INTERNATIONAL STANDARD

**ISO/IEC 15504-3**

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# Information technology — Process assessment —

## Part 3: Guidance on performing an assessment

*Technologies de l'information — Évaluation des procédés du logiciel —*

*Partie 3: Réalisation d'une évaluation*



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to the national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 15504-3 was prepared by Joint Technical Committee ISO/IEC/TC JTC 1, *Information technology*, Subcommittee SC 7, *Software and system engineering*.

This first edition cancels and replaces ISO/IEC TR 15504-4:1998 and ISO/IEC TR 15504-6:1998, which have been technically revised.

ISO/IEC 15504 consists of the following parts, under the general title *Information technology — Process assessment*:

— *Part 2: Performing an assessment*

— *Part 3: Guidance on performing an assessment*

— *Part 4: Guidance on use for process improvement and process capability determination*

The following parts are in preparation:

— *Part 1: Concepts and vocabulary*

— *Part 5: An exemplar Process Assessment Model*

The complete series will replace ISO/IEC TR 15504-1 to ISO/IEC TR 15504-9.

# Introduction

This part of ISO/IEC 15504 assumes familiarity with the normative part of the standard. It is primarily addressed to the competent assessor and other people, such as the sponsor of the assessment, who need guidance on ensuring that the requirements for performing an assessment have been met. It will also be of value to developers of assessment methods and of tools to support an assessment.

ISO/IEC 15504-1 will provide a general introduction to the concepts of process assessment and a glossary for assessment related terms.

ISO/IEC 15504-2 sets out the minimum requirements for performing an assessment that ensure consistency and repeatability of the ratings. The requirements help to ensure that the assessment output is self-consistent and provides evidence to substantiate the ratings and to verify compliance with the requirements.

ISO/IEC 15504-2 defines the Measurement Framework for process capability and the requirements for:

a) performing an assessment;

b) process reference models;

c) process assessment models;

d) verifying conformity of process assessment.

This part of ISO/IEC 15504 provides guidance for interpreting the minimum requirements for performing an assessment. It also provides guidance on:

— the nature of the measurement framework;

— the role and function of process reference models;

— the requirements for and selection of a process assessment model;

— the selection and use of assessment tools;

— criteria for assessor competence; and

— verification of conformity of process assessment.

ISO/IEC 15504-3 incorporates, as Annex A, an exemplar documented assessment process.

Process assessment, as defined in this International Standard, is based on a two dimensional model containing a process dimension and a capability dimension. The process dimension is provided by an external process reference model, which defines a set of processes characterized by statements of process purpose and process outcomes. The capability dimension consists of a measurement framework comprising six process capability levels and their associated process attributes.

The assessment output consists of a set of process attribute ratings for each process assessed, termed the process profile, and may also include the capability level achieved by that process.

Process assessment is applicable in the following circumstances:

a) by or on behalf of an organization with the objective of understanding the state of its own processes for process improvement;



 

b) by or on behalf of an organization with the objective of determining the adequacy of its own processes for a particular requirement or class of requirements;

c) by or on behalf of an organization with the objective of determining the adequacy of another organization's processes for a particular contract or class of contracts.

As described in ISO/IEC 15504-4, process assessment is an activity that can be performed either as part of a process improvement initiative or as part of a capability determination approach. The formal entry to the assessment process occurs with the compilation of the assessment input, which defines the purpose of the assessment (why it is being carried out), the scope of the assessment, what constraints apply to the assessment and any additional information that needs to be gathered. The assessment input also defines the responsibility of the various parties in the performance of an assessment. An assessor who has the necessary competence and skills oversees the assessment. Assessors may be from within the organization, external to the organization or a combination of both.

An assessment is carried out against a defined assessment input utilizing conformant process assessment model(s) related to one or more conformant or compliant process reference models. ISO/IEC 15504-5 contains an exemplar process assessment model that is based upon the process reference model defined in Annex F of ISO/IEC 12207:1995/Amd 1:2002.

# Information technology — Process assessment —

# Part 3: Guidance on performing an assessment



## 1 Scope

This part of ISO/IEC 15504 provides guidance on meeting the minimum set of requirements for performing an assessment contained in ISO/IEC 15504-2.

It provides an overview of process assessment and interprets the requirements through the provision of guidance on:

a) performing an assessment;

b) the measurement framework for process capability;

c) process reference models and process assessment models;

d) selecting and using assessment tools;

e) competency of assessors;

f) verification of conformity.

This document uses the following schema: the text inside a box is quoted from the normative ISO/IEC 15504-2 and the text following a box is guidance about the normative text. If the quoted text includes a clause reference, it is understood that ISO/IEC 15504-2 should be referred to.

## 2 Normative references

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

ISO/IEC 15504-2:2003, *Information technology — Process assessment — Part 2: Performing an assessment*

ISO/IEC TR 15504-9, *Information technology — Software process assessment — Part 9: Vocabulary*[1)]

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC TR 15504-9 apply.

1) A revision of this document is in preparation under the following reference: ISO/IEC 15504-1.

# 4 Overview of Process Assessment

## 4.1 Introduction

Process assessment is undertaken to understand the capability of an Organizational Unit's current processes. Process assessment may encompass all or a subset of the processes (e.g. project management, development, maintenance, configuration management) used by an organization.

Process assessment is performed by one or more assessor(s), one of them (the competent assessor) being responsible for assuring conformity of the assessment to the requirements in ISO/IEC 15504-2.

The assessment of the Organizational Unit's processes is made utilizing a Process Assessment Model based upon a Process Reference Model (e.g. ISO/IEC 12207:1995/Amd 1:2002). A Process Reference Model describes the processes in terms of purpose and outcomes. A Process Assessment Model provides detailed indicators necessary to assess the achievement of the process attributes.

There is a set of 9 process attributes applicable to any process and characterizing the capability of an implemented process. They are defined in ISO/IEC 15504-2.

Process attributes are grouped into capability levels that define an ordinal scale of process capability and provide a rational route for improvement of each individual process. Each process attribute represents measurable characteristics which support achievement of the process purpose and contribute to meeting the business goals of the organization.

The fundamental assessment output consists of up to nine process attribute ratings (referred to as a process profile) for each process assessed.

## 4.2 Assessment process

An assessment must be conducted according to a documented process that is capable of meeting the assessment purpose. The key elements of a documented assessment process are closely tied to the requirements for performing an assessment, defined in Clause 4 of ISO/IEC 15504-2. A brief overview of these elements is given in the next section while more details on interpreting the activities for performing an assessment are given in Clause 5 of this part of the standard. Note, however, that the guidance provided does not constitute a complete, documented assessment process. Its purpose is to provide help in interpreting the requirements in ISO/IEC 15504-2 and to provide a starting point for selecting or creating a documented assessment process.

The documented assessment process is the set of instructions for conducting the assessment. A documented assessment process addresses the following aspects of the conduct of an assessment:

— defining the inputs to an assessment such as purpose, scope, constraints and the identity of the conformant Process Assessment Model to be used;

— defining key roles and responsibilities;

— providing guidance for planning, data collection, data validation, process attributes rating and reporting of assessment results;

— recording of assessment outputs.

Clause 5 provides guidance on requirements for the assessment process and 11.3 provides guidance on verifying conformity of process assessments. In addition, Annex A provides an exemplar documented assessment process.

### 4.3 Measurement Framework for Process Capability

The Measurement Framework defines a six point ordinal scale of increasing process capability ranging from a process which is not capable of achieving its purpose (process capability level zero) to a process which optimizes its performance (process capability level 5). Each process has a set of process attribute ratings that constitute the process profile. Process attribute ratings are expressed using the process attribute scale as defined in ISO/IEC 15504-2. The process capability level model is described in terms of the process attribute ratings that must be achieved in order to achieve a particular level. Clause 6 provides guidance on the Measurement Framework for process capability.

### 4.4 Process Reference Model

A Process Reference Model describes a set of one or more processes in terms of purpose and expected outcomes.

The purpose describes the high-level objectives that the process should achieve while the associated outcomes are the expected results of a successful enactment of the process. The purpose statements in conjunction with the outcomes describe what to achieve, but do not prescribe how the process should achieve its objectives. Clause 7 provides guidance on Process Reference Models and 11.1 provides guidance on verifying conformity or compliance of Process Reference Models.

Annex F of ISO/IEC 12207:1995/Amd 1:2002, as well as ISO/IEC 15288, provide Process Reference Models.

### 4.5 Process Assessment Model

A Process Assessment Model as defined in this International Standard is one that meets the requirements specified in ISO/IEC 15504-2. In summary, a conformant Process Assessment Model is one:

— that is suitable for the purpose of process assessment;

— whose relevant elements are mapped to the processes described in a selected conformant Process Reference Model(s), and to the relevant process attributes defined in ISO/IEC 15504-2;

— that is base upon a set of indicators for use during an assessment to gather the information about processes and process attributes;

— that has a formal and verifiable mechanism for expressing the information gathered using the Process Assessment Model into process attribute ratings as defined in ISO/IEC 15504-2.

Clause 8 provides guidance on Process Assessment Models and 11.2 provides guidance on verifying conformity of Process Assessment Models. The model in ISO/IEC 15504-5 is an exemplar Process Assessment Model based on the Process Reference Model defined in ISO/IEC 12207:1995/Amd 1:2002.

### 4.6 Assessment Tools

In any assessment, data will need to be collected, recorded, stored, collated, processed, analysed, retrieved and presented. This may be supported by various tools. For some assessments, the support tools may be paper-based (forms, questionnaires, checklists, etc.). In some cases the volume and complexity of the assessment information may result in the need for computer-based support tools.

Regardless of the form of the supporting tools, their objectives are:

— to help an assessor perform an assessment in a consistent and reliable manner, reducing subjectivity and contributing to the achievement of valid, useful and comparable assessment results;

— to perform the assessment more efficiently.

In order to achieve these objectives, the tools need to make a Process Assessment Model and its indicators accessible to the assessors.

Clause 9 provides guidance on selecting and using assessment tools.

## 4.7 Competency of assessment team

Assessments are performed by individuals:

— with an adequate mix of education, training and experience on relevant processes,

— who have access to appropriate documented guidance on how to perform the defined assessment activities,

— who have the competencies to use the tools chosen to support the assessment.

The competency of team members should be verified by the competent assessor before assigning roles and responsibilities for performing the assessment.

The competency of the competent assessor will be verified by the sponsor.

Clause 10 provides guidance on competency of assessors.

## 4.8 Assessment approaches

### 4.8.1 Self-assessment

A self-assessment is carried out by an organization to assess the capability of its own process. The sponsor of a self-assessment is normally internal to the Organizational Unit as are the member(s) of the assessment team.

### 4.8.2 Independent assessment

An independent assessment is an assessment conducted by an assessment team whose member(s) are independent of the Organizational Unit being assessed. An independent assessment may be conducted, for example, by an organization on its own behalf as independent verification that its assessment program is functioning properly; the assessment sponsor will belong to the same organization but not necessarily to the Organizational Unit being assessed.

The sponsor of an assessment may be external to the Organizational Unit being assessed, such as an acquirer who wishes to have an independent determination of process capability. The degree of independence, however, may vary according to the purpose, scope and context of the assessment.

In the case of an external assessment sponsor, mutual agreement between the assessment sponsor and the assessed organisation is assumed.

## 4.9 Success factors for process assessment

The following factors are essential to a successful process assessment.

