
**Information technology — Process
assessment — Process assessment
model for software testing**

*Technologies de l'information — Évaluation du procédé — Modèle
d'évaluation du procédé pour l'essai de logiciel*

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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. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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).

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/IEC JTC 1, *Information technology, SC 7, Software and systems engineering*.

Introduction

The ISO/IEC 330xx set of standards covering the domain of process assessment are based on a view of assessment that establishes architecture of the following three components:

- process models that define processes, the entities that are the subject of assessment;
- measurement frameworks that provide scales for evaluating specified attributes;
- a specification of the process to be followed in conducting assessments.

This International Standard provides an example of a process assessment model for software testing for use in performing a conformant assessment in accordance with the requirements of ISO/IEC 33002.

An integral part of conducting an assessment is to use a process assessment model (PAM) related to a process reference model (PRM) and conformant with the requirements defined in ISO/IEC 33004.

A process reference model cannot be used alone as the basis for conducting a consistent and reliable assessment of process capability since the level of detail is not sufficient. Therefore,

- the description of the process purpose and process outcome(s) provided by the process reference model needs to be supported with a comprehensive set of indicators of process performance, and
- the capability levels and process attributes defined in ISO/IEC 33020 and its associated rating scale need to be supported with a set of indicators of process capability.

Used in this way and in conjunction with a documented process, consistent and repeatable ratings of process capability is possible.

This International Standard, a process assessment model for software testing, contains a set of indicators to be considered when interpreting the intent of the process reference model. These indicators may also be used when implementing a process improvement program or to help evaluate and select an assessment model, methodology, and/or tools.

The process reference model defined in ISO/IEC/IEEE 29119-2 has been used as the basis for the ISO/IEC 33063 exemplar process assessment model for software testing.

The following are provided within this International Standard:

- [Clause 4](#) provides a detailed description of the structure and key components of the process assessment model, which introduces the following two dimensions: a) process dimension; b) capability dimension. Assessment indicators are also introduced in this Clause;
- [Clause 5](#) addresses the process dimension. It uses process definitions from ISO/IEC/IEEE 29119-2 to identify a process reference model. The processes of the process reference model are described in the process assessment model in terms of purpose and outcomes. The process assessment model expands the process reference model process definitions by including a set of process performance indicators called base practices for each process. The process assessment model also defines a second set of indicators of process performance by associating work products with each process;
- [Clause 6](#) addresses the capability dimension. It duplicates the definitions of the capability levels and process attributes from ISO/IEC 33020 and expands each of the attributes through the inclusion of a set of generic practices. These generic practices belong to a set of indicators of process;
- [Annex A](#) provides a statement of conformance of the process assessment model for software testing to the requirements defined in ISO/IEC 33004;
- [Annex B](#) provides a guideline on how the planning and scoping of an assessment is done with this process assessment model for software testing;

NOTE As the processes described in this model are generic when practically applied to an assessment, they have to be applied to the different test phases or test levels or test types encountered in the project which is to be assessed. The multiple applications of the processes have to be documented in the assessment scope. It also provides guideline on the use of additional processes from other process assessment models.

- [Annex C](#) provides selected characteristics for typical work products to assist the assessor in evaluating the capability level of processes;
- [Annex D](#) introduces additional process areas for the process assessment model;
- [Annex E](#) provides the additional process reference model processes which will be used by the PAM in [Annex D](#);
- Bibliography contains a list of informative references.

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Information technology — Process assessment — Process assessment model for software testing

1 Scope

This International Standard

- defines a process assessment model that meets the requirements of ISO/IEC 33004 and that supports the performance of an assessment of process capability using the process measurement framework defined in ISO/IEC 33020. The process assessment model provides indicators for guidance on the interpretation of the process purposes and outcomes as defined in ISO/IEC/IEEE 29119-2 and the process attributes as defined in ISO/IEC 33020, and
- provides guidance, by example, on the definition, selection, and use of assessment indicators.

A process assessment model comprises a set of indicators of process performance and process capability. The indicators are used as a basis for collecting the objective evidence that enables an assessor to assign ratings, following the requirements of ISO/IEC 33002. The set of indicators included in this International Standard is not intended to be an all-inclusive set nor is it intended to be applicable in its entirety. Subsets that are appropriate to the context and scope of the assessment should be selected.

The process assessment model in this International Standard is directed at assessment sponsors and competent assessors who wish to select a model and associated documented process method for assessment (for either capability determination or process improvement).

Any process assessment model for software testing meeting the requirements defined in ISO/IEC 33004 concerning models for process assessment may be used for assessment. Different models and methods might be needed to address differing business and testing needs. This assessment model is provided as an exemplar of a model meeting all the requirements expressed in ISO/IEC 33004.

2 Normative references

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

ISO/IEC/IEEE 29119-1, *Software and systems engineering — Software testing — Part 1: Concepts and definitions*

ISO/IEC/IEEE 29119-2, *Software and systems engineering — Software testing — Part 2: Test processes*

ISO/IEC 33001, *Information technology — Process assessment — Concepts and terminology*

ISO/IEC 33004, *Information technology — Process assessment — Requirements for process reference, process assessment and maturity models*

ISO/IEC 33020, *Information technology — Process assessment — Process measurement framework for assessment of process capability*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 33001, ISO/IEC/IEEE 29119-1, and ISO/IEC/IEEE 29119-2 apply.

4 Overview of the process assessment model

4.1 General

ISO/IEC 33063 provides an exemplar Process assessment model (PAM) for software testing that includes examples of assessment indicators.

The process reference model (PRM) defined in ISO/IEC/IEEE 29119-2, together with the process attributes defined in ISO/IEC 33020, establish the process assessment model used as a common basis for performing assessments of software testing process capability, allowing for the reporting of results using a common rating scale.

The process assessment model is a two-dimensional model of process capability. In one dimension, the process dimension, the processes are defined and classified into process categories. 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.

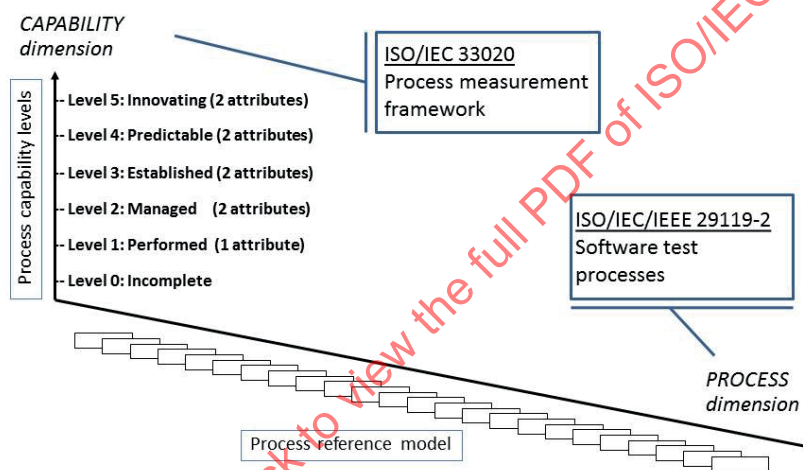


Figure 1 — Relationship between the process assessment model and its inputs

Figure 1 shows the relationship between the general structure of the process assessment model, ISO/IEC 33020 and ISO/IEC/IEEE 29119-2.

The process reference model and the capability dimension defined in ISO/IEC 33020 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 the process purpose and outcomes in the process reference model, and the process attribute definitions in ISO/IEC 33020, need to be supported with a comprehensive set of indicators of process performance and process capability that are used for assessment performance.

The exemplar process assessment model for software testing defined in ISO/IEC 33063 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 testing process capability.

4.2 Structure of the process assessment model

4.2.1 Overview

This clause describes the detailed structure of the process assessment model and its key components.

This process assessment model expands upon the process reference model by adding the definition and use of assessment indicators. Assessment indicators comprise of indicators of process performance and process capability. These are defined to support the assessor's judgment of the performance and capability of an implemented process.

[Clause 5](#), together with its associated [Annex C](#), describes the components of the process dimension. [Clause 6](#) describes the components of the capability dimension while [Annex A](#) provides a demonstration of conformity that meets the requirements of ISO/IEC 33004.

ISO/IEC 33004 requires that processes included in a process reference model satisfy the following criterion:

"The fundamental elements of a process reference model are the set of descriptions of the processes within the scope of the model. These process descriptions shall meet the following requirements:

- a) *a process shall be described in terms of its purpose and outcomes;*
- b) *the set of process outcomes shall be necessary and sufficient to achieve the purpose of the process;*
- c) *process descriptions shall not contain or imply aspects of the process quality characteristic beyond the basic level of any relevant process measurement framework conformant with ISO/IEC 33003."*

As processes are directly derived and applied from ISO/IEC/IEEE 29119-2, these requirements are satisfied.

The process assessment model includes process groups defined in ISO/IEC/IEEE 29119-2 which are:

- the organizational test Process;
- the test management processes;
- the dynamic test processes;

The static test process group is added in an informative [Annex D](#) expanding the current process reference model since they are the processes to be assessed when considering industry practice.

4.2.2 Processes

[Figure 2](#) lists the processes from ISO/IEC/IEEE 29119-2 that are included in the process dimension of the process assessment model for software testing.

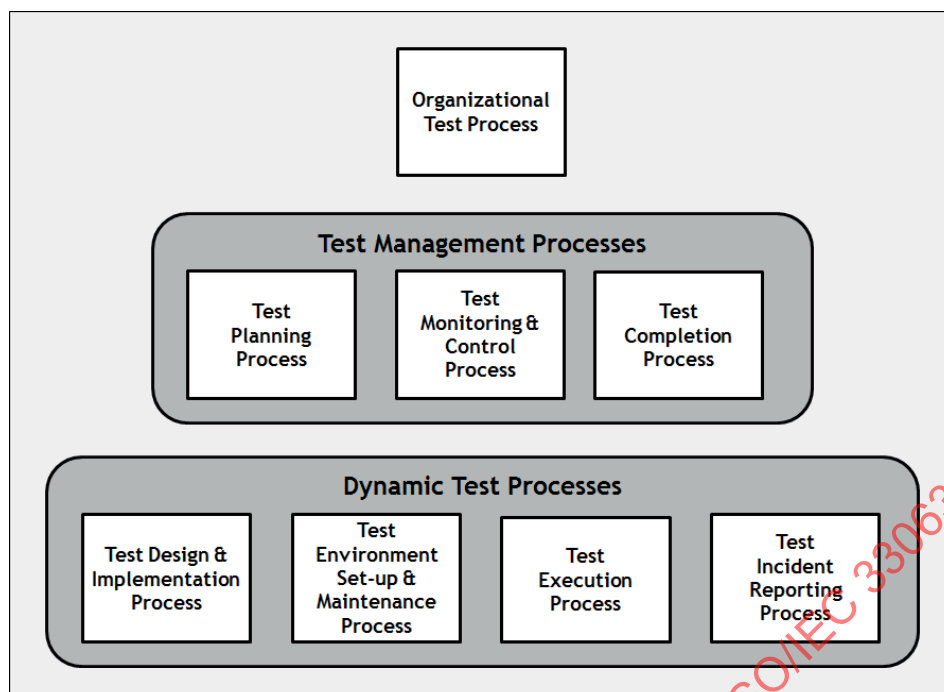


Figure 2 — Process groups and processes of PRM, ISO/IEC/IEEE 29119-2

Test processes in this process assessment model are classified into organizational test (OT) process group, test management (TM) process group and dynamic test (DT) process group, exactly following the structure given in the process reference model.

The **organizational test** process group includes a single process performed for the creation and maintenance of organizational test specifications, such as organizational test policies, organizational test strategies, and other organization-wide specifications.

This group includes the process listed in [Table 1](#).

Table 1 — Organizational test process group

Process Identification	Process name	Source
OT.1	Organizational test process	ISO/IEC/IEEE 29119-2

The **test management** process group consists of processes that cover the management of testing. The processes contain practices that may be used by anyone who manages the whole test project or a particular test phase, test level or test type within the project.

This group includes the processes listed in [Table 2](#).

