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

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ISO/IEC 33063

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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.

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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;

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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.

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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.

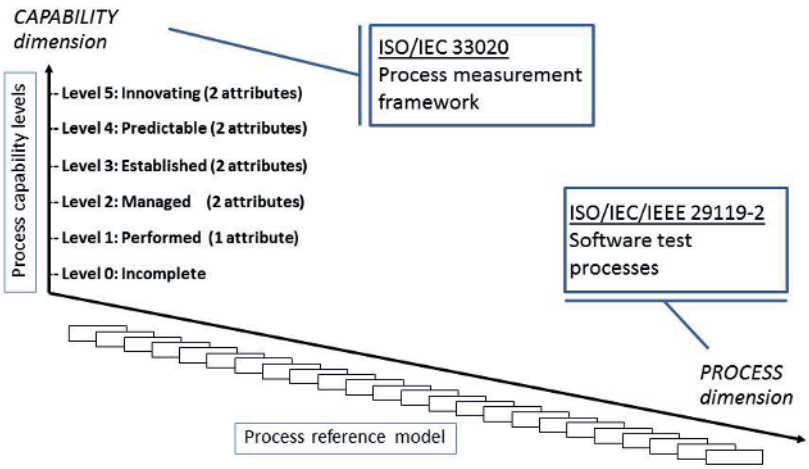

Figure 1 — Relationship between the process assessment model and its inputs

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.

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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.

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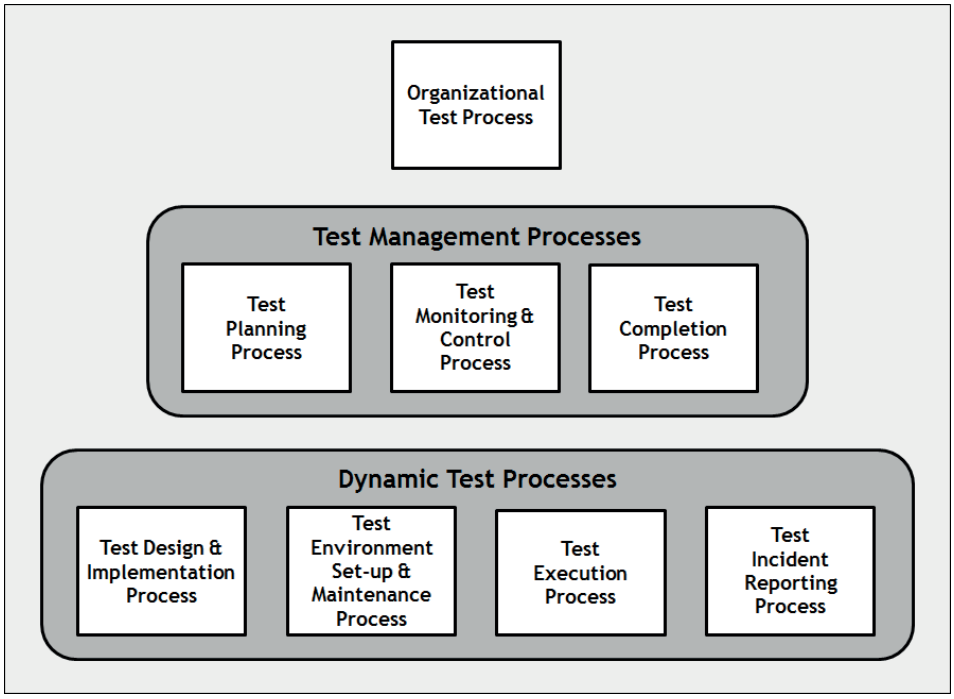

Figure 2 — Process groups and processes of PRM, ISO/IEC/IEEE 29119-2

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.

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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.

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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.

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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.

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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.