### 4.9.1 Commitment

The commitment of the sponsor is essential to ensuring that the assessment objectives are met. This commitment requires that the necessary resources, time and personnel are available to perform the assessment. The competent assessor will confirm the sponsor's commitment to proceed with the assessment.

#### 4.9.2 Motivation

The attitude of the organization's management has a significant influence on the outcome of an assessment. The organization's management, therefore, needs to motivate participants to be open and constructive. Process assessments focus on the process, not on the performance of Organizational Unit members implementing the process. The intent is to make the processes more effective in support of the defined business goals, not to allocate blame to individuals.

Providing feedback and maintaining an atmosphere that encourages open discussion about preliminary findings during the assessment helps to ensure that the assessment output is meaningful to the Organizational Unit. The organization needs to recognize that the participants are a principal source of knowledge and experience about the process and that they are in a good position to identify potential weaknesses.

#### 4.9.3 Confidentiality

Respect for the confidentiality of the sources of information and documentation gathered during assessment is essential in order to secure that information. Where interviews or discussions are employed, consideration should be given to ensuring that participants do not feel threatened or have any concerns regarding confidentiality. Some of the information provided might be proprietary to the Organizational Unit. It is therefore important that adequate controls are in place to handle such information.

#### 4.9.4 Relevance

The Organizational Unit members should believe that the assessment will result in some benefits that will accrue to them directly or indirectly.

#### 4.9.5 Credibility

The sponsor, the management and the staff of the Organizational Unit should all believe that the assessment will deliver a result which is objective and is representative of the assessment scope. It is important that all parties can be confident that the assessors have adequate assessment experience, are sufficiently impartial and have an adequate understanding of the Organizational Unit and its business to conduct the assessment.



## 5 Guidance on Requirements for Performing an Assessment

### 5.1 General

The requirements for performing an assessment defined in ISO/IEC 15504-2 aim at achieving a greater degree of uniformity in the approach to process assessment, so as to maximize the reliability of different approaches and provide a degree of comparability between the results of different assessments. It may make sense to verify the requirements prior to and during the course of the assessment so that corrective actions can occur.

### 5.2 The assessment process activities

*The assessment shall be conducted according to a documented assessment process that is capable of meeting the assessment purpose.*

*[ISO/IEC 15504-2, 4.2.1]*

This clause addresses two different aspects of process assessment:

— The documented assessment process shall be capable of meeting the assessment purpose;

— The assessment shall be conducted in accordance with the documented assessment process.

The assessment purpose is defined as one of the assessment inputs [ISO/IEC 15504-2, 4.4.2 b)]; this International Standard defines assessment purpose as “a statement, provided as part of the assessment input, which defines the reason for performing the assessment.”

A documented assessment process supports repeatability of an assessment approach. Subclause 5.6 provides guidance on the selection of a documented assessment process.

### 5.2.1 Planning

*The documented assessment process shall contain at minimum the following activities:*

*a)* ***Planning*** *A plan for the assessment shall be developed and documented, including at minimum:*

*1) the required inputs defined in this part of ISO/IEC 15504;*

*2) the activities to be performed in conducting the assessment;*

*3) the resources and schedule assigned to these activities;*

*4) the identity and defined responsibilities of the participants in the assessment;*

*5) the criteria to verify that the requirements of this International Standard have been met;*

*6) a description of the planned assessment outputs.*

*[ISO/IEC 15504-2, 4.2.2 a)]*



The activities to be performed will be determined by the chosen documented assessment process tailored as necessary.

The resource and schedule depend strongly on information contained in the assessment input such as scope and purpose of the assessment. This information should be reviewed thoroughly before planning. Timing and resource needs may change during the process assessment activities. Monitoring and corrective actions to maintain schedule and resources should be one of the planned activities.

In the first version of the plan some information may be missing or not available (e.g. identity of all participants). As process assessment activities progress, the plan will be updated with the necessary information.

Clause 11 provides guidance on the criteria to verify that the requirements of this International Standard have been met.

The assessment output that will be delivered to the assessment Sponsor will be identified and briefly described. The minimum output required is the assessment record. Any additional information [as indicated by ISO/IEC 15504-2, 4.5.2 f)] will need to be defined in the plan.

### 5.2.2 Data collection

b) ***Data Collection*** *Data required for evaluating the processes within the scope of the assessment [see 4.4.2 c)] and additional information [see 4.4.2 j)] shall be collected in a systematic manner, applying at minimum the following:*

1) *the strategy and techniques for the selection, collection, analysis of data and justification of the ratings shall be explicitly identified and shall be demonstrable;*

2) *correspondence shall be established between the organizational unit's processes, specified in the assessment scope, and the elements in the Process Assessment Model;*

3) *each process identified in the assessment scope shall be assessed on the basis of objective evidence;*

4) *the objective evidence gathered for each attribute for each process assessed shall be sufficient to meet the assessment purpose and scope;*

5) *the identification of the objective evidence gathered shall be recorded and maintained to provide the basis for verification of the ratings.*

*[ISO/IEC 15504-2, 4.2.2 b)]*

Data collection may be performed in various ways such as interviews, questionnaires, discussions and artefact review. Before starting data collection, the Organizational Unit's processes should be mapped to the processes defined within the Process Assessment Model.

The sampling mechanism should ensure that the set of processes selected is appropriate to the assessment purpose. The sampling information and rationale should be retained.

The information gathering may be organized as part of a monitoring or reporting mechanism used by one or more projects. Alternatively, information collection may be automated or semi-automated through the support of a tool. A tool could be used continuously throughout the life cycle, for example, at defined milestones to measure adherence to the process, to measure process improvement progress, or to gather information to facilitate a future assessment.

### 5.2.3 Data validation

c) Data Validation The data collected shall be validated *to:*

1) *confirm that the evidence collected is objective;*

2) *ensure that the objective evidence is sufficient and representative to cover the scope and purpose of the assessment;*

3) *ensure that the data as a whole is consistent.*

*[ISO/IEC 15504-2, 4.2.2 c)]*

The data collected should accurately represent the processes assessed. Validation of this data should include assessing whether the sample size chosen is representative of the processes assessed.

The following mechanisms are useful in supporting data validation:

— comparing results to those from previous assessments for the same Organizational Unit;

— looking for consistencies between connected or related processes;

— feedback sessions of preliminary findings to the Organizational Unit.

Some data validation may take place during the data collection phase, as data is gathered and evaluated.

If validation cannot be achieved, the circumstance should be clearly stated in the process assessment output together with a risk analysis associated with potential lack of validity of the results.

### 5.2.4 Process attribute rating

*d)* ***Process attribute rating*** *A rating shall be assigned based on validated data for each process attribute.*

*1) the set of process attribute ratings shall be recorded as the process profile for the defined organizational unit;*

*2) during the assessment, the defined set of assessment indicators in the Process Assessment Model shall be used to support the assessor's judgement in rating process attributes in order to provide the basis for repeatability across assessments;*

*3) the decision-making process that is used to derive rating judgements shall be recorded;*

*4) traceability shall be maintained between an attribute rating and the objective evidence used in determining that rating;*

*5) for each process attribute rated, the relationship between the indicators and the objective evidence shall be recorded.*

*[ISO/IEC 15504-2, 4.2.2 d)]*



Rating is essentially based on assessor's judgement and relies on validated objective evidence. This judgement should take into account assessment purpose and assessment context.

When the rating elements of the Process Assessment Model used are different from the defined process attributes (ISO/IEC 15504-2, Clause 5), then these ratings should be translated according to the mechanisms defined in the Process Assessment Model (see 8.1.3).

Attribute ratings should be validated and recorded, ensuring that each rating record can be uniquely identified and traced to the process to which it relates. A rating is assigned for each process attribute and the set of process attribute ratings is provided as the process profile of the assessed Organizational Unit. Each process attribute is rated based on validated objective evidence gathered using assessment indicators provided by the Process Assessment Model.

In deciding the rating for each attribute assessed, it is desirable to have the maximum agreement among the assessors. If the agreement is not unanimous then rules must be set for the decision making process (e.g. consensus, majority vote, etc.). The agreed rule should be recorded.

The process profile should be presented in form(s) that allow straightforward interpretation of their meaning and value. The requirements for constructing a Process Assessment Model ensure that the indicators are traceable to the statements of process purpose and outcomes in the Process Reference Model and to the process attributes in ISO/IEC 15504-2, Clause 5. In this clause, further traceability is required between attribute ratings and the objective evidence used. This is required in order to justify the assessor's judgements

and provide the basis for repeatability. In other words, a third party verification or repetition of the rating, could trace all the evidence associated to an attribute rating and presumably would arrive at the same results. Furthermore, in order to facilitate this traceability and in order to provide confidence on the effective presence of an indicator, it is required that, for each attribute rated, the link between indicators and objective evidence be recorded.

#### 5.2.5 Reporting

> e) ***Reporting*** *The assessment results, including at minimum the outputs specified in 4.5, shall be documented and reported to the assessment sponsor or to their delegated representative.*
>
> *[ISO/IEC 15504-2, 4.2.2 e)]*

The reporting of the assessment results might simply be in the form of a presentation for an internal assessment or might be in the form of a detailed report for an independent external assessment. In addition, other findings and proposed action plans may be prepared for presentation, depending upon the assessment purpose and whether this additional analysis is performed at the same time as the assessment. The results may be presented in absolute terms or relative terms in comparison to previous assessment results, benchmark data, comparison to business needs, etc.

The assessment results will normally be used as a basis for developing an improvement plan or determining capability and associated risks as appropriate. This guidance is provided in ISO/IEC 15504-4.

### 5.3 Roles and responsibilities

#### 5.3.1 Responsibilities of the Sponsor

> *The sponsor of the assessment shall:*
>
> *a) verify that the individual who is to take responsibility for conformity of the assessment is a competent assessor;*
>
> *b) ensure that resources are made available to conduct the assessment;*
>
> *c) ensure that the assessment team has access to the relevant resources.*
>
> *[ISO/IEC 15504-2, 4.3.1]*

The sponsor will have the responsibilities and the authority to make sure that adequate resources and competencies are made available in order to perform a conformant assessment. Examples of relevant resources the assessment team require access to are: key personnel for interviews, infrastructure needed during assessment, artefacts to be examined. Although no specific responsibility is assigned to the Organizational Unit's management directly, their commitment and motivation is very important. This is particularly true when the Sponsor is not a member of the Organizational Unit's management.

### 5.3.2 Responsibilities of the Competent Assessor

*The competent assessor shall:*

*a) confirm the sponsor's commitment to proceed with the assessment;*

*b) ensure that the assessment is conducted in accordance with the requirements of this part of ISO/IEC 15504;*

*c) ensure that participants in the assessment are briefed on the purpose, scope and approach of the assessment;*

*d) ensure that all members of the assessment team have knowledge and skills appropriate to their roles;*

*e) ensure that all members of the assessment team have access to appropriate documented guidance on how to perform the defined assessment activities;*

*f) ensure that the assessment team has the competencies to use the tools chosen to support the assessment;*

*g) confirm receipt of the assessment result deliverables by the sponsor;*

*h) on completion of the assessment, verify and document the extent of conformance of the assessment to ISO/IEC 15504 (see also 7.4).*

*[ISO/IEC 15504-2, 4.3.2]*

The competent assessor is responsible for ensuring that the assessment achieves its purpose and that it is conformant with the requirements of ISO/IEC 15504-2. It is therefore imperative that the competent assessor selects an appropriate documented assessment process. Even if the documented assessment process is selected by the assessment sponsor, the competent assessor remains responsible for ensuring that assessors are competent in its use.