Table 2 — Test management process group

Process Identification	Process name	Source
TM.1	Test planning process	ISO/IEC/IEEE 29119-2
TM.2	Test monitoring and control process	ISO/IEC/IEEE 29119-2
TM.3	Test completion process	ISO/IEC/IEEE 29119-2

The **dynamic test** process group consists of processes that prepare and maintain the test environment; design, implement and execute the tests and/or report the incidents resulting from the test execution.

The **dynamic test** process group includes the processes listed in [Table 3](#).

Table 3 — Dynamic test process group

Process Identification	Process name	Source
DT.1	Test design & implementation process	ISO/IEC/IEEE 29119-2
DT.2	Test environment set-up & maintenance process	ISO/IEC/IEEE 29119-2
DT.3	Test execution process	ISO/IEC/IEEE 29119-2
DT.4	Test incident reporting process	ISO/IEC/IEEE 29119-2

The **static test** process group consists of processes with related activities that review software and related work products and perform static analysis, which are not in the processes from ISO/IEC/IEEE 29119-2. The static test process group is defined and described in an informative [Annex D](#).

The **static test** process group includes the processes listed in [Table 4](#).

Table 4 — Dynamic test process group

Process Identification	Process name	Source
STAT.1	Software review process	ISO/IEC 12207
STAT.2	Static analysis process	ISO/IEC CD1 29119-2:2011

As illustrated in [B.2](#), the processes within the test management process group and dynamic test process group are generic. Within the context of an assessment they have to be applied to the whole project, different test phases, test levels or test types depending on the characteristics of the project to be assessed.

For example, processes within the test management process can be applied to the management of projects (e.g. master test level), of test levels such as unit testing or acceptance testing, or of types of testing such as security testing and performance testing. The processes within the dynamic test process group can e.g. be applied to integration testing or performance testing, security testing or other test phases/test levels/test types.

NOTE Application of the test management processes and dynamic test processes is unique for each situation with distinct characteristics, hence [B.2](#) is normative.

For practical purposes, in an informative [Annex D](#) and [E](#), three additional processes for organizational test and test management process group, and one additional process group are added. The additional processes such as *skill development process (OT.2)*, *problem resolution management process (TM.4)*, *measurement process (TM.5)*, and *software review process (STAT.1)* are from the ISO/IEC 12207 PRM, while the *static analysis process (STAT.2)* is defined based on the previous version of the PRM. Those additional processes in [Annex D](#) and [E](#) are selectively included for the practical assessment of software test processes reflecting the industry practice.

The guideline on the use of additional processes from other process assessment models is depicted in [B.3](#).

4.2.3 Process dimension

For the process dimension, all the processes in [Figure 2](#) are included within the process dimension of the process assessment model. The processes are classified into process Groups. There are four process groups: organizational test process, test management processes, dynamic test processes, and static test processes ([Annex D](#)). 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.

Satisfying the purpose statement of a process represents the first step in building a level 1 process capability where the expected outcomes are observable. The process groups and their associated processes are described in [Clause 5](#).

4.2.4 Capability dimension

For the capability dimension, the process capability levels and process attributes are identical to those defined in ISO/IEC 33020.

Evolving process capability is expressed in the Test 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 thereby providing a measure of the capability of the process. Attributes 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 ability to carry out a process. The levels constitute a rational way of progressing through improvement of the capability of any process and are defined in ISO/IEC 33020.

There are six capability levels which includes nine process attributes.

Level 0: Incomplete process

The process is not implemented, or fails to achieve the process purpose.

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

Level 1: Performed process

The implemented process achieves its process purpose.

Level 2: Managed process

The previously described Performed process is implemented in a managed fashion (planned, monitored and adjusted) and its work products are appropriately established, controlled and maintained.

Level 3: Established process

The previously described Managed process is implemented using a defined process that is capable of achieving the process outcomes.

Level 4: Predictable process

The previously described Established process now operates within defined limits to achieve the process outcomes. Quantitative management needs are identified, measurement data are collected and analysed to identify causes of variation.

Level 5: Innovating process

The previously described Predictable process is continually improved to respond to organizational change.

Within the process assessment model, the measure of capability is based upon the nine process attributes (PA) defined in ISO/IEC 33020. 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 5](#).

Table 5 — Capability levels and process attributes

Process attribute ID	Capability levels and process attributes
	Level 0: Incomplete process
	Level 1: Performed process
PA 1.1	Process performance
	Level 2: Managed process
PA 2.1	Performance management
PA 2.2	Work product management
	Level 3: Established process
PA 3.1	Process definition
PA 3.2	Process deployment
	Level 4: Predictable process
PA 4.1	Quantitative analysis
PA 4.2	Quantitative control
	Level 5: Innovating process
PA 5.1	Process innovation
PA 5.2	Process Innovation implementation

The process attributes are evaluated on a four point ordinal scale of achievement, as defined in ISO/IEC 33020. They provide insight into the specific aspects of process capability required to support process improvement and capability determination.

4.3 Assessment indicators

4.3.1 Overview

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 evidences related to assessment indicators.

There are two types of assessment indicators: process capability indicators, which apply to capability levels 1 to 5 and process performance indicators, which apply exclusively to capability level 1. These indicators are defined in 4.3.2.

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 attribute in the instantiated process. These indicators concern significant activities, resources or results associated with the achievement of the attribute purpose by a process.

The process capability indicators are:

- Generic practice (GP);
- Generic resource (GR);
- Generic work product (GWP).

As additional indicators for supporting the assessment of a process at Level 1, 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 performance of base practices (BPs) provides an indication of the extent of achievement of the process purpose and process outcomes. Work products (WPs) are either used or produced (or both), when performing the process.

The process performance and process capability indicators defined in the process assessment model represent types of objective evidence that may be found in an instantiation of a process and therefore could be used to judge achievement of capability.

Figure 3 shows how the assessment indicators are related to process performance and process capability.

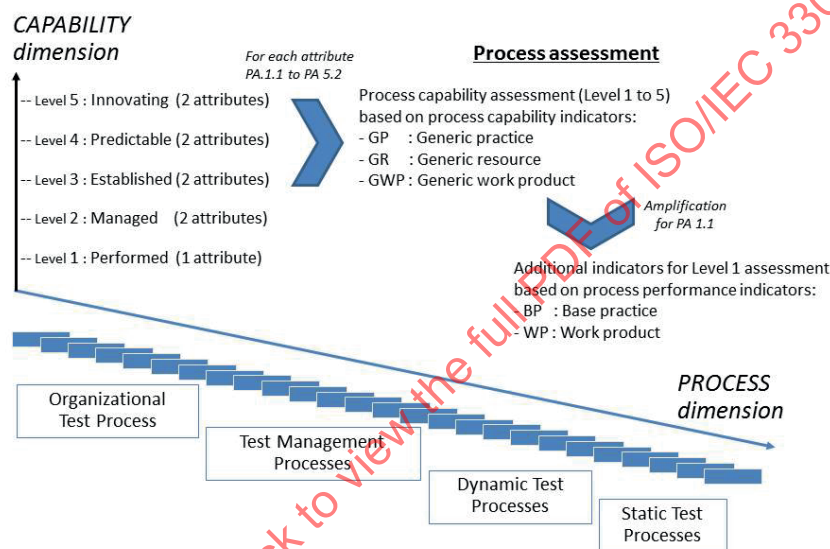


Figure 3 — Assessment indicators

4.3.2 Process capability indicators

The three types of process capability indicators related to levels 1 to 5 are identified in Figure 4. They are intended to be applicable to all processes.

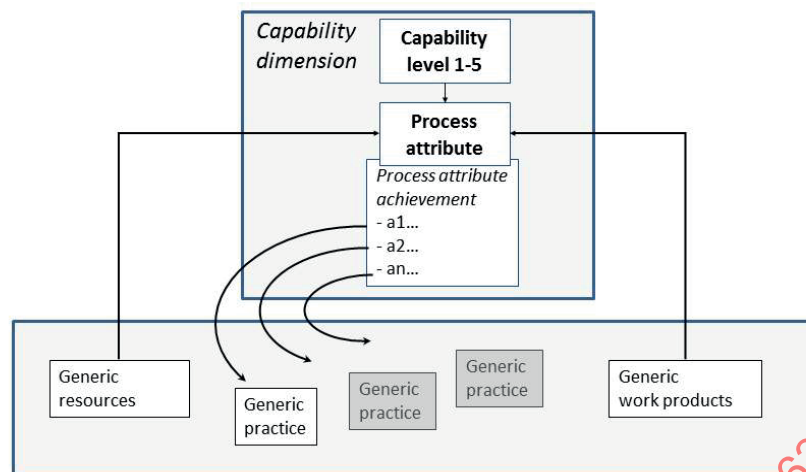


Figure 4 — Process capability indicators

All the process capability indicators relate to the process attributes defined in the capability dimension of the process assessment model. They represent the type of evidence that would support judgments of the extent to which the attributes are achieved. Evidence of their effective performance or existence supports the judgment of the degree of achievement of the 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 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 resource (GR)** indicators are associated resources that may be used when performing the process in order to achieve the attribute. These resources may include human resources, tools, methods and infrastructure. The availability of a resource indicates the potential to fulfill the purpose of a specific attribute.

NOTE The assessor should interpret the generic resources according to the process assessed; e.g. for PA 2.1 resources (with identified objectives, responsibilities and authorities), an assessor would look for roles (with identified objectives, responsibilities and authorities) in test management and dynamic test processes, but for organizational processes would look for governance structures (e.g. mandated committees, positions) with identified objectives, responsibilities and authorities.

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 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 three 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.1.1) has a single generic practice indicator (GP.1.1.1). In order to support the assessment of PA.1.1 and to amplify the process

performance achievement analysis, additional process performance indicators are defined in the process assessment model.

4.3.3 Process performance indicators

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.

[Clause 5](#) contains a complete description of the processes, including the base practices and the associated work products.

[C.1](#) contains a list of generic work products together with the work product characteristics.

[C.2](#) contains a complete list of specific work products, with the generic work products for completeness.

Similar to the concept of modularity in object orientation, the shared characteristics of a group of work products have been extracted into a generic work product. An assessor would refer to both the specific work product and the generic work product in the context of the specific work product when performing an assessment.

4.4 Measuring process capability

The process performance and process capability indicators in this model give examples of evidence that an assessor might obtain, or observe, in the performance of an assessment. The evidence obtained in the assessment can be mapped onto the set of indicators to enable correlation between the implemented process and the processes defined in this assessment model.

These indicators provide guidance for assessors in accumulating the necessary objective evidence to support judgments of capability. They are not intended to be regarded as a mandatory set of checklists to be followed.

An indicator is defined as an objective characteristic of a base practice or work product that supports the judgment of the performance or capability of an implemented process. The assessment indicators and their relationship to process performance and process capability are shown in [Figure 5](#).

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 and/or from statements made by the performers and managers of the processes.

The existence of base practices, work products and work product characteristics provide evidence of the performance of the processes associated with them. Similarly, the existence of process capability indicators provides evidence of process capability.

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.

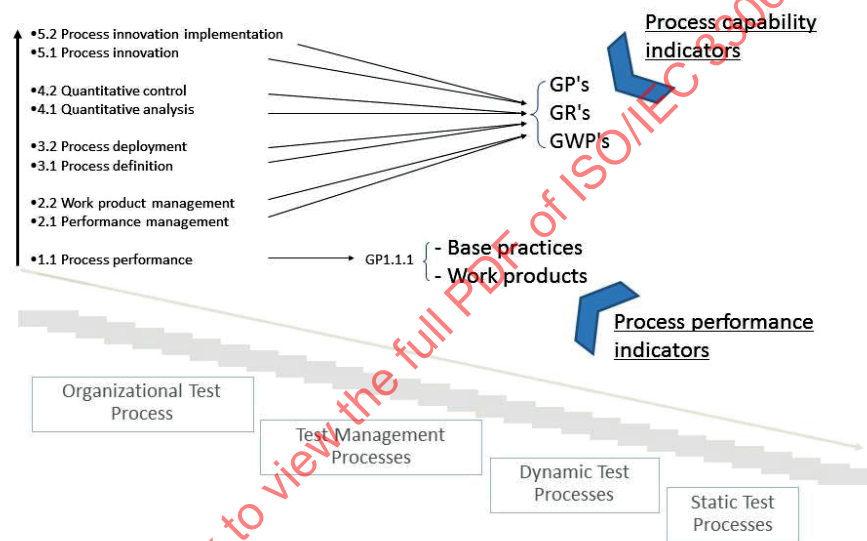


Figure 5 — Relationship between assessment indicators and process capability

5 Process dimension and process performance indicators (level 1)

5.1 General

This clause defines the processes and the process performance indicators of the process assessment model. The processes in the process dimension can be directly mapped to the processes defined in the process reference model.

