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Guide to performing assessments

Contents

Foreword

In June 1991, the fourth plenary meeting of ISO/IEC JTC1/SC7 approved a study period (resolution 144) to investigate the needs and requirements for a standard for software process assessment.

The results of the study (JTC1/SC7 N944R, 11 June 1992) came to the following conclusions:

a) there is international consensus on the needs and requirements for a standard for process assessment;

b) there is international consensus on the need for a rapid route to development and trialing to provide usable output in an acceptable timescale and to ensure the standard fully meets the needs of its users;

c) the standard should initially be published as a Technical Report Type 2 to enable the developing standard to stabilize during a period of the user trials, prior to its issuing as a full International Standard.

ISO/IEC Directives state that a Technical Report Type 2 may be used to publish a prospective standard for provisional application so that information and experience of its practical use may be gathered.

A new work item was subsequently approved in January 1993 by JTC1.

In June 1993 the SPICE project was established with a mandate from JTC1/SC7 to:

a) assist the standardization project in its preparatory stage to develop initial working drafts;

b) undertake user trials in order to gain early experience data which will form the basis for revision of the published Standard prior to its issuing as a full International Standard;

c) create market awareness and take-up of the evolving standard.

The SPICE project has completed the first of these tasks. The ISO/IEC working group (ISO/IEC SC7/WG10) which is responsible for developing the Technical Report subsequently distributed the working drafts through SC7 for PDTR registration ballot in June 1995. User trials continue to be undertaken and are phased to coincide with the ballot process to provide timely user experience feedback reports.

Following member body comment and experience feedback reports from the first phase of the SPICE project user trials, the working drafts have been revised and are now distributed for PDTR ballot. A second phase of SPICE project user trials is due to commence in September 1996 and will provide further experience feedback into the current review process.

This Technical Report Type 2 consists of the following parts, under the general title *Software Process Assessment:*

– Part 1 : *Concepts and introductory guide* (informative)
– Part 2 : *A reference model for processes and process capability* (normative)
– Part 3 : *Performing an assessment* (normative)
– Part 4 : *Guide to performing assessments* (informative)
– Part 5 : *An assessment model and indicator guidance* (informative)
– Part 6 : *Guide to qualification of assessors* (informative)
– Part 7 : *Guide for use in process improvement* (informative)
– Part 8 : *Guide for use in determining supplier process capability* (informative)
– Part 9 : *Vocabulary* (informative)

Introduction

Process assessment is a means of capturing information describing the current capability of an organization's processes and is initiated as a result of a desire to determine and/or improve the capability of these processes.

This part of the Technical Report provides guidance on interpreting the requirements set out in part 3. As an aid to understanding, the requirements from part 3 are embedded verbatim in italics at appropriate points within the text of this guide.

Although the guidance in this part of the Technical Report may be most easily understood in the context of a discrete team-based assessment, the principles are the same for a continuous, tool-based assessment. In a continuous assessment, however, the means of collecting data is different.

The guidance in this document is primarily aimed at the qualified assessor who has the responsibility for the selection and use of models, methods and tools for the assessment. The guidance may also be of use to the developers of assessment models, methods and tools as an aid to understanding the requirements.

The assessment team and other participants in an assessment may use the guidance to gain an understanding of process assessment.

1. Scope

This part of the Technical Report provides guidance on meeting the requirements for performing an assessment contained in part 3.

It provides an overview of process assessment and interprets the requirements through the provision of guidance on the selection and use of compatible models, methods, and instruments or tools for assessment.

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 suitability of its own processes for a particular requirement or class of requirements;

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

2. Normative references

There are no normative references in this part of the Technical Report

3. Definitions

For the purposes of this part of this Technical Report, the definitions in *Software Process Assessment - Part 9 : Vocabulary* apply.

4. Overview of process assessment

4.1 Context of process assessment

4.1.1 Process assessment

Process assessment is undertaken to understand the capability of an organizational unit's current processes. Process assessment deals potentially with all the software related processes (e.g. management, development, maintenance, support) used by an organization. This is accomplished by assessing the organizational unit's processes against an assessment model compatible with the reference model described in part 2 of this Technical Report.