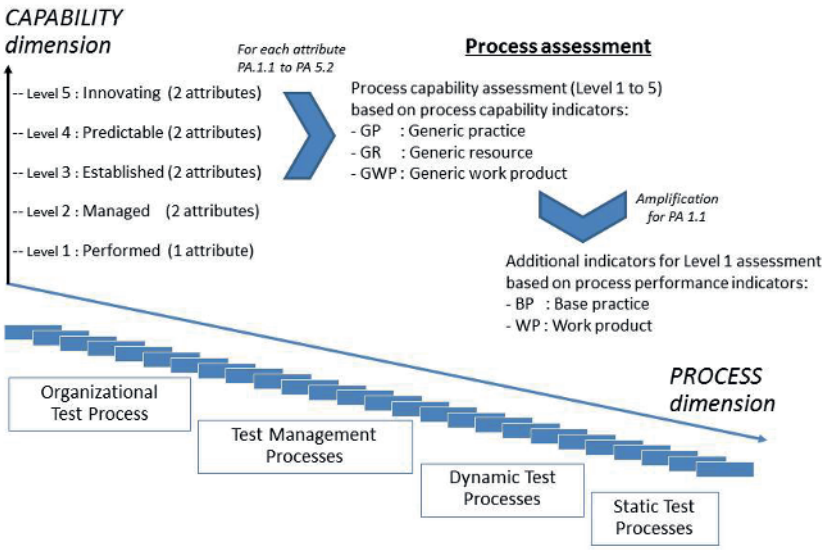

Figure 3 — Assessment indicators

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.

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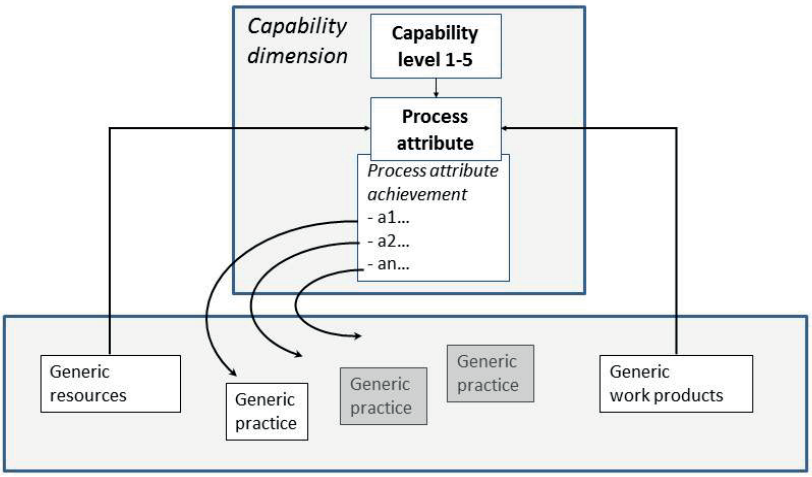

Figure 4 — Process capability indicators

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

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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.

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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.

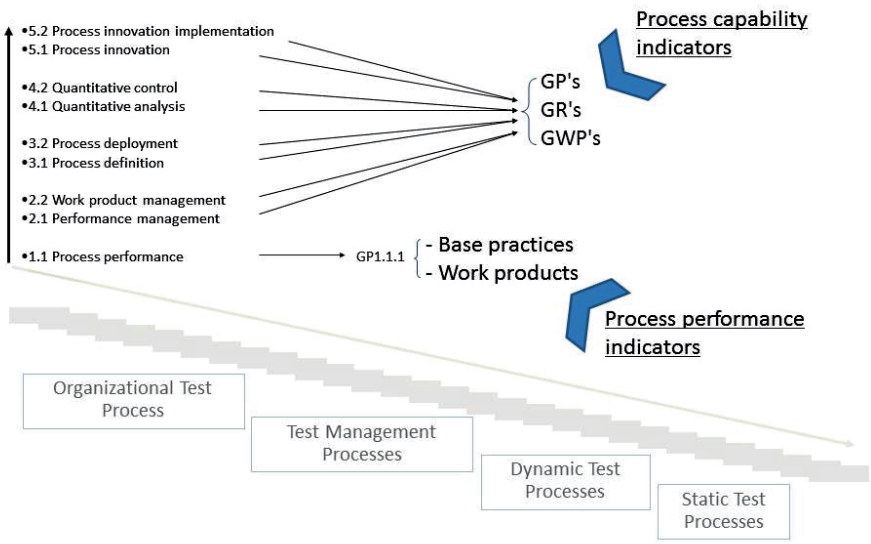

Figure 5 — Relationship between assessment indicators and process capability

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.

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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.

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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.

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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			

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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			

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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			

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