The processes are classified (for the purpose of this process assessment model) into process groups which are listed in [Clause 4](#).

The individual processes are described in terms of process name, process purpose, and process outcomes as defined in ISO/IEC/IEEE 29119-2.

In addition, the process performance indicators of the process assessment model provide information in the form of:

- a) a set of base practices for the process providing a definition of the tasks and activities needed to accomplish the test 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; and
- c) characteristics associated with each work product.

The process purposes, outcomes, the base practices and the work products associated with the processes are included in this clause. The work product characteristics are contained in [Annex C](#). The base practices and work products constitute the set of indicators of process performance.

The associated work products listed in this clause may be used when reviewing potential inputs and outputs of an organization's process implementation.

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 and testing methodology, size of the organization, etc.) is explicitly considered when using this information.

This assessment process 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 [Annex C](#).

NOTE Consideration of assessing the additional test process areas in [Annex D](#) such as *software review process (STAT.1)*, *static analysis process (STAT.2)*, *problem resolution management process (TM.4)* may be required to guarantee the assessment of all the test processes.

5.2 Organizational test process group

5.2.1 OT.1 Organizational test process

Process ID	OT.1
Process name	Organizational test process
Process purpose	The purpose of the organizational test process is to develop, monitor conformance and maintain organizational test specifications, such as the organizational test policy and organizational test strategy.
Process outcomes	As a result of the successful implementation of the organizational test process: a) The requirements for organizational test specifications are identified; b) The organizational test specifications are developed; c) The organizational test specifications are agreed by stakeholder(s); d) The organizational test specifications are made accessible; e) Conformance to the organizational test specifications is monitored; f) Updates to organizational test specifications are agreed to by stakeholder(s); and g) Updates to the organizational test specifications are made.

Base practices	OT.1. BP1: Develop organizational test specification. Develop an organizational test specification such as organizational test policy or organizational test strategy. [Outcome: a, b, c]
	OT.1.BP2: Monitor and control use of organizational test specification. Monitor and control usage of organizational test specification to determine whether it is being used effectively. [Outcome: d, e]
	OT.1.BP3: Update organizational test specification. Update organization test specification by reviewing feedbacks. [Outcome: e, f, g]

Work products					
Inputs			Outputs		
No	Name	Outcome	No	Name	Outcome
4.04	Quality policy	a, b, c			
8.02	Regulatory standards	a, b, c			
8.01	Organizational test specification	a, b, c	8.01	Organizational test specification	a, e, f, g
4.01	Organizational test policy	a, b, c	4.01	Organizational test policy	a, e, f, g
4.02	Organizational test strategy	a, b, c	4.02	Organizational test strategy	a, e, f, g

5.3 Test management process group

5.3.1 TM.1 Test planning process

Process ID	TM. 1
Process name	Test planning process
Process purpose	The purpose of the test planning process is to develop, agree, record and communicate to relevant stakeholders the scope and approach that will be taken to testing, enabling early identification of resources, environments and other requirements of testing.
Process outcomes	As a result of the successful implementation of the test planning process: a) The scope of work of the test project is analysed and understood; b) The stakeholders who will participate in the test planning are identified and informed; c) Risks that can be treated by testing are identified, analysed and classified with an agreed level of risk exposure; d) Test strategy, test environment, test tool and test data needs are identified; EXAMPLE Tools, special equipment, test environment, office space. e) Staffing and training needs are identified; f) Each activity is scheduled; g) Estimates are calculated and evidence to justify the estimates is recorded; EXAMPLE Cost, staff, and timeline estimates. h) The Test Plan is agreed to and distributed to all stakeholders.

Base practices	NOTE Base practices in this process relate to the project level test planning and also particular test planning of a testing phase (unit/ integration/ system/ acceptance test plan) or a testing type (e.g. performance/ security/ usability test plan).
	TM.1.BP1: Understand context. Understand and document the context and the software testing requirements [Outcome: a]
	NOTE This activity can be performed through reviewing the related documents (e.g. software development plan, related test basis, etc.) and identifying and interacting with the relevant stakeholders. This activity should also be an on-going activity throughout the lifetime of the project and the tasks in this activity can, in principle, be carried out in any order.
	TM.1.BP2: Organize test plan development. Create a plan for test plan development ensuring early involvement of testing in the software development life cycle. [Outcome: b]
	NOTE Normally test planning starts with development planning and completes during requirement & analysis phase.
	TM.1.BP3: Identify and analyze risks. Identify, classify, evaluate and document risks that are related to project and/or product, which can be treated by software testing. [Outcome: c]
	TM.1.BP4: Identify risk mitigation approaches. Identify and document appropriate means of treating the risks (such as test phases, test types, test techniques and test completion criteria). [Outcome: c]
	TM.1.BP5: Design test strategy. Design and document the test strategy and standard test process to be undertaken considering: — overall test planning in the project level or test planning for particular test phase(s) and/or test type(s) — functional and non-functional testing requirements — early involvement of test planning and design activities in development life cycle
	NOTE 1: The test strategy can take the following aspects into regard: selected test phases and test types, test item, test scope, product/project risk, software quality objective test design techniques, test completion criteria, test metrics, test environment and data requirement, test suspension and resumption criteria, retesting and regression testing, test tool requirements, test deliverables, testing tasks and (initial) estimates, staffing requirement, risk analysis result.
	NOTE 2: Where organizational test process is available, the existing process may be tailored to fit to the project context and risk. [Outcome: d, e, f]
	TM.1.BP6: Estimate test resources. Estimate the required resources to perform the complete set of actions described in the test strategy. [Outcome: g]
	TM.1.BP7: Determine staffing and scheduling. Identify the roles and skills that will be required to carry out the testing described in the test strategy. Each test activity in the test strategy should be scheduled. [Outcome: e, f, h]
	NOTE Where appropriate identify recruitment and/or training needs.
	TM.1.BP8: Record test plan. Document identified risks, test strategy and all the test decisions, final test estimates, test schedule and create the test plan. [Outcome: h]
	TM.1.BP9: Gain consensus on test plan. Issue the draft test plan for review and approval by stakeholders. [Outcome: h]
	TM.1.BP10: Communicate test plan and make available. Publish the test plan in a suitable form so that it is accessible to all stakeholders. [Outcome: h]

Work products					
Inputs			Outputs		
No	Name	Outcome	No	Name	Outcome
4.01	Organizational test strategy	a, b, c, d, e			
4.02	Organizational test policy	a, b, c, d, e			
8.01	Organizational test specification	a, b, c, d, e			
8.02	Regulatory standards	a, b, c			
6.04	Incident report	a			

Work products					
Inputs			Outputs		
No	Name	Outcome	No	Name	Outcome
3.04	Project management plan	a, b, c			
3.08	Test plan	l, m	3.08	Test plan	c, d, e, f, g, h, i, j, k, l, m

5.3.2 TM.2 Test monitoring and control process

Process ID	TM.2
Process name	Test monitoring and control process
Process purpose	The purpose of the test monitoring and control process is to determine whether testing progresses in accordance with the test plan and with organization test specifications (e.g. the organizational test policy and the organizational test strategy). It also initiates control actions as necessary and identifies necessary updates to the test plan (e.g. revise completion criteria or identify new actions to compensate for deviations from the test plan). The process is also used to determine whether testing progresses in accordance with higher level test plans, such as the project test plan, and to manage the testing performed at specific test phases (e.g. system testing) or for specific test types (e.g. performance testing).
Process outcomes	As a result of the successful implementation of the test monitoring and control process: a) The means of collecting suitable measures to monitor test progress and changing risk are set up; b) Progress against the test plan is monitored; c) New and changed test-related risks are identified, analysed and necessary action(s) invoked; d) Necessary control actions are identified; e) Necessary control actions are communicated to the relevant stakeholders; f) The decision to stop testing is determined; NOTE This particular process outcome has been changed to make it consistent with the purpose of process capability level 1, performed process. g) Test progress and changes to the risks are reported to stakeholders.
Base practices	TM.2.BP1: Set-up. Identify suitable measures for monitoring test progress against the test plan and define means of identifying new and changing risks. [Outcome: a] TM.2.BP2: Monitor. Monitor the progress of test processes (e.g. unit test, system test, performance test, usability test, etc.) against the test plan, then identify and document the divergence of actual testing from planned testing and analyse any new risks. [Outcome: b, c] TM.2.BP3: Control. Undertake the testing activities documented in the test plan and control directives received from higher level management processes. Identify and take corrective action to deal with any discrepancy between planned progress and actual progress. [Outcome: d, e, f] TM.2.BP4: Report. Document and communicate testing progress against the test plan to stakeholders. [Outcome: g]

Work products					
Inputs			Outputs		
No	Name	Outcome	No	Name	Outcome
4.02	Organizational test strategy	a			

Work products					
Inputs			Outputs		
No	Name	Outcome	No	Name	Outcome
4.01	Organizational test policy	a			
3.08	Test plan	a, b	3.08	Test plan	a, c
5.09	Test measures	b			
			6.11	Test status report	b, d, e, f, g

5.3.3 TM.3 Test completion process

Process ID	TM. 3
Process name	Test completion process
Process purpose	The purpose of the test completion process is to make available useful test assets are made available for later use, leave the test environment in a satisfactory condition, and record and communicate the results of the testing to relevant stakeholders. Test assets include test plans, test case specifications, test scripts, test tools, test data and test environment infrastructure.
Process outcomes	As a result of the successful implementation of the test completion process: a) Test assets are either archived or passed directly to the relevant stakeholders; b) The test environment is in its agreed state (e.g. so that it is available for the next test project); c) All test requirements are satisfied and verified; d) The test completion is reported; NOTE This particular process outcome has been changed to make it consistent with the purpose of process capability level 1, performed process e) The test completion report is written; NOTE This particular process outcome has been changed to make it consistent with the purpose of process capability level 1, performed process. f) The test completion report is communicated to relevant stakeholders.
Base practices	TM.3.BP1: Archive test assets. Identify test assets which may be of use in the next project or during the maintenance test phase (e.g. regression test suites) and made available using appropriate means, such as configuration management activities, if available. [Outcome: a] TM.3.BP2: Clean up test environment. Restore the test environment to a pre-defined state on completion of all testing activities. [Outcome: b] TM.3.BP3: Identify lessons learned. Document the outcomes of the meeting for collecting lessons learned in the test completion report and communicate to the relevant authorities. [Outcome: c] TM.2.BP4: Report test completion. Summarize the information collected during the project into a test completion report, determined the report and distribute to the relevant stakeholders. [Outcome: d, e, f] NOTE Relevant information from test plans, test results, test status reports, test completion reports, Incident reports, etc. can be used.

Work products					
Inputs			Outputs		
No	Name	Outcome	No	Name	Outcome
3.08	Test plan	a, b, c, d			
6.04	Incident report	a, c			

Work products					
Inputs			Outputs		
No	Name	Outcome	No	Name	Outcome
6.11	Test status report	a, c, d			
6.08	Test completion report	a, c, d	6.08	Test completion report	a, b, c, d, e, f
4.02	Organizational test strategy	a			

5.4 Dynamic test process group

5.4.1 DT.1 Test design & implementation process

Process ID	DT.1
Process name	Test design & implementation process
Process purpose	The purpose of the test design & implementation process is to derive test procedures that will be executed during the test execution process. As part of this process the test basis is analysed, features are combined into feature sets, test conditions, test coverage items, test cases, test procedures are derived and test sets are assembled.
Process outcomes	As a result of the successful implementation of the test design & implementation process: a) The test basis for each test item is analysed; b) The features to be tested are combined into feature sets; c) The test conditions are derived; d) The test coverage items are derived; e) Test cases are derived; f) Test sets are assembled; g) Test procedures are derived.