The reference model defines the set of universal software engineering processes that are fundamental to good software engineering and a set of process attributes, applicable to any process, that characterize the capability of an implemented process.

Processes in the reference model are grouped into a set of five process categories according to the type of activity they address. Each process has a defined purpose describing the high-level objectives that the process should achieve. The purpose statements do not prescribe how the process should achieve its objectives.

The nine process attributes in the reference model represent measurable characteristics of process management providing the capability of the process to effectively achieve its purpose and contribute to meeting the business goals of the organization. The nine process attributes are grouped into six capability levels that define an ordinal scale of process capability and provide a rational route for improvement of each individual process.

The assessment and rating framework is based upon assessing process instances. The fundamental assessment output, therefore, consists of a set nine process attribute ratings for each process instance assessed.

Although part 2 of this Technical Report covers a range of processes applicable to the software process, in many instances of process assessment a subset of these processes may be selected. For instance the sponsor may wish to focus attention on one or more critical process or on processes which 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 sophistication and complexity of the implemented process utilized within an organizational unit 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 qualified 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.

4.1.2 Process improvement

The assessment output identifies the current process attribute ratings, and optionally, the process capability level ratings of an organizational unit's processes and forms the basis to plan, prepare, implement and evaluate specific improvement actions, as described in part 7 of this Technical Report.

4.1.3 Process capability determination

The assessment output allows an organizational unit to identify, analyse and quantify its own strengths, weaknesses and risks, or to provide a capability profile to a potential purchaser as described in part 8 of this Technical Report.

4.2 Process rating scheme

The process assessment rating framework is based on assessing a specific process instance. A process instance is a singular instantiation of a process that is uniquely identifiable and about which information can be gathered in a repeatable manner. The guidance on data collection in clause 7 will help to increase the level of repeatability by different assessors.

Each process instance has a set of nine process attribute ratings that constitute the process profile for the instance. The process attributes are measured on a four-point ordinal scale that provides the detailed insight into specific aspects of process capability required to support process improvement and capability determination.

The process capability level model 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). 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.

When more than one instance of a process is assessed, additional insights may be gained by aggregating the ratings for the process instances to give a frequency distribution.

4.3 Assessment approaches

4.3.1 General

There are a number of approaches to assessment as described below which may be combined in several ways. For example it is possible to conduct a self assessment using a discrete or a continuous approach which may be manual or automated.

4.3.2 Self-assessment versus independent assessment

A self-assessment is carried out by an organization to assess the capability of its own software process. It may be discrete, or continuous, and may be carried out by the process owner or by a specialist team to support the process owner.

The sponsor of a self-assessment is always internal to the organization.

An independent assessment is an assessment conducted by an assessor or assessment team that is 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 programme is functioning properly or by an acquirer who wishes to have an independently derived assessment output.

In general, the sponsor of an independent assessment will be external to the organizational unit being assessed. The degree of independence, however, may vary according to the purpose and circumstances of the assessment. In an independent assessment conducted on behalf of an acquirer, the sponsor is external to the organization being assessed. In an independent assessment conducted by the organization on its own behalf the assessment sponsor will belong to the same organization as the organizational unit being assessed.

An independent assessment will generally be conducted as a team-based, discrete assessment.

4.3.3 Team-based versus automated assessment

A team-based approach establishes an assessment team to conduct an assessment. For a small assessment, a 'team' may consist of only one member. A team-based assessment will generally employ techniques such as interview and/or discussion with members of the assessed organization as a primary means of data gathering.

An automated approach to assessment involves the use of computer-based tools as the primary means of data gathering. Such tools may be of the 'expert system' class, in some sense replacing the role of assessor in a team-based assessment. Alternatively, the automation may take the form of continuous or incremental data collection and analysis over time.

4.3.4 Discrete versus continuous assessment

A discrete assessment is one that essentially takes a snapshot of the processes in use within the organizational unit being assessed, gathering all the data needed over a short period of time. A discrete assessment is typically conducted using a team-based approach.

