMEs) and entrepreneurship are essential drivers of economic and social well-being. Representing 99 % of all businesses, generating about 60 % of employment and totalling between 50 % and 60 % of value added in the OECD area'. The challenge facing OECD governments is to provide a business environment that supports the competitiveness of this large heterogeneous business population and that promotes a vibrant entrepreneurial culture.

From studies and surveys conducted, it is clear that the majority of International Standards do not address the needs of VSEs. Implementation of and conformance with these standards is difficult, if not impossible. Consequently, VSEs have no, or very limited, ways to be recognized as entities that produce quality systems/system elements, including software in their domain. Therefore, VSEs are excluded from some economic activities.

It has been found that VSEs find it difficult to relate International Standards to their business needs and to justify the effort required to apply standards to their business practices. Most VSEs can neither afford the resources, in terms of number of employees, expertise, budget and time, nor do they see a net benefit in establishing over-complex systems or software life cycle processes. To address some of these difficulties, a set of guides has been developed based on a set of VSE characteristics. The guides are based on subsets of appropriate standards processes, activities, tasks, and outcomes, referred to as profiles. The purpose of a profile is to define a subset of International Standards relevant to the VSEs' context; for example, processes, activities, tasks, and outcomes of ISO/IEC/IEEE 12207 for software; processes, activities, tasks, and outcomes of ISO/IEC/IEEE 15288 for systems; information products (documentation) of ISO/IEC/IEEE 15289 for software and systems.

VSEs can achieve recognition through implementing a profile and by being audited against ISO/IEC 29110 specifications.

The ISO/IEC 29110 series of standards and technical reports can be applied at any phase of system or software development within a life cycle. This series is intended to be used by VSEs that do not have experience or expertise in adapting/tailoring ISO/IEC/IEEE 12207 or ISO/IEC/IEEE 15288 standards to the needs of a specific project. VSEs that have expertise in adapting/tailoring ISO/IEC/IEEE 12207 or ISO/IEC/IEEE 15288 are encouraged to use those standards instead of the ISO/IEC 29110 series.

The ISO/IEC 29110 series is intended to be used with any lifecycle such as waterfall, iterative, incremental, evolutionary or agile.

Systems, in the context of the ISO/IEC 29110 series, are typically composed of hardware and software components.

The ISO/IEC 29110 series, targeted by audience, has been developed to improve system or software and/or service quality, and process performance. See [Table 1](#).

Table 1 — ISO/IEC 29110 target audience

ISO/IEC 29110	Title	Target audience
ISO/IEC/TR 29110-1	Overview	VSEs and their customers, assessors, standards producers, tool vendors and methodology vendors.
ISO/IEC 29110-2	Framework for profile preparation	Profile producers, tool vendors and methodology vendors. Not intended for VSEs.
ISO/IEC 29110-3	Certification and assessment guidance	VSEs and their customers, assessors, accreditation bodies.
ISO/IEC 29110-4	Profile specifications	VSEs, customers, standards producers, tool vendors and methodology vendors.
ISO/IEC/TR 29110-5	Management, engineering and service delivery guides	VSEs and their customers.
ISO/IEC 29110-6	Management and engineering guides not tied to a specific profile	VSEs and their customers.
ISO/IEC/TR 29110-7	Specific profile guidelines	VSEs and their customers.

If a new profile is needed, ISO/IEC 29110-4 and ISO/IEC/TR 29110-5 and ISO/IEC 29110-6 and or ISO/IEC/TR 29110-7 ISO/IEC/TR 29110-5 can be developed with minimal impact to existing documents.

ISO/IEC/TR 29110-1 defines the terms common to the ISO/IEC 29110 series. It introduces processes, lifecycle and standardization concepts, the taxonomy (catalogue) of ISO/IEC 29110 profiles and the ISO/IEC 29110 series. It also introduces the characteristics and needs of a VSE, and clarifies the rationale for specific profiles, documents, standards and guides.

ISO/IEC 29110-2 introduces the concepts for systems and software engineering profiles for VSEs. It establishes the logic behind the definition and application of profiles. For standardized profiles, it specifies the elements common to all profiles (structure, requirements, conformance, assessment). For domain-specific profiles (profiles that are not standardized and developed outside of the ISO process), it provides general guidance adapted from the definition of standardized profiles.

ISO/IEC 29110-3 defines certification schemes, assessment guidelines and compliance requirements for process capability assessment, conformity assessments, and self-assessments for process improvements. ISO/IEC 29110-3 also contains information that can be useful to developers of certification and assessment methods and developers of certification and assessment tools. ISO/IEC 29110-3 is addressed to people who have direct involvement with the assessment process, e.g. the auditor, certification and accreditation bodies and the sponsor of the audit, who need guidance on ensuring that the requirements for performing an audit have been met.

ISO/IEC 29110-4-m provides the specification for all profiles in one profile group that are based on subsets of appropriate standards elements.

ISO/IEC/TR 29110-5-m-n provides management, engineering and service delivery guides for the profiles in a profile group.

ISO/IEC 29110-6-m provides the specification for specific profiles that are based on subsets of appropriate standards elements.

ISO/IEC/TR 29110-7-x provides a guide for each profile in the specific profile group.

This document defines the process assessment guidelines needed to meet the purpose of defined VSE profiles. It is applicable to all VSE profiles and is compatible with ISO/IEC 33002.

Figure 1 describes the ISO/IEC 29110 series of International Standards (IS) and Technical Reports (TR) and positions the parts within the framework of reference. Overview, assessment guide, management and engineering guide are available from ISO as freely available Technical Reports (TR). The Framework document, profile specifications and certification schemes are published as International Standards (IS).

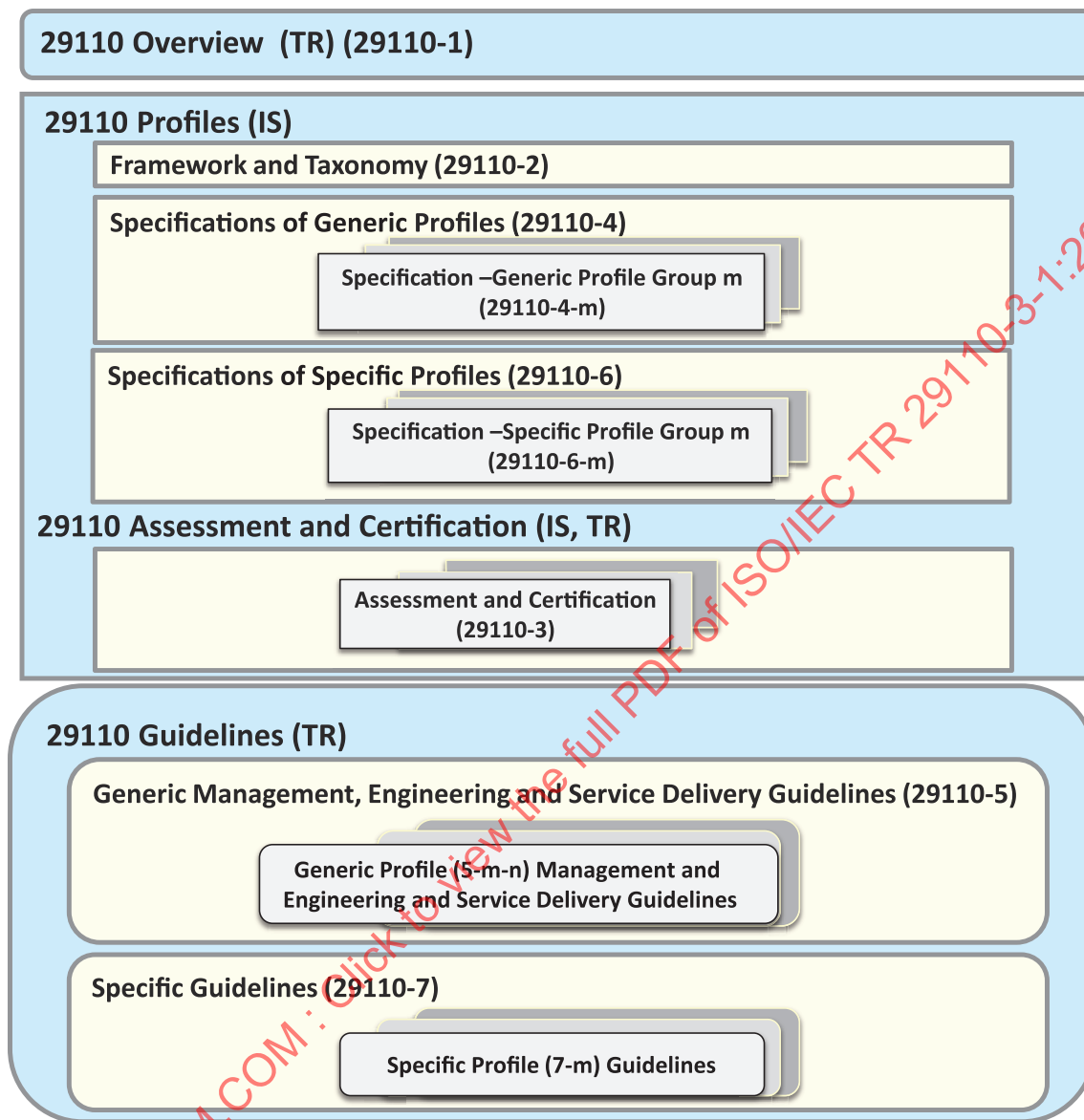


Figure 1 — The ISO/IEC 29110 series

Systems and software engineering — Lifecycle profiles for Very Small Entities (VSEs) —

Part 3-1: Process assessment guidelines

1 Scope

1.1 Fields of application

This document defines the process assessment guidelines needed to meet the purpose of defined VSE profiles. It is applicable to all VSE profiles and is compatible with ISO/IEC 33002.

The possible uses of this document are as follows.

- a) Assessment to evaluate the process capabilities. Use when an organization wants an assessment of profile conformance (basic, etc.) of the implemented processes.
- b) Supplier's capability assessment. Use when a customer asks for a third party to conduct an assessment in order to obtain a profile (basic, etc.) of the implemented process by the system or software development and maintenance supplier.

1.2 Target audience

The target audience of this document is primarily those who perform or have direct relationship with process assessments of VSEs. This document also contains information that can be useful to developers of assessment methods and assessment tools and those requiring additional guidance on the assessment process.

This document is addressed to people who have a direct relation with the assessment process based on the VSE profiles (e.g. the assessors and the sponsor of the assessment) who need guidance on ensuring that the requirements for performing an assessment have been met.

It is intended that ISO/IEC/TR 29110-1 be read first when initially exploring VSE profile documents.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC/TR 29110-1, *Systems and software engineering — Lifecycle profiles for Very Small Entities (VSEs) — Part 1: Overview*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC/TR 29110-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <http://www.iso.org/obp>

— IEC Electropedia: available at <http://www.electropedia.org/>

NOTE In the ISO/IEC 29110 series, to minimize confusion about the term 'basic' that is used to mean different ideas, the term 'Basic' with a capital B is used to refer to the Basic profile while the term 'basic' is used to mean forming an essential foundation or starting point (e.g. basic types of work products).

3.1

process profile

set of process attribute ratings for an assessed process

Note 1 to entry: Within the ISO/IEC 29110 series, a profile is defined as "set of one or more base standards and/or profiles and, where applicable, the identification of chosen classes, conforming subsets, option and parameters of those base standard, or standardized profiles necessary to accomplish a particular function" (ISO/IEC/TR 10000-1).

Note 2 to entry: When used unqualified in this document, this is the applicable definition.

[SOURCE: ISO/IEC 33001:2015, 3.2.18, modified — Note 1 to entry and Note 2 to entry have been added.]

3.2

process quality

ability of a process to satisfy stated and implied stakeholder needs when used in a specified context

[SOURCE: ISO/IEC 33001:2015, 3.4.8]

3.3

process quality level

representation of the achieved level of a *process quality* (3.2) characteristic derived from the process attribute ratings for an assessed process

[SOURCE: ISO/IEC 33001:2015, 3.4.10, modified — "point on a scale of achievement" has been replaced with "representation of the achieved level".]

3.4

target process profile

process profile (3.1) specifying which process attributes are required and the rating necessary for each process attribute for a required process

[SOURCE: ISO/IEC 33001:2015, 3.2.20]

4 Abbreviated terms

BP	base practice
OM	organizational management
PA	process attributes
PAM	process assessment model
PMP	process management process
PPM	project portfolio management
PRM	process reference model
RM	resource management
VSE	Very Small Entity

5 Process assessment framework

These guidelines apply to VSE process assessments. The assessment, as defined in this document, has two purposes:

- To evaluate the process capability based on a two-dimensional assessment model containing a process dimension and the process quality dimension. The process dimension refers to the processes defined in each VSE profile which are provided by an external process reference model (PRM). The process quality dimension consists of a Process measurement framework comprising process quality levels, their associated process attributes, and the rating scale.
- To evaluate whether an organization fulfils the targeted VSE profile based on the evaluated capabilities for the processes.

For an official recognition, the conformity assessments should be carried out following a process assessment process satisfying the requirements of ISO/IEC 33002 and described in [Clause 6](#). For self-assessments emphasizing identification of process improvements, other approaches can be applied (additional information can be found in other parts of ISO/IEC 29110 specifically dedicated to self-assessment).

According to ISO/IEC 33001, a process assessment is “a disciplined evaluation of an organizational unit’s processes against a process assessment model (PAM)”. In this context, the process assessment model consists of a subset of process purposes and outcomes of a process reference model, and the process attributes, quality levels and rating scale that are defined in the correspondent process assessment model. A process reference model is, for instance, ISO/IEC/IEEE 12207 and the applicable subset is defined in a Specification of a VSE profile, for instance, ISO/IEC 29110-4-1. The applied process assessment model, always conformant to ISO/IEC 33002, has as its result represented as a set of process attribute ratings, i.e. a process profile. [Figure 2](#) illustrates the relevant documents and data for a process applicable to VSE process assessment.

ISO/IEC 33002 sets out the minimum requirements for performing a process assessment that ensure consistency and repeatability of the ratings. The requirements help to ensure that the process assessment output is self-consistent and provides evidence to substantiate the ratings and to verify conformance with the requirements.

Self-assessments are typically performed to identify process improvement opportunities or to check current status of the organization’s performance. Self-assessments in VSEs are outside the scope of this document.

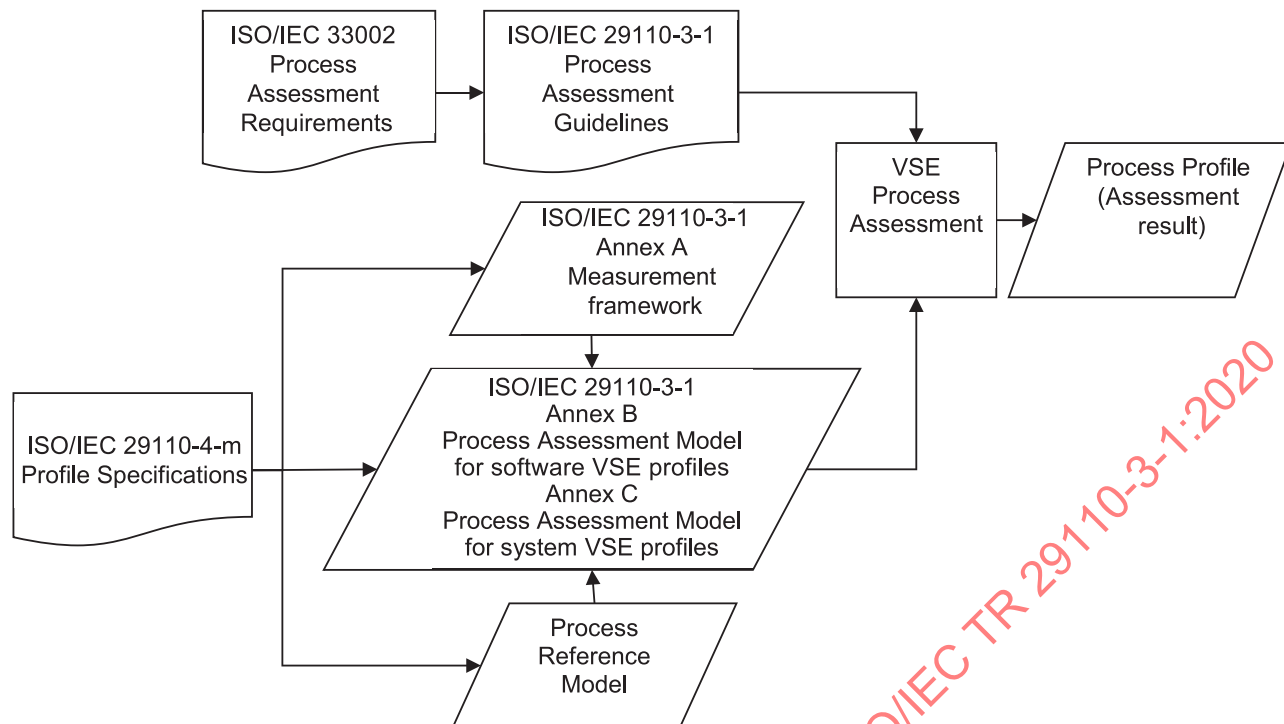


Figure 2 — Elements of VSE process assessment

6 VSE process assessment

6.1 Performing an assessment

6.1.1 General

In performing a process assessment based on the ISO/IEC 29110 series, the requirements expressed in ISO/IEC 33002 are intended to be satisfied in full. This clause provides additional guidance related specifically to the process assessment in VSEs.

A process assessment is conducted according to a documented process that is capable of meeting the process assessment purpose. The key elements of a documented assessment process are closely tied to the requirements for performing an assessment, defined in ISO/IEC 33002. The documented assessment process is the set of instructions for conducting the process assessment. A documented assessment process addresses the following aspects of the conduct of a process assessment:

- incorporate as a minimum, the tasks defined in ISO/IEC 33002;
- identify the classes of process assessment for which the documented assessment process can be applied and the nature and extent of tailoring associated with each class addressed by the documented process;
- define the criteria for ensuring coverage for both the defined organizational scope and the defined process scope for the assessment, in terms of the strategy for collecting and analysing data;
- identify or define the approach to be taken in performing the generation of process attribute ratings, including (where applicable) the aggregation of observations and/or characterisations across the elements of the assessment.

6.1.2 Assessment inputs

Process assessment inputs as specified in ISO/IEC 33002:2015, 4.4 are to be defined. In conducting process assessments of VSEs based on ISO/IEC 29110-4-1, the following issues are expected.

- The process scope of the process assessment [ISO/IEC 33002:2015, 4.4 (d) (1, 2)] should be determined by the target VSE profile specified for the process assessment.
- The organizational scope of the process assessment [ISO/IEC 33002:2015, 4.4 (d) (3)] should typically be the entire VSE; however, where the VSE deploys a small number of clearly distinct projects or functions, the scope can be limited to a single project or function.
- In defining the process assessment context [ISO/IEC 33002:2015, 4.4 (d) (4)], the process assessment plan should take into account the VSE business and engineering context and be affordable for a VSE.
- In defining the process assessment constraints [ISO/IEC 33002:2015, 4.4 (g)], the specific nature of the VSE should be explored to establish constraints on availability of resources or data that might affect the reliability of the process assessment.

6.1.3 Roles and responsibilities

Typically, the process assessment team for VSE process assessment process consists of at least one lead assessor or a lead assessor with other assessors. The assessors should be familiar with the VSE characteristics.

6.1.4 The assessment process

The activities to be performed will be determined by the chosen documented assessment process tailored as necessary. The documented process for the process assessment of a VSE should address all of the required activities defined in ISO/IEC 33002:2015, 4.2.

Specific concerns of relevance to process assessment of VSEs include the following.

a) Plan the assessment

Typically, the schedule for process assessment of a VSE will need to take account of the availability of key resources. The level of resources required for the process assessment should be determined according to the resources available to the VSE.

b) Collect the data

The strategy for data collection should take account of the nature of the work performed within the VSE and of the nature of the items of objective evidence that will typically be available. Often, process assessments in VSEs rely heavily on testimony from performers of the processes; however, to the best extent possible, the assessors should endeavour to obtain other supporting objective evidence drawn from the VSE work products.

c) Validate the data

The key issue in data validation in process assessment of a VSE is ensuring that the data collected is representative of the normal operations of the enterprise.

d) Derive results

In conducting process attribute rating, the assessors should focus on the extent to which the evidence obtained addresses the processes and process attributes being rated. The requirement for traceability between the rating and the evidence employed [ISO/IEC 33002:2015, 4.2.1 e) 1)] is relevant here.

e) Report the assessment

The assessors should ensure that the report to the sponsor of the process assessment covers the full scope of the VSE profile employed in the process assessment.

6.2 Use of the assessment results

The process assessment results can be used to:

- a) evaluate the process quality levels of an organization;
- b) determine the improvement opportunities, in order to enhance the organization's ability to meet its business goals by improving efficiency and quality of its products and services. The findings can be used as a base to perform the improvement plan;
- c) benchmark the process quality levels with other organizations in the market;
- d) select a supplier based on the supplier's quality level assessment.

6.3 Achievement of a VSE profile

This subclause provides guidance on how to determine whether an organization fulfils a VSE profile. The determination is based on the evaluated quality levels for the processes within each VSE profile. ISO/IEC 29110-4-1 defines the conformance requirements.

The requirements for the VSE profiles are defined in ISO/IEC 29110-4-1. The corresponding quality levels to be evaluated for each VSE profile can be derived from the respective parts of ISO/IEC 29110-4-1. At minimum, all mandatory elements of the VSE profile, as defined in ISO/IEC 29110-4-1, are the ones to be considered in the process assessment.

For example, the achievement of the software Basic profile, implies that the assessed processes achieve quality level one as defined in [Annex A](#). This means that the implemented process achieves its process purpose and its defined outcomes. For example, for the Generic Basic profile for software, the applicable process purposes are documented in ISO/IEC 29110-4-1 (process reference model for the Basic profile):

- Project management process;
- Software implementation process.

NOTE Process reference models are now to be contained in ISO/IEC 29110-4-1.