Base practices	DT.1.BP1: Identify feature sets. Identify the feature sets for unit testing broken down into the features to be tested, which is to be the basis for the test. [Outcome: a, b]
	DT.1.BP2: Derive test conditions. Based on the test completion criteria specified in the test plan, determine the test conditions for each feature. [Outcome: c]
	DT.1.BP3: Derive test coverage items. The test coverage items to be exercised are derived from the test conditions by applying test design techniques (e.g. statement testing, branch testing, decision testing, etc.) to achieve the test completion criteria specified in the test plan. [Outcome: d]
	DT.1.BP4: Derive test cases. Derive one or more test cases by determining pre-conditions, selecting input values and, where necessary, actions to exercise the selected test coverage items, and by determining the corresponding expected testing results. [Outcome: e]
	DT.1.BP5: Assemble test sets. Assemble one or more test sets by distributing test cases based on constraints for their execution. For instance, some test sets may require a specific environment set-up, or some may be appropriate for manual execution while others are more appropriate for automated execution, or some may require specific domain knowledge. [Outcome: f]
	DT.1.BP6: Derive test procedures. Derive test procedures by ordering test cases within a test set according to dependencies described by pre- and post-conditions and other testing requirements, such as risks to be treated for testing. [Outcome: g]

Work products					
Inputs			Outputs		
No	Name	Outcome	No	Name	Outcome
2.01	Test basis	a, b			
3.08	Test plan	a, b, c			
1.03	Test item	a, b, c			
4.05	Test strategy	a, b, c			
8.08	Test design techniques	b			
			9.14	Test feature set	a
			2.03	Test condition	b
			2.04	Test coverage item	c
			8.07	Test design	a, b, c
			8.05	Test case	d
			8.10	Test set	e
			5.10	Test procedure	f, g
			2.02	Traceability record(information)	a, b, c, d, e, f, g
			8.06	Test data requirements	f
			8.09	Test environment requirements	f

5.4.2 DT.2 Test environment set-up & maintenance process

Process ID	DT.2
Process name	Test environment set-up & maintenance process
Process purpose	The purpose of the test environment set-up & maintenance process is to establish and maintain the required test environment and to communicate its status to all relevant stakeholders.

Process outcomes	As a result of the successful implementation of the test environment set-up & maintenance process: a) The test environment is set-up in a state ready for testing; b) The status of the test environment is communicated to all relevant stakeholders, c) The test environment is maintained.
Base practices	DT.2.BP1: Establish test environment. Plan for the gathering of environment requirements, design and implement of the test environment. The status of the test environment shall be communicated to the relevant stakeholders, such as the testers and the test manager. [Outcome: a, b] NOTE Where appropriate, set up test data and test tools to support the testing and install and configure test items. DT.2.BP2: Maintain test environment. Maintain the required test environment for immediate and continuous use. A test environment defect log may be established which is managed and tracked to keep the environment in a state ready for testing. [Outcome: c]

Work products					
Inputs			Outputs		
No	Name	Outcome	No	Name	Outcome
8.09	Test environment requirements	a			
6.10	Test environment readiness report	b	6.10	Test environment readiness report	b
			1.02	Test environment	a, c
8.06	Test data requirements	a			
6.09	Test data readiness report	b	6.09	Test data readiness report	b
			9.13	Test data	a, c
1.03	Test Item	a			
3.08	Test plan	a			
2.01	Test basis	a			
5.10	Test procedure	a			

5.4.3 DT.3 Test execution process

Process ID	DT.3
Process name	Test execution process
Process purpose	The purpose of the test execution process is to execute the test procedures created in the test design & implementation process in the prepared test environment and record the results.
Process outcomes	As a result of the successful implementation of the test execution process: a) the test procedure(s) is/are executed; b) the test results are recorded; c) the actual and expected results are compared; and d) the test results are determined.

Base practices	DT.3.BP1: Execute test procedure(s). Execute one or more test procedures in the prepared test environment and maintain the test execution log and/or updates to record details of the test execution results. [Outcome: a, b]
	DT.3.BP2: Compare the results. Compare the actual and expected results for each test case in the test procedure. The test result of executing the test cases in the test procedure shall be determined. [Outcome: c, d]
	DT.3.BP3: Record test execution. Record test execution, as specified in the test plan. [Outcome: d]

Work products					
Inputs			Outputs		
No	Name	Outcome	No	Name	Outcome
3.08	Test plan	a, b			
1.03	Test item	a, b			
2.01	Test basis	a, b			
5.10	Test procedure	a, b			
			9.06	Test result	c, d
6.10	Test environment readiness report	a, b, c			
1.02	Test environment	a, b, c			
6.09	Test data readiness report	a, b, c			
9.13	Test data	a, b, c			
			9.05	Test execution log	b

5.4.4 DT.4 Test incident reporting process

Process ID	DT.4
Process name	Test incident reporting process
Process purpose	The purpose of the test incident reporting process is to report to the relevant stakeholders incidents requiring further action identified as a result of test execution. In the case of a new test this will require an incident report to be created. In the case of a retest, this will require the status of a previously-raised incident to be updated, but may also require a new incident report to be raised where further incidents are identified.
Process outcomes	As a result of the successful implementation of the test incident reporting Process: a) Test results are analysed; b) New incidents are confirmed; c) New incident report details are created; d) The status and details of previously-raised incidents are determined; e) Previously-raised incident report details are updated as appropriate; f) New and/or update incident reports are communicated to the relevant stakeholders.

Base practices	DT.4.BP1: Analyze test results. Analyze the test results, confirm any new incidents and/or determine the status and details of previously raised incidents. [Outcome: a, b, c] DT.4.BP2: Create/Update incident report. Create an incident report in the case of new incident and/or update the status of a previously-raised incident in the case of retest. The status of new and/or updated incidents shall be communicated to the relevant stakeholders. [Outcome: d, e, f]
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Work products					
Inputs			Outputs		
No	Name	Outcome	No	Name	Outcome
9.06	Test result	a, b			
5.10	Test procedure	a, b			
1.03	Test item	a, b			
2.01	Test basis	a, b			
9.05	Test execution log	a, b, c, d			
			6.01	Analysis report	a
			6.04	Incident report	b, c, d

6 Process capability indicators (level 1 to 5)

6.1 General

This clause presents the test process capability indicators related to the process attributes associated with capability levels 1 to 5 defined in the capability dimension of the test process assessment model. Test process capability indicators are the means of assessing the capabilities addressed by the defined process attributes. Evidence from test process capability indicators supports the judgment of the degree of achievement of the process attribute.

6.2 Process capability levels and process attributes

The capability dimension of the test process assessment model consists of six capability levels matching the capability levels defined in ISO/IEC 33020, which is a measurement framework for process capability conformant to ISO/IEC 33003.

This clause describes the process capability indicators for the nine process attributes included in the capability dimension for levels 1 to 5. [Clause 5](#) describes the test assessment indicators for process performance which is characterized by Level 1 process capability.

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

NOTE 1 In the next paragraphs, ISO/IEC 33020 process attribute definitions and attribute achievements are identified with italic font.

NOTE 2 Following each generic resource and generic work product is '[PA x.y Achievement 1]'. This refers to process attribute x.y achievement 1 which is satisfied by this indicator.

6.2.1 Process capability 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.

6.2.2 Process capability Level 1: Performed process

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

6.2.2.1 PA.1.1 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:

- a) *The process achieves its defined process outcomes.*

6.2.2.1.1 Generic practices for PA.1.1

PA.1.1.GP1 Achieve the process outcomes.

Achieve 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 [Clause 5](#).

6.2.2.1.2 Generic resources for PA.1.1

— Resources are used to perform the intent of process specific base practices. [PA 1.1 Achievement a]

6.2.2.1.3 Generic work products for PA.1.1

1.00 Object [PA 1.1 Achievement a]

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

6.2.3 Process capability Level 2: Managed process

The previously described *Performed process* is now implemented in a managed fashion (planned, monitored and adjusted) and its work products are appropriately established, controlled and maintained.

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

6.2.3.1 PA.2.1 Performance management attribute

The performance management attribute is a measure of the extent to which the performance of the process is managed. As a result of full achievement of this process attribute:

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- a) *Objectives for the performance of the process are identified;*
- b) *Performance of the process is planned;*
- c) *Performance of the process is monitored;*
- d) *Performance of the process is adjusted to meet plans;*
- e) *Responsibilities and authorities for performing the process are defined, assigned and communicated;*
- f) *Personnel performing the process are prepared for executing their responsibilities;*

- g) *Resources and information necessary for performing the process are identified, made available, allocated and used;*
- h) *Interfaces between the involved parties are managed to ensure both effective communication and clear assignment of responsibility.*

6.2.3.1.1 Generic practices for PA.2.1

PA.2.1GP1 Identify the objectives for the performance of the process. NOTE Performance objectives may include – (1) quality of the artifacts produced, (2) process cycle time or frequency and (3) resource usage and (4) boundaries of the process. Performance objectives are identified based on process requirements. The scope of the process performance is defined. Assumptions and constraints are considered when identifying the performance objectives.
PA.2.1.GP2 Plan 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.
PA.2.1.GP3 Monitor the performance of the process against the plans. The process is performed according to the plan(s). Process performance is monitored to ensure that planned results are achieved and to identify possible deviations.
PA.2.1.GP4 Adjust the performance of the process. Process performance issues are identified. Appropriate actions are taken when planned results and objectives are not achieved. The plan(s) are adjusted, as necessary. Rescheduling is performed as necessary.
PA.2.1.GP5 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.
PA.2.1.GP6 Prepare those performing the process to execute their responsibilities. 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.2.1.GP7 Identify and make available resources to perform the process according to plan. The human and infrastructure resources necessary for performing the process are identified, made available, allocated and used. The information necessary to perform the process is identified and made available.

PA.2.1.GP8 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.

6.2.3.1.2 Generic resources for PA.2.1

- Human resources with identified objectives, responsibilities and authorities; [PA.2.1 Achievement a, e, f, g, h]
- Facilities and infrastructure resources; [PA.2.1 Achievement a, e, g, h]
- Project planning, test management and control tools, including time and cost reporting; [PA.2.1 Achievement b, c, d]
- Workflow management system; [PA.2.1 Achievement e, h]
- Email and/or other communication mechanisms; [PA.2.1 Achievement e, h]
- Information and/or experience repository; [PA.2.1 Achievement b, c, f, g]
- Problem and issue test management mechanisms. [PA.2.1 Achievement d]

6.2.3.1.3 Generic work products for PA.2.1

3.00 Plan [PA.2.1 Achievement a, b, c, d, e, f, g, h]

- Defines objectives to perform the processes.
- 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.

6.00 Report [PA.2.1 Achievement b, c, d]

- 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.

9.00 Record [PA.2.1 Achievement c, d, e, f, g, h]

- States results achieved or provides evidence of activities performed in a process.
- Provides evidence of communication, meetings, reviews and corrective actions.
- Contains status information about corrective actions; schedule and work breakdown structure.

— Monitors identified risks.

6.2.3.2 PA.2.2 Work product management attribute

The work product management attribute is a measure of the extent to which the work products produced by the process are appropriately managed. As a result of full achievement of this attribute:

- a) *Requirements for the work products of the process are defined;*
- b) *Requirements for documentation and control of the work products are defined;*
- c) *Work products are appropriately identified, documented, and controlled;*
- d) *Work products are reviewed in accordance with planned arrangements and adjusted as necessary to meet requirements.*

NOTE 1 Requirements for documentation and control of work products may include requirements for the identification of changes and revision status, approval and re-approval of work products, distribution of work products, and for making relevant versions of applicable work products available at points of use.

NOTE 2 The work products referred to in this Clause are those that result from the achievement of the process purpose through the process outcomes.