Continuous assessment involves gathering data incrementally over time. The data gathering may be organized as part of a regular manual monitoring or reporting mechanism used by one or more projects. Alternatively, data collection may be automated or semi-automated through the support of an instrument or tool. An instrument could be used continuously throughout the software development life cycle, for example, at defined milestones to measure adherence to the process, to measure process improvement progress, or to gather data to facilitate a future assessment.

When using a continuous assessment approach there may not be an assessment team as there is for a team-based assessment, but there is still a need for an identified qualified assessor to ensure conformance to the requirements for assessment.

4.4 The assessment process

4.4.1 Overview

> *The assessment shall be conducted according to a documented process that is capable of meeting the assessment purpose.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.4]**

Irrespective of the type of assessment or the approach adopted, an assessment should be conducted according to a documented process. Some of the key elements of an assessment process are briefly described below, and described in more detail in clauses 5, 6 and 7. Note, however, that the guidance provided does not constitute a complete, documented process. Its role is to provide help in interpreting the requirements in parts 2 and 3 of this Technical Report, and to provide a starting point for selecting or creating a documented process.

The key elements of the process that are describe are the compatible assessment model, the assessment method, and supporting instruments and tools.

4.4.2 Compatible model

A compatible model is one that meets the requirements in part 2. In summary, a compatible model is one

- that has been constructed for use in process assessment;
- whose fundamental elements can be and are mapped to the process and capability dimensions of the reference model in part 2 of this Technical Report;
- that is equipped with sets of indicators for use during an assessment to gather the data about processes and process attributes;
- that has a formal mechanism for translating the data gathered against the model into process attribute ratings as defined in part 2 of this Technical Report.

The model in part 5 of this Technical Report is a compatible model.

4.4.3 Method

The method is the set of instructions and procedure for conducting the assessment. Depending upon the approach, a method should cover topics such as:

- roles and responsibilities;
- use of tools and techniques;
- resources;
- sequenced activities and procedures such as:
  - reviewing the assessment input;
  - selecting process instances;
  - planning and preparing for the assessment;
  - collecting and verifying information;
  - determining the ratings for process instances;
  - aggregating ratings;
  - validating the ratings;
  - presenting the assessment output.

4.4.4 Instruments and tools

In any assessment, data will need to be collected, recorded, stored, collated, manipulated, analysed, retrieved and presented. In general, an assessment method will by supported by various instruments and tools for data gathering, manipulation and presentation. For a small assessment of limited scope, the support tools and instruments may be manual and paper-based (forms, questionnaires, checklists, etc.). In most cases, however, the volume and complexity of the assessment data is considerable resulting in the need for computer-based support tools based on technologies such as spreadsheets, databases, expert systems, or integrated CASE tools.

Regardless of the form of the supporting instruments and tools, their objectives should be to help an assessor perform an assessment in a consistent and reliable manner, reducing assessor subjectivity and helping to ensure the validity, useability and comparability of assessment results. In order to achieve these objectives, the instruments and tools need to make the assessment model and its indicators accessible to the assessors.

4.5 Success factors for process assessment

The following factors are essential to a successful process assessment.

4.5.1 Commitment

Both the sponsor and owner should commit themselves to the objectives established for an assessment to provide the authority to undertake the assessment within an organization. This commitment requires that the necessary resources, time and personnel are available to undertake the assessment. The commitment of the assessment team is fundamentally important to ensuring that the objectives are met.

4.5.2 Motivation

The attitude of the organization's management, and the method by which the information is collected, 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 organizational unit members implementing the process. The intent is to make the processes more effective to support 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.

4.5.3 Confidentiality

Respect for the confidentiality of the sources of information and documentation gathered during assessment is essential in order to secure that information. If discussion techniques are utilized, 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 organization. It is therefore important that adequate controls are in place to handle such information.

4.5.4 Relevance

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

4.5.5 Credibility

The sponsor, and the management and staff of the organizational unit must 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 assessment team has adequate experience of assessment, is sufficiently impartial and has an adequate understanding of the organizational unit and its business to conduct the assessment.

5. Selection and use of a compatible model

This clause of this Technical Report provides guidance on the selection and use of a suitable model as the basis for performing a software process assessment. The guidance is intended for the use of assessors and sponsors of assessments. It is not directed specifically at the developers of compatible models, though it may be of use to them.