The related outcomes of the process reference model are documented in [Annex A](#) (supported by ISO/IEC/TR 29110-5-1-2 under the process-specific objectives). A detailed mapping of the VSE profile process elements to ISO/IEC/IEEE 15288, ISO/IEC/IEEE 12207, and other base standards are provided in ISO/IEC 29110-4-1.

6.4 Application of process assessment models

Use of ISO/IEC 33004 compliant process assessment model (PAM) ensures that the process assessment results are comparable, reliable, and repeatable. The assessor should confirm that the applied PAM is suitable for assessing the process capability in the context of VSEs.

The applied PAM should have a set of indicators that address the process purpose and outcomes, and demonstrate the achievement of the required capability level.

ISO/IEC 29110-4-1 Specifications for VSE profiles document a detailed mapping of process elements between ISO/IEC 29110-5-m-n and the process reference model in of ISO/IEC 29110-4-1, respectively.

A VSE-specific PAM can be derived by selecting those process assessment indicators relevant to the corresponding process outcomes defined in ISO/IEC 29110-4-1.

Two exemplars of PAMs are provided in [Annex B](#) and [Annex C](#), respectively.

[Annex A](#) presents two main process assessment aspects for the assessment of VSE software related processes: a) the measurement framework, and b) the principles of VSE maturity model (i.e. VSE profiles achievement rules).

[Annex B](#) presents the software process assessment model for the assessment of the processes of Software development VSEs, as defined in ISO/IEC 29110-4-1 and ISO/IEC 29110-5-2-1 (Basic profile processes for software and the organizational profile processes respectively). It also details the VSE maturity model specific for the software development VSEs.

[Annex C](#) presents the same two process assessment aspects as in [Annex B](#) but for the assessment of VSE system related processes

Each main aspect above is accompanied by their compliancy verification section towards their applicable requirements defined in ISO/IEC 330xx standards, respectively within each annex.

Annex A **(informative)**

Measurement framework for the assessment of process capability and VSE profiles

NOTE The statements using the verbal form "shall" in this annex are copied from the applicable standards and do not constitute requirements of this document.

A.1 Structure of the annex and overview

This annex provides the measurement framework for the evaluation of the process quality attributes of the processes defined in the ISO/IEC 29110 series for VSEs.

This annex sets out the measurement framework that may be used in the assessment of process capability and VSE profiles for Very Small Entities developing software. The requirements for process capability and VSE profile scales defined in this annex form a structure which:

- a) facilitates self-assessment;
- b) provides a basis for use in process improvement and capability determination;
- c) takes into account the context in which the assessed process is implemented;
- d) produces a process capability scale;
- e) is applicable across all application domains and mainly for a VSE;
- f) may provide an objective benchmark between organizations.

The capability of a process to perform at a specific level of performance depends on well established principles. [A.2](#) sets out those principles that are common to all domains. The process capability measurement framework described in this annex is expressed in terms of a set of process attributes. Each process attribute is defined in terms of a set of process attribute outcomes which can be evaluated to indicate the extent of achievement of the process attribute. The process attributes are organized into process capability levels, ranging from Incomplete (in which the process does not achieve its defined process outcomes) to Aligned (in which the process implemented aligned to the organizational business goals as well as ensuring customer satisfaction).

The result of an assessment, using a process assessment model that incorporates this process measurement framework, will be a set of process profiles, ratings of the achievement of the set of process attributes for each process in the scope of the assessment. The result can also be expressed in terms of the capability level ratings achieved for each process in the assessment scope. A capability level rating does not guarantee that an organization will perform its processes at any given process capability level, simply that it is capable of performing its processes at that level, at the time of the assessment.

This annex also presents the main concepts for VSE profiles, maturity levels within the ISO/IEC 29110 profiles for VSE.

A.2 Measurement framework for the assessment of process capability for processes for VSEs

A.2.1 General

This subclause defines a measurement framework for the assessment of process capability. The measurement framework provides a schema for use in characterizing the capability of an implemented process with respect to a process assessment model.

Within this process measurement framework, the measure of capability is based upon a set of process attributes (PA). Each attribute defines a measurable property of process capability. The extent of process attribute achievement is characterised on a defined rating scale. The process capability level for an assessed process is derived from the set of process attribute ratings represented in the process profile.

Process attributes are defined in such a way that they can be rated independently of one another; there can be other relationships between them, e.g. the achievement of one process attribute may be associated with the achievement of another process attribute within the process measurement framework.

A.2.2 Process capability levels and process attributes

Process capability is defined on a four point ordinal scale that enables capability to be assessed from the bottom of the scale, Incomplete, through to the top end of the scale, Aligned. The scale represents increasing capability of the implemented process, from failing to achieve the process purpose through to aligning to the organizational business goals as well as ensuring customer satisfaction.

Table A.1 — Capability levels and process attributes

Capability levels	Process attribute ID
Level 0: Incomplete process	
Level ALPHA: Performed process	PA.1 Process performance
Level BETA: Articulated Process	PA.2 Management of resources
	PA.3 Defined process
Level GAMMA: Aligned Process	PA.4 Process alignment

a) Level 0: Incomplete process

The process is not implemented or fails to achieve its process purpose.

At this level, there is little or no evidence of any systematic achievement of the process purpose.

b) Level ALPHA: Performed process

The implemented process achieves its process purpose. The following attribute of the process demonstrates the achievement of this level:

PA.1 Process performance attribute

The process performance attribute is a measure of the extent to which the process purpose is achieved. As a result of full achievement of this attribute, the process achieves its defined outcomes.

c) Level BETA: Articulated process

The previously described Performed process is now implemented in a managed fashion (resources managed) and it follows a monitored defined process.

The following attributes of the process, together with the previously defined attribute, demonstrate the achievement of this level:

1) **PA.2 Management of resources attribute**

The management of resources attribute is a measure of the extent to which the organizational resources are used for the performance of the process. As a result of full achievement of this attribute:

- performance of the process is planned and monitored;
- resource needs for the performance of the process are identified;
- responsibilities and authorities for performing the process are assigned and communicated;
- resources and information necessary for performing the process are made available, allocated and used;
- interfaces between the involved parties are managed to ensure both effective communication and clear assignment of responsibility.

2) **PA.3 Defined process attribute**

The defined process attribute is a measure of the extent to which the organizational process is defined and used for the performance of the process. As a result of full achievement of this attribute:

- a standard process, including appropriate tailoring guidelines, is defined that describes the fundamental elements that must be incorporated into a defined process, including competencies and roles and infrastructure;
- the defined process is deployed based upon an appropriately selected and/or tailored standard process, including the use of the standard competencies and roles and infrastructure;
- suitable methods for monitoring the effectiveness and suitability of the process are determined;
- appropriate data are collected and analyzed as a basis for understanding the behaviour of and to demonstrate the suitability and effectiveness of the process, and to evaluate how the process is performed and where continuous improvement of the process can be made.

d) **Level GAMMA: Aligned process**

The previously described Articulated process is now implemented aligned to the organizational business goals, as well as ensuring customer satisfaction.

The following attributes of the process, together with the previously defined attribute, demonstrate the achievement of this level:

PA.4 Process alignment attribute

The process alignment attribute is a measure of the extent to which the process is maintained aligned to the organization business objectives. As a result of full achievement of this attribute:

- process information needs and objectives (quantitative and qualitative) in support of relevant business goals are established;
- results of measurement are collected, analyzed and reported in order to monitor the extent to which the quantitative objectives for process performance are met;
- corrective actions are taken to address deviations from objectives defined.

A.2.3 Process attribute rating scale

Within this process measurement framework, a process attribute is a measureable property of process capability. A process attribute rating is a judgement of the degree of achievement of the process attribute for the assessed process.

A process attribute is measured using an ordinal scale as defined below.

— N Not achieved:

There is little or no evidence of achievement of the defined process attribute in the assessed process.

— P Partially achieved:

There is some evidence of an approach to, and some achievement of, the defined process attribute in the assessed process. Some aspects of achievement of the process attribute may be unpredictable.

— L Largely achieved:

There is evidence of a systematic approach to, and significant achievement of, the defined process attribute in the assessed process. Some weaknesses related to this process attribute may exist in the assessed process.

— C Completely achieved:

There is evidence of a complete and systematic approach to, and full achievement of, the defined process attribute in the assessed process. No significant weaknesses related to this process attribute exist in the assessed process.

The ordinal scale defined above is represented in terms of percentage achievement of a process attribute.

The corresponding percentages are:

N	Not achieved	0 % to ≤15 % achievement
P	Partially achieved	>15 % to ≤50 % achievement
L	Largely achieved	>50 % to ≤90 % achievement
C	Completely achieved	>90 % to ≤100 % achievement

A.2.4 Process attribute rating method

A process outcome is the observable result of successful achievement of the process purpose.

A process attribute outcome is the observable result of achievement of a specified process attribute.

Process outcomes and process attribute outcomes may be characterised as an intermediate step to providing a process attribute rating.

When performing rating, the rating method employed being relevant to the class of assessment, that for VSE process assessments is of R3 (as defined in ISO/IEC 33020), where the process attribute rating across assessed process instances are made without aggregation.

A.2.5 Process capability level model

The process capability level achieved by a process is derived from the process attribute ratings for that process according to the process capability level model defined in [Table A.2](#).

Table A.2 — Process capability level ratings

Scale	Process attributes	Rating
Level ALPHA	PA 1 Process performance	Completely
Level BETA	PA 1 Process performance	Completely
	PA.2 Management of resources	Completely
	PA.3 Defined process	Completely
Level GAMMA	PA 1 Process performance	Completely
	PA.2 Resource management	Completely
	PA.3 Defined process	Completely
	PA.4 Process alignment	Completely

A.3 Measurement framework for VSE profiles

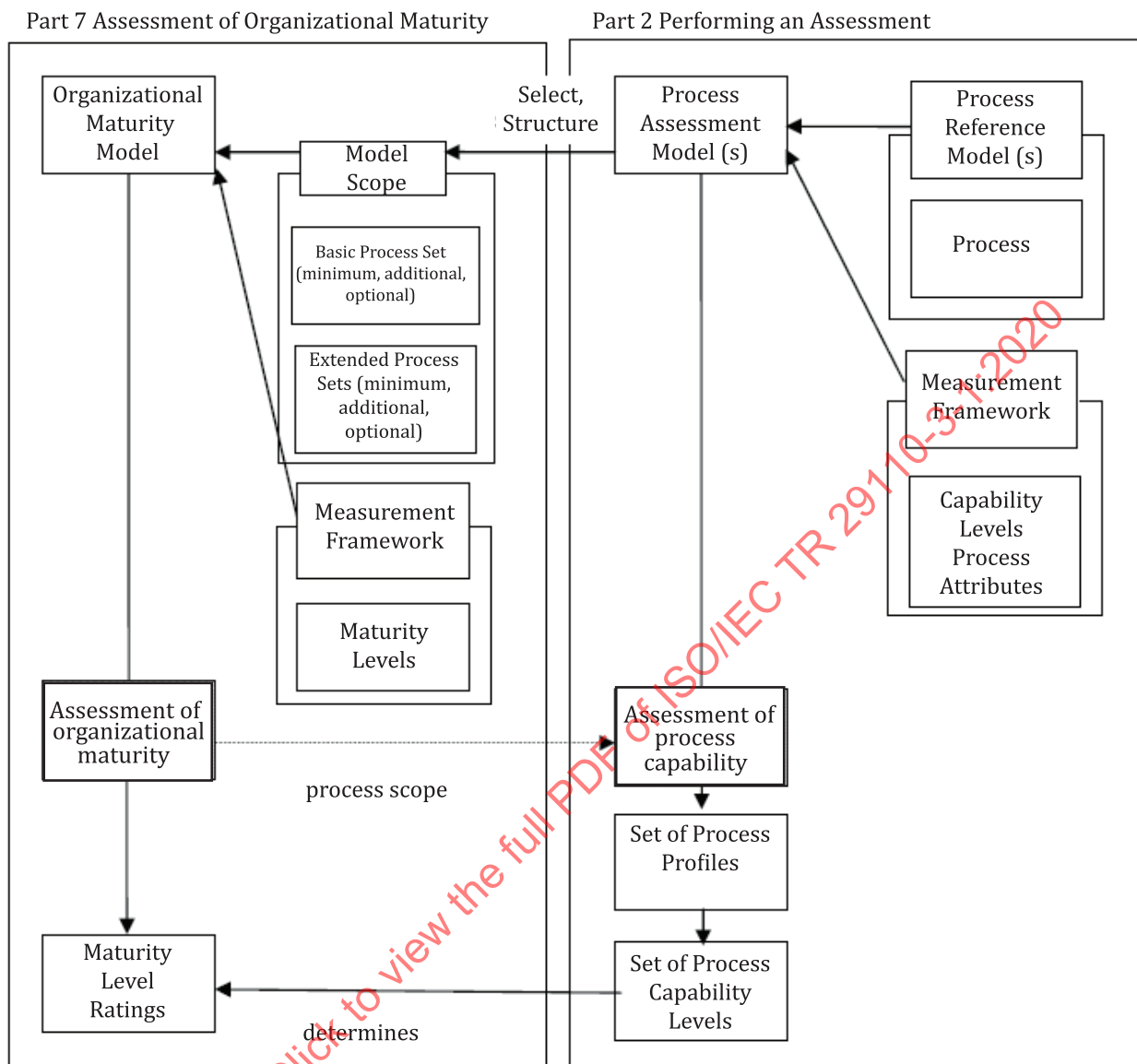
A.3.1 General

This clause defines a measurement framework for the assessment of VSE profiles, i.e. VSE maturity levels. VSE profiles are measured on a three point ordinal scale: from the Low profile, the Immature Organization through to the highest one, the Organizational profile. The scale represents the extent to which the organization has explicitly and consistently performed its basic key processes.

The scale for VSE profiles retains the semantic intent of the process capability levels that are defined in [A.2.2](#). The framework for process capability characterises the ability of a process to meet current or projected business goals; the framework of VSE organizational profile characterises the extent to which an organization consistently implements sets of processes within a defined scope. Thus, the two frameworks, while consistent, characterise different attributes of separate entities: the process and the organization. The measurement framework provides a schema for use in characterising the profile of an organization with respect to a specified process assessment model.

Within this measurement framework, each level of VSE profile is characterised by the demonstration of achievement of specified levels of process capability in process sets drawn from the specified process assessment model(s) (see [A.3](#)).

Processes in ISO/IEC 29110-4-1 can be categorized into one set based on its contributions to the business goals of the organization. The set of fundamental processes that support the primary activities of the organization is called the basic process set. Each VSE profile Level beyond level Basic is characterized by the implementation, at an appropriate level of process capability, of a further set of processes that drive the achievement of the capabilities relevant to each profile level. These are called extended process sets.



NOTE Amended from ISO/IEC/TR 15504-7:2008, Figure 1.

Figure A.1 — Relationship between assessment of process capability and derivation of VSE profiles

Figure A.1 above shows the relationship between the VSE profile model and the specified process assessment model(s) when an assessment of the organizational profile is conducted. The key elements are the defined components of the relevant process reference models and the measurement frameworks, shown in the figure as nested boxes. These components are used to construct models supporting the assessment of process capability and VSE profile. The definition of the VSE profile model scope and the selection of the basic and extended process sets are made in the context of the VSE profile model. Once the assessment has been planned employing a VSE profile model based upon one or more conformant process assessment models, the assessment is performed using the specified process assessment model(s) to obtain the set of process profiles. The process capability levels, derived from the process profiles, are then transformed into a VSE profile level rating according to the rules for deriving profile levels from capability levels.

A VSE profile is expressed on a scale from profile level 0 (Immature Organization) through Organizational profile level aligned as follows.

a) Level Immature Organization

The organization does not demonstrate effective implementation of its processes that are fundamental to support the organization's primary activities

At least one process in the basic process set is assessed at capability level 0.

b) Level Basic profile

The basic organizational profile is the implementation of one project, performing the processes identified as belonging to the Basic profile at level ALPHA. The organization demonstrates achievement of the purpose of the processes that are fundamental to support the organization's primary activities.

As a result of achieving this level, the organization:

- 1) implements the processes required to support the organization's primary activities;
- 2) performs sets of activities and tasks that achieve the purposes of these processes.

All processes in the basic process set are assessed at capability level ALPHA or higher.

c) Level Organizational profile

The previously described Basic profile is now implementing organizational processes. All Basic profile processes should be performed to GAMMA level (influenced by the management of multi-projects, aligned to the company objectives and towards customer satisfaction), plus all processes belonging to the organizational profile should be performed at capability level BETA or higher.

A.3.2 Rules for deriving VSE profiles from capability levels

Based on the measurement framework for assessment of process capability and process profiles for Very Small Entities (VSEs) defined in [A.2](#), the rating of an VSE profile is derived from a set of process profiles in the following manner.

- a) An assessment of process capability, compliant to the requirements of ISO/IEC 33002 and meeting the requirements of ISO/IEC 33004, is conducted.
- b) The process scope of the assessment embraces all of the processes in the basic process sets defined in the selected Organizational profile model.
- c) All process attributes up to and including the highest relevant capability level are rated for all processes in the scope of the assessment.
- d) Process capability level ratings are derived for all processes in the scope of the assessment.
- e) The profile level achieved by an organization are derived from the process capability level ratings according to the specific rules identified for each specific process assessment model (see [Annex B](#) and [Annex C](#))

A.4 Conformity verifications

A.4.1 Conformity verification of the measurement framework (defined in A.2)

This subclause presents how the measurement framework defined in A.2 fulfils all requirements for a process measurement framework (defined in ISO/IEC 33003). Where text has been quoted from ISO/IEC 33003:2015, that text is enclosed in a box, for ease of identification.

4.1 Conceptualization

A process capability level is characterised by one or more process attributes, which are formative measures of the process capability. Process attributes are required in order to construct the process capability. Process attributes are demonstrated by achievement of the process attribute outcomes, which are reflective measures. See Figure A.2.

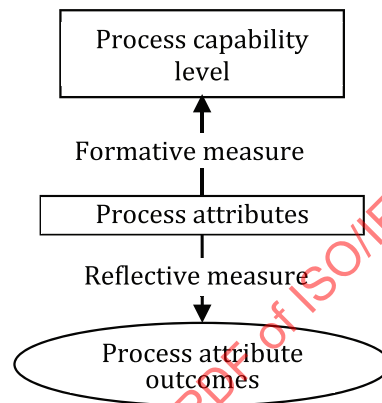


Figure A.2 — Formative and reflective measures of process capability (as per ISO/IEC 33003)

The concept of process capability does not provide a measure of anything other than process capability formed by process attributes. For example, process capability does not infer anything about organizational performance.

4.1.1 Requirements

a) A process measurement framework shall identify and address a single process quality characteristic;

The measurement framework is defined for the single process quality characteristic of software quality.

b) A process quality characteristic in a process measurement framework shall be defined on the basis of a multidimensional construct;

The process measurement framework is a construct comprised of four process attributes.

c) A process quality characteristic in a process measurement framework shall be defined as a set of process attributes;

The process measurement framework is a construct comprised of four process attribute.

d) Each process attribute shall define a property of the process quality characteristic;

The property defined by each process attribute is described in A.2.2.

e) Each process attribute that is not directly measurable shall be considered as a construct;

Each process attribute in this measurement framework is a construct and defined in this annex.

- f) Process attributes in a process measurement framework shall be defined as either reflective or formative

The process attributes of this measurement framework are formative.

- g) The process measurement framework shall document the policies and assumptions underlying its use and application;

The policies and assumptions underlying the use and application of this process measurement framework are set out in this annex.

4.2 Construct definition

4.2.1 Requirements

- a) The construct definition shall define the meaning of the process quality characteristic and its process attributes in a process measurement framework;

The meaning of the process quality characteristic and its process attributes are given in [A.2](#).

- b) The construct definition shall clarify the specification of the process quality characteristic and its process attributes as dimensions;

The specifications of the process quality characteristic and its process attributes are given in [A.2](#).

- c) The construct definition shall provide a guide for the operationalization of the process quality characteristic and its process attributes;

Operationalization of the process quality characteristic and its process attributes is given in [A.2](#).

- d) The construct definition shall state the scales of composite measures such as categorical (e.g. a series of ordinal values such as capability level) or numeric;

The scales of composite measures in this measurement framework are given in [A.2](#).

- e) At least one of the process attributes shall comprise the achievement of the defined process purpose and process outcomes for the process; this is termed the process performance attribute;

The process performance attribute (PA.1) comprises the achievement of the defined process purpose through achievement of the process outcomes for that process.

4.3 Operationalization

4.3.1 Requirements

- a) All process attributes shall be defined according to their construct specification;

The process attributes are defined in [A.2.1](#); the descriptions follow a common approach, described in [A.2](#).

- b) Achievement of process attributes shall be verifiable through objective evidence.

In the process performance attribute, the achievement of process outcomes is demonstrable based on objective evidence.

4.4 Construct specification examination

4.4.1 Requirements

Construct specifications of the process quality characteristic and its associated process attributes shall be examined through operationalization and with rationale.

Each process attribute is operationalized through a set of base or derived measures depending on the class of assessment. See [A.2.3](#) and [A.2.4](#).

4.5 Rating process attributes

4.5.1 Requirements

a) The process attributes shall be scored;

The unit of measurement is specified in [A.2.2](#).

b) A measurement scale, i.e., nominal, ordinal, interval, or ratio, shall be defined for the process attributes

The measurement scale for base measures are ordinal, defined in [A.2.2](#).

c) A measurement method shall be identified that objectively assigns value to each measure.

The method for assigning a value to the measure of process capability is described in [A.2.4](#).

4.6 Aggregation

4.6.1 Requirements

a) All aggregations required within the measurement framework shall be identified;

Aggregation methods are defined in [A.2.3](#).

b) Aggregation methods shall be specified

Aggregation methods are defined in [A.2.3](#).

c) Aggregation methods shall be statistically valid.

Rationales for the validity of aggregation methods in this international standard are given in [A.2.3](#).

b) Aggregation methods shall utilize consistent measurement scales

Aggregation methods are defined in [A.2.3](#).

c) Aggregation methods shall be consistent with the measurement framework policies and assumptions;

d) Aggregation methods shall be consistent with construct specifications.