6.2.3.2.1 Generic practices for PA.2.2

PA.2.2.GP1 Define the requirements for the work products The requirements for the work products to be produced are defined. Requirements may include defining contents and structure. Quality criteria of the work products are identified. Appropriate review and approval criteria for the work products are defined.
PA.2.2.GP2 Define the requirements for documentation and control of the work products. Requirements for the documentation and control of the work products are defined. Such requirements may include requirements for (1) distribution, (2) identification of work products and their components (3) traceability. Dependencies between work products are identified and understood. Requirements for the approval of work products to be controlled are defined.
PA.2.2.GP3 Identify, document and control the work products. The work products to be controlled are identified. Change control is established for work products. The work products are documented and controlled in accordance with requirements. Versions of work products are assigned to product configurations as applicable. The work products are made available through appropriate access mechanisms. The revision status of the work products may readily be ascertained.
PA.2.2.GP4 Review and adjust work products to meet the defined requirements. Work products are reviewed against the defined requirements in accordance with planned arrangements. Issues arising from work product reviews are resolved.

6.2.3.2.2 Generic resources for PA.2.2

- Requirement management method / toolset; [PA.2.2 Achievement a, b, c]
- Configuration management system; [PA.2.2 Achievement b, c]
- Documentation elaboration and support tool; [PA.2.2 Achievement b, c]

- Document identification and control procedure; [PA.2.2 Achievement b, c]
- Work product review methods and experiences; [PA.2.2 Achievement d]
- Review management method / toolset; [PA.2.2 Achievement d]
- Intranets, extranets and/or other communication mechanisms; [PA.2.2 Achievement b, c]
- Problem and issue management mechanisms. [PA.2.2 Achievement d]

6.2.3.3 Generic work products for PA.2.2

1.00 Object [PA.2.2 Achievement a, b, c, d]

- Demonstrates process specific work products to be managed.

3.00 Plan [PA.2.2 Achievement b]

- Expresses selected policy or strategy to manage work products.
- Describes requirements to develop, distribute, and maintain the work products.
- Defines quality control actions needed to manage the quality of the work product.

5.00 Record [PA.2.2 Achievement b, c, d]

- Demonstrates work product reviews and contributes to traceability.
- Records the status of documentation or work product.
- Contains and makes available work products and/or configuration items
- Supports monitoring of changes to work products.
- Describes non-conformance detected during work product reviews
- Provides evidence that the changes are under control.

8.00 Specification [PA.2.2 Achievement a, b]

- Defines the functional and non-functional test requirements for work products.
- Identifies work product dependencies.
- Identifies approval criteria for documents.
- Defines the attributes associated with a work product to be created.

6.2.4 Process capability Level 3: Established process

The previously described *Managed process* is now implemented using a defined process that is capable of achieving its process outcomes.

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

6.2.4.1 PA 3.1 Process definition attribute

The process definition attribute is a measure of the extent to which a standard process is maintained to support the deployment of the defined 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;*

- b) *The sequence and interaction of the standard process with other processes are determined;*
- c) *Required competencies and roles for performing a process are identified as part of the standard process;*
- d) *Required infrastructure and work environment for performing a process are identified as part of the standard process;*
- e) *Suitable methods for monitoring the effectiveness and suitability of the process are determined.*

6.2.4.1.1 Generic practices for PA.3.1

PA.3.1.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.3.1.GP2 Determine the sequence and interaction between processes so that they work as an integrated system of processes. The standard process's sequence and interaction with other processes are determined. Deployment of the standard process as a defined process maintains integrity of processes.
PA.3.1.GP3 Identify the roles and competencies for performing the standard process. Process performance roles are identified Competencies for performing the process are identified.
PA.3.1.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.3.1.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.

6.2.4.1.2 Generic resources for PA.3.1

- Process modelling methods / tools; [PA.3.1 Achievement a, b, c, d]
- Training material and courses; [PA.3.1 Achievement a, b, c]
- Resource management system; [PA.3.1 Achievement b, c]
- Process infrastructure; [PA.3.1 Achievement a, b]
- Audit and trend analysis tools; [PA.3.1 Achievement e]
- Process monitoring method. [PA.3.1 Achievement e]

6.2.4.1.3 Generic work products for PA.3.1

2.00 Description [PA.3.1 Achievement a, b, c, e]

- Describes the organizational 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 1 and 2 and the PA 3.2 Process deployment 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.

3.00 Plan [PA.3.1 Achievement c, d]

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

5.00 Procedure [PA.3.1 Achievement a, b, c, d, e]

- Provides evidence of organizational commitment to maintain a standard process to support the deployment of the defined process.

8.00 Specification [PA.3.1 Achievement a]

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

9.00 Record [PA.3.1 Achievement d]

- Is used to support and maintain the standard process assets.

6.2.4.2 PA.3.2 Process deployment attribute

The process deployment attribute is a measure of the extent to which the standard process is deployed as a defined process to achieve its process outcomes. As a result of full achievement of this attribute:

- a) *A defined process is deployed based upon an appropriately selected and/or tailored standard process;*
- b) *Required roles, responsibilities and authorities for performing the defined process are assigned and communicated;*
- c) *Personnel performing the defined process are competent on the basis of appropriate education, training, and experience;*
- d) *Required resources and information necessary for performing the defined process are made available, allocated and used;*
- e) *Required infrastructure and work environment for performing the defined process are made available, managed and maintained;*

- f) *Appropriate data are collected and analysed as a basis for understanding the behaviour of, and to demonstrate the suitability and effectiveness of the process, and to evaluate where continual improvement of the process can be made.*

6.2.4.2.1 Generic practices for PA.3.2

PA.3.2.GP1 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.
PA.3.2.GP2 Assign and communicate roles, responsibilities and authorities for performing the defined process. The roles for performing the defined process are assigned and communicated. The responsibilities and authorities for performing the defined process are assigned and communicated.
PA.3.2.GP3 Ensure necessary competencies for performing the defined process. Appropriate competencies for assigned personnel are identified. Suitable training is available for those deploying the defined process.
PA.3.2.GP4 Provide resources and information to support the performance of the defined process. Required human resources are made available, allocated and used. Required information to perform the process is made available, allocated and used.
PA.3.2.GP5 Provide adequate process infrastructure to support the performance of the defined process. 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.3.2.GP6 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 analysed 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.

6.2.4.2.2 Generic resources for PA.3.2

- Feedback mechanisms (customer, staff, other stakeholders); [PA.3.2 Achievement f]
- Process repository; [PA.3.2 Achievement a, b]
- Resource management system; [PA.3.2 Achievement b, c, d]
- Knowledge management system; [PA.3.2 Achievement d]
- Problem and change management system; [PA.3.2 Achievement f]
- Working environment and infrastructure; [PA.3.2 Achievement e]
- Data collection analysis system; [PA.3.2 Achievement f]
- Process assessment framework; [PA.3.2 Achievement f]
- Audit / review system. [PA.3.2 Achievement f]

6.2.4.2.3 Generic work products for PA.3.2

2.00 Description [PA.3.2 Achievement a]

- Describes the defined process for use by the project.
- Describes the verification activities needed to ensure the conformance of the project's defined process with the organization's standard process.
- Represents the interactions of the project's defined process with other processes.

3.00 Plan [PA.3.2 Achievement a, b, f]

- 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.

6.00 Report [PA.3.2 Achievement f]

- Provides results of the analysis, recommended corrective action, feedback to the process owner and to the organization's organizational standard process.
- Identifies improvement opportunities of the defined process.
- Provides evidence on the suitability and effectiveness of the defined process.

8.00 Specification [PA.3.2 Achievement f]

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

9.00 Record [PA.3.2 Achievement f]

- 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.
- Records the status of required corrective actions.
- Captures the project's work breakdown structure needed to define the tasks and their dependencies.
- Provides evidence that information is made available for performing the defined process.

6.2.5 Process capability Level 4: Predictable process

The previously described *Established process* now operates within defined limits to achieve its process outcomes. Quantitative management needs are identified, measurement data are collected and analysed to identify assignable causes of variation.

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

6.2.5.1 PA.4.1 Quantitative analysis process attribute

The quantitative analysis process attribute is a measure of the extent to which information needs are defined, relationships between process elements are identified and data are collected. . As a result of full achievement of this attribute:

- a) *The process is aligned with quantitative business goals;*
- b) *Process information needs in support of relevant defined quantitative business goals are established;*
- c) *Process measurement objectives are derived from process information needs;*
- d) *Measurable relationships between process elements that contribute to the process performance are identified;*
- e) *Quantitative objectives for process performance in support of relevant business goals are established;*
- f) *Appropriate measures and frequency of measurement are identified and defined in line with process measurement objectives and quantitative objectives for process performance;*
- g) *Results of measurement are collected, analysed and reported in order to monitor the extent to which the quantitative objectives for process performance are met.*

NOTE 1 Information needs typically reflect management, technical, project, process or product needs.

NOTE 2 Measures may be either process measures or product measures or both.

6.2.5.1.1 Generic practices for PA.4.1

PA.4.1.GP1 Align the process with quantitative business goals. Quantitative business goals relevant to the process are identified. The process supports achievement of the identified business goals.
PA.4.1.GP2 Identify process information needs, in relation with business goals. Business goals relevant to establishing quantitative process measurement objectives for the process are identified. Process stakeholders are identified and their information needs are defined. Information needs are relevant to the quantitative business goals.
PA.4.1.GP3 Derive process measurement objectives from process information needs. Process measurement objectives to satisfy defined process information needs are defined.
PA.4.1.GP4 Identify measurable relationships between process elements that contribute to the process performance. Relationships between process elements are determined. Measures of process performance are justifiable.
PA.4.1.GP5 Establish quantitative objectives for the performance of the defined process, according to the alignment of the process with the business goals. Process performance objectives are defined to explicitly reflect the quantitative business goals. Process performance objectives are verified with process stakeholders to be realistic and useful.

PA.4.1.GP6 Identify product and process measures that support the achievement of the quantitative objectives for process performance.

Detailed measures are defined to support monitoring, analysis and verification needs of process and product goals.

Measures to satisfy process measurement and performance objectives are defined.

Frequency of data collection is defined.

Algorithms and methods to create derived measurement results from base measures are defined, as appropriate.

Verification mechanism for base and derived measures is defined.

PA.4.1.GP7 Collect product and test process measurement results through performing the defined process.

Data collection mechanism is created for all identified measures.

Required data is collected in an effective and reliable manner.

Measurement results are created from the collected data within defined frequency.

Analysis of measurement results is performed within defined frequency.

Measurement results are validated to confirm that the results fulfil the process information needs.

Measurement results are reported to those responsible for monitoring the extent to which qualitative objectives are met.

6.2.5.1.2 Generic resources for PA.4.1

- Management information (cost, time, reliability, profitability, customer benefits, risks etc.); [PA.4.1 Achievement a, b, c, d, e, f, g]
- Applicable measurement techniques; [PA 4.1 Achievement f]
- Product and test process measurement tools and results databases; [PA.4.1 Achievement f, g]
- Process measurement framework; [PA.4.1 Achievement d, e, f, g]
- Tools for data analysis and measurement. [PA.4.1 Achievement c, d, e, f, g]

6.2.5.1.3 Generic work products for PA.4.1

2.00 Description [PA.4.1 Achievement a, b, d, f]

- Defines information needs for the process.
- Specifies candidate measures.

3.00 Plan [PA.4.1 Achievement c, e, f]

- Defines quantitative objectives for process performance.
- Specifies measures for the process.
- Defines tasks and schedules to collect and analyse data.
- Allocates responsibilities and resources for measurement.

5.00 Record [P. 4.1 Achievement g]

- Defines data to be collected as specified in plans and measures.

6.00 Report [PA.4.1 Achievement g]

- Provides results of process data analysis to identify process performance parameters.

- Monitors process performance based on results of measurement.

8.00 Specification [PA.4.1 Achievement b, c, f]

- Describes information needs and performance objectives.
- Provides a basis for analyzing process performance.
- Defines explicit criteria for data validation.
- Defines frequency of data collection.