In performing a process assessment, the practices observed in the organization unit being assessed are compared against those defined in a base model of good practice, to determine the extent to which the practices are resulting in an effective process. In order to achieve this, the model must contain descriptions of the practices to be observed, and indicators of the performance of these practices, so that the judgments of capability may be made reliably and consistently.

5.1 Compatibility with the reference model

> *The model used within the assessment shall be a compatible model of good software engineering practice that meets the requirements defined in part 2 of this Technical Report. An exemplar model is included in part 5 of this Technical Report.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.4]**

The first criterion for the selection of a model is that it achieves compatibility with the reference model. Compatibility is essential in order to provide a degree of comparability between the results of different assessments by maximizing the reliability of different approaches and achieving a greater degree of uniformity in the reporting of results.

5.1.1 Model Purpose

> *A model, based on good software engineering and process management principles, shall be developed, or have been developed, for the purpose of assessing software process capability.*
>
> **[Software Process Assessment - Part 2: A reference model for processes and process capability, 7.2]**

There are many different types of modeling techniques available for describing, specifying and enacting processes. Models that have not been specifically developed for the purpose of process assessment will not yield reliable results.

5.1.2 Model Scope

> *A model shall encompass all, or a non-empty subset, of the process dimension of the framework contained in [part 2 of] the Technical Report.*
>
> *A model shall address all or a continuous subset of the levels (starting at level 1) of the process capability dimension of the framework contained in [part 2 of] the Technical Report for all of the processes within its scope.*
>
> **[Software Process Assessment - Part 2: A reference model for processes and process capability, 7.3]**

The reference model defines 29 processes in five different process categories. Any model, to be compatible with the reference model, must contain at least a part of this scope. The model may be a sub-set of the reference model. It may be a super-set of the reference model, covering all of the defined processes together with additional process descriptions outside the standard scope. A compatible model may also include processes outside the reference model providing it encompasses at least one process from it. Finally, the scope of the model may be directly equivalent to the reference model.

For the capability dimension, a model must cover a complete set of capabilities for all of the processes in its scope. The set of capabilities must encompass the whole of the capability level scale in the reference model or a subset starting at level 1. It is permissible, therefore, for a model to claim coverage of levels 1 to 3 only, but not of only levels 3 to 5.

In selecting a model, the assessors should ensure that the scope of the model covers the intended area of interest for the assessment. It would not be appropriate, for example, to select a model that was restricted to the Engineering processes if it was intended to investigate all aspects of requirements elicitation, as this would involve evaluation of some of the Customer-Supplier processes.

5.1.3 Model elements and indicators

> *A model shall be based on a set of elements that explicitly address the purposes, as defined in the reference model in [part 2 of] the Technical Report, of all the processes within the scope of the model, and that demonstrate the achievement of the process attributes within the capability level scope of the model.*
>
> **[Software Process Assessment - Part 2: A reference model for processes and process capability, 7.4]**

In order for a model to be compatible with the reference model, it must address the purposes of the processes as defined in the reference model, and the achievement of the process attributes that constitute the capability dimension. In order to meet the requirements of the other components of this Technical Report, it must also document a set of indicators of process performance and capability that enable judgments of process capability to be soundly based on objective evidence.

> *In order to provide the basis for repeatability across assessments, the defined set of indicators in the compatible model shall be used during the assessment to support the assessors' judgment in rating process attributes. …Objective evidence based on the indicators that support the assessors' judgment of process attribute ratings shall be recorded and maintained to provide the basis for verification of the ratings.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.4]**

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 paid to the use of indicators in the model, the comprehensiveness of the indicator set, and the applicability of the indicator set for the two defined purposes. Part 5 of this Technical Report comprises a model with a comprehensive set of indicators, that may serve as a guide to the extent of coverage to be expected.