Consistency with policies and assumptions, and with the construct specifications is described in [A.2.3](#).

4.7 Sensitivity analysis

4.7.1 Requirements

a) Sensitivity analysis shall be performed for measurement scales of base and derived measures.

Sensitivity of the process capability scale was tested during the SPICE trials^{[9][10]}, as well as the Moprosoft experiences. The investigations included inter-rater agreement and internal consistency, both of which were found to be acceptable. The possibility of increasing internal consistency was investigated by varying the four category scale to a three or two category scale by combining either the middle two ratings [N, (P, L), C] or the outer two ratings [(N, P), (L, C)]. The current four category scale cannot be improved by reduction to a three or two category scale.

Sensitivity of process capability level ratings was investigated during the SPICE trials and reported in the interim report^[11], as well as in the Moprosoft trials. Overall, the investigation concluded that distortion downward of the capability level rating had greater effect than distortion upwards, but that guidance should be provided to assessors concerning the potential effects of distortion.

b) Sensitivity analysis shall be performed for aggregation methods

Some sensitivity analysis data related to aggregation is available in Reference ^[11]; however, its relevance to the current approach is limited. The issue of aggregation was examined in detail during the development of the International Standard.

c) Sensitivity analysis shall be performed for weights, if applicable.

Weights are not used in this measurement framework so are not applicable.

5 Requirements for the validation of process measurement frameworks

5.1 Requirements

- a) Plans for reliability and validity of process measurement frameworks shall be established at the beginning of standardization. These plans shall include post-standardization activities.
- b) Claims on reliability and validity of process measurement frameworks shall be consistent with construct specification.
- c) Consistency (also refers to equivalence) as a reliability measure shall be examined for process attributes, if reflective.
- d) Validities shall be examined for the process quality characteristic and its process attributes in a process measurement framework.
- e) Construct specification shall be empirically examined for the process quality characteristic and its measures in a process measurement framework.
- f) External measures (e.g. goals, criteria, and/or achievements) of a process measurement framework under development shall be documented for validity investigation.

Post hoc statistical analysis has been performed to validate process measurement frameworks. Validation has been performed during the SPICE trials conducted during standard development.

The measurement method and capability scale were tested during the SPICE trials. There has been no change to the concepts of the measurement scale that would invalidate the process capability scale or the findings of the trial.

When data is available during trials and/or after the publication of a framework, rigorous statistical analyses will be required for all the applicable requirements.

The results of such analyses are documented in References ^[9], ^[10] and ^[11].

A.4.2 Conformity of the requirements for a VSE profile or maturity model for VSEs (defined in A.3)

This subclause verifies how the defined VSE profiles or maturity model (defined in A.3 complemented by what is defined in B.5 and C.5 for software and system concrete process assessment models, respectively) meets the requirements for conformance defined in ISO/IEC 33004. The Organizational

Profile or maturity model can be used in the performance of assessments that meet the requirements of ISO/IEC 33002. It may also be used as a guide for an Organizational Profile or maturity model developer.

For ease of reference, the requirements from ISO/IEC 33004 are embedded verbatim in the text of this clause. Where text has been quoted from ISO/IEC 33004:2015, that text is enclosed in a box, for ease of identification. They should not be construed as normative elements of this annex.

This VSE profile or maturity model has been explicitly constructed to be an elaboration of the process assessment model defined in [Annex B](#). The conformance claim is relatively simple. For other models, particularly ones with a different architecture, the demonstration of conformance may be more difficult.

7.3.1 A maturity model shall document the community of interest of the maturity model and the actions taken to achieve consensus within that community of interest:

- a) the relevant community of interest shall be characterized or specified;
- b) the extent of achievement of consensus shall be documented;
- c) if no actions taken to achieve consensus, a statement to this effect shall be documented.

The Organizational maturity model is designed for the specific domain of the software industry, specific for VSE organizations; as process includes approaches designed to achieve consensus within the community of interest.

7.3.2 The maturity model shall define:

- a) a declaration of scope of application;
- b) its use with respect to a process quality characteristic associated with business success in the domain of application.

In [A.1](#), the scope of application and its use are declared.

7.3.3 A maturity model shall be based upon one or more specified process assessment models that utilize a common process measurement framework for the specified process quality characteristic.

The VSE maturity model is based upon [A.3](#) and the process assessment model for software processes for VSEs defined in [B.5](#) and for systems defined in [C.5](#). Conformance of the process assessment models are demonstrated in [Annex B](#) and [Annex C](#).

The VSE maturity model contains all processes contained in ISO/IEC 29110-4-1 (rules in [Annex B](#)) and all processes contained in ISO/IEC/TR 29110-5-6-2 (rules in [Annex C](#)). These are assigned to basic process sets.

The VSE maturity model addresses all of the maturity levels defined in the measurement framework in [A.3](#).

7.3.4 Scale of organizational process maturity

A maturity model shall define an ordinal scale for organisational process maturity.

A maturity model shall specify a maturity level for each point on the ordinal scale.

A maturity model shall specify a continuous set of maturity levels, representing increasing levels of organizational process maturity, starting at the basic maturity level.

A maturity level shall be defined with a unique identification and description.

A maturity level shall be characterised by the demonstration of achievement of a set of process profile(s).

In [A.3](#), the maturity levels are declared.

7.3.5 Process descriptions

A set of processes from the specified process assessment model(s), which represent operations seen as essential for achievement for the specified level of maturity, shall be selected and assigned to each maturity level in the maturity model.

Basic process set

A set of processes shall be selected from the specified process assessment model(s) that represent operations seen as essential for business success in the domain. This set of processes shall be termed the basic process set for the maturity model.

The basic maturity level (maturity level 1) shall be represented by achievement of the process performance attribute for all processes in the basic process set.

Extended process sets

Sets of processes shall be selected from the specified process assessment model(s) for all levels above the basic level in the maturity model that represent operations seen as essential for achievement for the specified level of maturity. These shall be termed the extended process sets for the maturity model.

Additional processes

A basic or extended process set may include additional processes that:

- are required for assessments with a particular scope of application; and
- are optional depending on the particular circumstances of the organization.

A maturity model shall include specifications of the particular circumstances for inclusion of any additional processes in the basic and extended process sets.

In [A.3](#), the process set is defined and its use are declared. The processes drawn from ISO/IEC 29110-4-1 that constitute the basic process set are listed in [Annex B](#) and [Annex C](#) for the specific PAMs, along with their status and the conditions under which they are to be applied. No extended process set is defined for this measurement framework.

7.3.6 Rules for deriving maturity level from process quality level

The basic maturity level shall be represented by achievement of the process performance attribute for all processes in the basic process set.

A maturity model shall define the rules for deriving an organizational process maturity level rating from the set of process profiles that result from an assessment.

In [A.3](#), the rules for deriving maturity level from process quality level are defined.

Annex B (informative)

Exemplar software life cycle process assessment model for Very Small Entities

NOTE The statements using the verbal form "shall" in this annex are copied from the applicable standards and do not constitute requirements of this document.

B.1 Structure of the process assessment model

This annex:

- defines a process assessment model that meets the requirements of ISO/IEC 33004 and that supports the performance of an assessment by providing indicators for guidance on the interpretation of the process purposes and outcomes as defined in ISO/IEC 29110-4-1 (processes included in the Basic profile for Very Small Entities for software) and the process attributes as defined in [Annex A](#) (our MF);
- provides guidance, by example, on the definition and use of assessment indicators.

The process assessment model is a two-dimensional model of process capability. In one dimension, the process dimension, the processes are defined in ISO/IEC 29110-4-1 (the PRM). In the other dimension, the capability dimension, a set of process attributes grouped into capability levels is defined. See [Figure B.1](#). The process attributes provide the measurable characteristics of process capability.

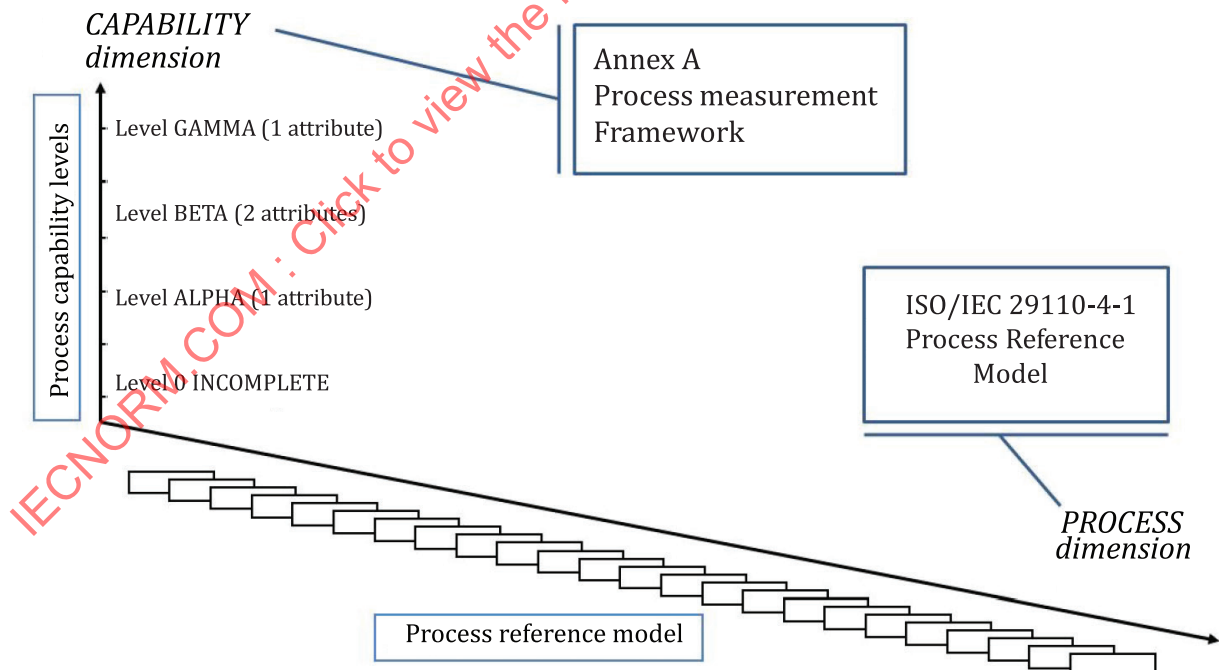


Figure B.1 — Structure of the process assessment model

The process reference model defined in ISO/IEC 29110-4-1, associated with the process attributes defined in [Annex A](#), establishes a process assessment model used as a common basis for performing assessments of software engineering process capability, allowing for the reporting of results using a common rating scale.

The process reference model and the capability dimension defined in [Annex A](#) cannot be used alone as the basis for conducting reliable and consistent assessments of process capability since the level of detail provided is not sufficient. The descriptions of process purpose and outcomes in the process reference model and the process attribute definitions in [Annex A](#) need to be supported with a comprehensive set of indicators of process performance and process capability that are used for assessment performance

The indicators are used as a basis for collecting the objective evidence that enables an assessor to assign ratings. The set of indicators included in this annex is intended to be an all-inclusive set and it is intended to be applicable in its entirety.

The process assessment model in this annex (this PAM) is directed at assessment sponsors and lead assessors who wish to select a model and associated documented process method, for assessment (for either capability determination or process improvement). Additionally, it may be of use to developers of assessment models in the construction of their own model, by providing examples of good software engineering and management practices.

The process assessment model defined in this annex is conformant with the ISO/IEC 33004 requirements for a process assessment model and can be used as the basis for conducting an assessment of software engineering process capability for VSEs.

Copyright release for the process assessment model: Users of this annex may freely reproduce the detailed descriptions contained in the assessment model as part of any tool or other material to support the performance of process assessments, so that it can be used for its intended purpose.

B.2 Processes dimension

[Figure B.2](#) lists the processes from ISO/IEC 29110-4-1 that are included in the process dimension of the process assessment model.

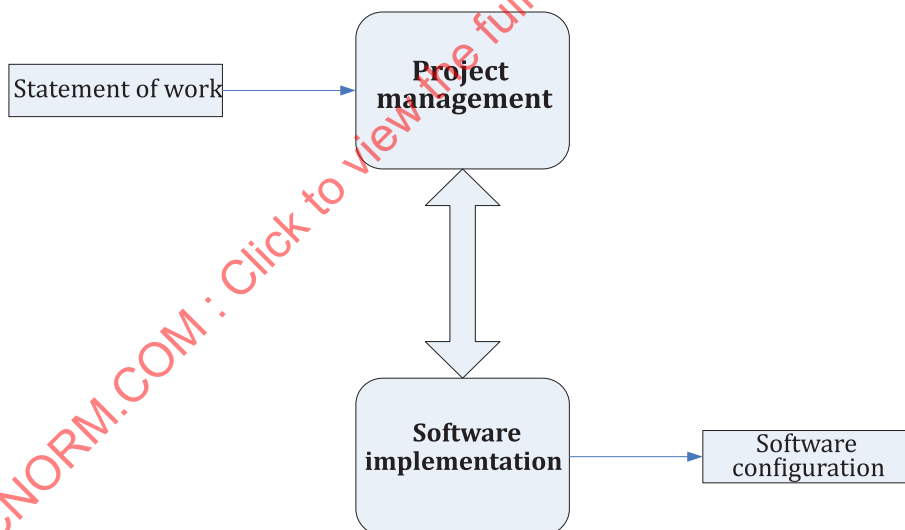


Figure B.2 — Processes included in the software Basic profile for VSEs

The organizational group of processes are interrelated (see [Figure B.3](#)).

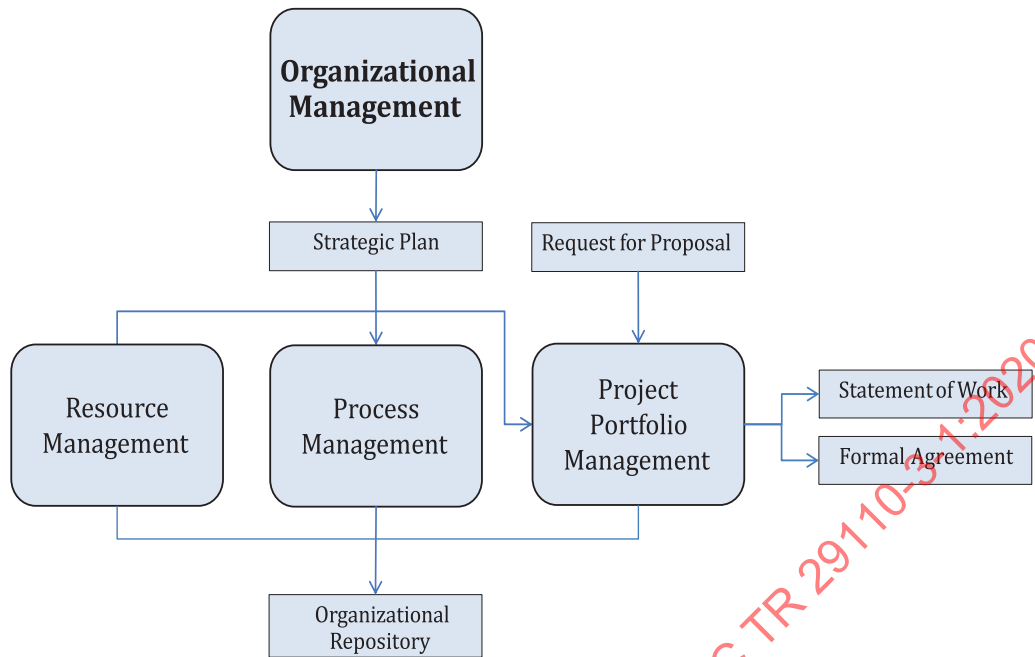


Figure B.3 — Processes included in the Organizational profile for VSEs

The organizational management process provides a *Strategic Plan* which defines project strategies, budget, and required processes.

The resource management process, process management process and project portfolio management process receive the *Strategic Plan as an input that will guide its activities*. The resource management receives the *Resource Request* from all the processes and projects, analyzes them and assigns resources to the processes and projects according to the *Resource Policies and/or Mechanisms*.

The process management process receives the *Process Improvement Suggestions* from all the processes, analyzes them and applies this suggestions to the processes in order to improve them. The Process Evaluation activity, evaluates the processes implementation finding strengths and weakness, and coordinates the resolution of the weakness.

The project portfolio management process receives the *Request for Proposal* form the customers, activates the accepted projects and supervises the correct execution of these projects.

For the process dimension, all the processes in [Figure B.2](#) and [Figure B.3](#) are included within the process dimension of the process assessment model. Each process in the process assessment model is described in terms of a purpose statement. These statements contain the unique functional objectives of the process when performed in a particular environment. A list of specific outcomes is associated with each of the process purpose statements, as a list of expected positive results of the process performance.

B.3 Capability dimension

For the capability dimension, the process capability levels and process attributes are identical to those defined in [Annex A](#), the measurement framework (MF).

Evolving process capability is expressed in the process assessment model in terms of process attributes grouped into capability levels. Process attributes are features of a process that can be evaluated on a scale of achievement, providing a measure of the capability of the process. They are applicable to all processes. Each process attribute describes a facet of the overall capability of managing and improving the effectiveness of a process in achieving its purpose and contributing to the business goals of the organization.

A capability level is a set of process attribute(s) that work together to provide a major enhancement in the capability to perform a process. The levels constitute a rational way of progressing through improvement of the capability of any process and are defined in [Annex A](#) (the MF).

Within the process assessment model, the measure of capability is based upon the one process attributes (PA) defined in [Annex A](#) (the MF). Process attributes are used to determine whether a process has reached a given capability. Each attribute measures a particular aspect of the process capability.

At each level, there is no ordering between the process attributes; each attribute addresses a specific aspect of the capability level. The list of process attributes is shown in [Table A.1](#).

The process attributes are evaluated on a four point ordinal scale of achievement, as defined in [Annex A](#) (the MF). They provide insight into the specific aspects of process capability required to support process improvement and capability determination.

B.4 Assessment indicators

B.4.1 General

The process assessment model is based on the principle that the capability of a process can be assessed by demonstrating the achievement of process attributes on the basis of evidence related to assessment indicators. These indicators provide guidance for assessors in accumulating the necessary objective evidence to support judgments of capability. Assessment indicators are used to confirm that certain practices were performed, as shown by observable evidence collected during an assessment. All such evidence comes either from the examination of work products of the processes assessed or from statements made by the performers and managers of the processes.

The evidence obtained should be recorded in a form that clearly relates to an associated indicator, so that the support for the assessor's judgment can be readily confirmed or verified as required by ISO/IEC 33002.

The output from a process assessment is a set of process profiles, one for each process within the scope of the assessment. Each process profile consists of a set of the process attribute ratings for an assessed process. Each attribute rating represents a judgment by the assessor of the extent to which the attribute is achieved. To improve the reliability and repeatability of the assessment, the judgments of the assessor are based on a coherent set of recorded objective evidences. The assessment indicators, and their relationship to process performance and process capability, are shown in [Figure B.4](#).

There are two types of assessment indicators: process capability indicators, which apply to capability levels ALPHA to GAMMA and process performance indicators, which apply exclusively to capability level ALPHA. These indicators are defined in [B.4.2](#).

The process attributes in the capability dimension have a set of process capability indicators that provide an indication of the extent of achievement of the process attribute in the instantiated process. These indicators concern significant activities, resources or results associated with the achievement of the process attribute purpose by a process.

The process capability indicators are:

- generic practice (GP);
- generic work product (GWP).

As additional indicators for supporting the assessment of a process at Level ALPHA, each process in the process dimension has a set of process performance indicators which is used to measure the degree of achievement of the process performance attribute for the process assessed.

The process performance indicators are:

- base practice (BP);

— work product (WP).

The process performance indicators are used to measure the degree of achievement of the process performance attribute (PA.1) for the process assessed.

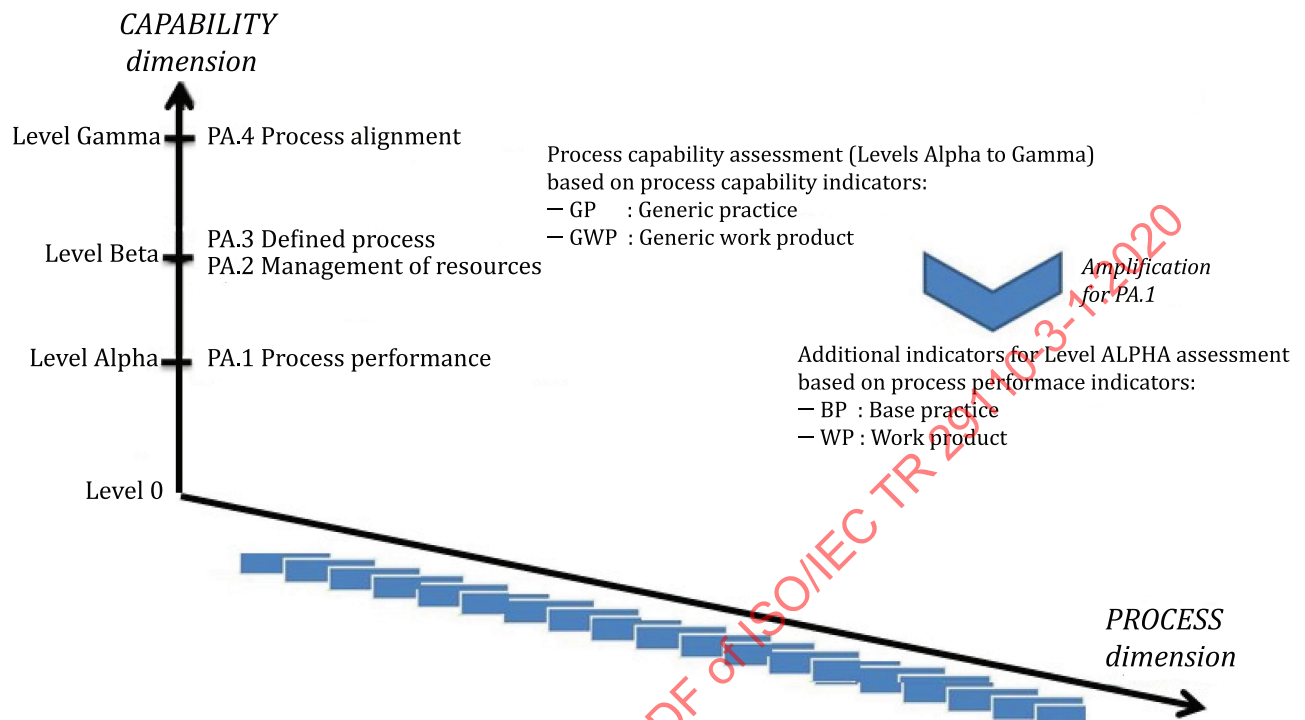


Figure B.4 — Assessment indicators

The process capability indicators represent the type of evidence that would support judgments of the extent to which the process attributes are achieved. Evidence of their effective performance or existence supports the judgment of the degree of achievement of the process attribute. The generic practices are the principal indicators of process capability.