6.2.5.2 PA.4.2 Quantitative control process attribute

The quantitative control process attribute is a measure of the extent to which objective data are used to manage process performance that is predictable As a result of full achievement of this attribute:

- Techniques for analysing the collected data are selected:*
- Assignable cause of process variation are determined through analysis of collected data;*
- Distributions that characterize the performance of the process are established; ;*
- Corrective actions are taken to address special and common causes of variation;*
- Separate distributions are established (as necessary) for analysing the process under the influence of assignable causes of variation.*

6.2.5.2.1 Generic practices for PA.4.2

PA.4.2.GP1 Select analysis techniques, appropriate to collected data. Process control analysis methods and techniques are defined. Selected techniques are validated against process control objectives.
PA.4.2.GP2 Determine assignable causes of process variation by analysing the collected data. Variation in process performance is attributed to a specific, unpredictable cause. Assignable cause indicates a possible problem in the defined process.
PA.4.2.GP3 Establish distributions that characterize the process performance. Variation in measurement results is used to analyse process performance. Deviations are analysed to identify potential cause(s) of variation. Trends of process performance are estimated.
PA.4.2.GP4 Identify and implement corrective actions to address assignable causes. Results are provided to those responsible for taking action. Corrective actions are determined to address each assignable cause. Corrective actions are implemented to address assignable causes of variation. Corrective action results are monitored. Corrective actions are evaluated to determine their effectiveness.
PA.4.2.GP5 Establish separate distributions for analysing the process under the influence of assignable causes of variation. Consequences of process variation are analysed. Distributions are used to quantitatively understand process performance.

6.2.5.2.2 Generic resources for PA.4.2

- Process control and analysis techniques; [PA.4.2 Achievement a, b]
- Statistical analysis tools / applications; [PA.4.2 Achievement b, c, e]
- Process control tools / applications. [PA.4.2 Achievement c, d, e]

6.2.5.2.3 Generic work products for PA.4.2

2.00 Description [PA.4.2 Achievement b, c, e]

- Defines parameters for process control.
- Defines and maintains control limits for selected base and derived measurement results.

3.00 Plan [PA.4.2 Achievement a]

- Defines analysis methods and techniques at detailed level.

6.00 Report [PA.4.2 Achievement a, c, d, e]

- Provides analyzed measurement results of process performance.
- Identifies corrective actions to address assignable causes of variation.
- Ensures that selected techniques are effective and measures are validated.

9.00 Record [PA.4.2 Achievement b, c, d, e]

- Provides measurement data to identify special causes of variation.
- Provides information on defects and problems.
- Records the changes.
- Documents corrective actions to be implemented.
- Monitors the status of corrective actions.
- Collects the data and provides the basis for analysis, corrective actions and results reporting.

6.2.6 Process capability Level 5: Innovating process

The previously described *Predictable process* is continually improved to respond to organizational change.

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

6.2.6.1 PA.5.1 Process innovation process attribute

The process innovation attribute is a measure of the extent to which changes to the process are identified from investigations of innovative approaches to the definition and deployment of the process. As a result of full achievement of this attribute:

- Process innovation objectives for the process are defined that support the relevant business goals;*
- Appropriate data are analysed to identify opportunities for best practice and innovation;*
- Innovation opportunities derived from new technologies and process concepts are identified;*
- An implementation of test strategy is established to achieve the test process innovation objectives.*

6.2.6.1.1 Generic practices for PA.5.1

PA.5.1.GP1 Define the process innovation objectives for the process that support the relevant business goals. Directions to process innovation are set. New business visions and goals are analyzed to give guidance for new process objectives and potential areas of process change. Quantitative and qualitative process innovation objectives are defined and documented.
PA.5.1.GP2 Analyze data of the process to identify opportunities for best practice and innovation. Feedback on opportunities for innovation is actively sought. Innovation opportunities are identified. Industry best practices are identified and evaluated.
PA.5.1.GP3 Identify innovation opportunities of the process from new technologies and process concepts. Impact of new technologies on process performance is identified and evaluated. Impact of new process concepts is identified and evaluated. Innovation opportunities are identified. Emergent risks are considered in identifying innovation opportunities.
PA.5.1.GP4 Define an implementation strategy based on long-term innovation vision and objectives. Commitment to innovation is demonstrated by organizational management and process owner(s). Proposed process changes are evaluated and piloted to determine their benefits and expected impact on defined business objectives. Changes are classified and prioritized based on their impact on defined innovation objectives. Measures that validate the results of process changes are defined to determine expected effectiveness of the process change. Implementation of the approved change(s) is planned as an integrated program or project. Implementation plan and impact on business goals are discussed and reviewed by organizational management.

6.2.6.1.2 Generic resources for PA.5.1

- Process innovation framework; [PA.5.1 Achievement a, c, d]
- Process feedback and analysis system (measurement data, causal analysis results etc.); [PA.5.1 Achievement b]
- Piloting and trialling mechanism. [PA.5.1 Achievement b, c]

6.2.6.1.3 Generic work products for PA.5.1

2.00 Description [PA.5.1 Achievement c, d]

- Identifies potential areas of innovation and new technology.

3.00 Plan [PA.5.1 Achievement a, d]

- Defines improvement objectives for the process
- Allocates resources for improvement activities.
- Schedules activities for root cause analysis.
- Defines an approach to implementing selected innovations.
- Identifies scope of pilot innovation activities.

5.00 Procedure [PA.5.1 Achievement a]

- Establishes expectations for conduct and evaluation of pilot innovations.

6.00 Report [PA.5.1 Achievement b, c]

- Identifies potential innovations and process changes.

8.00 Specification [PA.5.1 Achievement a]

- Define and maintain business goals.
- Provides evidence of management commitment.

9.00 Record [PA.5.1 Achievement b]

- Provides analytical data to identify opportunities for best practice and innovation.
- Identifies potential innovation opportunities.
- Records information on new technology and techniques.

6.2.6.2 PA.5.2 Process innovation implementation process attribute

The process innovation implementation attribute is a measure of the extent to which changes to the definition, management and performance of the process achieves the relevant process innovation objectives. As a result of full achievement of this attribute:

- Impact of all proposed changes is assessed against the objectives of the defined process and standard process;*
- Implementation of all agreed changes is managed to ensure that any disruption to the process performance is understood and acted upon;*
- Effectiveness of process change on the basis of actual performance is evaluated against the defined product requirements and process objectives.*

6.2.6.2.1 Generic practices of PA.5.2

PA.5.2.GP1 Assess the impact of each proposed change against the objectives of the defined and standard process.

Objective priorities for process innovation are established.

Specified changes are assessed against product quality and process performance requirements and goals.

Impact of changes to other defined and standard processes is considered.

PA.5.2.GP2 Manage the implementation of agreed changes to selected areas of the defined and standard process according to the implementation strategy.

A mechanism is established for incorporating accepted changes into the defined and standard process(es) effectively and completely.

The factors that impact the effectiveness and full deployment of the test process change are identified and managed, such as:

- Economic factors (productivity, profit, growth, efficiency, quality, competition, resources, and capacity);
- Human factors (job satisfaction, motivation, morale, conflict / cohesion, goal consensus, participation, training, span of control);
- Management factors (skills, commitment, leadership, knowledge, ability, organisational culture and risks);
- Technology factors (sophistication of system, technical expertise, development methodology, need of new technologies).

Training is provided to users of the process.

Process changes are effectively communicated to all affected parties.

Records of the change implementation are maintained.

PA.5.2.GP3 Evaluate the effectiveness of process change on the basis of actual performance against process performance and capability objectives and business goals.

Performance and capability of the changed process are measured and compared with historical data.

A mechanism is available for documenting and reporting analysis results to management and owners of standard and defined process.

Measures are analysed to evaluate the effectiveness of process changes.

Other feedback is recorded, such as opportunities for further innovation of the standard process.

6.2.6.2.2 Generic resources for PA.5.2

- Change management system; [PA.5.2 Achievement a, b, c]
- Process evaluation system (impact analysis, etc.). [PA.5.2 Achievement a, c]

6.2.6.2.3 Generic work products for PA.5.2

2.00 Description [PA.5.2 Achievement b]

- Documents changes as a result of process improvement actions.

3.00 Plan [PA.5.2 Achievement a, b]

- Defines activities and schedule for pilot change implementation.
- Allocates resources for pilot implementation.
- Assigns responsibility for pilot implementation.
- Defines activities and schedule for organizational implementation of process change.
- Allocates resources and responsibilities for organizational implementation.
- Specifies scope of pilot implementation of proposed change.

6.00 Report [PA.5.2 Achievement a, b, c]

- Describes results of pilot implementation of process change.
- Evaluates effectiveness of process compared to process innovation objectives.
- Provides details on implementation of organizational changes.

- Describes proposed changes to organizational standard and defined process.

8.00 Specification [PA.5.2 Achievement c]

- Specifies measures derived from process improvement objectives.

9.00 Record [PA.5.2 Achievement b]

- Contains records of all completed and in-progress pilot implementations.
- Records history of and justification for changes.

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Annex A (informative)

Conformity of the process assessment model

A.1 General

This International Standard sets out a process assessment model that 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.

This clause serves as the statement of conformance of the process assessment model to the requirements defined in ISO/IEC 33004. For ease of reference, the requirements from Clause 6.4 of ISO/IEC 33004 are embedded verbatim in the text of this clause. They should not be construed as normative elements of this International Standard.

Since this process assessment model has been explicitly constructed to be an elaboration of the Process reference model defined in ISO/IEC/IEEE 29119-2, the conformance claim is relatively simple.

A.2 Requirements for process assessment models

Introduction

In order to assure that assessment results are translatable into the intended process measurement framework in a repeatable and reliable manner, process assessment models shall adhere to certain requirements. A process assessment model shall contain a definition of its purpose, scope and elements; its mapping to the process measurement framework and specified process reference model(s); and a mechanism for consistent expression of results.

[ISO/IEC 33004, 6.1]

The purpose of this process assessment model is to support assessment of process capability in accordance with the requirements of ISO/IEC 33020.

Process assessment model scope

Process assessment models are related to one or more process reference models and a process measurement framework. Processes in process assessment model(s) are based on the process descriptions provided in the process reference models; process attributes and process quality levels (if applicable) are derived from a measurement framework.

In order to assure that assessment results are translatable into a set of process profiles in a repeatable and reliable manner, process assessment models shall adhere to certain requirements.

[ISO/IEC 33004, 6.2]

The process scope of this process assessment model is defined in the process reference model specified in ISO/IEC/IEEE 29119-2 which defines a process reference model satisfying the requirements of ISO/IEC 33004, Clause 5. The process capability scope of this process assessment model is defined in the process measurement framework specified in ISO/IEC 33020, which defines a process measurement framework for process capability satisfying the requirements of ISO/IEC 33003.

Requirements for process assessment models

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

6.3.2 A process assessment model shall address, for a given process, all, or a continuous subset, of the levels (starting at level 1) of the process measurement framework for process capability 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.

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

- a) the selected process reference model(s);
- b) the selected processes taken from the process reference model(s);
- c) the process quality level of the process characteristics selected from the process measurement framework.

[ISO/IEC 33004, 6.3]

This process assessment model is based upon the process reference model defined in ISO/IEC/IEEE 29119-2, addressing all of the processes identified in [Clause 5](#).

In the capability dimension of this process assessment model, the model addresses all of the process attributes and capability levels defined in the process measurement framework in ISO/IEC 33020, Clause 5.

Assessment indicators

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

- a) explicitly addresses the purposes and process outcomes, as defined in the selected process reference model, of all the processes within the scope of the Process assessment model; and
- b) demonstrates the achievement of the process attributes for the process quality characteristic scopes of the process assessment model.

The assessment indicators generally fall into three types:

- a) Practices – institutionalized behaviours that support achievement of either the Process Purpose or a specific process attribute.
- b) Information items and their characteristics that demonstrate the respective achievements.
- c) Resources and infrastructure that support the respective achievements.

[ISO/IEC 33004, 6.3.4]

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 [Figure 3](#). The assessment indicators used are:

- base practices and work products; and
- generic practices, generic resources and generic work products

as shown in [Clause 4](#), [Figure 3](#). They support the judgment of the performance and capability of an implemented process.

Mapping process assessment models to process reference models

A process assessment model shall provide an 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 process measurement framework.