5.1.4 Mapping

> *The developer of a model shall provide a mapping from the fundamental elements of the model to the processes and process attributes of the reference model contained in [part 2 of] the Technical Report. The mapping shall be complete, clear, and unambiguous and shall substantiate the declaration of the scope of coverage.*
>
> **[Software Process Assessment - Part 2: A reference model for processes and process capability, 7.4]**

It is essential that the assessor has access to the details of the mapping of the elements of the model to the reference model. The mapping may be simple, as is the case in the model defined in part 5 of this Technical Report. Where the structure of the model is significantly different from the reference model, however, the mapping may be quite complex.

An assessor should attempt to confirm that the mapping is accurate, by sampling some of the lowest level components in the model, and confirming that the mapping declaration permits them to be located in the 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.

5.1.5 Translation

> *The developer of a model shall provide a formal and verifiable mechanism for converting data collected against the model into sets of process attribute ratings for each process instance assessed.*
>
> **[Software Process Assessment - Part 2: A reference model for processes and process capability, 7.5]**

The output from a process assessment is a set of process profiles; one profile for each instance of every process in the assessment scope. A process profile is a set of nine ratings, one for each process attribute. Assessment results from any compatible model must be able to be converted into this form, so that a common basis for comparison exists.

The mechanism for translation may be manual, or computer based. It may require the inclusion of additional information collected during the assessment, and may involve further judgment on the part of the assessor. The rules for translating the results however, should be clear and unambiguous, and are to be provided by the model developer.

If a model explicitly provides results in the format prescribed in this Technical Report, then there is no need for any translation mechanism.

5.2 Criteria for selecting a model

The model for an assessment may be selected by the assessor, or may be stipulated by the sponsor of the assessment (in which case, this should be documented as a constraint). In either case, there are criteria that will help ensure that the selection is appropriate for the use envisaged.

The major considerations in selecting a model, given that any model selected is compatible with the reference model, will be its suitability for the context of the assessment. The principal factors affecting the selection of a model will be:

- the planned scope of the assessment;
- the industry sector of the organization being assessed;
- the application domain of the software components that are the focus of the assessment; and
- specific requirements for strong comparability with other assessments or organizations.

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 these should be used if at all possible.

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 part 5 of this Technical Report is a generic model that should be applicable across all industry sectors and application domains.

5.3 Using a model in an assessment

A model provides the basic definitions of processes and process attributes that are the reference points against which judgments of process performance in the organization unit are made. As such, the use of a model throughout an assessment is essential.

It therefore follows that a qualified assessor should be highly knowledgeable about the specific model being used for the assessment - its structure, the basic elements of the model, and its relationship to the reference model.

Because the model also embeds a comprehensive set of indicators of process performance and capability, it is also an important reference point for the assessor in meeting the requirement to document the indicators referenced, and the justification for the ratings. In this role, the most common mode of access to the model will be as it is embedded in an appropriate assessment instrument. Clause 7 of this part of the Technical Report gives guidance on the selection and use of assessment instruments.

6. Selection and use of a method

This clause of this Technical Report provides guidance on the selection and use of a suitable method as the basis for performing a software process assessment. This guidance is intended for the use of assessors and sponsors of assessments. It is not directed specifically at the developers of assessment methods, though it may be of use to them.

In performing a process assessment, the method used must ensure that the requirements defined in part 3 are met. In order to achieve this, the method should contain descriptions of the activities to be performed, the responsibilities of key individuals and the documentary evidence that must be recorded. It may also define specific compatible models and tools that are required to be used with the method.

6.1 Compatibility with the requirements

In order to achieve 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, any method used should attempt to ensure that assessments performed are compliant with the requirements defined in part 3 of this Technical Report. The following clauses describe these requirements.

6.1.1 Defining the assessment input

> *The assessment input shall be defined prior to an assessment and approved by the sponsor of the assessment.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.2]**

The method should describe how all of the information required for the assessment input is collated, reviewed, approved and documented. It may be appropriate for the method to require tool support to collect and store this information. The assessment input, together with other information and analyses forms the assessment output. The method should provide support for recording or transferring the assessment input to a suitable form to become part of the assessment output.

The method should provide guidance on defining ownership and distribution of the assessment output.

The method should provide guidance on suitable confidentiality statements and how these are fulfilled.

The method should provide guidance on classifying the process context.

The method should define mechanisms to enable the assessment to be performed effectively within the constraints defined, or how the constraints and/or scope can be re-negotiated if this is not possible.