The generic practice (GP) indicators are activities of a generic type and provide guidance on the implementation of the process attribute's characteristics. They support the achievement of the process attribute and many of them concern management practices, i.e. practices that are established to support the process performance as it is characterized at level 1. During the evaluation of process capability, the primary focus is on the performance of the generic practices. In general, performance of all generic practices is expected for full achievement of the process attribute.

The generic work product (GWP) indicators are sets of characteristics that would be expected to be evident in work products of generic types as a result of achievement of a process attribute. The generic work products form the basis for the classification of the work products defined as process performance indicators; they represent basic types of work products that may be inputs to or outputs from all types of process.

These two types of indicators help to establish objective evidence of the extent of achievement of the specified process attribute.

Due to the fact that level Alpha capability of a process is only characterized by the measure of the extent to which the process purpose is achieved, the process performance attribute (PA.1) has a single generic practice indicator (GP.1.1). In order to support the assessment of PA.1 and to amplify the process performance achievement analysis, additional process performance indicators are defined in the process assessment model.

There are two types of process performance indicators; **base practice (BP)** indicators and **work product (WP)** indicators. Process performance indicators relate to individual processes defined

in the process dimension of the process assessment model and are chosen to explicitly address the achievement of the defined process purpose.

Evidence of performance of the base practices and the presence of work products with their expected work product characteristics provide objective evidence of the achievement of the purpose of the process.

A base practice is an activity that addresses the purpose of a particular process. Consistently performing the base practices associated with a process will help the consistent achievement of its purpose. A coherent set of base practices is associated with each process in the process dimension. The base practices are described at an abstract level, identifying “what” should be done without specifying “how”. Implementing the base practices of a process should achieve the basic outcomes that reflect the process purpose. Base practices represent only the first step in building process capability, but the base practices represent the unique, functional activities of the process, even if that performance is not systematic. The performance of a process produces work products that are identifiable and usable in achieving the purpose of the process. In this assessment model, each work product has a defined set of example work product characteristics that may be used when reviewing the work product to assess the effective performance of a process. Work product characteristics may be used to identify the corresponding work product produced/used by the assessed organization.

[B.4.2](#) contains a complete description of the processes, including the base practices and the associated work products. Each base practice has its own identifier. The identification number of each work product correspond to its detailed characteristics contained in [B.4.4](#).

[B.4.3](#) contains a complete description of the process attributes, including the generic practices and the associated generic work products. The identification number of each generic work product correspond to its detailed characteristics contained in [B.4.4](#).

[B.4.4](#) contains a complete list of specific and generic work products. An assessor would refer to the specific work product when performing an assessment.

The processes in the process dimension can be directly mapped to the processes defined in the process reference model. It also includes the rules of assessment indicators identification.

The individual processes are described in terms of process name, process purpose, and process outcomes as defined in ISO/IEC 29110-4-1 (PRM).

In addition, the process dimension of the PAM provides information in the form of the following:

- a) a set of base practices for the process providing a definition of the tasks and activities needed to accomplish the process purpose and fulfil the process outcomes; each base practice is explicitly associated to a process outcome;
- b) a number of input and output work products associated with each process and related to one or more of its outcomes;
- c) characteristics associated with each detailed work product.

The associated work products provide objective guidance for potential inputs and outputs to look for and objective evidence supporting the assessment of a particular process. A documented assessment process and assessor judgment is needed to ensure that process context (application domain, business purpose, development methodology, size of the organization, etc.) is explicitly considered when using this information. This list should not be considered as a checklist of what each organization should have but rather as an example and starting point for considering whether, given the context, the work products are necessary and contributing to the intended purpose of the process.

These work products are identified with their work product identifier number as used in [B.4.4](#).

A nomenclature for assessment indicators is defined in order to identify them unambiguously and relate them to the architecture of the model. The nomenclature for base practices facilitate the identification of the processes, the base practices that belong to each process.

Each practice is assigned an identifier consisting of a multi-part alphanumeric code.

Base practices used in this exemplar assessment model provide a definition of the tasks and activities needed to accomplish the process purpose and fulfil the process outcomes. A base practice is identified with the following sequence: PI.BPPN. Where the codes are the following:

- PI process identifier (2 letters) (e.g. PM for project management);
- BP the text “BP” used to signify base practice.

B.4.2 Process performance indicators

B.4.2.1 Software Basic profile group

B.4.2.1.1 PM. Project management

Table B.1 — Software project management process base practices indicators

Process ID	PM
Process name	Project management
Process purpose	The purpose of the project management process is to establish and carry out in a systematic way the Tasks of the software implementation project, which allows complying with the project's Objectives in the expected quality, time and costs.
Process outcomes	a) The scope of the work for the project shall be defined. b) The tasks and resources necessary to complete the work shall be estimated (schedule, effort, cost, duration). c) Planning for the execution of the project shall be developed according to the scope and the tasks defined. d) A software version control strategy shall be developed. e) Planning shall be reviewed and agreed by the customer. f) Progress of the project against the planning shall be monitored and reported. g) Risks shall be identified and monitored during the conduct of the project h) Changes shall be addressed, analyzed and evaluated for cost, schedule and technical impact. i) Relevant items of software configuration shall be identified and controlled including their storage, baseline, handling, and modifications. j) Releases of items shall be controlled and made available to relevant stakeholders. k) Product shall be completed and delivered to the customer as planning. l) Meetings with the work team and the customer shall be held to guarantee that work done complies with the project requirements and planning. m) Agreements resulting from meetings shall be registered and tracked. n) Actions to correct planning problems and unachieved targets (schedule, effort, cost, duration) shall be taken. o) Project closure shall be performed to get the customer acceptance.

Table B.1 (continued)

Base practices	PM.BP1 Review the Statement of Work [Outcome: a] PM.BP2 Define with the Customer the Delivery Instructions of each one of the Deliverables specified in the Statement of Work. [Outcome: e] PM.BP3 Identify the specific Tasks to be performed in order to produce the Deliverables and their Software Components identified in the Statement of Work. Include Tasks in the SI process along with verification, validation, and reviews with Customer and Work Team Tasks to ensure the quality of work products. Identify the Tasks to perform the Delivery Instructions. Document the Tasks. [Outcome: b] PM.BP4 Establish the Estimated Duration to perform each task. [Outcome: b] PM.BP5 Identify and document the Resources: human, material, equipment, and tools, standards, including the required training of the Work Team to perform the project. Include in the schedule the dates when Resources and training will be needed. [Outcome: b] PM.BP6 Establish the Composition of Work Team assigning roles and responsibilities according to the Resources. [Outcome: b] PM.BP7 Assign estimated start and completion dates to each one of the Tasks in order to create the Schedule of the Project Tasks taking into account the assigned Resources, sequence and dependency of the Tasks. [Outcome: b] PM.BP8 Calculate and document the project Estimated Effort and Cost. [Outcome: b] PM.BP9 Identify and document the risks which may affect the project. [Outcome: g] PM.BP10 Document the Version Control Strategy in the Project Plan. [Outcome: d] PM.BP11 Generate the Project Plan integrating the elements previously identified and documented. [Outcome: c] PM.BP12 Include Product Description, Scope, Objectives, and Deliverables in the Project Plan. [Outcome: c] PM.BP13 Verify and obtain approval of the Project Plan. Verify that all Project Plan elements are viable and consistent. The results found are documented in a Verification Results and corrections are made until the document is approved by PM. [Outcome: c] PM.BP14 Review and accept the Project Plan. Customer reviews and accepts the Project Plan, making sure that the Project Plan elements match with the Statement of Work. [Outcome: e] PM.BP15 Establish the Project Repository using the Version Control Strategy. [Outcome: d] PM.BP16 Monitor the Project Plan execution and record actual data in Progress Status Record. [Outcome: f] PM.BP17 Analyze and evaluate the Change Request for cost, schedule and technical impact. The Change Request can be initiated externally by the Customer or internally by the Work Team. Update the Project Plan, if the accepted change does not affect agreements with Customer. Change Request, which affects those agreements, needs to be negotiated by both parties (see PM.2.4) [Outcome: h] PM.BP18 Conduct revision meetings with the Work Team, identify problems, review risk status, record agreements, and track them to closure. [Outcome: l, m] PM.BP19 Conduct revision meetings with the Customer, record agreements and track them to closure. Change Request initiated by Customer or initiated by Work Team, which affects the Customer, needs to be negotiated to reach acceptance of both parties. If necessary, update the Project Plan according to new agreement with Customer. [Outcome: l, m] PM.BP20 Perform backup according to the Version Control Strategy. [Outcome: i]
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Table B.1 (continued)

	PM.BP21 Perform Project Repository recovery using the Project Repository Backup, if necessary. [Outcome: i] PM.BP22 Evaluate project progress with respect to the Project Plan, comparing: — actual Tasks against planned Tasks; — actual results against established project Objectives; — actual resource allocation against planned Resources; — actual cost against budget estimates; — actual time against planned schedule; — actual risk against previously identified. [Outcome: e] PM.BP23 Establish actions to correct deviations or problems and identified risks concerning the accomplishment of the plan, as needed, document them in Correction Register and track them to closure. [Outcome: n] PM.BP24 Identify changes to requirements and/or Project Plan to address major deviations, potential risks or problems concerning the accomplishment of the plan, document them in Change Request and track them to closure. [Outcome: h, i] PM.BP25 Formalize the completion of the project according to the Delivery Instructions established in the Project Plan, providing acceptance support and getting the Acceptance Record signed. [Outcome: o] PM.BP26 Update Project Repository. [Outcome: i, j] PM.BP27 Perform delivery according to Delivery Instructions. [Outcome: k]
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Table B.2 — Software project management process work products indicators

Work products	
Inputs	Outputs
	1 Acceptance Record [Outcome: o]
2 Change Request [Outcome: i, h]	2 Change Request [Outcome: g, h, i, m]
3 Correction register [Outcome: l, m]	3 Correction register [Outcome: n]
4 Delivery instructions [Outcome: k]	4 Delivery instructions [Outcome: a]
	6 Meeting Record [Outcome: e, l, m]
7 Project status record [Outcome: e, h, i, l, m, n]	7 Project status record [Outcome: e]
8 Project Plan [Outcome: d, e, g, i, k, l, m, o]	8 Project Plan [Outcome: b, c, e, g, i, l, m]
9 Project Repository [Outcome: k]	9 Project Repository [Outcome: d, j]
	10 Project repository backup [Outcome: i]
14 Software Configuration [Outcome: k, o]	14 Software Configuration [Outcome: g, j]
16 Statement of Work [Outcome: a, b]	
	20 Verification results [Outcome: e]
22 Version control strategy [Outcome: c, d, j]	22 Version control strategy [Outcome: d]

B.4.2.1.2 SI. Software implementation**Table B.3 — Software implementation process base practices indicators**

Process ID	SI
Process name	Software implementation

Table B.3 (continued)

Process purpose	The purpose of the software implementation process is the systematic performance of the analysis, design, construction, integration, and tests activities for new or modified software products according to the specified requirements.
Process outcomes	a) Software requirements shall be defined. b) Software requirements shall be analyzed for correctness and testability. c) Software requirements shall be agreed by the customer. d) Software requirements shall be baselined and communicated to work team and customer. e) Software architectural and detailed design shall be developed and baselined. f) Software architectural and detailed design shall describe the software components and their internal and external interfaces. g) Software components defined by the detailed design shall be produced. h) Unit test shall be performed to verify the consistency with requirements and the detailed design. i) Software shall be produced by integrating software components. j) Software shall be tested and verified, the results shall be recorded. k) Consistency and traceability between software requirements, software architectural, software detailed design and software components shall be established. l) Defects identified in reviews, traceability analysis, tests and verifications shall be corrected. m) Software configuration shall be integrated, baselined and stored in the project repository;
Base practices	SI.BP1 Document or update the Requirements Specification. Identify and consult information sources (Customer, users, previous systems, documents, etc.) in order to get new requirements. Analyze the identified requirements to determinate the Scope and feasibility. Generate or update the Requirements Specification [Outcome: a, b] SI.BP2 Verify and obtain approval of the Requirements Specification. Verify the correctness and testability of the Requirements Specification and its consistency with the Product Description. Additionally, review that requirements are complete, unambiguous, and not contradictory. The results found are documented in Verification Results and corrections are made until the document is approved by AN. If significant changes were needed, initiate a Change Request. [Outcome: b] SI.BP3 Validate and obtain approval of the Requirements Specification . Validate that Requirements Specification satisfies needs and agreed upon expectations, including the user interface usability. The results found are documented in a Validation Results and corrections are made until the document is approved by the CUS. [Outcome: c] SI.BP4 Incorporate the requirements specification to the software configuration in the baseline [Outcome: d] SI.BP5 Document or update the Software Design. Analyze the Requirements Specification to generate the architectural design, its arrangement in subsystems and Software Components defining the internal and external interfaces. Describe in detail the appearance and the behaviour of the interface based on the Requirements Specification in a way that Resources for its implementation can be foreseen. Provide the detail of Software Components and their interfaces to allow the construction in an evident way. Generate or update the Traceability Record. [Outcome: e, f, k]

Table B.3 (continued)

	SI.BP6 Verify and obtain approval of the Software Design. Verify correctness of Software Design documentation, its feasibility and consistency with their Requirement Specification. Verify that the Traceability Record contains the adequate relationships between requirements and the Software Design elements. The results found are documented in a Verification Results and corrections are made until the document is approved by DES. If significant changes were needed, initiate a Change Request. [Outcome: f] SI.BP7 Establish or update Test Cases and Test Procedures for integration testing based on Requirements Specification and Software Design. Customer provides testing data, if needed. [Outcome: j] SI.BP8 Verify and obtain approval of the Test Cases and Test Procedures. Verify consistency among Requirements Specification, Software Design and Test Cases and Test Procedures. The results found are documented in a Verification Results and corrections are made until the document is approved. [Outcome: j] SI.B9 Update the Traceability Record incorporating the Test Cases and Test Procedures. [Outcome: j, k] SI.BP10 Incorporate the Software Design and Traceability Record to the Software Configuration as part of the baseline. Incorporate the Test Cases and Test Procedures to the Project Repository. [Outcome: k, m] SI.BP11 Construct or update Software Components based on the detailed part of the Software Design. [Outcome: g] SI.BP12 Design or update unit test cases and apply them to verify that the Software Components implements the detailed part of the Software Design. [Outcome: h] SI.BP13 Correct the defects found until successful unit test (reaching exit criteria) is achieved. [Outcome: h] SI.BP14 Update the Traceability Record incorporating Software Components constructed or modified. [Outcome: k] SI.BP15 Incorporate Software Components and Traceability Record to the Software Configuration as part of the baseline. [Outcome: k, m] SI.BP16 Integrates the Software using Software Components and updates Test Cases and Test Procedures for integration testing, as needed. [Outcome: i, j] SI.BP17 Perform Software tests using Test Cases and Test Procedures for integration and document results in Test Report. [Outcome: j] SI.BP18 Correct the defects found and perform regression test until exit criteria is achieved. [Outcome: l] SI.BP19 Updates the Traceability Record, if appropriate. [Outcome: k] SI.BP20 Incorporate the Test Cases and Test Procedures, Software, Traceability Record, Test Report to the Software Configuration as part of the baseline. [Outcome: m] SI.BP21 Document the Maintenance Documentation or update the current one. [Outcome: m] SI.BP22 Verify and obtain approval of the Maintenance Documentation. Verify consistency of Maintenance Documentation with Software Configuration. The results found are documented in a Verification Results and corrections are made until the document is approved. [Outcome: m] SI.BP23 Incorporate the Maintenance Documentation as baseline for the Software Configuration. [Outcome: m]
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Table B.4 — Software implementation process work products indicators

Work products	
Inputs	Outputs
	2 Change Request [Outcome: b, f]
	5 Maintenance Documentation [Outcome: m]
8 Project Plan [Outcome: a, b]	
11 Requirements Specification [Outcome: b, c, d, e, f, j, k]	11 Requirements Specification [Outcome: a, b, c]
12 Software [Outcome: j, k, l, m]	12 Software [Outcome: i, j, l]
13 Software components [Outcome: h, j, k, m]	13 Software components [Outcome: g, h]
14 Software Configuration [Outcome: m]	14 Software Configuration [Outcome: d, k, m]
15 Software Design [Outcome: g, j, k, m]	15 Software Design [Outcome: e, f]
17 Test cases and test procedures [Outcome: j, l, m]	17 Test cases and test procedures [Outcome: j]
18 Test report [Outcome: l, m]	18 Test report [Outcome: j, l]
19 Traceability Record [Outcome: g, j, k, l, m]	19 Traceability Record [Outcome: k]
	20 Verification results [Outcome: b, f, j, m]
	21 Validation results [Outcome: c]

B.4.2.2 Organizational profile group**B.4.2.2.1 RM. Resource management process****Table B.5 — Resource management process base practices indicators**

Process ID	RM
Process name	Resource management
Process purpose	The purpose of the resource management process is to obtain and provide the organization with the necessary resources.
Process outcomes	a) Human resources and infrastructure policies and/or mechanisms shall be defined to support the organization and projects. b) Organization and project requests for resources shall be responded according to defined policies and/or mechanisms. c) Resource acquisition activities, human resources, training and infrastructure maintenance shall be monitored. d) Corrections to remediate problems shall be taken when requirements are not satisfied.
Base practices	RM.BP1 Generate or update Resource Policies and/or Mechanisms. Generate or update the Human Resource Policies and/or Mechanisms, based on business needs. Generate or update Goods, Services and Infrastructure Policies and/or Mechanisms based on business needs. [Outcome a]

Table B.5 (continued)

	RM.BP2 Review the Resource Policies and/or Mechanisms. Management reviews and accepts the Resource Policies and/or Mechanisms making sure it complies with the needs of the VSE organization and that it is operationally feasible. Corrections are made until the document is approved. [Outcome a] RM.BP3 Generate or update the Organizational Repository Strategy. [Outcome a] RM.BP4 Review the Organizational Repository Strategy. Management reviews the Organizational Repository Strategy making sure it complies with the needs of the organization or the project and that it is operationally feasible. Corrections are made until the document is approved. [Outcome: a] RM.BP5 Prepare or update Maintenance Plan/Record based on criteria for preventive maintenance described in Goods, Services and Infrastructure Policies and/or Mechanisms. [Outcome: c] RM.BP6 Review the Resource Request Management reviews and accepts the Resource Request making sure that elements are feasible according to the budget and correspond to the organization's needs. Corrections are made until the document is approved by Management and accepted by the resource management responsables. [Outcome b] RM.BP7 Evaluate Resource Request. Review Resource Requests based on the Resource Policies and/or Mechanisms. Decide if elements required in the Resource Requests were not previously assigned. Decide if the elements required in the Resource Requests should be reallocated within the VSE or acquired externally and services/training required should be provided through internal or external suppliers based on the Resource Policies and/or Mechanisms. Decide if any corrective maintenance is needed based on the Maintenance Plan/Records. Generate or update the Procurement Requirements. [Outcome: b] RM.BP8 Schedule activities (training and maintenance). Generate or update the Training Plan/Record based on the Procurement Requirements. Generate or update Maintenance Plan/Record for corrective maintenance based on the Procurement Requirements. [Outcome: c] RM.BP9 Obtain human resource requirements. Execute human resource procurement activities based on the Human Resource Policies and/or Mechanisms. Select, assign and obtain acceptance of human resources. Generate or update the Human Resource Register. [Outcome: b] RM.BP10 Obtain goods, services and infrastructure requirements. Execute goods, services and infrastructure procurement activities based on the Goods, Services and Infrastructure Policies and/or Mechanisms. Acquire the good or service and ask the applicant for acceptance. Generate or update the Supplier List. Generate or update the Goods or Service Register. [Outcome: c] RM.BP11 Execution of scheduled training activities. Carry out the Training Plan. Procure training, including evaluation of training provided. For each member of trained personnel, update the Human Resource Register. For each training activity performed, update the Training Plan/Record [Outcome: c]. RM.BP12 Execution of scheduled resource maintenance activities. Carry out the Resource Maintenance Plan. Execute the maintenance tasks. For each maintenance activity performed, update the Maintenance Plan/Record. [Outcome: c] RM.BP13 Evaluate periodically the performance of the human resources and record the evaluation in the Human Resource Record, according the Human Resource Policies and/or Mechanisms. [Outcome: c] RM.BP14 Generate Resource Report to Management. Generate Human Resource and Training section of the Resource Report based on Human Resource Record. Generate the Goods, Services and Infrastructure section of the Resource Report based on the, Goods or Services Record and the Supplier List. [Outcome: c] RM.BP15 Review if the selection, allocation, acceptance, training, evaluation and performance of human resources is adequate, based on the Human Resource Policies and/or Mechanisms. Corrections are made until deviations are closed [Outcome: c].
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Table B.5 (continued)

	RM.BP16 Review if the service rendered by the supplier and if the purchase and allocation of goods and services are adequate and timely, based on the Goods, Services and Infrastructure Policies and/or Mechanisms. Corrections are made until deviations are closed [Outcome: c, d]
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Table B.6 — resource management process work products indicators

Work products	
Inputs	Outputs
23 Human Resource record [Outcome: b, c]	23 Human Resource record [Outcome: b, c]
25 Resource Request [Outcome: b, c]	25 Resource Request [Outcome: b, c]
26 Resource Policy and/or mechanisms [Outcome: a, b, c, d]	26 Resource policy and/or Mechanisms [Outcome: a]
27 Procurement requirements [Outcome: c, d]	27 Procurement requirements [Outcome: b, c, d]
28 Goods or Services Record [Outcome: b, c]	28 Goods or Services Record [Outcome: c]
29 Supplier List [Outcome: c]	29 Supplier List [Outcome: c]
46 Strategic Plan [Outcome: a, b]	
48 Organizational Repository Strategy [Outcome: a]	48 Organizational Repository Strategy [Outcome: a]

B.4.2.2.2 PMP. Process management process**Table B.7 — Process management process base practices indicators**

Process ID	PMP
Process name	Process management process
Process purpose	The purpose of the process management process is to establish and improve the organizational processes of the VSE.
Process outcomes	a) The process management processes shall be defined and deployed to respond to the organizational needs. b) Followance of the defined processes by the organization and projects shall be assured by applying the planned process evaluations. c) Problems shall be identified and deviations corrected. d) Keep the organization informed of the process status. e) Gather and analyze the information from process evaluations and improve the process based on process evaluations, process improvement suggestions and best practices. f) Establish an Organizational Repository, integrate and store the processes relevant documentation.