The mapping shall be complete, clear and unambiguous. The mapping of the assessment indicators within the process assessment model shall be to:

- a) the purposes and outcomes of the processes in the specified process reference model;*
- b) the process attributes (including all of the results of process attribute achievements listed for each process attribute) in the process measurement framework.*

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

[ISO/IEC 33004, 6.3.5]

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 [Clause 5](#).

Each of the process attributes in this process assessment model is identical to the process attribute defined in the process measurement framework. The generic practices address the characteristics from each process attribute. The generic resources and generic work products relate to the process attribute as a whole.

[Table A.1](#) lists the mappings of the GPs to the achievements associated with each process attribute.

Table A.1 — Mapping of generic practices

GP	Practice name	Maps To
PA 1.1: Process performance process attribute		
GP 1.1.1	Achieve the process outcomes.	PA.1.1.a
PA 2.1: Performance management process attribute		
GP 2.1.1	Identify the objectives for the performance of the process.	PA.2.1.a
GP 2.1.2	Plan the performance of the process to fulfill the identified objectives.	PA.2.1.b
GP 2.1.3	Monitor the performance of the process against the plans.	PA.2.1.c
GP 2.1.4	Adjust the performance of the process	PA.2.1.d
GP 2.1.5	Define responsibilities and authorities for performing the process.	PA.2.1.e
GP 2.1.6	Prepare those performing the process to execute the process.	PA.2.1.f
GP 2.1.7	Identify and make available resources to perform the process according to plan.	PA.2.1.g
GP 2.1.8	Manage the interfaces between involved parties.	PA.2.1.h
PA 2.2: Work product management process attribute		
GP 2.2.1	Define the requirements for the work products.	PA.2.2.a
GP 2.2.2	Define the requirements for documentation and control of the work products.	PA.2.2.b
GP 2.2.3	Identify, document and control the work products.	PA.2.2.c

GP 2.2.4	Review and adjust work products to meet the defined requirements.	PA.2.2.d
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PA 3.1: Process definition process attribute

GP 3.1.1	Define the standard process that will support the deployment of the defined process.	PA.3.1.a
GP 3.1.2	Determine the sequence and interaction between processes so that they work as an integrated system of processes.	PA.3.1.b
GP 3.1.3	Identify the roles and competencies for performing the process.	PA.3.1.c
GP 3.1.4	Identify the required infrastructure and work environment for performing the process.	PA.3.1.d
GP 3.1.5	Determine suitable methods to monitor the effectiveness and suitability of the process.	PA.3.1.e

PA 3.2: Process deployment process attribute

GP 3.2.1	Deploy a defined process that satisfies the context specific requirements of the use of the standard process.	PA.3.2.a
GP 3.2.2	Assign and communicate roles, responsibilities and authorities for performing the defined process.	PA.3.2.b
GP 3.2.3	Ensure necessary competencies for performing the defined process.	PA.3.2.c
GP.3.2.4	Provide resources and information to support the performance of the defined process.	PA.3.2.d
GP 3.2.5	Provide process infrastructure to support the performance of the defined process.	PA.3.2.e
GP 3.2.6	Collect and analyze data about performance of the process to demonstrate its effectiveness and suitability.	PA.3.2.f

PA 4.1 Quantitative analysis process attribute

GP 4.1.1	Align the process with quantitative business goals.	PA.4.1.a
GP.4.1.2	Identify process information needs, in relation with quantitative business goals.	PA.4.1.b
GP 4.1.3	Derive process measurement objective from process information needs.	PA.4.1.c
GP 4.1.4	Identify measurable relationships between process elements that contribute to the process performance.	PA.4.1.d
GP 4.1.5	Establish quantitative objectives for the performance of the defined process, according to the alignment of the process with the business goals.	PA.4.1.e
GP 4.1.6	Identify product and process measure that support the achievement of the quantitative objectives for process performance.	PA.4.1.f
GP 4.1.7	Collect product and process measurement results through performing the defined process.	PA.4.1.g

PA 4.2 Quantitative control process attribute

GP 4.2.1	Select analysis techniques, appropriate to collected data.	PA.4.2.a
GP 4.2.2	Determine assignable causes of process variation by analyzing the collect data.	PA.4.2.b
GP 4.2.3	Establish distributions that characterize the process performance.	PA.4.2.c
GP 4.2.4	Identify and implement corrective actions to address assignable causes.	PA.4.2.d

GP.4.2.5	Establish separate distributions for analyzing the process under the influence of assignable causes of variation.	PA.4.2.e
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PA 5.1 Process innovation process attribute

GP 5.1.1	Define the process innovation objectives for the process that support the relevant business goals.	PA.5.1.a
GP 5.1.2	Analyse data of the process to identify opportunities for best practices and innovation.	PA.5.1.b
GP 5.1.3	Identify innovation opportunities of the process from new technologies and process concepts	PA.5.1.c
GP.5.1.4	Derive an implementation strategy based on long-term innovation vision and objectives.	PA.5.1.d

PA 5.2 Process innovation implementation attribute

GP 5.2.1	Assess the impact of each proposed change against the objectives of the defined and standard process.	PA.5.2.a
GP 5.2.2	Manage the implementation of agreed changes to selected areas of the defined and standard process according to the implementation strategy.	PA.5.2.b
GP 5.2.3	Evaluate the effectiveness of process change on the basis of actual performance against process objectives and business goals.	PA.5.2.c

Expression of assessment results

<i>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 specified process reference model(s).</i>		[ISO/IEC 33004, 6.3.6]
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The processes in this process assessment model are identical to those defined in the process reference model. The process attributes and the process attribute ratings in this process assessment model are identical to those defined in the process 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 B (informative)

Assessment guidelines

B.1 General assessment guideline (informative)

This process assessment model for software testing builds upon the standard ISO/IEC/IEEE 29119. Within this standard the test process is described in a generic way using a multi-layer approach (see [Figure B.1](#)).

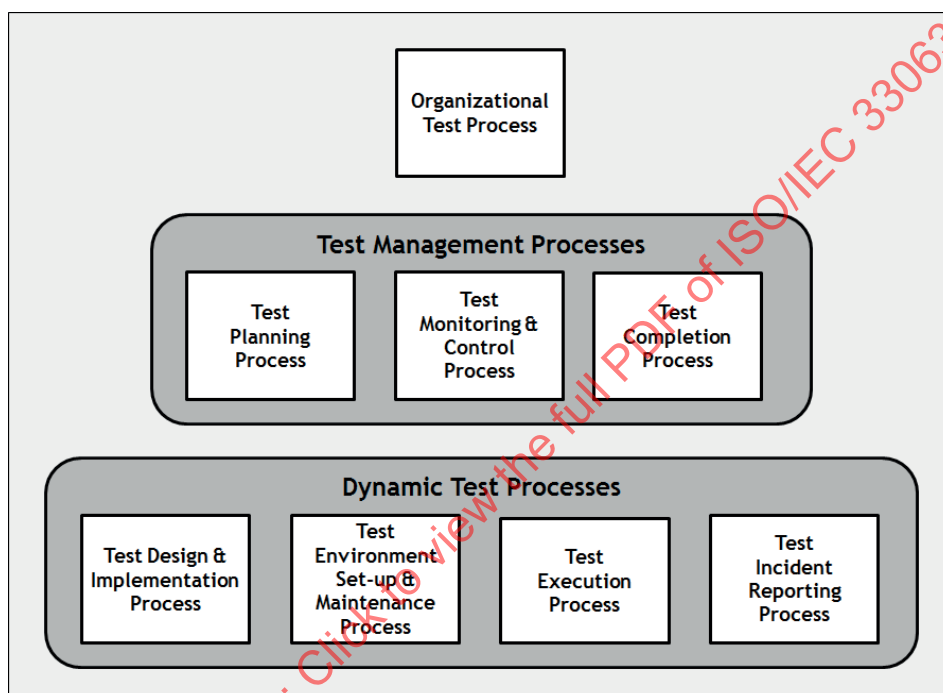


Figure B.1 — Multi-layer test process with all test processes

The top level consists of the Organizational Test Process Group consisting of one process called the Organizational Test Process. The second level is the Test Management process group (TM). The three processes Test Planning Process, Test Monitoring and Control Process and Test Completion Process belong to this group. The bottom layer is the Dynamic Test Process group (DT). Within this group four processes are defined: Test Design & Implementation Process, Test Environment Set-Up Process, Test Execution Process and Test Incident Reporting Process.

All can be seen in [Figure 1](#), no test phases or test types are prescribed within ISO/IEC/IEEE 29119-2. As every project is different, the testing needs also differ. In a project which develops a safety-related system a lot of emphasis will be placed on testing with several test phases and test types, whereas a project which develops a web application might do less testing.

In order to accommodate all projects the generic description of test processes was chosen. This is an important concept in ISO/IEC/IEEE 29119 and needs to be known in order to understand the standard. The process assessment model described in this standard follows the same concept. For each of the generic processes defined in ISO/IEC/IEEE 29119-2 a corresponding process description in the process assessment model is defined.

However, this generic approach has a high impact of the planning and scoping of an assessment. In case a project has two test phases, e.g. unit testing and system testing, the test processes defined in the Test Management process group (TM) and in the Dynamic Test Process group (DT) will have to be “applied” two times. Test design and implementation, test environment will not be the same for unit testing and system testing. Also test planning, monitoring & control and test completion may be done differently for the two test phases and therefore be assessed separately.

In addition, conformant with the requirements of ISO/IEC 33002 the lead assessor may decide together with the assessment sponsor to include further processes from other process assessment model.

B.2 Process application guideline (normative)

Within the scope definition of the assessment the lead assessor together with the sponsor shall specify which processes will be assessed and to which the test level(s), test phase(s), and test type(s) they are applied.

In case a project has two test phases, e.g. unit testing and system testing, and a test type (non-functional testing), e.g. reliability testing, the test processes defined in the Test Management process group (TM) and in the Dynamic Test Process group (DT) will have to be “applied” three times. It also needs application of the Test Management process group (TM) for project test including project (master) test plan process. The following processes would be assessed and rated separately:

- OT.1 Organization test process
- TM.1 Test planning process [for Project Test]
- TM.2 Test monitoring and control process [for Project Test]
- TM.3 Test completion process [for Project Test]
- TM.1 Test planning process [for Unit Testing]
- TM.2 Test monitoring and control process [for Unit Testing]
- TM.3 Test completion process [for Unit Testing]
- DT.1 Test design and implementation process [for Unit Testing]
- DT.2 Test environment set-up and maintenance process [for Unit Testing]
- DT.3 Test execution process [for Unit Testing]
- DT.4 Test incident reporting process [for Unit Testing]
- TM.1 Test planning process [for System Testing]
- TM.2 Test monitoring and control process [for System Testing]
- TM.3 Test completion process [for System Testing]
- DT.1 Test design and implementation process [for System Testing]
- DT.2 Test environment set-up and maintenance process [for System Testing]
- DT.3 Test execution process [for System Testing]
- DT.4 Test incident reporting process [for System Testing]
- TM.1 Test planning process [for Reliability Testing]
- TM.2 Test monitoring and control process [for Reliability Testing]
- TM.3 Test completion process [for Reliability Testing]

- DT.1 Test design and implementation process [for Reliability Testing]
- DT.2 Test environment set-up and maintenance process [for Reliability Testing]
- DT.3 Test execution process [for Reliability Testing]
- DT.4 Test incident reporting process [for Reliability Testing]

When the lead assessor performs the rating of the Test Design and Implementation Process and Test Planning Process, for example, they have to be rated three times for unit testing, system testing, and reliability testing as seen in [Figure B.2](#).

Processes to be investigated	Rating	Application Scoping (context)
Test Design and implementation process	Fully	System testing
	Partially	Unit testing
	Largely	Reliability testing
Test Planning Process	Fully	System testing
	Fully	Unit testing
	Fully	Reliability testing

Figure B.2 — Example of process rating

In the case in [Figure B.2](#), the application context shall be clearly scoped if the lead assessor is to perform rating once for each of both processes, for example, partially for the Test Design and Implementation Process and fully for the Test Planning Process. This means that the Test Design and Implementation Process is partially achieved and Test Planning Process is fully achieved only in the scope of unit testing, system testing and reliability testing. Here, the Test Planning Process for project test, so called the Project (or Master) Test Planning Process can be assessed together or separately based on the lead assessor's judgement.