The method should provide mechanisms to support the collection of any other information defined by the assessment sponsor.

6.1.2 Responsibilities

> *The sponsor of the assessment shall verify, on the basis of documentary evidence, that the assessor who is to take responsibility for and oversee the assessment (the qualified assessor) has the necessary competence and skills. Guidance on assessor qualification is given in Part 6 of this Technical Report.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.3]**

The method should provide mechanisms to allow the sponsor to ensure that the nominated qualified assessor has the competencies to undertake the assessment and mechanisms to validate those competencies.

The method should define the other roles and responsibilities within the assessment and what competencies are required for each role.

> *The qualified assessor shall ensure that the assessment is conducted in accordance with the requirements in parts 2 and 3 of this Technical Report and takes account of relevant guidance in the other parts of this Technical Report. On completion of the assessment, the qualified assessor shall certify that the requirements have been met.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.3]**

The method should provide mechanisms to ensure that the assessment is conformant with the requirements set out in parts 2and 3. The method should define how this conformance is achieved and provide mechanisms to validate compliance with the method requirements, where this is the mechanism by which conformance is achieved. The method should identify the form of certification of compliance with the requirements.

6.1.3 Assessment process

> *The assessment shall be conducted according to a documented process that is capable of meeting the assessment purpose.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.4]**

The method should define a documented process for undertaking all of the activities required to perform the method. This should define the process for all required supporting activities, such as document control, quality assurance, project management, as well as for the key activities associated with the assessment process itself. This might be in the form of guidance material, procedures, standards etc.

The method should define how qualified assessors are to attain the required competencies to use the method correctly, for example training courses, experience levels.

> *Assessors participating in the assessment shall have access to appropriate guidance on how to conduct the assessment and the necessary competence to use any instruments or tools chosen to support the assessment.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.4]**

The method should provide all necessary guidance required, in addition to the process definition (see previous clause).

> *The model used within the assessment shall be a compatible model of good software engineering practice that meets the requirements defined in part 2 of this Technical Report. An exemplar model is included in part 5 of this Technical Report.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.4]**

The method should identify a compatible model or models for use with the method, or provide guidance on selection and use of an alternative compatible model.

> *Correspondence shall be established between the organizational unit's processes specified in the assessment scope through the compatible model used for assessment to the processes in part 2 of this Technical Report.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.4]**

The method should provide guidance on identifying how to map the organizational unit's processes to the processes defined within the compatible model used. This will normally also require guidance on translating the compatible model assessment profiles back to representations of the organizational unit's process capability.

> *Each process identified in the assessment scope shall be assessed by examining one or more instances of each process. The set of process instances selected for assessment shall be sufficient to meet the assessment purpose and scope. The rationale and justification for the selection of the instances assessed shall be recorded.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.4]**

The method should provide guidance on sampling to ensure that the set of process instances selected is appropriate to the assessment purpose.

The method should provide mechanisms to retain the sampling information and rationale.

> *A rating shall be assigned and validated for each process attribute, up to and including the highest capability level defined in the assessment scope, for each process instance assessed.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.4]**

The method should provide mechanisms to assign ratings to the defined rating components in the model selected to support the method. Where these rating components are different from the process attributes defined in part 2 of this Technical Report then the method should provide guidance on the use of the mechanisms defined in the compatible model to translate the method rating components to the process attribute ratings defined in part 2.

The method should define mechanisms to validate the ratings assigned for the processes assessed.

The method should define mechanisms to record the ratings for all the process instance assessed, ensuring that each rating record can be uniquely identified to the process instance to which it relates.

> *The set of process attributes ratings for each assessed process instance within the assessment scope shall be recorded as the process profile. The process profile may also include capability levels for each process instance and any aggregated ratings (see 5.6 and 5.7 of part 2 of this Technical Report).*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.4]**

The method should provide mechanisms to represent the process profiles in forms that allow straightforward interpretation of their meaning and value. This should support the representation of aggregated ratings.

In order to provide the basis for repeatability across assessments, the defined set of indicators in the compatible model shall be used during the assessment to support the assessors' judgement in rating process attributes. An example of a defined set of indicators covering the whole scope of the reference model is included within the exemplar model in part 5 of this Technical Report.