### 5.3.3 Responsibilities of the Assessors

*The assessors shall:*

*a) carry out assigned activities associated with the assessment, e.g. detailed planning, data collection, data validation and reporting;*

*b) rate the process attributes.*

*[ISO/IEC 15504-2, 4.3.3]*

The rating activities are performed solely by the competent assessor and assessors. Other personnel may participate as assessment team members providing specific expertise or supporting clerical work. They may support assessors in formulating the judgement but will not be responsible for the final rating of process attributes.

## 5.4 Defining the initial assessment input

*The assessment input shall be defined prior to the data collection phase of an assessment and approved by the sponsor of the assessment or the sponsor's delegated authority.*

*[ISO/IEC 15504-2, 4.4.1]*

All the information required for the assessment input should be collated, reviewed, approved and documented before commencing the assessment. The approval of the assessment input by the sponsor of the assessment is essential since it includes the driving elements of the assessment process. By approving the assessment input the sponsor also demonstrates involvement and commitment to the purpose of the assessment.

*At a minimum, the assessment input shall specify:*

*a) the identity of the sponsor of the assessment and the sponsor's relationship to the organizational unit being assessed;*

*[ISO/IEC 15504-2, 4.4.2 a)]*

The sponsor is normally an individual internal to the organization but not necessarily to the Organizational Unit being assessed. In case of independent assessments, the sponsor may be a legal entity external to the Organizational Unit being assessed, such as an acquirer who wishes to have an independently derived assessment output.

*b) the assessment purpose;*

*[ISO/IEC 15504-2, 4.4.2 b)]*

Different types of assessments have different purposes. The purposes may vary depending upon the business goals of the sponsor such as facilitating internal process improvement or selecting suppliers (either internal or external).

*c) the assessment scope including:*

*1) the processes to be investigated within the organizational unit;*

*2) the highest capability level to be investigated for each individual process within the assessment scope;*

*3) the organizational unit that deploys the processes;*

*4) the context which includes:*

*i) the size of the organizational unit;*

*ii) the application domain of the products or services of the organizational unit;*

*iii) key characteristics (e.g. size, criticality, complexity and quality) of the products or services of the organizational unit.*

*[ISO/IEC 15504-2, 4.4.2 c)]*

The process scope may include one or more processes together with the highest capability levels which are to be included in the assessment. Limiting the number of processes and capability levels used in the assessment has the effect of focusing the investigation. For instance, the sponsor may wish to focus attention on one or more critical processes or on processes that are candidates for improvement actions. In process capability determination mode, an acquirer may wish to evaluate the capabilities of suppliers only for the processes related to the tender or contract requirements.

The selection of the Organizational Unit should reflect the sponsor's intended use of the assessment output. For example, if the output is to be used for process improvement then the Organizational Unit scope should match that of the intended improvement effort. An Organizational Unit scope could be anything from one project to the entire organization.

The sophistication and complexity of the implemented process will be dependent upon the context of that process within the Organizational Unit. For instance, the planning required for a five person project team will be much less than for a fifty person team. This process context, recorded in the assessment input, influences how a competent assessor should judge and rate the process attributes for an implemented process. The process context also influences the degree of comparability between process attribute and/or process capability level ratings.

*d) the assessment approach;*

*[ISO/IEC 15504-2 d)]*

The assessment approaches possible are described in 4.8 of this guidance (self-assessment and independent assessment).

*e) the assessment constraints considering, at minimum:*

*1) availability of key resources;*

*2) the maximum duration of the assessment;*

*3) specific processes or organisational units to be excluded from the assessment;*

*4) the quantity and type of objective evidence to be examined in the assessment;*

*5) the ownership of the assessment outputs and any restrictions on their use;*

*6) controls on information resulting from a confidentiality agreement.*

*[ISO/IEC 15504-2, 4.4.2 e)]*

The success of the assessment may be affected if the key resources are not available. Consideration needs to be given to minimize disruption of normal business activities.

The process and scope may be tailored to accommodate the available time.

It may be necessary to exclude certain parts of an Organizational Unit due to the lifecycle phase, etc.

Constraints may be given on the quantity and type of objective evidence to be collected and examined. For instance, it may be stated that not more than 20 % of the Organizational Unit's personnel should be interviewed, or it may be stated that evidence should be collected only by interview and not by examination of documents, etc.

The exclusion of processes as a constraint may seem redundant since the scope [ISO/IEC 15504-2, 4.4.2 c)] defines the processes to be assessed. Nevertheless it may happen that while assessing a process within the defined scope, it may be necessary to investigate other related processes useful in the understanding of a particular attribute. In this case the related process may be one explicitly excluded and will therefore not be examined.

*f) the identity of the Process Assessment Model (including the identity of the Process Reference Model(s) used) that meets the requirements defined in 6.3;*

*If the Process Reference Model(s) include system or software engineering processes then the relationship of these processes with ISO/IEC 15288 or ISO/IEC 12207:1995/Amd 1:2002 (Annex F) shall be defined;*

*[ISO/IEC 15504-2, 4.4.2 f)]*

For ease of application, one may wish to use a single Process Assessment Model; however, depending on the purpose of the assessment, selected parts of other Process Assessment Models may be used.

When assessing system or software engineering processes, the Process Assessment Model used and its related Process Reference Model(s) may be based on or have a relationship with ISO/IEC 12207 Amd 1 and ISO/IEC 15288.

The assessment input will state the relationship, if any, that exists between the Process Reference Model(s) and the two standards: ISO/IEC 12207:1995/Amd 1:2002 and ISO/IEC 15288. It is noted that even "no relationship" is a relationship that will be stated.

*g) the identity of the competent assessor;*

*h) the criteria for competence of the assessor who is responsible for the assessment;*

*[ISO/IEC 15504-2, 4.4.2 g) and h)]*

Clause 10 provides guidance regarding assessor competence. The documented assessment process should provide specific criteria related to who is eligible to be the competent assessor.

*i) the identity and roles of assessees, the assessment team and assessment support staff with specific responsibilities for the assessment;*

*[ISO/IEC 15504-2, 4.4.2 i)]*

The number of assessors engaged in assessment activities may vary, however the combined knowledge and experience of the assessors fosters the confidence in the assessment results. Assessment team members from the Organizational Unit can help to provide process context and supports ownership and credibility of the results.

The selection of assessees should be representative of the Organizational Unit being assessed. If the participants are representative of the Organizational Unit then the assessment results are more likely to provide an accurate view of the process capability.

*j) any additional information to be collected during the assessment to support process improvement or process capability determination, e.g. specific data (or metrics) that are needed to quantify the organization's ability to meet a particular business goal (this may also include information detailed at 6.3.5 and associated note).*

*[ISO/IEC 15504-2, 4.4.2 j)]*

Information supporting the process context, such as opportunities for improvement or risks to acquisition, should be documented.

*Any changes in the assessment input shall be agreed with the sponsor or the sponsor's delegated authority and documented in the assessment record.*

*[ISO/IEC 15504-2, 4.4.3]*

During the execution of the assessment, changes may occur in the definition of the assessment input. The changes should be approved by the sponsor or delegated authority. If these changes have an impact on time schedule and resources the assessment planning should be revised appropriately.

An impact analysis should also be performed against the data already collected to determine whether some assessment activities may need to be repeated.

## 5.5 Recording the assessment output

*Information which is pertinent to the assessment and will support understanding the output of the assessment shall be compiled and included in the assessment record for retention by the sponsor or their delegated authority.*

*At a minimum, the assessment record shall contain:*

*a) the date of the assessment;*

*b) the assessment input;*

*c) the identification of the objective evidence gathered;*

*d) identification of the documented assessment process;*

*e) the set of process profiles resulting from the assessment (i.e. one profile for each process assessed);*

*f) the identification of any additional information collected during the assessment as specified in clause 4.4.2 j).*

*[ISO/IEC 15504-2, 4.5.1 - 4.5.2]*



The information content of the assessment output is intended to support understanding of the assessment results and facilitate activities such as benchmarking and third party verification. The records may be retained in different forms paper-based or electronic depending upon the circumstances and tools used to support the assessment.

Based on any confidentiality agreement or access restrictions identified in the assessment input, different records may be retained by the sponsor, the competent assessor, the Organizational Unit, or another person or body.

## 5.6 Selecting a Documented Assessment Process

This clause provides guidance on the selection and use of a documented assessment process for use in the conduct of an ISO/IEC 15504 conformant process assessment. The guidance is primarily intended for the use of assessors and sponsors of assessments. It is not directed specifically at the developers of Process Assessment Models, though it may be of use to them.

The documented assessment process may be selected by the assessor, or may be stipulated by the sponsor of the assessment (in which case, this should be documented in the assessment input as a constraint). In either case, there are criteria that will help ensure that the selection is appropriate for the use envisaged. Particular documented assessment processes may be appropriate to particular process contexts, particular assessment approaches and particular processes. All of these factors may influence the decision to select a particular documented assessment process. Organizations may also be constrained to use a particular documented assessment process if it has been chosen as the de facto standard to ensure the most effective use of resources.

If there are a priori constraints on the Process Reference Model and/or the Process Assessment Model to be used these may induce constraints on the documented assessment process chosen.

The major consideration in selecting a documented assessment process will be its ability to ensure that the assessment purpose is met. Also of critical importance is its suitability for the context and scope of the assessment. The principal factors affecting its selection will be:

— the planned purpose of the assessment;

— the planned scope of the assessment;

— the assessment approach selected;

— the process context of the selected processes;

— the amount of risk in the accuracy of the findings that the assessment sponsor will accept

Where documented assessment processes exist that have been specifically developed to support a particular assessment approach or approaches, then these should be used if at all possible. Larger, more complex organizations may also be constrained to select documented assessment processes that have the ability to cover the range of their business activities to ensure consistency of approach, reuse of competencies, etc.

There are a host of secondary factors that will also affect the selection decision. These factors relate more to practical matters such as cost, duration, and availability of other resources – such as assessors – needed to conduct the assessment. There may be constraints associated with the use of a documented assessment process such as the use of specially qualified assessors or availability of assessment-related materials.

A documented assessment process has to be suitable for tailoring to meet the specific needs of an individual assessment. The purpose, scope and overall approach to the assessment will impact on the way in which the required activities are performed. The assessment process for a specific assessment may be tailored by the addition or deletion of specified tasks, providing the minimum required set of activities is performed. Tailoring guidelines may address:

— the level of detail required in the plans;

— source and means of collection of data;

— mechanisms for storage and retrieval of data;

— additional tasks to be performed as part of the assessment;

— means for achieving agreement on process ratings; and

— approaches to the reporting of results.

## 6 Measurement Framework for Process Capability

The measurement framework is based on the concept of processes having common attributes. These process attributes have been defined and allocated to capability levels.

The following clauses provide an interpretation of the meaning of the capability levels, along with guidance on how to recognize the achievement of the nine process attributes allocated to capability levels 1 through 5.

## 6.1 Level 0: Incomplete process

***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.*

*[ISO/IEC 15504-2, 5.1]*

The *Incomplete* process is one that is either not performed at all, or for which there is little or no evidence of systematic achievement of the process purpose. Systematic achievement is characterized by the routine performance of necessary actions and the presence of appropriate input and output work products which, collectively, ensure that the process purpose is achieved.

Level 0 is the only capability level with no attributes; in effect, level 0 can be considered as the state of not being at capability level 1 or above. Accordingly, determination of a process as being level 0 will be largely based on the lack of adequate objective evidence to consider it to be operating at level 1.