Table B.7 (continued)

Base practices	PMP.BP1. Establish or update the Process Plan to define, deploy and improve the organizational VSE's processes based on Required Process and Process Improvements Actions. Identify and describe activities. Assign dates and responsibilities. [Outcome a] PMP.BP2. Establish or update the Evaluation Definition and Record of organizational VSE's processes, for which it is necessary to: — determine the Type of Evaluations that will be carried out on the VSE organization; — for each evaluation, the Scope, Method and Evaluation Criteria is determined. [Outcome b] PMP.BP3. Update the Process Plan to include the evaluation task of the Evaluation Definition and Record: — identify and describe activities; — assign dates and responsibilities. [Outcome a] PMP.BP4. Identify the acquisition and training needs to carry out the process management process based on Process Plan and Evaluation Definition and Record. Document the resources and training needed in Resource Request. [Outcome a] PMP.BP5. Confirm that resources allocation approved corresponds to the Resource Request. [Outcome: a] PMP.BP6. OM assigns the process owners to an organizational VSE's process and the PSM notifies and documents the assignation in Process Owners of the Process Definition. [Outcome: a] PMP.BP7 Review the Process Plan. OM reviews and accepts the Process Plan making sure that it reflects the organizational management objectives. The Process Owner reviews and accepts the Process Plan making sure that the tasks, dates and responsibilities stated are attainable. The corrections are made until the document is approved and accepted. [Outcome a, c] PMP.BP8. Monitor the execution of the Process Plan and identify any adjustments required. Monitor and track until closure. [Outcome b] PMP.BP9 Establish or prepare the Organizational Repository according to the Organizational Repository Strategy. [Outcome: f] PMP.BP10 Include the Project Repository of each closed project into the Organizational Repository [Outcome f] PMP.BP11 Backup the Organizational Repository according the Organizational Repository Strategy. [Outcome: f] PMP.BP12. Establish or update the Process Map according to the Process Improvements Actions and the Process Plan using the best practices, if necessary. [Outcome: a, e] PMP.BP13. Review the Process Map. Review that the Process Map reflects the organizational management needs. The corrections are made until the document is approved. [Outcome: b, c] PMP.BP14. Identify the organizational best practices and good experiences and complement them with the best practices and the Process Improvements Actions, according to the Process Plan. Use this information to create or to update the Process Documentation according to the Process Map. [Outcome: e] PMP.BP15. Review the Process Documentation. For each process review that the Process Documentation reflects the organizational best practices, good experiences and follows the best practices. The corrections are made until the document is approved [Outcome: b, c]
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Table B.7 (continued)

	PMP.BP16. Integrate or update the Process Definition. — Define SW tools requirements and training needs for each process. — Define Process Owner for each process. [Outcome: c] PMP.BP17. Train the organization on the processes based on Process Documentation, and according the Process Plan. [Outcome: a, d] PMP.BP18 Update the Organizational Repository with the Process Definition. [Outcome: f] PMP.BP19. PSM deploys the organizational VSE's process following Process Documentation and the Process Plan. NOTE 1 VSE executes in projects and processes the updated activities documented in the Process Documentation. NOTE 2 PSM implements processes in pilot projects, if it is necessary. NOTE 3 During a certain period of time, the PSM coaches the VSE on the Process Documentation deployment. [Outcome: b] PMP.BP20. Generate or update dates, scope and responsible roles of the next Evaluation Report. According to the Process Plan and the Evaluation Definition and Record, the AS determines the next evaluation Dates, Scope and Responsible Roles, confirm them with the responsible roles, and document them in the Evaluation Report. [Outcome: e] PMP.BP21. Generate or update strengths and weaknesses of the Evaluation Report The AS assesses selected organizational process execution, according to the Scope confirmed and the Evaluation Definition and Record, with respect to the Process Definition, identifying and documenting Strengths and Weakness in the Evaluation Report. [Outcome: e] PMP.BP22. Review the Evaluation Report. Review that the Evaluation Report reflects the real execution process status. The corrections are made until the document is accepted. [Outcome: c, e] PMP.BP23 Include the Evaluation Report information into the Evaluation Record. [Outcome: e] PMP.BP24. Analyze the Strengths and Weakness of the Evaluation Report to identify Process Improvement Suggestions and document them in the Process Improvement Record. [Outcome: e] PMP.BP25. Gather Process Improvement Suggestions made by the VSE in any time. Document them in the Process Improvement Suggestions. [Outcome: e] PMP.BP26. Gather Process Improvement Suggestions made. Document them in the Process Improvement Suggestions. [Outcome: e] PMP BP.27 Analyze, select and prioritize the Process Improvement Suggestions to be carried out. For each suggestion selected, establish actions to close it and document them in the Process Improvements Actions. [Outcome: e] PMP.BP28. Inform the OM periodically about the processes status, based on the Process Plan, the Evaluation Definition and Record and the Process Improvement Record. Document it into the Process Progress Report. [Outcome: d] PMP.BP29 Generate the Process Improvement Suggestions for this process, based on experience on the process implemented. [Outcome: e]
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Table B.8 — process management process work products indicators

Work products	
Inputs	Outputs
24 Process Improvement suggestions [Outcome: e]	24 Process Improvement suggestions [Outcome: e]
25 Resource Request [Outcome: a]	25 Resource Request [Outcome: a]
31 Process Plan [Outcome: a, b, c, d, e]	31 Process Plan [Outcome: a, b, c]
32 Process definition [Outcome: b, c, e, f]	32 Process definition [Outcome: a, b, c, e]
33 Evaluation Definition and Record [Outcome: a, d, e, k, o]	33 Evaluation Definition and Record [Outcome: b, e]
34 Evaluation report [Outcome: c, e]	34 Evaluation report [Outcome: c, e]
35 Process Improvement record [Outcome: a, d, e]	35 Process Improvement record [Outcome: e]
	36 Organizational Repository Backup [Outcome: f]
46 Strategic plan [Outcome: a]	
48 Organizational Repository Strategy [Outcome: f]	
49 Organizational Repository [Outcome: f]	49 Organizational Repository [Outcome: ff]
9 Project Repository [Outcome: f]	

B.4.2.2.3 PPM project portfolio management process**Table B.9 — Project portfolio management process base practices indicators**

Process ID	PPM
Process name	Project portfolio management
Process purpose	The purpose of the project portfolio management is to generate projects for the VSE, provide technical content to establish the projects Formal Agreement, and supervise its performance while monitoring the customer satisfaction.
Process outcomes	a) Policies and/or Mechanisms for projects and for customer relationship shall be established. b) Project Generation Schedule shall be established. c) The projects and their organization that are going to be implemented shall be generated. d) Project activities shall be performed and maintained under control by complying with the project portfolio policies and mechanisms. e) Customer Comments and Complaints Correction Register shall be collected. f) Customer Comments and Complaints shall be responded by defining and executing Corrective or Preventive Actions. g) Project Generation Schedule status shall be evaluated and Progress Status Record for all projects shall be generated. h) Actions shall be tracked to closure. i) A Project Portfolio Report shall be generated. j) The mechanisms related to project closure shall be implemented.

Table B.9 (continued)

Base practices	PPM.BP1 Generate or update the Project Portfolio Policies and/or Mechanisms based on business needs and including customer Relationship based on business needs. [Outcome a]
	PPM.BP2 Review the Project Portfolio Policies and/or Mechanisms. PPM and PM review and accept the Project Portfolio Policies and/or Mechanisms making sure it complies with the needs of the organization and that it is operationally feasible. [Outcome a]
	PPM.BP3 Generate or update the Project Generation Schedule including actions and work programs to generate and close project opportunities. [Outcome b]
	PPM.BP4 Perform project generation activities, according to the Project Generation Schedule: Identify needs of possible project prospects. Estimate time and cost for each identified project prospect. Generate and submit Technical Proposals for the identified opportunities. Prepare Formal Agreements for the accepted proposals and collect Customers approval. [Outcome: c]
	PPM.BP5 Perform project activation activities Assign Project Manager. Generate Statement of Work based on Technical Proposal and Formal Agreement. Document the corresponding information in the Project Record [Outcome: d]
	PPM.BP6 Perform project definition activities Collect and approve the Project Plan. Document the corresponding information in the Project Record [Outcome: c]
	PPM.BP7 Perform Customer related activities Implement Project Portfolio Policies and/or Mechanisms for Customer Relations. Collect Customer satisfaction and document it in the Customer Comments and Complaints Record [Outcome: e, f]
	PPM.BP8 Analyze status of the Project Generation Schedule. If needed, establish actions to correct deviations or problems. Generate or update Correction Register and track them to closure. [Outcome: g]
	PPM.BP9 Collect and Analyze Progress Status Record from all active projects. If needed, establish actions to correct deviations or problems. Generate or update Correction Register and track them to closure. [Outcome: g]
	PPM.BP10 Collect and Analyze Customer Comments and Complaints Record. If needed, establish actions to correct deviations or problems. Generate or update Correction Register and track them to closure. [Outcome: f, h]
	PPM.BP11 Generate Project Portfolio Report. Generate the Project Portfolio Report based on Project Generation Schedule, Correction Register and Progress Reports from all active projects. Include Customer Relations Report based on Customer Comments and Complaints Record. [Outcome: i]
	PPM.BP12 Approve the Acceptance Record from closing projects. [Outcome: j]

Table B.10 — Project portfolio management process work products indicators

Work products	
Inputs	Outputs
3 Correction Register [Outcome: h]	3 Correction Register [Outcome: f, g, h]
38 Formal Agreement [Outcome: c, d]	38 Formal Agreement [Outcome: c]
39 Customer comments and complaints records [Outcome: f, h]	39 Customer comments and complaints records [Outcome: e, f]
7 Progress Status Record [Outcome: g, h]	
	40 Project Record [Outcome: c, d]
8 Project Plan [Outcome: c]	8 Project Plan [Outcome: c]
	41 Project Portfolio report [Outcome: h]
42 Request for Proposal [Outcome: c]	
	16 Statement of Work [Outcome: d]
43 Technical Proposal [Outcome: c, d,]	43 Technical Proposal [Outcome: c]

Table B.10 (continued)

Work products	
Inputs	Outputs
46 Strategic Plan [Outcome: a, b]	
50 Project Portfolio Policies and/or Mechanisms [Outcome: a, e, f]	50 Project Portfolio Policies and/or Mechanisms [Outcome: a]
51 Project Generation Schedule [Outcome: c, g, h]	51 Project Generation Schedule [Outcome: b]
	1 Acceptance record [Outcome: j]

B.4.2.2.4 OM. Organizational management process**Table B.11 — Organizational management process base practices indicators**

Process ID	OM
Process name	Organizational management
Process purpose	The purpose of the organizational management process is to make sure that value is delivered by the organization to the customer through planning, organizing, monitoring and controlling organizational activities
Process outcomes	a) An appropriated value proposition and its corresponding business model shall be establish or refined. b) Objectives for the organization, based on the business model shall be developed or revised. c) The strategies and resources necessary to support those objectives shall be established. d) The achievement of the objectives, identify deviations and control actions shall be measured.
Base practices	OM.BP1 Collect information about market changes Review changes in consumer needs and habits. [Outcome: a] OM.BP2 Collect information about technology trends. Review latest trends in technology solutions and base technology. [Outcome: a] OM.BP3 Collect information about competitors. Review important actions, market strategies and product improvements. [Outcome a] OM.BP4 Identify participants in the planning group. The first time the group is formed with the main actors in the VSE organization. In subsequent times, the group is formed with each process responsible, including operational processes. [Outcome: b] OM.BP5 Schedule planning sessions. Identify resources needed. Schedule planning sessions. Acquire resources and services needed for the sessions. [Outcome: b] OM BP.6 Establish budget restrictions [Outcome: b] OM.BP7 Develop or revise the business model. Identify target customer segments based on market information and technology trends. Establish a value proposition identifying problems, needs and desires of customers. Identify the customer relationship type(s) and channel(s) to be established, including sales channel(s). Identify key partners and suppliers needed to provide value to our customers and the type of relationship to be established with them. Identify key processes, projects, activities and resources needed to provide value to customers, including those needed to establish and maintain customer and partners relationship. Identify key functional areas and organizational structure. [Outcome: b]

Table B.11 (continued)

	OM.BP8 Develop or revise objectives for the VSE organization. Develop or revise the organizational Mission, Vision and Values. Establish middle and short term objectives for the VSE organization, with indicators and goals for each indicator, including sales and quality objectives, based on the business model [Outcome: b]
	OM.BP9 Establish the Strategic Plan for the VSE. Establish processes, internal projects and functional areas needed for the achievement of the objectives. Establish purpose, objectives, indicators and goals for each process, project and functional area, aligned with organizational objectives. Establish resources needed for each process, project and functional area. Establish customer strategy. Establish budget. [Outcome: c]
	OM.BP10 Analyze risks. Identify risks that could interfere in the achievement of the objectives. Assign probability and impact for each risk. Establish mitigation actions and contingency plans for each risk. Assign responsibility for each risk. [Outcome: c]
	OM.BP11 Review the Resource Report. Evaluate periodically the achievement of objectives related to resources and establish corrective and preventive actions (generate or update Correction Register and track them to closure). If necessary, adjust the Strategic Plan accordingly to the Resource Report results. [Outcome: d]
	OM.BP12 Review the Process progress report. Evaluate periodically the achievement of objectives related to processes and establish corrective and preventive actions (generate or update Correction Register and track them to closure). If necessary, adjust the Strategic Plan accordingly to the Process progress Report results. [Outcome: d]
	OM.BP13 Review the Project portfolio report. Evaluate periodically the achievement of objectives related to projects and establish corrective and preventive actions (generate or update Correction Register and track them to closure). If necessary, adjust the Strategic Plan accordingly to the Project portfolio Report results. [Outcome: d]

Table B.12 — Organizational management process work products indicators

Work products	
Inputs	Outputs
	3 Correction Register [Outcome: d]
30 Resource Report [Outcome: d]	
37 Process progress report [Outcome: d]	
41 Project portfolio report [Outcome: d]	
44 Environmental information Report [Outcome: b]	44 Environmental information Report [Outcome: a]
45 Business model [Outcome: b, c]	45 Business model [Outcome: b]
46 Strategic Plan [Outcome: b, c, d]	46 Strategic Plan [Outcome: b, c, d]
47 Planning agenda [Outcome: b]	47 Planning agenda [Outcome: b]
	52 VSE risk management plan [Outcome: c]

B.4.3 Process capability levels and process attributes indicators (PA.1 to PA.4)

B.4.3.1 General

This subclause presents the process capability indicators related to the process attributes associated with capability levels ALPHA to GAMMA defined in the capability dimension of the process assessment model. Process capability indicators are the means of achieving the capabilities addressed by the considered process attributes. Evidence of process capability indicators support the judgment of the degree of achievement of the process attribute.

The capability dimension of the process assessment model consists of three capability levels matching the capability levels defined in [A.2](#). This subclause describes the process capability indicators for the four process attributes included in the capability dimension for levels ALPHA to GAMMA. [B.4.3](#)

describes the assessment indicators for process performance which is characterized by Level ALPHA process capability and the assessment indicators for capability levels BETA and GAMMA..

Level 0 does not include any type of indicators. Level 0 reflects a non-implemented process or a process which fails to partially achieve its outcomes.

NOTE In the [B.4.3.2](#) to [B.4.3.4](#), process attribute definitions and attribute achievements are identified with italic font.

B.4.3.2 Level ALPHA: Performed process

PA.1 Process performance attribute

The process performance attribute is a measure of the extent to which the process purpose is achieved. As a result of full achievement of this attribute, the process achieves its defined outcomes.

Generic practices for PA.1

GP 1.1 Achieve the process outcomes

Perform the intent of the base practices.

Produce work products that evidence the process outcomes

NOTE The assessment of a performed process is based on process performance indicators, which are defined in [B.4.2](#).

Generic work products for PA.1

0-1 Work product [PA.1. Achievement a]

— Work products exist that provide evidence of the achievement of the process outcomes.

B.4.3.3 Level BETA: Articulated process

B.4.3.3.1 General

The previously described *Performed process* is now implemented in a managed fashion (resources managed) and it follows a monitored defined process.

The following attributes of the process, together with the previously defined attribute, demonstrate the achievement of this level.

B.4.3.3.2 PA.2 Management of resources attribute

The Management of resources attribute is a measure of the extent to which the organizational resources are used for the performance of the process. As a result of full achievement of this attribute:

- a) performance of the process is planned and monitored;
- b) resource needs for the performance of the process are identified;
- c) responsibilities and authorities for performing the process are assigned and communicated;
- d) resources and information necessary for performing the process are made available, allocated and used;
- e) interfaces between the involved parties are managed to ensure both effective communication and clear assignment of responsibility.

Generic practices for PA.2

PA.2.GP.1 Plan and monitor the performance of the process to fulfil the identified objectives. Plan(s) for the performance of the process are developed. The process performance cycle is defined. Key milestones for the performance of the process are established. Estimates for process performance attributes are determined and maintained. Process activities and tasks are defined. Schedule is defined and aligned with the approach to performing the process. Process work product reviews are planned. The process is performed according to the plan(s). Process performance is monitored to ensure planned results are achieved.
PA.2.GP.2 Identify and make available resources to perform the process according to plan. The human and infrastructure resources necessary for performing the process are identified. The information necessary to perform the process is identified.
PA.2.GP.3 Define responsibilities and authorities for performing the process. Responsibilities, commitments and authorities to perform the process are defined, assigned and communicated. Responsibilities and authorities to verify process work products are defined and assigned. The needs for process performance experience, knowledge and skills are defined. Competencies for management and execution of the process are ensured by training or work-based learning. Required competencies are identified based on the responsibilities.
PA.2.GP.4 Make available resources to perform the process according to plan. The human and infrastructure resources necessary for performing the process are made available, allocated and used. The information necessary to perform the process is made available.
PA.2.GP.5 Manage the interfaces between involved parties. The individuals and groups involved in the process performance are determined. Responsibilities of the involved parties are assigned. Interfaces between the involved parties are managed. Communication is assured between the involved parties. Communication between the involved parties is effective.

Generic work products for PA.2

0-2 Plan [PA.2 Achievement a, b, c, d]

- Defines objectives to perform the process.
- Describes assumptions and constraints considered in defining the objectives.
- Includes milestones and timetable to produce the work products of the process.
- Identifies tasks, resources, responsibilities and infrastructure needed to perform the process.
- Considers risks related to fulfil defined objectives.
- Identifies stakeholders and communication mechanisms to be used.
- Describes how the plan is controlled and adjusted when needed.

0-3 Record [PA.2 Achievement d, e]

- States results achieved or provides evidence of activities performed in a process.
- Provides evidence of communication, meetings, reviews and corrections.

0-4 Register [PA.2 Achievement c, e]

- Contains status information about corrections; schedule and work breakdown structure.
- Monitors identified risks.

0-5 Report [PA.2 Achievement b, c]

- Monitors process performance against defined objectives and plans.
- Identifies deviations in process performance.
- Describes results and status of the process.
- Provides evidence of management activities.

B.4.3.3.3 PA.3 Defined process attribute

The defined process attribute is a measure of the extent to which the organizational process is defined and used for the performance of the process. As a result of full achievement of this attribute:

- a) a standard process, including appropriate tailoring guidelines, is defined that describes the fundamental elements that must be incorporated into a defined process, including competencies and roles and infrastructure;
- b) the defined process is deployed based upon an appropriately selected and/or tailored standard process, including the use of the standard competencies and roles and infrastructure;
- c) suitable methods for monitoring the effectiveness and suitability of the process are determined;
- d) appropriate data are collected and analyzed as a basis for understanding the behaviour of, and to demonstrate the suitability and effectiveness of the process, and to evaluate how the process is performed and where continuous improvement of the process can be made.

Generic practices for PA.3**PA.3.GP1 Define the standard process that will support the deployment of the defined process.**

A standard process is developed that includes the fundamental process elements.

The standard process identifies the deployment needs and deployment context.

Guidance and/or procedures are provided to support implementation of the process as needed.

Appropriate tailoring guideline(s) are available as needed.

PA.3.GP3 Identify the roles and competencies for performing the standard process.

Process performance roles are identified.

Competencies for performing the process are identified.

PA.3.GP4 Identify the required infrastructure and work environment for performing the standard process.

Process infrastructure components are identified (facilities, tools, networks, methods, etc).

Work environment requirements are identified.

PA.3.GP5 Determine suitable methods and measures to monitor the effectiveness and suitability of the standard process.

Methods and measures for monitoring the effectiveness and suitability of the process are determined.
Appropriate criteria and data needed to monitor the effectiveness and suitability of the process are defined.