Objective evidence based on the indicators that support the assessors' judgement of process attribute ratings shall be recorded and maintained to provide the basis for verification of the ratings

[Software Process Assessment Part 3: Performing an assessment, 4.4]

The method should provide mechanisms to record information and/or ratings associated with the indicators defined in the compatible model selected.

The method should define how the records are to be retained. They may be paper-based or electronic depending upon the circumstances and tools used to support the assessment. The method should define whether the records are retained by the sponsor, the assessor, the assessed organization, or another person or body depending upon any confidentiality agreement or access restrictions identified in the assessment input.

6.1.4 Recording the Output

Information which is pertinent to the assessment and which may be helpful in understanding the output of the assessment shall be compiled and included in the assessment record for retention by the sponsor .

[Software Process Assessment Part 3: Performing an assessment, 4.5]

The method should provide mechanisms to record and retain the assessment output. These mechanisms should ensure that all confidentiality requirements defined can be complied with.

6.2 Selecting methods

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

The method should provide guidance and models that assist in estimating the resource requirements that will be needed to perform an assessment of the scope defined.

The method should provide support to ensure that each defined role can attain the required competencies, for example training and experience requirements.

The major considerations in selecting a method will be its suitability for the context and scope of the assessment. The principal factors affecting the selection of a method 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.

Where methods 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 methods that have the ability to cover the range of their business activities to ensure consistency of approach, reuse of competencies, etc.

6.3 Using methods

The method selected will significantly influence how the assessment is conducted and its usefulness to the organizational unit assessed. The qualified assessor plays a pivotal role in ensuring that the purpose of the assessment is achieved.

6.4 Role of the qualified assessor

The qualified assessor is responsible for ensuring that the assessment achieves its purpose and that it is conformant with the requirements of parts 2 and 3 of this Technical Report. It is therefore imperative that the qualified assessor selects an appropriate method. Where the method is selected by the assessment sponsor, then it is the responsibility of the qualified assessor to ensure that assessment team members or users of the method are competent in its use.

7. Selection and use of instruments and tools

7.1 The purpose of instruments and tools within an assessment

In any assessment, data will need to be collected, recorded, stored, collated, manipulated, analysed, retrieved and presented. In general, an assessment method will be supported by one or more instruments and tools for data gathering, manipulation and presentation. For a small assessment of limited scope, the support tools and instruments may be manual and paper-based (forms, questionnaires, checklists, etc.). In most cases, however, the volume and complexity of the assessment data is considerable resulting in the need for computer-based support tools based on technologies such as spreadsheets, databases, expert systems, or integrated CASE tools.

Apart from providing the support for recording the assessment input and the assessment output, the use of computer-based instruments and tools will be found to be particularly helpful in implementing several of the requirements in part 3 of this Technical Report.

7.2 Implementation of indicators

7.2.1 Incorporating indicators

> *In order to provide the basis for repeatability across assessments, the defined set of indicators in the compatible model shall be used during the assessment to support the assessors' judgement in rating process attributes. An example of a defined set of indicators covering the whole scope of the reference model is included within the exemplar model in part 5 of this Technical Report.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.4]**

In many cases, the defined set of indicators of the compatible model can most readily be made available to the assessors by incorporating them within an instrument or tool. In this way the indicators and, through them, the assessment model are accessible to the assessor during an assessment. The requirements for constructing a compatible model ensure that the indicators are traceable to the statements of process purpose or the process attributes in the reference model in part 2 of this Technical Report.

In its most basic form, an instrument containing the indicators may be a paper-based set of forms. For all but the smallest assessment, however, a computer-based tool may prove to be more usable. Regardless of the form of the supporting instruments and tools, the objective of their use should be to help an assessor perform an assessment in a consistent and reliable manner by reducing assessor subjectivity and helping to ensure the validity, useability and comparability of assessment results.