## 6.2 Level 1: Performed process

***Level 1: Performed process***

*The implemented process achieves its process purpose.*

*The following attribute of the process demonstrates the achievement of this level:*

*[ISO/IEC 15504-2, 5.2]*

The *Performed* process achieves its process purpose through the performance of necessary actions and the presence of appropriate input and output work products which, collectively, ensure that the process purpose is achieved.

Level 1 is the only capability level with one attribute.

While the sole attribute at level 1 is stated in such a way as to be common to all processes (as are all process attributes) in reality the attribute is related to process performance and the achievement of process outcomes which differ from process to process. In other words the indicators that would demonstrate the evidence of achieving the only attribute in level 1 are not common to all processes but are specific for the process being assessed.

Capability level 1 focuses exclusively on the extent to which the outcomes defined for the process are achieved. A process outcome describes one or more of the following:

— production of an artefact;

— a significant change of state;

— meeting of specified constraints, e.g. requirements, goals, etc.

The above elements are based on 6.2.4 of *ISO/IEC 15504-2*.

Accordingly, assessors will need to focus their attention on work products and actions which relate to one or more of the above process outcomes, depending on the nature of the particular process outcome being considered.

***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 outcomes.*

*[ISO/IEC 15504-2, 5.2.1]*

Process Reference Models define, for each process, a purpose and expected outcomes while a Process Assessment Model will provide the indicators for both process performance and process capability.

The indicators relevant for process attribute 1.1 are the process performance indicators, which will be different from process to process but will generally consist of:

— identified work products that are input to the process;

— identified work products that are produced by the process;

— actions taken to transform the input work products into output products.

Assessors will try to verify that the people performing the process understand the purpose of the process itself and perform the necessary actions. The work products resulting from performing the activities, together with input work products, are further evidence of process performance. However, the simple existence of these work products is not sufficient; it should be evident that they contribute to achieving the process purpose.

## 6.3 Level 2: Managed process

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

*[ISO/IEC 15504-2, 5.3]*

The *Managed* process is planned, monitored and adjusted to meet identified objectives for the performance of the process and to produce work products that are appropriately identified, documented and controlled.

The primary distinction from the Performed Level is that the performance of the process is now planned, monitored and adjusted to deliver work products that fulfil expressed requirements. Thus, the essential elements of the managed process are the management of its performance and the explicit focus on work product management. The critical role that proactive management of these two aspects of the process fulfils is to increase assurance that what is produced is what is needed and that the process operates in a more predictable manner.

The proactive management of the process will result in artefacts and/or activities which are verifiable (e.g. planning and/or plans, monitoring mechanisms and/or adjustments to the process based upon the results of comparison of the planned versus actual performance of the process).

***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 attribute:*

*a) objectives for the performance of the process are identified;*

*b) performance of the process is planned and monitored;*

*c) performance of the process is adjusted to meet plans;*

*d) responsibilities and authorities for performing the process are defined, assigned and communicated;*

*e) resources and information necessary for performing the process are identified, made available, allocated and used;*

*f) interfaces between the involved parties are managed to ensure both effective communication and also clear assignment of responsibility.*

*[ISO/IEC 15504-2, 5.3.1]*

The performance management attribute is concerned with the application of basic management techniques to provide reasonable assurance that process performance objectives are met.

The identification of process performance objectives is a critical requirement for achievement of this attribute. Typically, performance objectives would include things such as – (1) quality of artefacts produced, (2) process cycle time and (3) resource usage. Note that process performance objectives will in turn be driven by other considerations such as process inputs and overall project and/or product constraints and characteristics. At this level of process capability process performance objectives may be expressed in either qualitative terms (e.g. peer reviews will be easy to understand and to conduct) or quantitative terms (e.g. peer reviews will, on average, detect at least 80 % of the defects in the product).

Some processes (e.g. supporting, organizational and management processes) may not require planning for each instance but may perform continuously under standing arrangements.

Without clearly defined responsibilities and understood lines of authority, any group undertaking is at risk from the start. Hence, an important facet of the managed process is the explicit assignment of responsibility and authority for performing the process. The essential aspects to be addressed are the identification, assignment and communication of responsibilities and authorities for performing the process. Note that all stakeholders in the process (e.g. process owner, process implementers, etc) should be informed of these activities.

The resources and information needed to implement the process in accordance with the identified process performance objectives are identified, made available, allocated and used. It is especially important to be prepared to make appropriate adjustments to the resources and information made available as the performance of the process is now being managed and potentially being adjusted as necessary to respond to deviations from the planned performance.

Associated with the management of resources needed to perform the process is the management of interfaces between the involved parties to ensure effective communication and clear assignment of responsibility. There are typically several types of stakeholders to consider – the process owner(s), the process implementer(s), those who provide the necessary resources and information, those involved upstream of the process and those downstream of the process and potentially others. Since even seemingly minor changes in the process performance may have a significant impact on one or more of the stakeholders, it is vital that the interfaces between these parties be planned, monitored and adjusted as appropriate and that these be communicated in a clear and timely manner.

***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, 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 outcomes.*

*[ISO/IEC 15504-2, 5.3.2]*

The work product management attribute is concerned with the application of basic management techniques to provide reasonable assurance that work products produced are appropriately identified, documented, and controlled. The work products referred to in this clause are those that result from the achievement of the process outcomes (e.g. those resulting from the process attaining capability level 1).

A work product is an artefact associated with the execution of a process; accordingly the nature of the work product will vary depending on the purpose of the process. Some work products may be a part of the deliverable product while others may not (e.g. some quality records such as personnel records, or meeting minutes).

Requirements for the work products of the process are identified to provide a basis for their production (as well as verification). Note that work product requirements will likely have a significant influence on the performance requirements for the process itself; thus, the two process attributes at capability level 2 are interdependent.

Requirements for the work products of the process may be functional requirements which pertain to attributes of the work product (performance, size, etc.) or may be non-functional requirements which pertain to agreements or constraints which are not directly related to work product attributes (delivery dates, packaging, etc.) or may be a combination of both.

Requirements for the documentation and control of the work products of the process are also defined; these are considered as distinct from the requirements for the work products. Various degrees of change control or configuration management may be appropriate depending on specific aspects of the work products and/or the project.

The requirements for the documentation and control of the work products of the process are then applied as the basis for appropriate identification, documentation, and control of the work products.

Work products of the process resulting from implementation of the process are reviewed in accordance with planned arrangements and adjusted as necessary to meet requirements. The extent and nature of review will depend upon many factors, all of which should be considered as part of the planning for work product management.

## 6.4 Level 3: Established process

***Level 3: Established process***

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

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

*[ISO/IEC 15504-2, 5.4]*

The *Established* process is based upon a standard process which is effectively deployed as a defined process to achieve its process outcomes. The process is performed using a defined process tailored from an established and maintained standard process. The standard process identifies resources – both human and infrastructure — needed for performance of the process, and these are incorporated into the defined process. Appropriate data are collected to identify opportunities for understanding and improving both the standard process and the defined process.

The primary distinction from the Managed Level is that the process of the Established Level is a defined process tailored from a Standard Process.

Capability level 3 provides the foundation for progression to the next level of process capability by establishing a standard process which is tailored and effectively deployed along with the infrastructure needed to provide the basis for a closed loop feedback cycle for process improvement.

***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) a standard process, including appropriate tailoring guidelines, is defined that describe the fundamental elements that must be incorporated into a defined process;*

*b) the sequence and interaction of the standard process with other processes is 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.*

*NOTE A standard process may be used as-is when deploying a defined process, in which case tailoring guidelines would not be necessary.*

*[ISO/IEC 15504-2, 5.4.1]*

The process definition attribute is concerned with establishment of a standard process, its use as the basis for performance of the defined process and the collection and evaluation of process performance data as the basis for understanding and improvement of the standard process.

A defined process is created by tailoring the standard process, taking into account the constraints and conditions that constitute the environment in which the process will be deployed. In practical terms achievement of this attribute is governed by the extent to which the standard process and associated tailoring

guidelines are defined and available, and the extent to which the tailoring guidelines provide clear direction regarding appropriate adaptation of the standard process to the range of applications for which the standard process is intended to apply.

A “defined process” is a process that is tailored from the organization’s set of standard processes according to the organization’s tailoring guidelines; has a maintained process description; and contributes work products, measures, and other process improvement information to the organization’s process assets. A project’s defined process provides a basis for planning, performing, and improving the project’s tasks and activities.

Tailoring a process makes, alters or adapts the process description for a particular end. For example, a project creates its defined process by tailoring the organization’s set of standard processes to meet the objectives, constraints, and environment of the project. “Tailoring guidelines” are used to enable organizations to deploy standard processes in diverse contexts. The organization’s set of standard processes is described at a general level that may not be directly usable to perform a process. Tailoring guidelines aid those who establish the defined processes for projects. Tailoring guidelines describe what can and cannot be modified and identify process components that are candidates for modification.

The sequence and interaction of processes does not necessarily imply sequential execution; it may mean concurrent execution, cyclic feedback, or some other interaction.

An obvious precondition for receiving meaningful feedback on the standard process is usage of the defined process with fidelity; that is, the implementers of the process are acting in accordance with the defined process. Perfectly tailored processes are of no lasting value if they are not reflective of the work being done.

As process usage data is collected, a basis for understanding the behaviour of the standard process is accumulated. This repository of knowledge provides the basis for understanding and improvement of the standard process.



***PA 3.2 Process deployment attribute***

*The process deployment attribute is a measure of the extent to which the standard process is effectively 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 continuous improvement of the process can be made.*

*NOTE Competency results from a combination of knowledge, skills and personal attributes that are gained through education, training and experience.*

*[ISO/IEC 15504-2, 5.4.2]*

The process deployment attribute is concerned with the effective deployment of a defined process tailored from the set of standard process assets available to the Organizational Unit. There are a number of critical aspects which contribute to effective deployment as identified in the definition of the attribute.

Achievement of this attribute is reflected in fidelity to the standard process, as tailored for application to each specific instance. The attribute also reflects the effective deployment of resources to the implementation of the defined process, and the collection and analysis of data for understanding and refining the behaviour of the defined process.

Another critical aspect of this process attribute is ensuring that enabling conditions for successful deployment (implementation) of the defined process are present. Enabling conditions include:

— defining the specific attributes of human resources that implement the process;

— understanding the process infrastructure and work environment required for performing the defined process;

— successful allocation and deployment of the required human resources and process infrastructures;

— a common defined understanding of roles, responsibilities and competencies for performing the defined process.

The process infrastructure encompasses tools, methods and special facilities that are required for performance of the defined process.

The determination, collection and analysis of appropriate data relating to implementation of the defined process provide a basis for understanding the behaviour of the defined process as well as demonstrating the suitability and effectiveness of the defined process. This, in turn, contributes to the ongoing improvement of the standard process elements upon which the defined process is based.

## 6.5 Level 4: Predictable process

***Level 4: Predictable process***

*The previously described Established process now operates within defined limits to achieve its process outcomes.*

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

*[ISO/IEC 15504-2, 5.5]*

The *Predictable* process operates consistently within defined limits to achieve its process outcomes; in addition, its implementation is supported and driven through quantitative information derived from relevant measurement. The performance of processes which operate at capability level 4 are quantitatively managed and behave in predictable ways to support overall business goals. Special causes of variation in performance are addressed.

The primary distinction from the Established Level is that the defined process is now performed consistently within defined limits to achieve its process outcomes.