The need to conduct internal audit and management review is established.

Process changes are implemented to maintain the standard process.

PA.3.GP6 Deploy a defined process that satisfies the context specific requirements of the use of the standard process.

The defined process is appropriately selected and/or tailored from the standard process.

Conformance of defined process with standard process requirements is verified.

The roles for performing the defined process are assigned and communicated.

The responsibilities and authorities for performing the defined process are assigned and communicated.

Appropriate competencies for assigned personnel are identified.

Suitable training is available for those deploying the defined process.

Required human resources are made available, allocated and used.

Required information to perform the process is made available, allocated and used.

Required infrastructure and work environment is available.

Organizational support to effectively manage and maintain the infrastructure and work environment is available.

Infrastructure and work environment is used and maintained.

PA.3.GP7 Collect and analyze data about performance of the process to demonstrate its suitability and effectiveness.

Data required to understand the behaviour, suitability and effectiveness of the defined process are identified.

Data are collected and analyzed to understand the behaviour, suitability and effectiveness of the defined process.

Results of the analysis are used to identify where continual improvement of the standard and/or defined process can be made.

Generic work products for PA.3

0-6 Process description [PA.3 achievement a, b]

- Describes the standard process, including the fundamental process elements, interactions with other processes and appropriate tailoring guidelines.
- Addresses the performance, management and deployment of the process, as described by capability levels ALPHA and the PA.3 Process definition attribute.
- Addresses methods to monitor process effectiveness and suitability.
- Identifies data and records to be collected when performing the defined process, in order to improve the standard process.
- Identifies and communicates the personnel competencies, roles and responsibilities for the standard and defined process.
- Identifies the personnel performance criteria for the standard and defined process.

- Identifies the tailoring guidelines for the standard process.

- Identifies process measures.

0-7 Repository [PA.3 achievement a]

- Used to support and maintain the standard process assets.

0-8 Standard [PA.3 achievement a]

- Provides reference for the standards used by the standard process and identification about how they are used.

0-9 Strategy [PA.3 achievement a]

- Identifies approaches for defining, maintaining and supporting a standard process, including infrastructure, work environment, training, internal audit and management review.

0-2 Plan [PA.3 achievement b]

- Expresses the strategy for the organizational support, allocation and use of the process infrastructure.
- Describes the project's resources and the elements of the infrastructure needed to deploy the defined process.
- Expresses the strategy to satisfy the project's training needs.
- Identifies process improvement proposal(s) based on analysis of suitability and effectiveness.

0-3 Record [PA.3 achievement b, c, d]

- Provides evidence that the project personnel possess the required authorities, skills, experience and knowledge.
- Provides evidence that project personnel have received the required training to satisfy the needs of the project.
- Provides evidence that project infrastructure and working environment are made available and maintained for performing the defined process.

0-4 Register [PA.3 achievement a, d]

- Records the status of required corrective actions.
- Captures the project's work breakdown structure needed to define the tasks and their dependencies.

0-7 Repository [PA.3 achievement d]

- Provides evidence that information is made available for performing the defined process.

B.4.3.4 Level GAMMA: Aligned process

B.4.3.4.1 General

The previously described Articulated process is now implemented aligned to the organizational business goals, as well as ensuring customer satisfaction.

The following attributes of the process, together with the previously defined attribute, demonstrate the achievement of this level.

B.4.3.4.2 PA.4 Process alignment attribute

The process alignment attribute is a measure of the extent to which the process is maintained aligned to the organization business objectives. As a result of full achievement of this attribute:

- a) process information needs and objectives (quantitative and qualitative) in support of relevant business goals are established;
- b) results of measurement are collected, analyzed and reported in order to monitor the extent to which the quantitative objectives for process performance are met;
- c) corrective actions are taken to address deviations from objectives defined.

Generic practices for PA.4

PA.4.GP1 Determine the business goals to be addressed by quantitative management. [PA.4 Achievement: a] Select the relevant business goals from the organization's business goals to be addressed by quantitative or qualitative measurement. Select the process elements from the standard process that are to be included in the organization's measurement. Establish the organization's set of statistical or other quantitative or qualitative techniques to manage the organization's set of processes Establish the control limits of process performance for the process elements based on historical data.
PA.4 GP.2. Collect and analyze the data. [PA.4 Achievement: b] Monitor the performance of the selected process elements to establish stable, capable and predictable process within control and performance limits. Analyze the data using the organization's set of statistical or quantitative or qualitative techniques to establish an understanding of the variation of the selected processes or process elements. Identify and analyze causes of variation to determine the root cause.
PA.4.GP.3 Determine the corrective and preventative actions. [PA.4 Achievement: c] Determine corrective and preventative actions (as needed) to be taken to address the special and other causes of variation to prevent re-occurrence. Implement the corrective and preventative actions (as needed) to address variances outside control and performance limits.

Generic work products for PA.4

0-10 Goals [PA.4 achievement a]

- Business goals.
- Mission and vision statement.

0-11 Measure [PA.4 achievement b, c]

- Process measure.
- Process performance model.

0-2 Plan [PA.4 achievement a]

- Measurement plan.

0-12 Policy [PA.4 achievement a]

- Quality and Organizational policy.

0-3 Record [PA.4 achievement b, c]

- Provides evidence of process performance data.
- Provides evidence of customer satisfaction data.

0-4 Register [PA.4 achievement c]

- Corrective actions.
- Preventive action.

0-5 Report [PA.4 achievement b]

- Process performance report.
- Analysis report.

B.4.4 Work product characteristics

Work product characteristics listed in this subclause can be used when reviewing potential inputs and outputs of process implementation. The characteristics are provided as guidance for the attributes to look for, in a particular, sample work product to provide objective evidence supporting the assessment of a particular process. A documented process and assessor judgment is needed to ensure that the process context (application domain, business purpose, development methodology, size of the organization, etc.) is considered when using this information. Work products and their characteristics should be considered as a starting point for considering whether, given the context, they are contributing to the intended purpose of the process, not as a check-list of what every organization must have.

[Table B.13](#) contains the list of detailed work products, indicators for the capability level Alpha. [Table B.14](#) contains the list of generic work products, indicators for the capability levels Beta and Gamma.

Table B.13 — Detailed work product characteristics

WP ID	WP name	WP characteristics
1	Acceptance record	Documents the Customer acceptance of the Deliverables of the project. It may have the following characteristics: — record of the receipt of the delivery; — identifies the date received; — identifies the delivered elements; — records the verification of any Customer acceptance criteria defined; — identifies any open issues (if applicable); — signed by receiving Customer.
2	Change request	Identifies a Software, or documentation problem or desired improvement, and requests modifications. It may have the following characteristics: — identifies purpose of change; — identifies request status (new, accepted, rejected); — identifies requester contact information; — impacted system(s); — impact to operations of existing system(s) defined; — impact to associated documentation defined; — criticality of the request, date needed. The applicable statuses are: initiated, evaluated, and accepted.

Table B.13 (continued)

WP ID	WP name	WP characteristics
3	Correction register	Identifies activities established to correct a deviation or problem concerning the accomplishment of a plan. It can have the following characteristics: — identifies the initial problem; — defines a solution; — identifies corrective actions taken; — identifies the ownership for completion of defined actions; — identifies the open date and target closure date; — contains a status indicator; — indicates follow up actions.
4	Delivery instructions	Includes the following: — elements required for product release identified (i.e. hardware, software, documentation etc.); — delivery requirements; — sequential ordering of Tasks to be performed; — applicable releases identified; — identifies all delivered Software Components with version information; — identifies any necessary backup and recovery procedures. The applicable statuses are: verified, accepted, updated, and reviewed
5	Maintenance documentation	Describes the Software Configuration and the environment used for development and testing (compilers, design tools, construction and tests). It may have the following characteristics: — includes or refers to all Software Configuration elements developed during implementation; — identifies environment used for development and testing (compilers, design tools, construction and tests tools); — written in terms that maintenance personnel can understand. The applicable statuses are: verified and baselined.
6	Meeting record	Records the agreements established with Customer and/or Work Team. It may have the following characteristics: — purpose of meeting; — attendees; — date, place held; — reference to previous minutes; — what was accomplished; — identifies issues raised; — any open issues; — next meeting, if any. The applicable status is: updated.

Table B.13 (continued)

WP ID	WP name	WP characteristics
7	Progress status record	Records the status of the project against the Project Plan. It can have the following characteristics: — status of actual Tasks against planned Tasks; — status of actual results against established Objectives/goals; — status of actual resource allocation against planned Resources; — status of actual cost against budget estimates; — status of actual time against planned schedule; — status of actual risk against previously identified; — record of any deviations from planned Tasks and reason why. The applicable status is: evaluated.
8	Project plan	Presents how the project processes and activities will be executed to assure the project's successful completion, and the quality of the deliverable products. It Includes the following elements which may have the characteristics as follows: — product description; — purpose; — general Customer requirements; — scope description of what is included and what is not; — objectives of the project; — deliverables - list of products to be delivered to Customer; — tasks, including verification, validation and reviews with Customer and Work Team, to assure the quality of work products; tasks may be represented as a Work Breakdown Structure (WBS); — estimated duration of tasks; — resources (humans, materials, standards, equipment and tools) including the required training, and the schedule when the Resources are needed; — composition of Work Team; — schedule of the Project Tasks, the expected start and completion date for each task, and the relationship and dependencies of the Tasks; — estimated Effort and Cost; — identification of Project Risks; — version control strategy; — product repository tools or mechanism identified; — location and access mechanisms for the repository specified;

Table B.13 (continued)

WP ID	WP name	WP characteristics
		— version identification and control defined; — backup and recovery mechanisms defined; — storage, handling and delivery (including archival and retrieval) mechanisms specified; — delivery instructions; — elements required for product release identified (i.e., hardware, software, documentation etc.); — delivery requirements; — sequential ordering of Tasks to be performed; — applicable releases identified; — identifies all delivered Software Components with version information; — identifies any necessary backup and recovery procedures. The applicable statuses are: verified, accepted, updated and reviewed.
9	Project repository	Electronic container to store project work products and deliveries. It may have the following characteristics: — stores project work products; — stores released Deliverables products; — storage and retrieval capabilities; — ability to browse content; — listing of contents with description of attributes; — sharing and transfer of work products between affected groups; — effective controls over access; — maintain work products descriptions; — recovery of archive versions of work products; — ability to report work products status; — changes to work products are tracked to Change Requests. The applicable statuses are: recovered and updated.
10	Project repository backup	Repository used to backup the Project Repository and, if necessary, to recover the information.
11	Requirements specification	Identifies the software requirements. It may have the following characteristics. — Introduction –general description of Software and its use within the Scope of the Customer business. — Requirements description: — Functionality — established needs to be satisfied by the Software when it is used in specific conditions. Good functional requirements are when being adequate, accurate and safe. — User interface — definition of those user interface characteristics that allow to understand and learn the Software easily so the user be able to perform his/her Tasks efficiently including the interface exemplar description. — External interfaces — definition of interfaces with other software or hardware. — Reliability — specification of the software execution level concerning the maturity, fault tolerance and recovery.

Table B.13 (continued)

WP ID	WP name	WP characteristics
		— Efficiency — specification of the software execution level concerning the time and use of the Resources. — Maintenance — description of the elements facilitating the understanding and execution of the future Software modifications. — Portability — description of the Software characteristics that allow its transfer from one place to other. — Design and construction limitations/constraints — needs imposed by the Customer. — Interoperability — capability for two or more systems or Software Components be able to change information each other and use it. — Reusability — feature of any product/sub-product, or a part of it, so that it can be used by several users as an end product, in the own software development, or in the execution of other software products. — Legal and regulative — needs imposed by laws, regulations, etc. Each requirement is identified, unique and it is verifiable or can be assessed. The applicable statuses are: verified, validated and baselined.
12	Software	Software item (Software source and executable code) for a Customer, constituted by a collection of integrated Software Components. The applicable statuses are: tested and baselined.
13	Software components	A set of related code units. The applicable statuses are: unit tested, corrected and baselined.
14	Software configuration	A uniquely identified and consistent set of software products including: — Requirements Specification; — Software Design; — Traceability Record; — Software Components; — Software; — Test Cases and Test Procedures; — Test Report; — Product Operation Guide; — Software User Documentation; — Maintenance Documentation. The applicable statuses are: delivered and accepted.

Table B.13 (continued)

WP ID	WP name	WP characteristics
15	Software design	Textual and graphical information on the Software structure. This structure may include the following parts: Architectural high level software design — Describes the overall Software structure: — identifies the required Software Components; — identifies the relationship between Software Components; — consideration is given to any required: — software performance characteristics; — hardware, software and human interfaces; — security characteristics; — database design requirements; — error handling and recovery attributes. Detailed low level software design — includes details of the Software Components to facilitate its construction and test within the programming environment; — provides detailed design (could be represented as a prototype, flow chart, entity relationship diagram, pseudo code, etc.); — provides format of input/output data; — provides specification of data storage needs; — establishes required data naming conventions; — defines the format of required data structures; — defines the data fields and purpose of each required data element; — provides the specifications of the program structure. The applicable statuses are: verified and baselined.
16	Software user documentation	Describes the way of using the Software based on the user interface. It may have the following characteristics: — user procedures for performing specified Tasks using the Software; — installation and de-installation procedures; — brief description of the intended use of the Software (the concept of operations); — the supplied and required Resources; — needed operational environment; — availability of problem reporting and assistance; — procedures to access and exit the Software; — lists and explains Software commands and system provided messages to the user; — as appropriate for the identified risk, it includes warnings, cautions, and notes, with corrections; — it includes troubleshooting and error correction procedures. It is written in terms understandable by users. The applicable statuses are: preliminary, verified and baselined.

Table B.13 (continued)

WP ID	WP name	WP characteristics
17	Statement of work	Description of work to be done related to Software development. It may include: — product description; — purpose; — general customer requirements; — scope description of what is included and what is not; — objectives of the project; — deliverables list of products to be delivered to Customer. The applicable status is: reviewed.
18	Test cases and test procedures	Elements needed to test code. Test Case may include: — identifies the test case; — test items; — input specifications; — output specifications; — environmental needs; — special procedural requirements; — interface dependencies. Test Procedures may include: — identifies test name, test description and test completion date; — identifies potential implementation issues; — identifies the person who completed the test procedure; — identifies prerequisites; — identifies procedure steps including the step number, the required action by the tester and the expected results. The applicable statuses are: verified and baselined.
19	Test report	Documents the tests execution. It may include: — a summary of each defect; — identifies the related test case; — identifies the tester who found each defect; — identifies the severity for each defect; — identifies the affected function(s) for each defect; — identifies the date when each defect originated; — identifies the date when each defect was resolved; — identifies the person who resolved each defect. The applicable status is: baselined.
20	Traceability record	Documents the relationship among the requirements included in the Requirements Specification, Software Design elements, Software Components, Test Cases and Test Procedures. It may include: — identifies requirements of Requirements Specification to be traced; — provides forward and backward mapping of requirements to Software Design elements, Software Components, Test Cases and Test Procedures. The applicable statuses are: verified, baselined and updated.

Table B.13 (continued)

WP ID	WP name	WP characteristics
21	Verification results	Documents the verification execution. It may include the record of: — participants; — date; — place; — duration; — verification check-list; — passed items of verification; — failed items of verification; — pending items of verification; — defects identified during verification.
22	Validation results	Documents the validation execution, It may include the record of: — participants; — date; — place; — duration; — validation check-list; — passed items of validation; — failed items of validation; — pending items of validation; — defects identified during validation.
23	Human resource record	Personnel and training information of human resources. It may have the following characteristics: - Human Resource Register — personal data; — education; — experience; — roles assigned; — training. - Training Plan/Record description of the training activities. It may have the following characteristics: — courses, workshops, mentoring, on the job training etc.; — calendar (planned and actual information); — trainers; — logistics.
24	Process improvement suggestions	Contain the suggested information to improve an implemented process. It may have the following characteristics: — improvement suggestions of a process methods; — improvement suggestions of a process tools; — improvement suggestions of a process formats; — improvement suggestions of a process standards.

Table B.13 (continued)

WP ID	WP name	WP characteristics
25	Resource request	The Resource Request may have the following characteristics. — Plan for the necessary resources, knowledge and skills needed to perform the process or project. The request may include: — Human Resource requirements (knowledge and skills); — Infrastructure requirements (hardware, software, tools) — Requests for resource acquisition of the elements or any training needed. The request may include: — Description; — Due date.
26	Resource policies and/or mechanisms	Policies and/or mechanisms to manage the VSE resources. It may have the following characteristics. — Human Resource Policies and/or Mechanisms: — elements to consider in the selection, acceptance, allocation, training, and evaluation of human resources; — criteria and periodicity for the evaluation of performance of human resources. — Goods, Services and Infrastructure Policies and/or Mechanisms: — elements to consider in the acquisition of goods and services, and in the maintenance of the infrastructure; — periodicity for the preventive maintenance. NOTE This could be established as policies and/or mechanisms.
27	Procurement requirements	Information of the approved requirements that are going to be procured. It may have the following characteristics: — description of resource; — type of acquisition (internal/external); — due date; — approved budget.
28	Goods or services record	Goods and services main information. It may have the following characteristics: — Good or Services Register characteristics of good or service. It may have the following characteristics: — price; — purchase date; — allocation of good or service; — useful life; — service period. — Maintenance Plan/Record description of preventive and corrective infrastructure maintenance activities. It may have the following characteristics: — schedule (planned and actual information); — responsible parties; — suppliers (internal or external).
29	Supplier list	Record of good or service suppliers, including their general data, goods or services provided, satisfaction evaluation, among others.

Table B.13 (continued)

WP ID	WP name	WP characteristics
30	Resource report	Periodic report concentrating information on: — Human Resource and Training Report: — Human Resource Status; — performed and planned training activities. — Goods, Services and Infrastructure: — acquired goods and services; — satisfaction evaluation of acquired goods and services; — performed and planned maintenance activities.
31	Process plan	The definition of the process taxonomy and the tasks involved in manage the VSE processes. It may have the following characteristics: — Content of processes, index of the elements a process must define. It may have the following characteristics: — name; — purpose; — objectives; — input, output and internal products; — roles involved; — activities. — Schedule for: — process definition tasks; — process deployment tasks; — process evaluation tasks; — process improvement tasks.
32	Process definition	The information and documents that defines a process. It may have the following characteristics: — Process Map; — Process Owner; — Process Documentation; — Software Tools Requirements and Training Needs.
33	Evaluation definition and record	The standard information needed to carry out evaluations in the VSE. It may have the following characteristics: — type of evaluations; — scope; — method; — evaluation criteria; — evaluation record, a repository of all evaluations made in the VSE: — dates; — scopes; — responsible roles; — strengths; — weakness.

Table B.13 (continued)

WP ID	WP name	WP characteristics
34	Evaluation report	Report that contains the needed information to carry out and the results of an evaluation. It may have the following characteristics: — dates; — scope; — responsible roles; — strengths; — weakness.
35	Process improvement record	The repository of all improvement suggestions and for those selected the actions to be carried out to deploy the improvements suggestions. It may have the following characteristics: — Process Improvement Suggestions; — Process Improvement Actions.
36	Organizational repository backup	A backup of the Organizational Repository containing all the important information of the VSE processes and project. It may have the following characteristics: — Main processes products; — Project Repository.
37	Process progress report	Contains the minimal information the VSE periodically needs to know about the VSE processes status. It may have the following characteristics: — summary of evaluations; — summary of improvements.
38	Formal agreement	It may have the following characteristics: — identifies customer requirements (functional and non functional); — identifies time frame for delivery; — identifies budget and resources provided by both parts; — identifies what is to be purchased and any subcontractors; — identifies any warranty information; — identifies any copyright and licensing information; — identifies acceptance criteria; — identifies change management and problem resolution procedures; — identifies customer's role; — evidence of review and approval by authorised signatories. * Select content from ISO/IEC 15504-5.
39	Customer comments and complaints record	Record of customer's comments and complaints, gathered by the project portfolio management.
40	Project record	Administrative project information. It may have the following characteristics: — name; — responsible party; — starting and end date; — customer; — price.

Table B.13 (continued)

WP ID	WP name	WP characteristics
41	Project portfolio report	It may have the following characteristics: — Project Generation Report: Contains a summary of Project Generation Schedule status, and the project generation results. — Projects Report: Contains a summary of the status of all projects Progress Status Records. — Customer Relations Report: Contains a summary of the status of customer related activities and Customer Comments and Complaints records.
42	Request for proposal	It may have the following characteristics: — reference to the requirements specifications; — identifies desired characteristics, such as: — system architecture, configuration requirements; — quality criteria or requirements; — project schedule requirements; — expected delivery/service dates; — cost/price expectations; — regulatory standards/requirements; — identifies submission date for resubmission of the response. * Select content from ISO/IEC 15504-5
43	Technical proposal	It may have the following characteristics: — proposed solution; — proposed schedule; — scope of initial proposal: — the requirements that would be satisfied; — the requirements that could not be satisfied, and provides a justification of variants; — identifies conditions (e.g. time, location) that affect the validity of the proposal; — identifies obligations of the acquirer and the consequences of these not being met; — defines the estimated price of proposed development, product, or service. * Proposed content from ISO/IEC 15504-5, 12-00
44	Environmental information report	It may have the following characteristics: — market information; — technology trends; — competitors information.

Table B.13 (continued)

WP ID	WP name	WP characteristics
45	Business model	It may have the following characteristics: — customer segments and characteristics; — value proposition; — products and services description; — customer relationship; — key partners and suppliers; — key processes; — key internal projects; — key activities; — key resources; — key functional areas.
46	Strategic plan	It may have the following characteristics: — mission; — vision; — values; — objectives with indicators and goals; — required processes; — required internal projects; — required functional areas; — objectives relationship table; — organizational objectives alignment with process, areas and projects objectives; — customer strategy; — budget; — planning group.
47	Planning agenda	It may have the following characteristics: — date; — location; — participants; — special requirements.
48	Organizational repository strategy	— Identified what needs and objectives or goals there are to be satisfied by the organizational repository. — Establishes the options and approach for satisfying needs, objectives or goals for the organizational repository. — Establishes the evaluation criteria against which the strategic options are evaluated for the organizational repository. — Identify any constraints/risks of the organizational repository and how these will be addressed.