B.3 Guideline on the use of additional processes from other PAM (informative)

Conformant with the requirements of ISO/IEC 33002 the lead assessor may decide together with the assessment sponsor to include further processes from other process assessment model. For example, if the assessment sponsor wants to assess the tester's skills and training, the process "ORG.4A Skill Development Process" from the process assessment model in ISO/IEC 15504-5 may be added. Other examples of additional processes from other PAM are shown in [Annex D](#). They include the Measurement Process (MAN.6 Measurement from ISO/IEC 15504-5), Software Review Process (SUP.4 Joint Review from ISO/IEC 15504-5), and the Static Analysis Process (from [Annex E](#)).

Other candidates for the additional processes from other PAM can be the Incident Management Process, the Configuration Management Process, and so forth that the lead assessor together with the help from assessment sponsor considers necessary for practical test process assessment.

Annex C (informative)

Work product characteristics

Work product characteristics listed in this Annex 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 are defined using the schema in [Table C.1](#), which is based on the approach defined in ISO/IEC/IEEE 15289. 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 checklist of what every organization must have.

Table C.1 — Work product identification

Work product identifier #	An identifier number for the work product which is used to reference the work product.
Work product name	Provides an example of a typical name associated with the work product characteristics. This name is provided as an identifier of the type of work product the practice or process might produce. Organizations may call these work products by different names. The name of the work product in the organization is not significant. Similarly, organizations may have several equivalent work products which contain the characteristics defined in one work product type. The formats for the work products can vary. It is up to the assessor and the organizational unit coordinator to map the actual work products produced in their organization to the examples given here.
Work product characteristics	Provides examples of the potential characteristics associated with the work product types. The assessor may look for these in the samples provided by the organizational unit

C.1 Generic work products

The Generic Work Product 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 attribute. The generic work products form the basis for the classification of the work products defined as process performance indicators. These work product types are basic input types to process owners of all types of processes.

NOTE The set of generic work product classes including its descriptions and typical characteristics is derived from ISO/IEC/IEEE 15289.

WP ID	Generic Work Product Class	Generic Work Product Description	Generic Work Product Typical Characteristics
1.00	object	An entity created to serve a purpose, or created in the course of serving that purpose. Its existence is observable and rationalised by its material or behavioural characteristics. It may exist as a complete, partial or exemplifying realization of a product, be a subordinate part of a product, be a by-product or be a part of an enabling system	– identity, name of object – purpose, value that caused its creation – ownership and responsibility for object – status, state and classification of object – distinguishing observable qualities and properties – functional and behavioural characteristics – dimensional and parametric characteristics – relationship with and dependencies on surroundings – observable interactions or effects on other objects – interfaces, connections to surroundings – location, position in surroundings – safety, security, privacy and environmental regulations
2.00	description	Represent a planned or actual context of use, function, design, service, or item NOTE: A description of something that is required is a specification.	– object, subject or class represented – purpose and applicability of description – concerned parties, viewpoints, views – range of use, and validity of description – accuracy, detail and abstraction level – model dimensions, degrees of freedom – description language, notation, nomenclature – applicable standards, formats and styles – representations of function, attributes, properties – descriptions of architecture, arrangement, interfaces – depiction of composition or form – definition of classification, category, ranking, type

WP ID	Generic Work Product Class	Generic Work Product Description	Generic Work Product Typical Characteristics
3.00	plan	Define when, how, and by whom specific processes or activities are to be performed.	– definition of undertaking, purpose and objectives of plan – strategy and policy guiding plan – plan owner, stakeholders, responsible parties and their authorities – plan status, version, reviews and modifications – proposed events, actions and tasks – predicted timescales, durations, dates of actions – assumed dependencies, conditions, constraints, risks – allocated resources, labour, facilities, materials – planned budget, cost, expenditures – defined milestones, results and progress targets – decision points and authorization gates – options and contingency actions
4.00	policy	Establish an organization's high-level intention and approach to achieve objectives for, and ensuring effective control of, a service, process, or management system.	- Date of issue, effective date, and status - Scope - Issuing organization - Approval authority and identification of those accountable for enforcing the policy - Authoritative references for compliance or conformance (such as policies, laws and regulations, standards, contracts, requirements, and vision or mission statements) - Body, including objectives - Glossary - Change history
5.00	procedure	Define in detail when and how to perform certain activities or tasks, including tools needed.	– purpose, outcomes and results of performing actions – issuing authority and controls – roles, responsibilities and duties – actors, their competence and proficiency – dependency on requirements, standards and directives – achievement, goals, completion criteria – definition of transformations and their products – work definitions, instructions to act – progression and dependencies of action – guiding method and practices – enabling tools and infrastructure

WP ID	Generic Work Product Class	Generic Work Product Description	Generic Work Product Typical Characteristics
6.00	report	Describe the results of activities such as investigations, assessments, and tests. A report communicates decisions.	– purpose or benefit of report – source, author and authority to report – interested parties, recipients, distribution – knowledge, understanding communicated – information, data, facts and evidence contained – analysis, inspections and audits employed – timing, validity, condition of information use – dependence on circumstances, constraints and assumptions – reported status, results, achievements, conformance, compliance or outcomes – identified faults, failings or errors – inferred patterns, trends or predications– conclusions, recommendations, rationale
7.00	request	Record information needed to solicit a response.	– objective, purpose or outcome of request – expression of a demand, need or desire – communication of enquiry, solicitation or an order to provide – initiation of supply, provision or support – definition of action, change or exchange – identification of required products, services, capability or resources – authorization of tasking or commitments – specified terms, conditions to act, agreement conveyed – required availability of requested provision communicated
8.00	specification	Provide requirements for a required service, product, or process.	– definition of needs, wishes and circumstances – statement of requirements – definition of constraints and conditions – standards and regulations invoked – dimensions of achievement and outcome – criteria of conformance, correctness and compliance – definition of measures, indicators, limitations, values, and thresholds – statements of action and conduct – required functions, performance, behaviour or service levels – definitions of interfaces, interaction, location and connection – conditions of acceptance, permissible exceptions and deviations – conditions of change and variation

WP ID	Generic Work Product Class	Generic Work Product Description	Generic Work Product Typical Characteristics
9.00	record	Organize the data an organizational entity retains. NOTE: Consistent with the ISO 9000- series, the purpose of a record is to state results achieved or to provide evidence of activities performed by an organizational entity.	– record identity or title – content, description and reason for record – ownership, origin and authorship – practices, agreements, commitments and regulations applying to record – authorities and condition of storage, retrieval, replication and deletion – medium and format of record – location, conditions and periods of storage – applicable information privacy, security and integrity – declaration of status, configuration and base-line information – information on audit, validity and history

C.2 Generic work products and specific work products

Specific work product types are typically created by process owners and applied by process deployers in order to satisfy an outcome of a particular process purpose.

NOTE Generic work product types are included in the list for completeness.

WP ID	Origin of WP	Work Product Name	Work Product Typical Characteristics
1.0	ISO/IEC/IEEE 15289	Object	Refer to C.1 for Generic Work Product typical characteristics
1.01	New	Static analysis item	- function and non-function of system and software - customer requirements - product specification - software process and structure - data type and structure - storage or repository
1.02	ISO/IEC/IEEE 29119-3	Test environment	- development environment - working environment- hardware and software system - installed system - integrated system
1.03	ISO/IEC/IEEE 29119-3	Test item	- function and non-function of system and software - customer requirements - product specification - regularity and standards - software process and structure - data type and structure - storage or repository - test tools - test Environment

WP ID	Origin of WP	Work Product Name	Work Product Typical Characteristics
2.0	ISO/IEC/ IEEE 15289	Description	Refer to C.1 for Generic Work Product typical characteristics
2.01	ISO/IEC/ IEEE 29119-1	Test basis	- product and project description - product specification - system and software structure
2.02	ISO/ IEC 15504-5	Traceability record(information)	- mapping information between requirement, test case/suite list, and coverage - configuration information-
2.03	ISO/IEC/ IEEE 29119-1	Test condition	- component or system under testing - system function, transaction, attribute, parameter and feature - quality attribute - software requirement
2.04	ISO/IEC/ IEEE 29119-3	Test coverage item	- acceptance criteria - test conditions - test objectives - safety and security conditions
3.0	ISO/IEC/ IEEE 15289	Plan	Refer to C.1 for Generic Work Product typical characteristics
3.01	ISO/IEC/ IEEE 15289	Acquisition plan	- what needs to be acquired - approach for acquiring the product or service - evaluation or supplier selection criteria - acceptance strategy
3.02	ISO/ IEC 15504-5	Human resource management plan	- Human resource objectives / goals / policies - Satisfaction of human resource needs such as skills, competencies, etc. - Human resource management
3.03	ISO/ IEC 15504-5	Problem management plan	- problem resolution activities including identification, recording, description and classification - problem resolution approach: evaluation and correction of the problem - problem tracking - any timing constraints - mechanism to collect and distribute problem resolutions
3.04	ISO/IEC/ IEEE 15289	Project management plan	- work breakdown structure - task relationships/external dependencies - achievement milestones - organizational infrastructure - procured items and services - project review times/events - reserves for risk management

WP ID	Origin of WP	Work Product Name	Work Product Typical Characteristics
3.05	ISO/IEC/ IEEE 29119-3	Project test plan	- master test plan - specific level test plan - validation & verification plan - staffing plan - test resource/environment plan - monitoring and control - test completion - entry and exit conditions - project and product risk identification & treatment - schedule and estimation
3.06	ISO/ IEC 15504-5	Quality plan	- Objectives/goal for quality - quality assessment/assuring method - regulatory and standards - customer requirements - expected quality criteria - quality measurement
3.07	ISO/ IEC 15504-5	Review plan	- review technique - review schedule and owner - review level and type - review process
3.08	ISO/IEC/ IEEE 29119-3	Test plan	- master test - detail level test - level test process and procedure - test input and output - test progress - test measurement - test staff - test schedule and estimation
3.09	ISO/IEC/ IEEE 15289	Training plan	- current staff capabilities - skills required - means available to achieve training goals
4.0	ISO/IEC/ IEEE 15289	Policy	Refer to C.1 for Generic Work Product typical characteristics
4.01	ISO/IEC/ IEEE 29119-1	Organizational test policy	- test lifecycle management policy - test lifecycle reference models - test process improvement policy - resource allocation plan - training strategy

WP ID	Origin of WP	Work Product Name	Work Product Typical Characteristics
4.02	ISO/IEC/ IEEE 29119-3	Organizational test strategy	- decision-making strategy - risk treatment strategy - configuration management strategy - information management strategy - integration strategy - test strategy - measurement strategy
4.03	ISO/ IEC 15504-5	Personnel policy	- recruitment policy - training policy - career opportunities for individuals in the organization - team building strategy - reward and recognition strategy - performance appraisal strategy
4.04	ISO/ IEC 15504-5	Quality policy	- established by the top management - appropriate to the organisation - aligned to organization's business objectives - product and process quality goals - establishment and review of quality objectives - commitment to comply with requirements - commitment to improve the effectiveness of the quality management system
4.05	ISO/IEC/ IEEE 29119-3	Test strategy	- specific level or instantiated test strategy - risk mitigation strategy - test technique approach
4.06	ISO/ IEC 15504-5	Training strategy	- options and approach for satisfying training needs - evaluation criteria against which the strategic options are evaluated - constraints/risks and how these will be addressed
5.0	ISO/IEC/ IEEE 15289	Procedure	Refer to C.1 for Generic Work Product typical characteristics
5.01	ISO/ IEC 15504-5	Training material	- Coverage of system, application, operations, maintenance as appropriate to the application - Courses listings and availability
5.02	ISO/IEC/ IEEE 15289	Customer satisfaction survey	- mechanism to collect data on customer satisfaction: - customers to be contacted - data to be collected from the customer - target date for responses - products/services under investigation - methods to analyze feedback