***PA 4.1 Process measurement attribute***

*The process measurement attribute is a measure of the extent to which measurement results are used to ensure that performance of the process supports the achievement of the relevant process performance objectives in support of defined business goals. As a result of full achievement of this attribute:*

*a) process information needs in support of relevant defined business goals are established;*

*b) process measurement objectives are derived from process information needs;*

*c) quantitative objectives for process performance in support of relevant business goals are established;*

*d) measures and frequency of measurement are identified and defined in line with process measurement objectives and quantitative objectives for process performance;*

*e) results of measurement are collected, analysed and reported in order to monitor the extent to which the quantitative objectives for process performance are met;*

*f) measurement results are used to characterise process performance.*

*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.*

*[ISO/IEC 15504-2, 5.5.1]*



The process measurement attribute is concerned with the existence of an effective system for the collection of measures relevant to the performance of the process and the quality of the work products. The measures are applied to determine the extent of achievement of the organization's business goals.

Relevant business goals are understood and clearly identified, and some form of correspondence is established between the business goals and the specific goals and measures for product and process.

Figure 1 illustrates the relationship between some of the important concepts related to the Process Measurement Attribute.

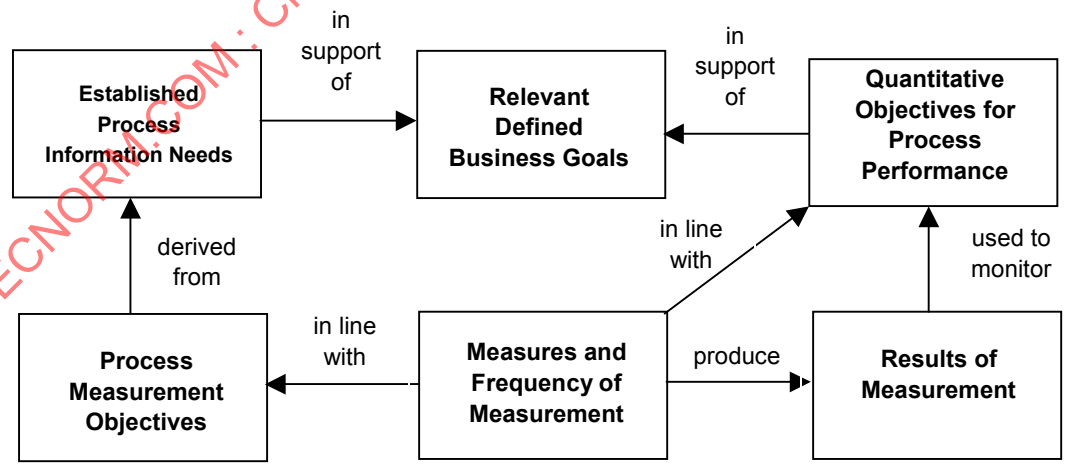


**Figure 1 — Relationship of concepts from the Process Measurement Attribute**

An example of "*relevant business goal*" for an Organizational Unit deploying primarily a "*software construction*" process based on detailed design provided by its customers, may be "*to become a market leader for rapid turnaround in a particular market niche such as software for e-business*". In this example, the "*information needs*" for management may be things such as:

— how long it takes to develop and return a software unit (normalized for size and complexity),

— how much each software unit costs to develop (normalized for size and complexity),

— how acceptable each unit is in terms of requirements satisfaction, defect density, maintainability and aesthetics.

Based on this example of "*information needs*", the derived "*process measurement objectives*" may be to quantify things such as:

— actual development response time, size and complexity,

— actual development cost,

— extent of requirements satisfaction,

— defect density,

— maintainability,

— aesthetics.

The "*measures*" in line with these "*process measurement objectives*" may be:

i) normalized time in hours and tenths of an hour

— actual time, size and complexity

j) Normalized cost

— actual cost, size and complexity

— normalized cost is within stated limit (yes/no)

k) Acceptability

— requirements satisfaction as a % of identified requirements

— normalized defect density as the number of defects per 100 lines

— maintainability against a % marking scheme

— aesthetics against a % marking schema

On the other hand, in order to support the relevant business goals, an "*objective for process performance* " for the software construction process may be "*to minimize software unit development time within stated cost and acceptability thresholds*", where "*acceptability threshold*" may refer to: degree of requirements satisfaction, defect density, maintainability of code, aesthetics of graphical user interface. The process performance objective becomes a "*quantitative objective*" when these thresholds are defined.

Remaining on this example we may have "*quantitative objectives for process performance*" stated as:

*"For a normalized unit of 100 source lines and complexity of 5 (on a 10 point scale):*

— *as little time as possible,*

— *cost not exceeding $1000,*

— *requirements satisfaction not less than 100 %,*

— *defect density not greater than : 0.01 % for class A, 0.1 % for class B, 1 % for class C,*

— *maintainability score greater than 85 %,*

— *aesthetic score greater than 65 %."*

It is not sufficient to simply collect the measures; they need to be analysed and reported in order to allow the monitoring of the extent to which the quantitative objective for process performance have been achieved.

***PA 4.2 Process control attribute***

*The process control attribute is a measure of the extent to which the process is quantitatively managed to produce a process that is stable, capable, and predictable within defined limits. As a result of full achievement of this attribute:*

*a) analysis and control techniques are determined and applied where applicable;*

*b) control limits of variation are established for normal process performance;*

*c) measurement data are analysed for special causes of variation;*

*d) corrective actions are taken to address special causes of variation;*

*e) control limits are re-established (as necessary) following corrective action.*

*[ISO/IEC 15504-2, 5.5.2]*



The analysis and control techniques chosen will be influenced by the nature of the process as well as by the overall context of the Organizational Unit being assessed. For example, not all processes are equally suited to statistical control, and alternative techniques (e.g. Pareto analysis, fishbone diagrams, etc.) can be selected that demonstrate a qualitative understanding of the process.

The analysis techniques that have been identified should be applied for the purpose of identifying the root causes of variation in process performance. The control limits for process performance can be defined either on the basis of experience, or in terms of establishing targets for performance.

Special causes of variation refer to defects in a process which are not inherent to the process but rather incidental; these typically stem from implementation problems.

Quantitative management of process performance implies effective implementation of corrective action designed to address identified special causes of variation. An Organizational Unit effectively using measurement will use measurement and analysis to justify decisions taken, on the basis of their impact on delivery or benefit to the business.

## 6.6 Level 5: Optimizing process

***Level 5: Optimizing process***

*The previously described Predictable process is continuously improved to meet relevant current and projected business goals.*

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

*[ISO/IEC 15504-2, 5.6]*

The *Optimizing* process is changed and adapted in an orderly and intentional manner to effectively respond to changing business goals; this takes place on an ongoing basis. This level of process capability depends fundamentally on the quantitative understanding of process behaviour that is the hallmark of a predictable process.

A process operating at capability level 5 exhibits three critical behaviours that distinguish it from a predictable process. Firstly, a proactive focus on continuous improvement in the fulfilment of both current and projected (relevant) business goals of the Organizational Unit; that is, an intentional and planned effort to improve the effectiveness and efficiency of the process. Secondly, an orderly and planned approach to identifying appropriate changes to the process and introducing them so as to minimize undesired disruption to the operation of the process. Finally, the effectiveness of the changes is evaluated against actual results and adjustments are made as necessary to achieve desired product and process goals.

Performance of the predictable process is continuously improved to meet current and projected business goals. Quantitative objectives for improvement of process performance are established, based on the relevant business goals of the Organizational Unit. Data are collected and analyzed to identify opportunities for best practice and innovation; common causes of variation in performance are identified and addressed. Optimizing a process involves piloting innovative ideas and technologies and changing non-effective processes to meet defined goals or objectives.

The primary distinction from the Predictable Level is that the defined and standard processes now dynamically change and adapt to effectively meet current and projected business goals.

***PA 5.1 Process innovation attribute***

*The process innovation attribute is a measure of the extent to which changes to the process are identified from analysis of common causes of variation in performance, and from investigations of innovative approaches to the definition and deployment of the process. As a result of full achievement of this attribute:*

*a) process improvement objectives for the process are defined that support the relevant business goals;*

*b) appropriate data are analysed to identify common causes of variations in process performance;*

*c) appropriate data are analysed to identify opportunities for best practice and innovation;*

*d) improvement opportunities derived from new technologies and process concepts are identified;*

*e) an implementation strategy is established to achieve the process improvement objectives.*

*[ISO/IEC 15504-2, 5.6.1]*



The process innovation attribute is concerned with the existence of a proactive focus on continuous improvement in the fulfilment of both current and projected (relevant) business goals of the Organizational Unit.

Having explicitly defined process improvement objectives provides the basis for level 5 capability. These, in conjunction with the current and projected (relevant) business goals of the organization, provide the drivers for all of the associated level 5 behaviours.

Innovation is another driver of process improvement and may stem from analysis of data related to best practices or the introduction of new technologies.

Understanding the source of existing process problems as well as potential process problems induced by process improvement goals provides an important source of proposed process changes.

Proposed process changes will result from the consideration of the existing process in light of current and projected (relevant) business goals of the Organizational Unit.

The complexity of organizational deployment and the long-term nature of continuous improvement require a well considered strategy to ensure successful achievement of capability level 5. The strategy will need to provide for achievement of the results that in aggregate comprise this capability level.

***PA 5.2 Process optimization attribute***

*The process optimization attribute is a measure of the extent to which changes to the definition, management and performance of the process result in effective impact that achieves the relevant process improvement objectives. As a result of full achievement of this attribute:*

*a) impact of all proposed changes is assessed against the objectives of the defined process and standard process;*

*b) implementation of all agreed changes is managed to ensure that any disruption to the process performance is understood and acted upon;*

*c) effectiveness of process change on the basis of actual performance is evaluated against the defined product requirements and process objectives to determine whether results are due to common or special causes.*

*[ISO/IEC 15504-2, 5.6.2]*

The process optimization attribute is concerned with an orderly and proactive approach to identifying appropriate changes to the process and introducing them so as to minimize undesired disruption to the operation of the process. The effectiveness of changes is evaluated against actual results and adjustments are made as necessary to achieve relevant process improvement objectives.

In order to achieve the most improvement possible with available resources the impact of proposed changes is estimated; the quantitative understanding of the predictable process will help in assessing the impact of proposed changes.

The implementation timing and sequencing of agreed changes is carefully planned so as to ensure a minimal amount of disruption to process performance. This planning will typically consider factors such as project criticality and status, process change effectiveness evaluation and new business generation.

Understanding the actual impact of process changes is a critical aspect of level 5 capability; this knowledge provides the basis for closed loop learning.

## 6.7 Rating process attributes

The capability levels and process attributes described above, as defined in ISO/IEC 15504-2, 5.1 to 5.6, provide the basic elements of a measurement framework for rating process capability. To complete the framework, a scale for rating the extent of achievement of a process attribute is defined.

***Process attribute rating scale***

*The extent of achievement of a process attribute is measured using an ordinal scale of measurement as defined below.*

***Process attribute rating values***

*The ordinal rating scale defined below shall be used to express the levels of achievement of the process attributes.*

***N*** *Not achieved:*

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

***P*** *Partially achieved:*

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

***L*** *Largely achieved:*

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

***F*** *Fully achieved:*

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

*The ordinal points defined above shall be understood in terms of a percentage scale representing extent of achievement.*

*The corresponding values shall be:*

| | | |
|---|---|---|
| ***N*** | *Not achieved* | *0 to 15 % achievement* |
| ***P*** | *Partially achieved* | *> 15 % to 50 % achievement* |
| ***L*** | *Largely achieved* | *> 50 % to 85 % achievement* |
| ***F*** | *Fully achieved* | *> 85 % to 100 % achievement.* |

*[ISO/IEC 15504-2, 5.7.1 - 5.7.2]*



The numerical expression of the rating levels is intended to provide firm anchor points to support the judgement of the assessor(s). It is not implied that the percentage achievements should be explicitly recorded, but that the values shown should guide assessors in performing the rating task. Further it should be noted that the non-linear placement of the anchor points is intentional; it is by this means that further definition of the process attribute rating values is provided. The use of a non-linear rating scale facilitates easier and more reliable discrimination judgements.