Table B.13 (continued)

WP ID	WP name	WP characteristics
49	Organizational repository	— Effective controls over access. — Type of items maintained. — Supporting hardware, software and product applications. — Identifies appropriate version control. — Ability to identify where the asset has been used for traceability issues. — Feedback from asset usage.
50	Project portfolio policies and/or mechanisms	— Established by the top management: — appropriate to the organization; — aligned to organization's business objectives; — addresses product and process quality goals; — supports the establishment and review of quality objectives; — commitment to comply with requirement; — commitment to improve the effectiveness of the quality management system; — defined performance assessment strategy.
51	Project generation schedule	— Identifies the potential projects to be performed. — Identifies the expected and actual start and completion date for the required projects. — Allows the identification of strategic projects and projects dependencies. — Identifies project completion status vs. planned date. — Has a mapping to schedule resource data.
52	VSE risks management plan	It may have the following characteristics: — risk list with probability, impact and exposure; — risk mitigation actions with dates and responsible; — risk contingency plans.

Table B.14 — Generic work product characteristics

WP ID	WP name	WP characteristics
0-1	Work product	— Defines the attributes associated with an artefact from a process execution: — key elements to be represented in the work product
0-2	Plan	As appropriate to the application and purpose) — Identifies the plan owner — Includes: — the objective and scope of what is to be accomplished; — assumptions made; — constraints; — risks; — tasks to be accomplished;

Table B.14 (continued)

WP ID	WP name	WP characteristics
		— schedules, milestones and target dates; — critical dependencies; — maintenance disposition for the plan. — Method/approach to accomplish plan — Identifies: — task ownership, including tasks performed by other parties (e.g. supplier, customer); — quality criteria; — required work products. — Includes resources to accomplish plan objectives: — time; — staff (key roles and authorities e.g. sponsor); — materials/equipment; — budget. — Includes contingency plan for non-completed tasks. — Plan is approved.
0-3	Record	— Work product stating results achieved or provides evidence of activities performed in a process. — An item that is part of a set of identifiable and retrievable data.
0-4	Register	A register is a compilation of data or information captured in a defined sequence to enable: — an overall view of evidence of activities that have taken place; — monitoring and analysis; — provides evidence of performance of a process over time.
0-5	Report	A work product describing a situation that: — includes results and status; — identifies applicable/associated information; — identifies considerations/constraints; — provides evidence/verification.
0-6	Process description	— A detailed description of the process/procedure which includes: — tailoring of the standard process (if applicable); — purpose of the process; — outcomes of the process; — task and activities to be performed and ordering of tasks; — critical dependencies between task activities; — expected time required to execute task; — input / output work products; — links between input and output work products; — identifies process entry and exit criteria; — identifies internal and external interfaces to the process; — identifies process measures;

Table B.14 (continued)

WP ID	WP name	WP characteristics
		— identifies quality expectations; — identifies functional roles and responsibilities; — approved by authorised personnel.
0-7	Repository	— Repository for components. — Storage and retrieval capabilities. — Ability to browse content. — Listing of contents with description of attributes. — Sharing and transfer of components between affected groups. — Effective controls over access. — Maintain component descriptions. — Recovery of archive versions of components. — Ability to report component status. — Changes to components are tracked to change/user requests.
0-8	Standard	— Identifies who/what they apply to. — Expectations for conformance are identified. — Conformance to requirements can be demonstrated. — Provisions for tailoring or exception to the requirements are included.
0-9	Strategy	— Identifies what needs and objectives or goals there are to be satisfied. — Establishes the options and approach for satisfying the needs, objectives, or goals. — Establishes the evaluation criteria against which the strategic options are evaluated. — Identifies any constraints/risks and how these will be addressed.
0-10	Goals	— Identifies the objective to be achieved. — Identifies who is expected to achieve the goal. — Identifies any incremental supporting goals. — Identifies any conditions constraints. — Identifies the timeframe for achievement. — Are reasonable and achievable within the resources allocated. — Are current, established for current project, organization. — Are optimized to support known performance criteria and plans.
0-11	Measure	— Quantitative or qualitative attribute for a product or process. — Defines the method for collecting data. — Understood by those expected to use them. — Provides value to the organization/project. — References any relevant goals. — Non-disruptive to the work flow. — Appropriate to the process, life cycle model, organization. — Has appropriate analysis and commentary to allow meaningful interpretation by users.

Table B.14 (continued)

WP ID	WP name	WP characteristics
0-12	Policy	— Authorized. — Available to all personnel impacted by the policy. — Establishes practices/rules to be adhered to.

B.5 Rules to derive VSE profiles from process capability levels

The VSE profile level achieved by an organization is derived from the process capability level ratings according to the specific rules identified for each specific process assessment model, in this case:

- a) to achieve the Basic profile for software, all processes assigned to Basic group achieve process capability level ALPHA or higher;
- b) to achieve the Organizational profile level, all processes assigned to organizational group achieve process capability level BETA or higher and the ones assigned to the Basic profile achieve capability level GAMMA.

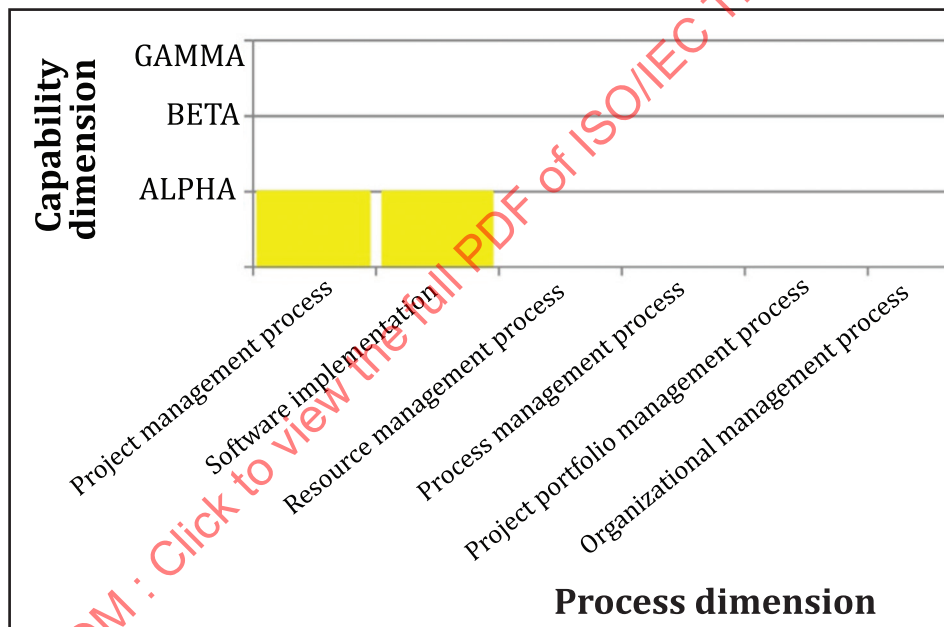


Figure B.5 — Rules for deriving Basic profile

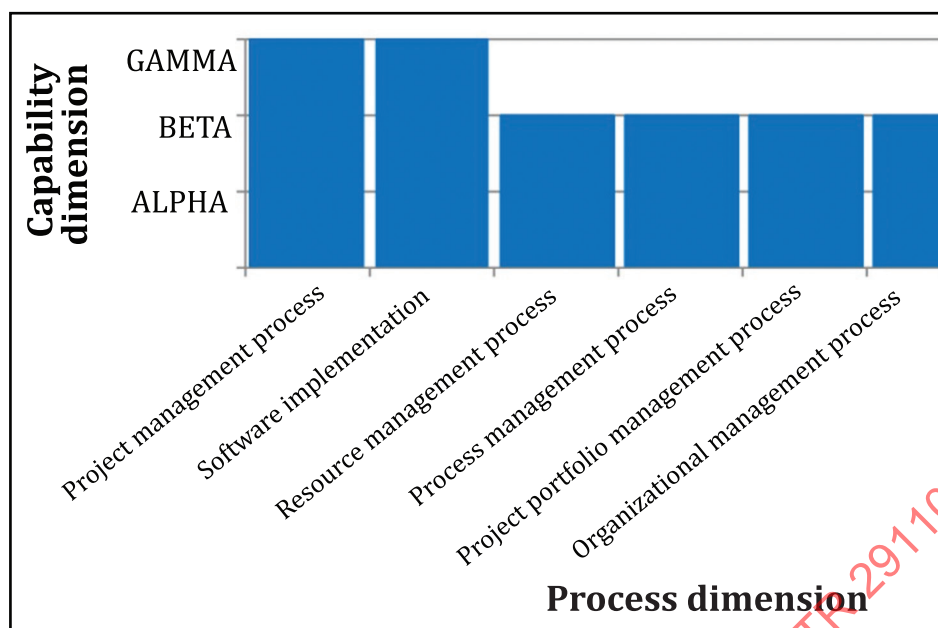


Figure B.6 — Rules for deriving Organizational Profile

Figure B.5 and Figure B.6 show the rules for deriving profile levels from capability levels. The figures illustrate the relationship between capability levels and processes, overlaid with the boundaries that characterize Profiles Levels. The VSE profile achieved by a VSE is derived from the process attribute ratings for each process according to the VSE profile model defined in Table B.15. The Basic profile is achieved when both the Basic profile processes (project management and software implementation)

Table B.15 — VSE profile ratings

Scale	Process	Process capability	Process attributes	Rating
Basic profile	Project management	ALPHA	VSE Process Performance	C
	Software implementation	ALPHA	VSE Process Performance	C
Organizational profile	Project management	GAMMA	VSE Process Performance	C
			Management of resources	C
			Defined Process	C
			Process Alignment	C
	Software implementation	GAMMA	VSE Process Performance	C
			Management of resources	C
			Defined Process	C
			Process Alignment	C
	Process management	BETA	VSE Process Performance	C
			Management of resources	C
			Defined Process	C
	Project portfolio management	BETA	VSE Process Performance	C
			Management of resources	C
			Defined Process	C

Table B.15 (continued)

Scale	Process	Process capability	Process attributes	Rating
	Resource management	BETA	VSE Process Performance	C
			Management of resources	C
			Defined Process	C
	Organizational management	BETA	VSE Process Performance	C
			Management of resources	C
			Defined Process	C

B.6 Conformity of the exemplar process assessment model

This subclause verifies how the defined process assessment model meets the requirements for conformance defined in ISO/IEC 33004. The process assessment model can be used in the performance of assessments that meet the requirements of ISO/IEC 33002. It may also be used as a guide for a VSE profile or maturity model developer.

For ease of reference, the requirements from ISO/IEC 33004 are embedded verbatim in the text of this clause. Where text has been quoted from ISO/IEC 33004:2015, that text is enclosed in a box, for ease of identification. They should not be construed as normative elements of this annex.

6.3.1 A process assessment model shall relate to a single process quality characteristic.

6.3.2 A process assessment model shall incorporate a single process measurement framework based on the selected process quality characteristic.

The process quality characteristics measures through this process assessment model is the capability level of the VSE processes. The only one measurement framework used is the ones defined in [Annex A](#).

6.3.3 A process assessment model shall be based on one or more process reference models and a process measurement framework.

6.3.4 A process assessment model shall relate to at least one process from the selected process reference model(s).

6.3.5 A process assessment model shall declare its scope of coverage in the terms of:

- the selected process quality characteristic;
- the selected process measurement framework;
- the selected process reference model(s);
- the selected processes from the process reference model(s);
- the process attributes and (if relevant) the process quality levels of the process quality characteristic selected from the process measurement framework.

This process assessment model is based upon the process reference model defined in ISO/IEC 29110-4-1.

In the capability dimension of this process assessment model, the model addresses all of the capability levels defined in the measurement framework in [Annex A](#).

If the selected process measurement framework provides a nominal scale, then the process assessment model shall, for a given process, address all of the defined process attributes, including the process performance attribute.

If the process measurement framework provides an ordinal or interval scale, then the process assessment model shall address, for a given process, all, or a continuous subset, of the levels (starting at process quality level 1) of the process measurement framework for the process quality characteristic for each of the processes within its scope.

NOTE It would be permissible for a model, for example, to address solely process quality level 1 or to address process quality levels 1, 2 and 3, but it would not be permissible to address process quality levels 2 and 3 without process quality level 1

This process assessment model addresses all process attributes and capability levels defined in the measurement framework defined in [Annex A](#).

6.3.8 Assessment indicators

A process assessment model shall be based on a set of assessment indicators that

- a) explicitly address the purpose and process outcomes, as defined in the selected process reference model, of each of the processes within the scope of the process assessment model;
- b) demonstrate the achievement of the process attributes within the scope of the process assessment model;
- c) demonstrate the achievement (where relevant) of the process quality levels within the scope of the process assessment model.

The assessment indicators generally fall into three types:

- a) practices that support achievement of either the process purpose or the specific process attribute;
- b) information items and their characteristics that demonstrate the respective achievements;
- c) resources and infrastructure that support the respective achievements.

The process assessment model provides a two-dimensional view of process capability for the processes in the process reference model, through the inclusion of assessment indicators as shown in [B.4](#). The assessment indicators used are, as shown in [Figure B.4](#):

- base practices and work products for the process attribute ALPHA;
- generic practices and generic work products for the other process attributes.

They support the judgment of the performance and capability of an implemented process.

6.3.9 Mapping process assessment models

A process assessment model shall provide explicit mapping from the relevant elements of the process assessment model to the processes of the selected process reference model(s) and to the relevant process attributes of the selected process measurement framework. The mappings shall be complete, clear and unambiguous.

This enables process assessment models that are structurally different to be related to the same process reference model(s) and the process measurement framework.

6.3.9.1 Mapping to process reference models

The mapping of the assessment indicators within the process assessment model shall be to the purpose and process outcomes of the processes in the selected process reference model.

6.3.9.2 Mapping to process measurement framework

The mapping of the assessment indicators within the process assessment model shall be to the process attributes (including all the process attribute outcomes listed for each process attribute) in the process measurement framework.

Each of the processes in this process assessment model is identical in scope to the process defined in the process reference model. Each base practice and work product is cross-referenced to the process outcomes it addresses. All work products relate as inputs or outputs to the process as a whole (see mappings in [B.4](#)).

Each of the process attributes in this process assessment model is identical to the process attribute defined in the measurement framework. The base practices and work products address the characteristics from each process attribute.

[Table B.16](#) lists the mappings of the indicators to the achievements associated with each process attribute.

Table B.16 — Mapping of indicators and process attributes

Indicators	Practice name	Maps to
PA.1: Process performance attribute: BPs and WPs	Achieve the process outcomes.	PA.1
GPs and GWPs	All indicators in B.4	PA.2 PA.3 PA.4

6.3.10 Expression of assessment results

A process assessment model shall provide a formal and verifiable mechanism for representing the results of an assessment as a set of process attribute ratings for each assessed process (the process profiles) selected from the process reference model(s).

NOTE The expression of results may involve a direct translation of process assessment model ratings into a process profile as defined in this International Standard, or the conversion of the data collected during the assessment (with the possible inclusion of additional information) through further judgment on the part of the assessor

The processes in this process assessment model are identical to those defined in the process reference model. The process attributes and the process attributes rating in this process assessment model are identical to those defined in the measurement framework. As a consequence, results of assessments based upon this process assessment model are expressed directly as a set of process attribute ratings for each process within the scope of the assessment. No form of translation or conversion is required.

Annex C (informative)

Exemplar system life cycle process assessment model for Very Small Entities

NOTE The statements using the verbal form "shall" in this annex are copied from the applicable standards and do not constitute requirements of this document.

C.1 Structure of the process assessment model

This annex:

- defines a process assessment model that meets the requirements of ISO/IEC 33004 and that supports the performance of an assessment by providing indicators for guidance on the interpretation of the processes defined in ISO/IEC/TR 29110-5-6-2 (processes included in the Basic profile for Very Small Entities) and the process attributes as defined in [Annex A](#) (our MF);
- provides guidance, by example, on the definition and use of assessment indicators.

The process assessment model is a two-dimensional model of process capability. In one dimension, the process dimension, the processes are defined in ISO/IEC/TR 29110-5-6-2. In the other dimension, the capability dimension, a set of process attributes grouped into capability levels is defined. The process attributes provide the measurable characteristics of process capability.

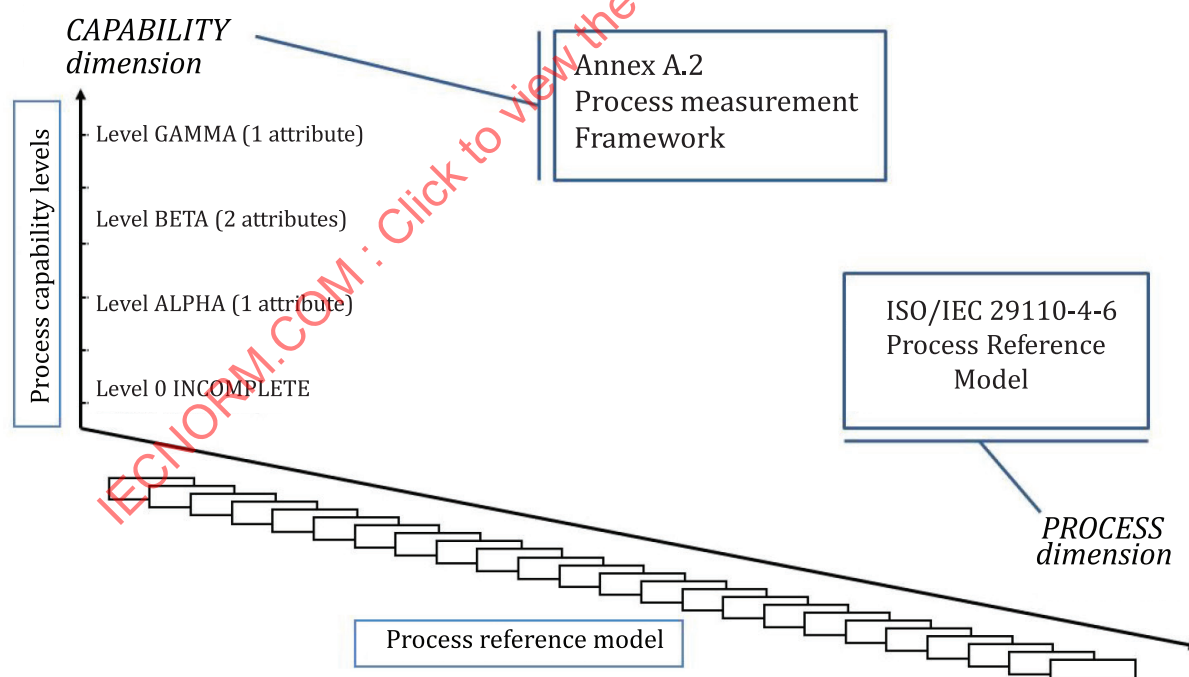


Figure C.1 — Structure of the process assessment model

The process reference model defined in ISO/IEC/TR 29110-5-6-2, associated with the process attributes defined in [Annex A](#), establishes a process assessment model used as a common basis for performing

assessments of software engineering process capability, allowing for the reporting of results using a common rating scale.

The process reference model and the capability dimension defined in [Annex A](#) cannot be used alone as the basis for conducting reliable and consistent assessments of process capability since the level of detail provided is not sufficient. The descriptions of process purpose and outcomes in the process reference model, and the process attribute definitions in [Annex A](#), need to be supported with a comprehensive set of indicators of process performance and process capability that are used for assessment performance

The indicators are used as a basis for collecting the objective evidence that enables an assessor to assign ratings. The set of indicators included in this annex is intended to be an all-inclusive set and is it intended to be applicable in its entirety.

The process assessment model in this annex (this PAM) is directed at assessment sponsors and lead assessors who wish to select a model, and associated documented process method, for assessment (for either capability determination or process improvement). Additionally, it may be of use to developers of assessment models in the construction of their own model, by providing examples of good software engineering and management practices.

The process assessment model defined in this annex is conformant with the ISO/IEC 33004 requirements for a process assessment model and can be used as the basis for conducting an assessment of software engineering process capability for VSEs.

Copyright release for the process assessment model: Users of this annex may freely reproduce the detailed descriptions contained in the assessment model as part of any tool or other material to support the performance of process assessments, so that it can be used for its intended purpose.

C.2 Processes dimension

[Figure C.2](#) lists the processes from ISO/IEC/TR 29110-5-6-2 that are included in the process dimension of the process assessment model.

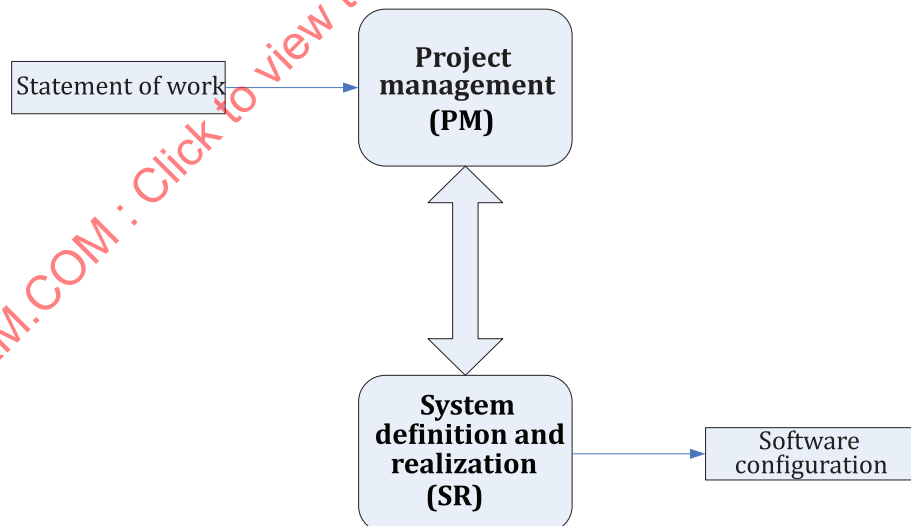


Figure C.2 — Process included in the systems engineering Basic profile for VSE

[Figure C.2](#) lists the processes from ISO/IEC/TR 29110-5-6-2 that are included in the process dimension of the process assessment model.