***Process attribute ratings***

*Each process attribute shall be rated using the ordinal rating scale defined above. A process shall be assessed up to and including the highest capability level defined in the assessment scope.*

*NOTE The set of process attribute ratings for a process forms the process profile for that process. The output of an assessment includes the set of process profiles for all assessed processes.*

*[ISO/IEC 15504-2, 5.7.3]*

Use of the process attribute rating scale is enabled by the use of a formal and verifiable mechanism for representing the results of assessment as a set of process attribute ratings for each process assessed.

***Referencing of process attribute ratings***

*Each process attribute rating shall be given an identifier that records the process name and the process attribute assessed.*

*NOTE The ratings may be represented in any format, such as a matrix or as part of a database, provided that the representation allows the identification of individual ratings according to this referencing scheme.*

*[ISO/IEC 15504-2, 5.7.4]*

The set of ratings of the process attributes for a process constitutes the result of the measurement of capability defined in this International Standard; the result is termed the process profile for that process. For any assessment, the results of rating comprise a set of process profiles for each process in the scope of the assessment. The profile may contain up to nine ratings (one for each process attribute) but this can be reduced if the scope of the assessment is limited in terms of the capability levels addressed. Assessments using any Process Assessment Model should provide a mechanism for expressing the evaluation of process capability as a series of process profiles.

## 6.8 Process capability level model

***Achievement of process capability levels***

*The capability level achieved by a process shall be derived from the process attribute ratings for that process according to the process capability level model defined in Table 1.*

*NOTE The purpose of this requirement is to ensure uniformity of meaning when a process capability level is quoted for a process.*

*[ISO/IEC 15504-2, 5.8.1]*

**Table 1 — Capability level ratings**

| *Scale* | *Process Attributes* | *Rating* |
|---|---|---|
| *Level 1* | *Process Performance* | *Largely or fully* |
| *Level 2* | *Process Performance* | *Fully* |
| | *Performance Management* | *Largely or fully* |
| | *Work Product Management* | *Largely or fully* |
| *Level 3* | *Process Performance* | *Fully* |
| | *Performance Management* | *Fully* |
| | *Work Product Management* | *Fully* |
| | *Process Definition* | *Largely or fully* |
| | *Process Deployment* | *Largely or fully* |
| *Level 4* | *Process Performance* | *Fully* |
| | *Performance Management* | *Fully* |
| | *Work Product Management* | *Fully* |
| | *Process Definition* | *Fully* |
| | *Process Deployment* | *Fully* |
| | *Process Measurement* | *Largely or fully* |
| | *Process Control* | *Largely or fully* |
| *Level 5* | *Process Performance* | *Fully* |
| | *Performance Management* | *Fully* |
| | *Work Product Management* | *Fully* |
| | *Process Definition* | *Fully* |
| | *Process Deployment* | *Fully* |
| | *Process Measurement* | *Fully* |
| | *Process Control* | *Fully* |
| | *Process Innovation* | *Largely or fully* |
| | *Process Optimization* | *Largely or fully* |



The elements in Table 1 are based on 5.8.1 of *ISO/IEC 15504-2.*

Table 1 defines the relationship between process attribute ratings and process capability levels. Once the relevant process attribute ratings are assigned, Table 1 provides the mechanism for unambiguously deriving the corresponding process capability level.

The translation table makes clear that in order for a process to be rated as level 2, the process attribute for level 1 must be rated as fully achieved while the process attributes for level 2 can be rated as largely achieved or fully achieved. Similarly for higher capability levels; all of the process attributes at lower levels must be rated as fully achieved while those at the level can be rated as largely achieved or fully achieved.

## 7 Process Reference Models

This clause provides guidance on the selection and use of conformant Process Reference Models. As a necessary preliminary to this, guidance is provided on interpreting the requirements for a Process Reference Model. The guidance on interpretation will be of interest primarily to providers of Process Reference Models while the guidance on selection and use will be of primary interest to users of Process Reference Models.

## 7.1 Interpreting The Requirements For A Process Reference Model

### 7.1.1 Contents of a Process Reference Model

*A Process Reference Model shall contain:*

*a) a declaration of the domain of the Process Reference Model;*

*b) a description, meeting the requirements of 6.2.4 of this International Standard, of the processes within the scope of the Process Reference Model;*

*c) a description of the relationship between the Process Reference Model and its intended context of use;*

*d) a description of the relationship between the processes defined within the Process Reference Model.*

*[ISO/IEC 15504-2, 6.2.3.1]*

This requirement establishes the minimum contents of a Process Reference Model; additional material may be present but only the contents cited in ISO/IEC 15504-2 can be treated as normative (see below).

The declaration of scope would typically take the form of a description of the domain of application and the specific aspects of that domain that are addressed. For example, a Process Reference Model might be developed for use in the software industry and might address software life cycle processes (e.g. ISO/IEC 12207:1995/Amd 1:2002). Typically this scope declaration would include itemization of the processes comprising the Process Reference Model.

Accompanying the declaration of scope as described above would be descriptions of each of the processes encompassed by the Process Reference Model; these process descriptions provide the additional detail required to ensure their usability in the framework established by this international standard. ISO/IEC 15504-2, 6.2.4, provides specific requirements on the content and structuring of these process descriptions.

Since there are typically multiple ways of partitioning processes to provide utility for a particular mode of application, the Process Reference Model also provides a declaration of the intended usage of the Process Reference Model.

To help ensure correct understanding of the intended usage of the Process Reference Model, a description of how the processes defined within the Process Reference Model relate to one another must be provided. This description would typically relate specific processes in the Process Reference Model to aspects of the domain within which the processes would operate. For example, ISO/IEC 12207:1995/Amd 1:2002 defines a set of processes which collectively address software development; the individual processes map in a straightforward manner to the activities required to produce software.



### 7.1.2 Constraints on the Content of a Process Reference Model

#### 7.1.2.1 Community Consensus

*The Process Reference Model shall document the community of interest of the model and the actions taken to achieve consensus within that community of interest:*

*a) the relevant community of interest shall be characterized or specified;*

*b) the extent of achievement of consensus shall be documented;*

*c) if no actions are taken to achieve consensus, a statement to this effect shall be documented;*

*[ISO/IEC 15504-2, 6.2.3.2]*

One indicator of the acceptability and utility of a specific partitioning of a domain into processes will be the extent to which the stakeholders in a community of interest have participated in the definition of the Process Reference Model. Since most communities of interest will only be able to actively use a relatively small number of Process Reference Models (for a given domain), it is in everyone's best interest to know in advance the steps that have been taken by the provider of a Process Reference Model to gain consensus.

International Standards progress through a defined process consisting of multiple checkpoints prior to achieving the status of international standard. These steps provide inherent assurance of a significant degree of international consensus. Similarly, the provider of a Process Reference Model will explicitly document the measures taken to ensure consensus within the communities of interest for the Process Reference Model.

Anticipating that there will be special situations where community consensus is less relevant to the usefulness of a Process Reference Model, the requirements of ISO/IEC 15504-2, 6.2.3, provide that if no measures are taken then a statement to this effect is adequate to meet the requirements of this clause. An example of such a situation would be where an organization has developed over the course of time a set of processes whose utility has been proven by years of experience. If that organization finds it advantageous to reverse engineer a Process Reference Model so that the framework of this International Standard can be employed then taking explicit steps to gain consensus might be considered to have little or no value.

#### 7.1.2.2 Uniqueness of Definition and Identification

*The processes defined within a Process Reference Model shall have unique process definitions and identification.*

*[ISO/IEC 15504-2, 6.2.3.3]*

The purpose of this requirement is self-evident; it is to prevent confusion within the context of a given Process Reference Model. No two processes within a Process Reference Model can have the same definition or identification.

#### 7.1.2.3 Limitation on Normative Content

*NOTE Any elements contained in a Process Reference Model that are not included in this clause are to be considered informative.*

*[ISO/IEC 15504-2, 6.2.3]*

In general, developers of Process Reference Models will have additional content in the Process Reference Model beyond that mandated by the requirements in Clause 6 of ISO/IEC 15504-2. The purpose of this part of ISO/IEC 15504-2, 6.2.3, is to make clear that only the content mandated by Clause 6 of ISO/IEC 15504-2 can be treated as normative in respect of the determination of conformance to this International Standard.

### 7.1.3 Process Descriptions

*The fundamental elements of a Process Reference Model are the descriptions of the processes within the scope of the model. The process descriptions in the Process Reference Model incorporate a statement of the purpose of the process which describes at a high level the overall objectives of performing the process, together with the set of outcomes which demonstrate successful achievement of the process purpose. These process descriptions shall meet the following requirements:*

*a) A process shall be described in terms of its purpose and outcomes;*

*b) In any process description the set of process outcomes shall be necessary and sufficient to achieve the purpose of the process;*

*c) Process descriptions shall be such that no aspects of the Measurement Framework as described in Clause 5 of this International Standard beyond level 1 are contained or implied.*

*An outcome statement describes one of the following:*

- *production of an artefact;*
- *a significant change of state;*
- *meeting of specified constraints, e.g. requirements, goals etc.*

*[ISO/IEC 15504-2, 6.2.4]*

The provisions of ISO/IEC 15504-2, 6.2.4, are critical to the proper functioning of a Process Assessment Model based on a Process Reference Model within the framework of ISO/IEC 15504. These provisions reflect fundamental assumptions about how processes are structured so as to be compatible with the measurement framework for process capability defined by ISO/IEC 15504.

Note that the terms process purpose and process outcome are defined in ISO/IEC TR 15504-9 and that a key aspect of these terms is the emphasis on being observable. This is crucial to the viability of a successful assessment since assessors can only be expected to render repeatable and reliable ratings if they are basing them on observable aspects of process enactment.

The process purpose will normally consist of a single paragraph (one or more sentences) stating the purpose of performing the process describing at a high level the overall objectives of performing the process. The process purpose is supplemented by an enumeration of the principal process outcomes associated with that process. A process outcome is an observable result of the successful implementation of a process. Process outcomes will normally be worded as descriptive statements

The process outcomes for each process are usually listed in the description of each process immediately after the phrase, “As a result of successful implementation of the process:”. By evaluating the attainment of the process outcomes, an assessor can form a judgment of the capability of the process.

## 7.2 Selecting Process Reference Models

In theory there are many factors that can be used to differentiate one Process Reference Model from another. In practice it is likely that only a few will need to be considered before the best choice becomes apparent.

The factors can be structured into the following groups: contextual, technical and legacy.

### 7.2.1 Contextual Selection Factors

Contextual selection factors are those factors which an Organizational Unit has little or no influence over; these factors will tend to have less to do with the technical merits of a Process Reference Model and more to do with external constraints or needs imposed on the Organizational Unit.

One example would be a government regulatory agency imposing a requirement that a particular Process Reference Model be used; another would be a business opportunity which demands the use of a particular Process Reference Model as a condition of contract award and/or performance.

Finally, de facto standards exist within some industry segments which in effect dictate which Process Reference Models are acceptable.

### 7.2.2 Technical Selection Factors

Technical selection factors are those that relate to the suitability of a Process Reference Model given the specific nature of the Organizational Unit and the usage context.

One of the most critical technical selection factors will be whether the Process Reference Model defines a set of processes consistent with the needs of the Organizational Unit that will be assessed. Clearly a Process Reference Model should include processes of interest to the Organizational Unit, although an Organizational Unit is not obliged a priori to employ all of the processes defined by a Process Reference Model.

The granularity of the processes defined by a Process Reference Model will be an important selection consideration. Given a specific usage context, e.g. say configuration management of software, there are in general multiple ways of partitioning the process domain both along functional lines as well as along the granularity dimension. One Process Reference Model for this domain might define five processes while another might define fifteen. The tradeoffs to be considered in this regard would include the degree of complexity needed, the precision of assessment results needed, and the acceptable level of effort to conduct an assessment using a Process Assessment Model conformant with the given Process Reference Model.

A related consideration may be the degree of compatibility with other Process Reference Models to which the Organizational Unit is either required or chooses to be assessed against.

### 7.2.3 Legacy Selection Factors

Legacy selection factors are those which relate to the history of process improvement efforts within an Organizational Unit; such things as core expertise with a particular set of process definitions or a particular assessment approach might impact the selection of a Process Reference Model such that the choice of a Process Reference Model is actually driven by the assessment approach used by the Organizational Unit in the past. Organizational Units just getting started in process improvement will not need to consider this in their selection process.

An example would be an Organizational Unit which was an early adopter of ISO/IEC 12207 and which now wishes to engage in assessment of those processes encompassed by ISO/IEC 12207.



## 8 Process Assessment Models

### 8.1 Interpreting the requirements for a Process Assessment Model

This clause provides guidance on the selection and use of a Process Assessment Model as the basis for performing a process assessment. The guidance is intended for the use of assessors and sponsors of assessments. It is not directed specifically at the developers of Process Assessment Models, though it may be of use to them.

A Process Assessment Model works in conjunction with a documented assessment process to form the basis for an organization to determine the state of its processes from a process capability perspective; the Process

Assessment Model provides the reference set of indicators which are used as a basis for gathering objective evidences and determining the extent to which the process attribute or process purpose has been achieved.

There are many different types of modelling techniques available for describing, specifying and implementing processes. Models that have not been specifically developed for the purpose of process assessment may not yield reliable results, and their suitability for purpose should be verified before selection. The suitability for use in assessing process capability will be a function of the degree of focus of the model's indicators on observable aspects of process enactment and the model's degree of alignment with the relevant Process Reference Model and the measurement framework for process capability. A primary means of verification of suitability is the extent to which a model (and its associated Process Reference Model(s)) satisfies the relevant requirements put forth in ISO/IEC 15504-2.

The applicable engineering principles will be specific to the intended domain of application of the Process Assessment Model; the process management principles are embedded in the Measurement Framework for process capability (ISO/IEC 15504-2, 4).

### 8.1.1 Process Assessment Model scope

*A Process Assessment Model shall relate to at least one process from the specified Process Reference Model(s).*

*A Process Assessment Model shall address, for a given process, all, or a continuous subset, of the levels (starting at level 1) of the 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 level 1, or to address levels 1, 2 and 3, but it would not be permissible to address levels 2 and 3 without level 1.*

*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 capability levels selected from the Measurement Framework.*

*[ISO/IEC 15504-2, 6.3.2]*



The Process Reference Model defines a set of processes that are considered to be fundamental to efficient and effective operations in the domain of interest. Any Process Assessment Model, to be conformant with the Process Reference Model, must contain at least a part of this scope. The process scope of a Process Assessment Model may be a sub-set of the processes defined in the Process Reference Model. It may be a super-set of the Process Reference Model, covering all of the defined processes together with additional processes outside the scope of the Process Reference Model.

A Process Assessment Model may also include processes outside the Process Reference Model providing it encompasses at least one process from it. Finally, the scope of the model may be directly equivalent to the Process Reference Model.

The Process Assessment Model shall explicitly declare its scope of coverage as described above.

### 8.1.2 Process Assessment Model indicators

*A Process Assessment Model shall be based on a set of indicators that explicitly addresses the purposes and outcomes, as defined in the selected Process Reference Model, of all the processes within the scope of the Process Assessment Model; and that demonstrates the achievement of the process attributes within the capability level scope of the Process Assessment Model. The indicators focus attention on the implementation of the processes in the scope of the model.*

*[ISO/IEC 15504-2, 6.3.3]*

A model shall document a set of indicators of process performance and process capability that enable judgements of process capability to be soundly based on objective evidence.

There is a clear expectation that the indicators will fall into two categories: factors that indicate the performance of the process, and factors that indicate its capability. In selecting a model, clear attention should be given to the use of indicators in the model, the comprehensiveness of the indicator set, and the applicability of the indicator set.

ISO/IEC 15504-5 provides an exemplar a model with a comprehensive set of indicators, which may serve as a guide to the extent of coverage to be expected for the Process Reference Model defined in Annex F of ISO/IEC 12207:1995/Amd 1:2002. Annex B of this document also provides guidance on indicators.

### 8.1.3 Mapping Process Assessment Models to Process Reference Models

*A Process Assessment Model shall provide an explicit mapping from the fundamental elements of the model to the processes of the selected Process Reference Model and to the relevant process attributes of the Measurement Framework.*

*The mapping shall be complete, clear and unambiguous. The mapping of the 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 achievements listed for each process attribute) in the Measurement Framework.*

*This enables Process Assessment Models that are structurally different to be related to the same Process Reference Model.*

*[ISO/IEC 15504-2, 6.3.4]*



The requirements for mapping play a crucial role in ISO/IEC 15504 by providing the foundation for translating results from a ISO/IEC 15504-conformant assessment into a common format which facilitates comparability of assessment ratings. The requirements for mapping call for the Process Assessment Model to be accompanied by a detailed set of mappings which demonstrate how the indicators of process performance provide coverage for the purposes and outcomes of the processes in the specified Process Reference Model and how the indicators of process capability within the model provide coverage for the process attributes (including all of the results of achievement of the process attributes) in the measurement framework.

It is essential that the assessor has access to the details of the mapping of the elements of the model to the Process Reference Model. The mapping may be simple, as is the case in the model defined in ISO/IEC 15504-5 where the processes of the Process Reference Model are in correspondence with the processes of the Process Assessment Model and the Process Assessment Model employs a continuous architecture. Where the structure of the model is significantly different from the Process Reference Model, as in the case of a Process Assessment Model employing other architectures (e.g. staged architecture), the mapping will likely be more complex.

An assessor should confirm that the mapping is meaningful, for example by sampling some of the lowest level components in the model, and locating them in the Process Reference Model, either as elements of a process or as contributors to a process attribute. Mappings that result in elements being identified as components of more than one process attribute may indicate problems with the model structure, which could result in ambiguous translation of results.

### 8.1.4 Expression of assessment results

*A Process Assessment Model shall provide a formal and verifiable mechanism for representing the results of assessment as a set of process attribute ratings for each process selected from the specified Process Reference Model(s).*

*NOTE The expression of results may involve a direct translation of Process Assessment Model ratings into a process profile as defined in this international standard, or the conversion of the data collected during the assessment (with the possible inclusion of additional information) through further judgement on the part of the assessor.*

*[ISO/IEC 15504-2, 6.3.5]*

One of the key components of the assessment output from an ISO/IEC 15504-conformant assessment is a set of process profiles, one for each process included in the scope of the assessment. A process profile is a set of up to nine ratings, one for each process attribute, for a process included in the scope of the assessment.

The mechanism for the expression of assessment results may be manual, automated, or a combination of the two. It may require the inclusion of additional information collected during the assessment, and may involve further judgement on the part of the assessor. The rules for translating the results however, should be clear and unambiguous, and are to be provided by either the model developer or method provider.

If a model explicitly provides results in the format prescribed in ISO/IEC 15504-2, then there is no need for any translation mechanism.

## 8.2 Selection of a Process Assessment Model

The model for an assessment will typically be selected by the competent assessor, or the sponsor of the assessment (in which case, this should be documented as a constraint). Irrespective of which party makes the final decision, there are factors to consider that will help ensure that the selection is appropriate for the use envisaged.

The overriding objective in selecting a model, given that any model selected is compatible with the Process Reference Model, will be its suitability for the context of the assessment. Some principal factors affecting the selection of a model will be:

- the planned scope of the assessment;
- the business goals of the Organizational Unit being assessed;
- the industry sector of the Organizational Unit being assessed;
- the application domain of the software components that are the focus of the assessment;
- business opportunities that may demand the use of a particular Process Assessment Model as a condition of contract performance;
- the inclusion of an improvement path for increasing the process maturity of an Organizational Unit and
- specific requirements for strong comparability with other assessments or Organizational Units.

Where models exist that have been specifically developed for use in particular industry sectors (e.g., telecommunications, defence, aerospace) or for particular application domains (e.g. high security systems, safety critical systems, real time embedded software) then, when applicable, these should be considered.

When an organization wishes to conduct an assessment in an area that is not representative of its normal domain, it should take care that the model chosen is suitable. For example, an aerospace organization that wishes to assess the processes responsible for maintenance of its internal management systems might find that an industry specific model is not the most suitable for the task.

The model provided in ISO/IEC 15504-5 is a generic model for the software industry that is designed to be applicable across all industry sectors and application domains.

The first selection factor to be considered is the matter of whether a Process Reference Model exists for the Process Assessment Model being considered. If this is not the case then a suitable Process Reference Model will need to be constructed and a determination made that it satisfies the requirements for a Process Reference Model.

Given this, the various selection factors to be considered can be classified similarly to those for the selection of a Process Reference Model, i.e. contextual factors, technical factors and legacy factors.

### 8.2.1 Contextual Factors

#### 8.2.1.1 Market Acceptance

An important selection factor over which an individual organization will typically have relatively little influence is the extent to which a market segment has a de facto assessment approach already established. If this is the case then an individual organization will likely find this to be the most influential selection factor. Of course this does not preclude an organization from using additional assessment approaches but most will find the additional cost and effort to be prohibitive.

It should be noted that over the course of time, as the uptake of ISO/IEC 15504-conformant assessment approaches increases, this consideration will become less of a factor since assessment results will be transformable into a single process capability profile and legacy considerations will become less influential.

#### 8.2.1.2 Customer Requirement

Some business opportunities may demand the use of a particular Process Assessment Model as a condition of bidding and/or as a condition of contract performance.

### 8.2.2 Technical Factors

#### 8.2.2.1 Granularity of indicators

Process Assessment Models will in general provide differing degrees of visibility into a process based on the number of assessment indicators provided by the Process Assessment Model. Given the same process scope, a Process Assessment Model with twenty assessment indicators would be considered to provide greater visibility into a process than a Process Assessment Model with ten assessment indicators. Thus an important selection consideration is the degree of visibility desired or needed. As a general rule greater visibility implies greater precision in assessment ratings and also more specific input to subsequent process improvement efforts. Of course, this improved visibility comes at a greater cost in terms of effort during the assessment to elicit data regarding the assessment indicators and then processing the data to formulate assessment ratings. A related consideration is the impact of the number of assessment indicators for a given process scope on the prescriptiveness of a Process Assessment Model. As a general rule, as the number of assessment indicators increases, the degree of prescriptiveness increases. This assertion is based on the assumption that the indicator set is a non-redundant set of indicators.