The organizational group of processes are interrelated (see [Figure B.3](#)).

The organizational management process provides a Strategic Plan which defines project strategies, budget, and required processes.

The resource management process, the process management process and the project portfolio management process receive the *Strategic Plan as an input that will guide its activities*.

The resource management receives the *Resource Request* from all the processes and projects, analyzes them and assigns resources to the processes and projects according to the *Resource Policies and/or Mechanisms*.

The process management process receives the *Process Improvement Suggestions* from all the processes, analyzes them and applies these suggestions to the processes in order to improve them. The Process Evaluation activity evaluates the processes implementation finding strengths and weakness, and coordinates the resolution of the weakness.

The project portfolio management process receives the *Request for Proposal* form the customers, activates the accepted projects and supervises the correct execution of these projects.

For the process dimension, all the processes in [Figure C.2](#) and [Figure B.3](#) are included within the process dimension of the process assessment model. Each process in the process assessment model is described in terms of a purpose statement. These statements contain the unique functional objectives of the process when performed in a particular environment. A list of specific outcomes is associated with each of the process purpose statements, as a list of expected positive results of the process performance.

C.3 Capability dimension

For the capability dimension, the process capability levels and process attributes are identical to those defined in [Annex A](#), the measurement framework (MF).

Evolving process capability is expressed in the process assessment model in terms of process attributes grouped into capability levels. Process attributes are features of a process that can be evaluated on a scale of achievement, providing a measure of the capability of the process. They are applicable to all processes. Each process attribute describes a facet of the overall capability of managing and improving the effectiveness of a process in achieving its purpose and contributing to the business goals of the organization.

Within the process assessment model, the measure of capability is based upon the one process attributes (PA) defined in [Annex A](#) (the MF). Process attributes are used to determine whether a process has reached a given capability. Each attribute measures a particular aspect of the process capability.

At each level there is no ordering between the process attributes; each attribute addresses a specific aspect of the capability level. The list of process attributes is shown in [Table A.1](#).

The process attributes are evaluated on a four point ordinal scale of achievement, as defined in [Annex A](#) (the MF). They provide insight into the specific aspects of process capability required to support process improvement and capability determination.

C.4 Assessment indicators

C.4.1 General

The process assessment model is based on the principle that the capability of a process can be assessed by demonstrating the achievement of process attributes on the basis of evidence related to assessment indicators. These indicators provide guidance for assessors in accumulating the necessary objective evidence to support judgments of capability. Assessment indicators are used to confirm that certain practices were performed, as shown by observable evidence collected during an assessment. All such evidence comes either from the examination of work products of the processes assessed or from statements made by the performers and managers of the processes.

The evidence obtained should be recorded in a form that clearly relates to an associated indicator, so that the support for the assessor's judgment can be readily confirmed or verified as required by ISO/IEC 33002.

The output from a process assessment is a set of process profiles, one for each process within the scope of the assessment. Each process profile consists of a set of the process attribute ratings for an assessed process. Each attribute rating represents a judgment by the assessor of the extent to which the attribute is achieved. To improve the reliability and repeatability of the assessment, the judgments of the assessor are based on a coherent set of recorded objective evidences. The assessment indicators, and their relationship to process performance and process capability, are shown in [Figure C.3](#).

There are two types of assessment indicators: process capability indicators, which apply to capability levels ALPHA to GAMMA and process performance indicators, which apply exclusively to capability level ALPHA. These indicators are defined in [C.4.2](#).

The process attributes in the capability dimension have a set of process capability indicators that provide an indication of the extent of achievement of the process attribute in the instantiated process. These indicators concern significant activities, resources or results associated with the achievement of the process attribute purpose by a process.

The process capability indicators are:

- generic practice (GP);
- generic work product (GWP).

As additional indicators for supporting the assessment of a process at Level ALPHA, each process in the process dimension has a set of process performance indicators which is used to measure the degree of achievement of the process performance attribute for the process assessed.

The process performance indicators are:

- base practice (BP);
- work product (WP).

The process performance indicators are used to measure the degree of achievement of the process performance attribute (PA.1) for the process assessed.

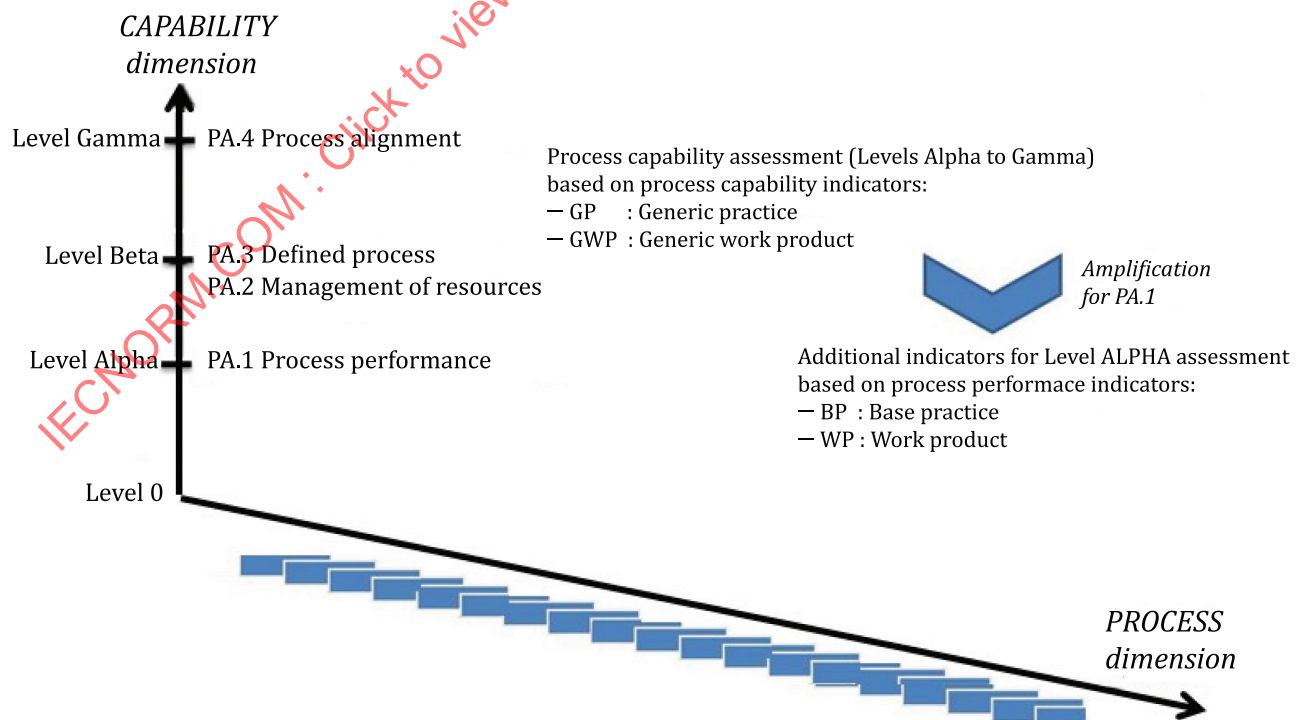


Figure C.3 — Assessment indicators

The process capability indicators represent the type of evidence that would support judgments of the extent to which the process attributes are achieved. Evidence of their effective performance or existence supports the judgment of the degree of achievement of the process attribute. The generic practices are the principal indicators of process capability.

The generic practice (GP) indicators are activities of a generic type and provide guidance on the implementation of the process attribute's characteristics. They support the achievement of the process attribute and many of them concern management practices, i.e. practices that are established to support the process performance as it is characterized at level 1. During the evaluation of process capability, the primary focus is on the performance of the generic practices. In general, performance of all generic practices is expected for full achievement of the process attribute.

The generic work product (GWP) indicators are sets of characteristics that would be expected to be evident in work products of generic types as a result of achievement of an process attribute. The generic work products form the basis for the classification of the work products defined as process performance indicators; they represent basic types of work products that may be inputs to or outputs from all types of process.

These two types of indicators help to establish objective evidence of the extent of achievement of the specified process attribute.

Due to the fact that level 1 capability of a process is only characterized by the measure of the extent to which the process purpose is achieved, the process performance attribute (PA.1) has a single generic practice indicator (GP.1.1). In order to support the assessment of PA.1 and to amplify the process performance achievement analysis, additional process performance indicators are defined in the process assessment model.

There are two types of process performance indicators: **base practice (BP)** indicators and **work product (WP)** indicators. Process performance indicators relate to individual processes defined in the process dimension of the process assessment model and are chosen to explicitly address the achievement of the defined process purpose.

Evidence of performance of the base practices and the presence of work products with their expected work product characteristics, provide objective evidence of the achievement of the purpose of the process.

A base practice is an activity that addresses the purpose of a particular process. Consistently performing the base practices associated with a process will help the consistent achievement of its purpose. A coherent set of base practices is associated with each process in the process dimension. The base practices are described at an abstract level, identifying "what" should be done without specifying "how". Implementing the base practices of a process should achieve the basic outcomes that reflect the process purpose. Base practices represent only the first step in building process capability, but the base practices represent the unique, functional activities of the process, even if that performance is not systematic. The performance of a process produces work products that are identifiable and usable in achieving the purpose of the process. In this assessment model, each work product has a defined set of example work product characteristics that may be used when reviewing the work product to assess the effective performance of a process. Work product characteristics may be used to identify the corresponding work product produced/used by the assessed organization.

[C.4.2](#) contains a complete description of the processes, including the base practices and the associated work products. Each base practice has its own identifier. The identification number of each work product correspond to its detailed characteristics contained in [C.4.4](#).

[C.4.3](#) contains a complete description of the process attributes, including the generic practices and the associated generic work products. The identification number of each generic work product correspond to its detailed characteristics contained in [C.4.4](#).

[C.4.4](#) contains a complete list of specific work products. An assessor would refer to the specific work product when performing an assessment. Note that the generic work product characteristics are detailed in [B.4.4](#).

The processes in the process dimension can be directly mapped to the processes defined in the process reference model. It also includes the rules of assessment indicators identification.

The individual processes are described in terms of process name, process purpose, and process outcomes as defined in ISO/IEC/TR 29110-5-6-2 (PRM).

In addition, the process dimension of the PAM provides information in the form of the following:

- a) a set of base practices for the process providing a definition of the tasks and activities needed to accomplish the process purpose and fulfil the process outcomes; each base practice is explicitly associated to a process outcome;
- b) a number of input and output work products associated with each process and related to one or more of its outcomes;
- c) characteristics associated with each detailed work product.

The associated work products provide objective guidance for potential inputs and outputs to look for, and objective evidence supporting the assessment of a particular process. A documented assessment process and assessor judgment is needed to ensure that process context (application domain, business purpose, development methodology, size of the organization, etc.) is explicitly considered when using this information. This list should not be considered as a checklist of what each organization must have but rather as an example and starting point for considering whether, given the context, the work products are necessary and contributing to the intended purpose of the process.

These work products are identified with their work product identifier number as used in [C.4.4](#).

A nomenclature for assessment indicators is defined in order to identify them unambiguously and relate them to the architecture of the model. The nomenclature for base practices facilitate the identification of the processes, the base practices that belong to each process.

Each practice is assigned an identifier consisting of a multi-part alphanumeric code.

Base practices used in this exemplar assessment model provide a definition of the tasks and activities needed to accomplish the process purpose and fulfil the process outcomes. A base practice is identified with the following sequence: PI.BPPN. Where the codes are the following:

- PI process identifier (2 letters) (e.g. PM for project management);
- BP the text “BP” used to signify base practice.

C.4.2 Process performance indicators

C.4.2.1 Systems engineering Basic profile group

C.4.2.1.1 PM. Project management

Table C.1 — System project management process base practices indicators

Process ID	PM
Process name	Project management
Process purpose	The purpose of the project management process is to establish and carry out in a systematic way the Tasks of the system development project, which allows complying with the project's Objectives in the expected quality, time and costs.

Table C.1 (continued)

Process outcomes	a) The scope of the work for the project shall be defined. b) The tasks and resources necessary to complete the work shall be estimated (schedule, effort, cost, duration) requested and committed. c) Planning for the execution of the project shall be developed according to the scope and the tasks defined. d) A Configuration Management strategy shall be developed. e) Planning shall be reviewed and agreed by both the Customer and the Project Manager. f) Progress of the project against the planning shall be monitored and reported. g) A Risk Management Approach shall be developed; risks shall be identified, analyzed, prioritized and monitored during the conduct of the project; Resources to manage the risks shall be determined. h) Changes shall be addressed, analyzed and evaluated for cost, schedule and technical impact. i) Relevant items of system configuration shall be identified and controlled including their storage, baseline, handling and modifications. j) Releases of Product items shall be controlled and made available to relevant stakeholders. k) Product shall be completed and delivered to the Customer as planning. l) Meetings with the work team and the Customer, suppliers shall be held to guarantee that work done complies with the project requirements and planning.
	m) Agreements resulting from meetings shall be registered and tracked. n) Actions to correct planning problems and unachieved targets (schedule, effort, cost, duration) shall be taken. o) Project closure shall be performed to get the Customer acceptance. p) A system disposal strategy is defined. q) The system elements or waste products are destroyed, stored, reclaimed or recycled.
Base practices	PM.BP1 Review the Statement of Work [Outcome: a] PM.BP2 Define with the Customer the Delivery Instructions of each one of the Deliverables specified in the Statement of Work. [Outcome: e] PM.BP3 Define the System Breakdown Structure (SBS) that represents the relationship between the system and its system elements. [Outcome: b] NOTE 1 The system boundaries must be defined NOTE 2 This task is iterative as the SBS is based on the System Design Document (SDD). The SDD is at the beginning preliminary and all system elements hierarchy is not necessary defined completely. The SBS is updated while the SDD is progressively completed. PM.BP4 Select a product lifecycle and define milestones according to the Statement of Work. [Outcome: b] PM.BP5 Identify the specific Tasks to be performed in order to produce the Deliverables and their System Elements identified in the Statement of Work. Include Tasks in the SR process along with verification, validation and reviews with Customer/other stakeholders and Work Team Tasks to ensure the quality of work products. Identify the Tasks to perform the Delivery Instructions. Document the Tasks. This task is performed in parallel with the definition of the SEMP. [Outcome: b]

Table C.1 (continued)

	PM.BP6 Establish the Estimated Duration to perform each task. [Outcome: b] PM.BP7 Identify and document the Resources: human, material, equipment and tools, standards, including the required training of the Work Team to perform the project. Include in the schedule the dates when Resources and training will be needed. [Outcome: b] PM.BP8 Establish the Composition of Work Team assigning roles and responsibilities according to the Resources. [Outcome: b] PM.BP9 Assign estimated start and completion dates to each one of the Tasks in order to create the Schedule of the Project Tasks taking into account the assigned Resources, sequence and dependency of the Tasks. Define milestones of the project (e.g. end of phases, payments, deliveries) [Outcome: b] PM.BP10 Calculate and document the project Estimated Effort and Cost. [Outcome: b] PM.BP11 Identify and document a Risk Management Approach and the risks which may affect the project. [Outcome: g] PM.BP12 Identify and document a Disposal Management Approach. [Outcome: p] PM.BP13 Document the Configuration Management Strategy in the Project Plan. Identify the Configuration items. Define the applicable configuration status. Define the tasks and actors to manage the changes and the configuration. [Outcome: d, i] PM.BP14 Include System Description, Scope, Objectives and Deliverables, and reference to the SOW in the Project Plan. [Outcome: c]
	PM.BP15 Generate the Project Plan integrating the elements previously identified and documented. [Outcome: c] PM.BP16 Verify and obtain approval of the Project Plan. Verify that all Project Plan elements are viable and consistent. The results found are documented in a Verification Results and corrections are made until the document is approved by the Project Manager. [Outcome: c] PM.BP17 Review and accept the Project Plan. Customer and other Stakeholders review and accept the Project Plan, making sure that the Project Plan elements match with the Statement of Work. [Outcome: e] PM.BP18 Establish the Project Repository using the Configuration Management Strategy. [Outcome: d] PM.BP19 Assign Tasks to the work team members related to their role, according to the current Project Plan. [Outcome: b] PM.BP20 Monitor the Project Plan execution and record actual data in Progress Status Record. [Outcome: e] PM.BP21 Analyze and evaluate the Change Request for cost, schedule and technical impact. The Change Request can be initiated externally by the Customer and other Stakeholders, or internally by the Work Team. Update the Project Plan, if the accepted change affects agreements with Customer and Stakeholders. Change Request, which affects those agreements, needs to be negotiated by both parties. (see PM.2.4) [Outcome: h] PM.BP22 Conduct revision meetings with the Work Team, identify problems, review risk status, record agreements and track them to closure. [Outcome: l, m]

Table C.1 (continued)

	* If an artefact has to be purchased, review and issue the Purchase Order (PO) developed in activity SR.3 to acquire the artefact. PM.BP23 Conduct revision meetings with the Customer, Stakeholders, record agreements and track them to closure. Change Request initiated by Customer, and other Stakeholders, or initiated by Work Team, which affects the Customer, Stakeholders, needs to be negotiated to reach acceptance of both parties. If necessary, update the Project Plan according to new agreement with Customer and other stakeholders. [Outcome: l, m] PM.BP24 Perform configuration management. According to the configuration management strategy, manage in configuration the different artefacts of the project. Generate Product as planned. Identify changes (e.g. architecture, requirements) and/or Project Plan to address major deviations, potential risks or problems concerning the accomplishment of the project. Initiate Change Requests on baselined artefacts and analyze impacts (technical cost, quality) before change approval by the Project Manager. Track the changes to closure. [Outcome: h, i, j, k] PM.BP25 Manage Project Repository. Update Project Repository at each new System Configuration. Perform backup and recovery testing according to the Configuration Management Strategy. [Outcome: i] PM.BP26 Perform Project Repository recovery using the Project Repository Backup, if necessary. [Outcome: i] PM.BP27 Evaluate project progress with respect to the Project Plan, comparing actual Tasks against planned Tasks
	— Actual results against established project Objectives. — Actual resource allocation against planned Resources. — Actual cost against budget estimates. — Actual time against planned schedule. — Actual risk against previously identified. [Outcome: e] PM.BP28 Establish and execute actions to treat deviations or problems and identified risks concerning the accomplishment of the plan, as needed, document them in the Correction Register and track them to closure [Outcome: n] PM.BP29 Elaborate or update the Justification Document of the Project. Record the reasons of needs. Record issues, hypothesis, architecture trade-off studies and decisions of the project. Keep track of meetings and decisions. Regroup or reference the Verification and Validation Reports in the Justification Document (if appropriate or needed). Establish traceability between the rationale and the related Systems Engineering artefacts. [Outcome: h] PM.BP30 Formalize the completion of the project according to the Delivery Instructions established in the Project Plan, providing acceptance support and getting the Product Acceptance Record signed. [Outcome: o] PM.BP31 Update Project Repository. [Outcome: i, j] PM.BP32 Perform delivery according to Delivery Instructions. [Outcome: k] PM.BP34 Execute the Disposal Management Approach [Outcome: q]

Table C.2 — System project management process work products indicators

Work products	
Inputs	Outputs
1 Change Request [Outcome: i, h]	
	2 Change Request [Outcome: g, h, i, m]
3 Correction register [Outcome: l, m]	3 Correction register [Outcome: n]
	4 Disposed System [Outcome: p, q]
	9 Justification Document [Outcome: h]

Table C.2 (continued)

Work products	
Inputs	Outputs
10 Meeting Record [Outcome: l]	10 Meeting Record [Outcome: e, l, m]
	11 Product Acceptance Record [Outcome: o]
13 Project Plan [Outcome: d, e, g, i, k, l, m, o]	13 Project Plan [Outcome: a, b, c, e, g, i, j, l, m, p]
14 Project Repository [Outcome: k, o]	14 Project Repository [Outcome: d, j]
	15 Project repository backup [Outcome: i]
16 Project status record [Outcome: e, h, i, l, m, n]	16 Project status record [Outcome: e]
18 Statement of Work [Outcome: a, b, p]	
21 System Design document [Outcome: b]	

C.4.2.1.2 SR. System definition and realization

Table C.3 — System definition and realization process base practices indicators

Process ID	SR
Process name	System definition and realization
Process purpose	The purpose of the system definition and realization process is the systematic performance of the specification of system/system element, analysis, design, construction, integration and verification/validation activities for new or modified system according to the specified requirements.

Table C.3 (continued)

Process outcomes	a) Stakeholders requirements, system requirements (and Interfaces) and system elements requirements (and Interfaces) specifications shall be defined; Integration, Verification and Validation plan and Integration, Verification and Validation Test Procedures for the System verification and validation shall be established and updated. b) Stakeholders requirements, system requirements and system elements requirements shall be analyzed for correctness and testability. c) Stakeholders requirements shall be agreed by the Customer and other stakeholders. d) System requirements and system elements requirements shall be baselined and communicated to work team. e) System architectural design shall be developed and baselined. f) System architectural design shall describe the system elements and their internal and external interfaces. g) System elements defined by the design shall be produced or acquired. h) Acceptance tests shall be defined and performed to verify the consistency with requirements and the design. i) System elements shall be integrated. j) Integrated System Elements shall be tested and verified, the results shall be recorded. k) Consistency and traceability between stakeholder's requirements, system requirements (and Interfaces), System elements requirements (and Interfaces), system architectural design and system elements shall be established; consistency and traceability between Integration, Verification and Validation Plan and the specified Requirements and System Design and, between Integration, Verification and Validation Procedures and Integration, Verification and Validation Plan shall be established; consistency of System Maintenance Document and System Training Specification with System Requirements Specifications shall be established. l) Defects identified in reviews, traceability analysis, tests and verifications shall be corrected. m) System configuration shall be integrated, baselined and stored in the project repository. n) System Maintenance Document and System Training Specifications shall be established, updated, verified and approved. o) Delivery shall be performed and transition to Manufacturing and Inservice/After-sales Support effective.
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