#### 8.2.2.2 Process Architecture

While different architectures may be compatible with ISO/IEC 15504, they may have differing usage characteristics which potential users should understand. No architecture is superior to the others in all respects; rather they may offer complementary features. Accordingly, an organization may find one of them to be more useful depending on the particular need to be addressed as well as the overall process capability within the organization.

#### 8.2.2.3 Intended Domain and Process Scope

Since the choice of a Process Reference Model does not necessarily imply the use of one particular Process Assessment Model, an organization will generally still have a choice to make among Process Assessment Models that are compliant with the chosen Process Reference Model. One of the selection factors is the set of processes covered by the Process Assessment Model. For example, the situation depicted by Table 2 shows that after the decision has been made to select a particular Process Reference Model (which defines processes P1 through P10), there are three Process Assessment Models to choose from. If we assume that the organization needs to assess processes P1, P2 and P5, then, from the coverage prospective, Process Assessment Model 2 will be the chosen model since it is the only Process Assessment Model to provide coverage for the needed processes (a blank cell means that the Process Assessment Model does not provide coverage for the associated process.)

**Table 2 — Selection of a Process Assessment Model**

| Process | Process Assessment Model 1 | Process Assessment Model 2 | Process Assessment Model 3 |
|---|---|---|---|
| P1 | | Y | Y |
| P2 | Y | Y | |
| P3 | Y | Y | Y |
| P4 | Y | | Y |
| P5 | | Y | Y |
| P6 | | Y | Y |
| P7 | Y | | Y |
| P8 | Y | | Y |
| P9 | Y | | Y |
| P10 | Y | | |



## 9 Selecting and Using Assessment Tools

In any assessment, information will be collected, recorded, stored, collated, processed, analyzed, retrieved and presented. Tools can provide valuable support in collating the evidence used by the assessor to assign ratings to the process attributes for each process assessed, and in recording the ratings as the set of process profiles.

There are two basic types of Tools: paper-based and automated, which have different characteristics. The appropriateness of a tool depends on the planned mode of use and assessment methodology. To ensure effective and efficient performance, tools should be selected or designed to match the assessment process.

Tools may be used in a number of ways to support assessments:

— by assessors capturing information;

— by process owners or Organizational Unit representatives during preparation for and prior to an assessment capturing information for subsequent processing;

— by Organizational Unit representatives continuously throughout the development life cycle, and at defined milestones, to measure process adherence, process improvement progress or to gather information to facilitate a future assessment;

— after the assessment to retrieve or organize the assessment information to facilitate process improvement planning or analysis for capability determination;

— in a distributed approach for self-assessment throughout an organization;

— when sampled work-products and process information are collected incrementally and reviewed prior to the commencement of on-site assessment activities, such as interviews;

— to assist the assessor with the processing of the assessment information collected;

— to store and retrieve assessment results, making the results more accessible for process improvement planning or capability determination analysis;

— to assist the assessor with post-assessment analysis of the results such as the analysis of process improvement results against past performance history, or of a supplier profile against an established target profile;

— to collect information incrementally and in a distributed manner;

— to collect information incrementally at set milestone check points in the performance of a process or when a number of Organizational Units are to be assessed incrementally;

— to generate result profiles or help in the performance of gap analysis.

Competence to use the selected tools is a key factor in ensuring that information is collected, recorded, processed and analyzed in a reliable, repeatable and appropriate way. The assessors and other participants who will use the tools should be appropriately trained and have the necessary experience in the use of the tools. In addition to competence in operating the tools, training and/or experience should provide a good theoretical understanding of the underlying principles related to the Process Assessment Model, indicators, and rating.

Particular tools may be specified as part of the documented assessment process. Alternatively, the intending user may need to select appropriate tools. The guidance presented here is intended to highlight some of the considerations in selecting tools for use throughout the assessment. It does not address issues related to general support tools such as word processors and presentation tools. The ability of assessment tools to integrate together and to integrate with word processors and presentation tools, provides considerable assistance in preparing reports and presentations of the outputs of the assessment.

The selection criteria for the type of tool may be influenced by:

— the scope and purpose of assessment;

— need of assistance in collecting and storing information including assembling the assessment input and recording it in a suitable form for transfer to the assessment output;

— support for the chosen Process Assessment Model, at least for the scope of the assessment;

— ability to capture the information required to be used in the production of ratings as defined in ISO/IEC 15504-2;

— ability to capture and maintain supporting information as defined in the assessment input;

— support of the rating scheme defined in ISO/IEC 15504-2;

— support of representation of process profiles in forms that allow straightforward interpretation of their meaning and value;

— ability to store and retrieve assessment results for subsequent use in process improvement or capability determination;

— provision of appropriate segregation of different classes of information and data to enable the information and data to be used or distributed in different ways;

— ability to keep the captured information secure to meet confidentiality constraints;

— ability to perform dynamic scoping and tailoring to support specific cultural, organizational, sponsor, or assessment needs;

— provision of adequate configuration control of the tool and the results collected;

— ability to split by process and job function;

— ability to tailor the Process Assessment Model as required;

— portability considerations (usability for interviews, distributed inputs, simultaneous inputs);

— ability to handle multiple assessors' inputs;

— usability for interviews, self-assessment;

— ability to integrate with other tools (metrics, CASE, etc.);

— ability to maintain an audit trail of access to information input;

— real-time performance: speed of information input and retrieval;

— ability to call up practices required for specific interviews.

Guidance and standards for computer based tool selection are available in ISO/IEC 12119:1994, *Information technology — Software packages — Quality requirements and testing* and ISO/IEC 14598 (all parts), *Software engineering — Product evaluation*.

# 10 Guidance on Competency of Assessors

## 10.1 Overview

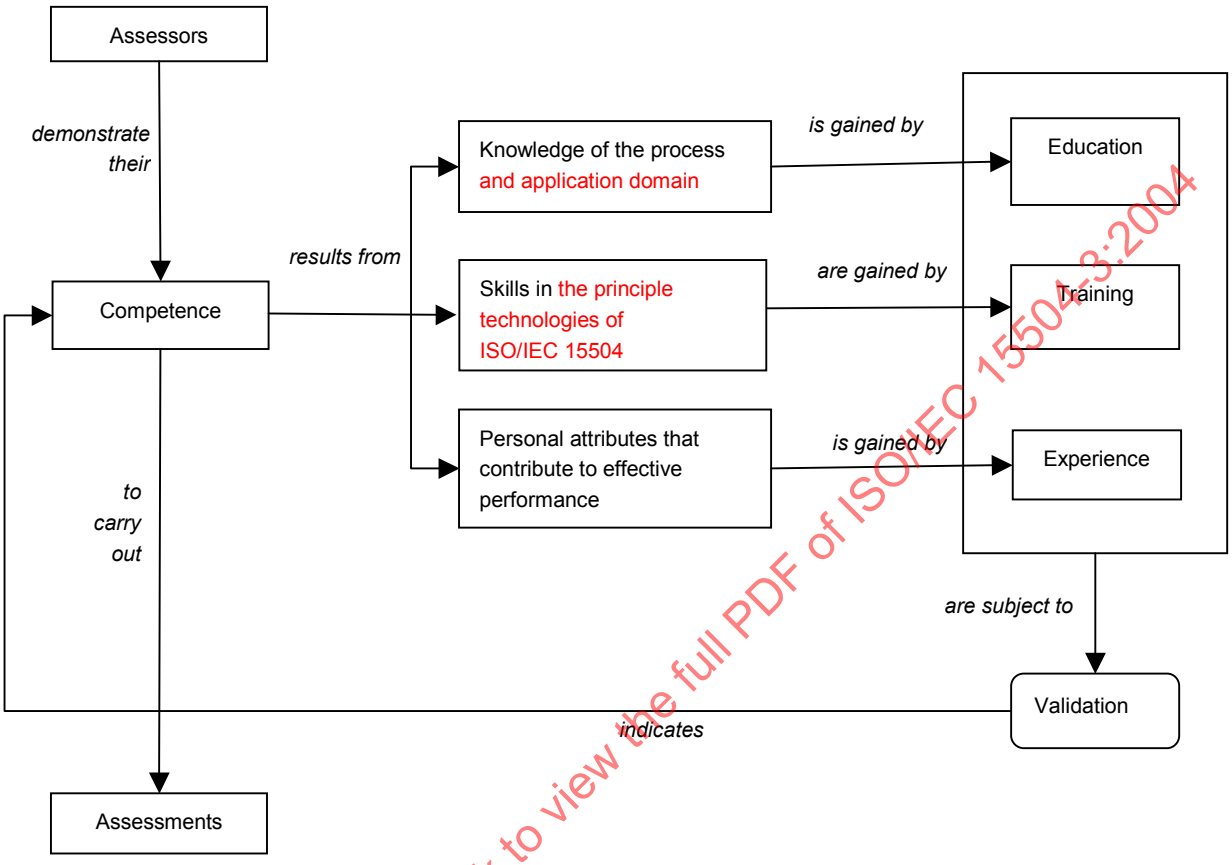


**Figure 2 — Demonstration and Validation of Assessor Competence**

Figure 2 shows the key relationships pertaining to the demonstration and validation of the competencies of assessors. These may be articulated as follows:

a) Assessors demonstrate their competence to carry out assessments.

b) Competence results from:

   1) the knowledge of the processes;

   2) skills in the principle technologies of this International Standard including: the Process Reference Model(s); Process Assessment Model(s), methods and tools; and rating processes;

   3) personal attributes which contribute to effective performance.

c) The knowledge, skills and personal attributes are gained by a combination of education, training and experience.

d) An alternative to the demonstration of competence is to validate an intending assessor's education, training and experience.

## 10.2 Gaining and maintaining competence

### 10.2.1 Provisional assessor

A provisional assessor has reached the acceptable levels of education, training and experience but has not necessarily participated in assessments conducted according to the provisions of this International Standard.

A provisional assessor should be trained and experienced in the process as well as in process assessment. A provisional assessor should have received training that satisfies the guidance of this International Standard. A provisional assessor should also have evidence of an acceptable level of education.

Acceptable levels of education may comprise:

— courses offered by a college or university;

— professional courses organized by recognized local or international bodies;

— vendor sponsored courses;

— employer sponsored courses.

Acceptable levels of training may comprise:

— training provided by recognized local or international bodies;

— training provided by vendors and trainers.

Acceptable levels of experience may comprise:

— direct "hands-on" experience in Process Reference Model specialist areas;

— management experience overseeing Process Reference Model specialist areas.

### 10.2.2 Competent assessor

A competent assessor will have participated in assessments conducted according to the provisions of this International Standard. A record should be maintained documenting education, training and experience.

### 10.2.3 Maintaining competence

To maintain competence, assessors should update their knowledge, skills and personal attributes by engaging in activities such as education, training and relevant professional activities as well as performing further assessments conducted according to the provisions of this International Standard. This should be reflected in the record mentioned in 10.2.2.



# 11 Guidance on Verification of Conformity

Verification of conformity with ISO/IEC 15504 requirements is a critical aspect of realizing one of the principal goals of ISO/IEC 15504, i.e. market uptake of the common measurement framework for the expression of process capability. Market uptake will depend on the confidence users have that assessment results from ISO/IEC 15504-conformant assessments, as expressed using the common measurement framework, have content validity (that is, they portray what they claim to portray) and that they are repeatable and reliable.