7.2.2 Tailoring indicators contained in an instrument

For enhanced useability within an assessment, computer-based instruments incorporating indicators could contain facilities for tailoring the indicators to suit particular circumstances. Examples include:

- the modification of indicator format to accommodate presentation style preferences (i.e., questions, sentences, tables, on-line input screens, etc.);
- the modification of indicator wording to accommodate synonyms or to account for cultural differences in meaning;
- the addition of characteristics to help select a relevant sub-set of indicators for use based on e.g. process area, user, job function, application domain, software product;
- the addition of new indicators to support new work products, new technology, or new or extended processes.

It is important, however, that any tailoring should not impair the availability of the set of indicators of the compatible model appropriate to the scope and context of the assessment.

7.3 Capturing and processing assessment data

> *A rating shall be assigned and validated for each process attribute, up to and including the highest capability level defined in the assessment scope, for each process instance assessed*
>
> *The set of process attributes ratings for each assessed process instance within the assessment scope shall be recorded as the process profile of that instance.*
>
> *Objective evidence based on the indicators that support the assessors' judgement of process attribute ratings shall be recorded and maintained to provide the basis for verification of the ratings. These records shall include*
>
> *a) practices and work products examined;*
>
> *b) the names of the individuals interviewed;*
>
> *c) justification for the ratings.*
>
> **[Software Process Assessment Part 3: Performing an assessment, 4.4]**

Instruments and tools are important as a means of collecting and storing information about the achievement of process purpose and capability associated with process attributes. Typically, this is achieved by recording evidence about the existence of indicators, and other types of information (organizational observations, notes about particular judgements, profiles, etc.). Data collection and retrieval mechanisms strongly affect the usability of instruments and tools.

Although information about the indicators does not form part of the process profile, it forms the essential evidence that supports an assessor's judgement of the ratings assigned. The characteristics defined by the indicator data provide a detailed record of what was found in the organizational unit. The data collected are, therefore, significant both for assessor's evaluation and for subsequent analysis and planning for process improvement.

Instruments and tools can provide valuable support in collating the evidence used by the assessor to assign ratings to the process attributes for each process instance assessed, and in recording the ratings as the set of process profiles.

Instruments and tools greatly aid in the presentation of the profiles in graphical form. Where more than one instance of a process is assessed, the process attribute ratings of the instances may be aggregated to show frequency distributions of each process attribute rating.

7.4 Selecting instruments and tools

In general, the method selected for the assessment (see clause 6) should describe the level of tool support needed. Particular tools may be specified as part of the method. Alternatively, the intending user of the method may need to select appropriate tools. The guidance presented here is intended to highlight some of the considerations in selecting instruments and tools for use throughout the assessment. It does not address issues related to general support tools such as word processors, although the ability of assessment instruments and tools to integrate together and to integrate with a word processing/presentation tools can prove of considerable assistance in preparing reports and presentations of the outputs of the assessment.

A comprehensive instrument or set of instruments and tools selected should

- be appropriate to the scope and purpose of assessment;
- provide assistance in collecting and storing information including assembling the assessment input and recording it in a suitable form for transfer to the assessment output;
- make available the compatible assessment model through the defined set of indicators, at least for the scope of the assessment;
- have the ability to capture the data required to be used in the production of ratings as defined in part 2 of this Technical Report;
- have the ability to capture and maintain supporting information as defined in the assessment input;
- support the rating process, according to the rating scheme defined part 2 of this Technical Report;
- support the representation of process profiles in forms that allow straightforward interpretation of their meaning and value, and the representation of aggregated ratings;
- have the ability to load, store and compare process profiles.
- provide appropriate segregation of different classes of information and data to enable the information and/or data to be used or distributed in different ways;
- provide the ability to store, retain and recall information and results for later use with appropriate levels of security.

The selection of the types of instruments and tools will be influenced by:

- the intended mode of use, method of assessment, and the compatible model chosen;
- the purpose of the assessment;
- facilities for customization and the impact on the tool's performance;
- the set of features or functions, and the quality characteristics, possessed by the instrument or tool;
- supplier identified limitations, or usage requirements;
- the availability of support for the instrument or tool (training, hot-line, documentation, etc.);

– the supplier's past history or other users' experiences in using the instrument or tool ;

the evaluation of the potential of the instrument or tool to aid meeting the requirements within this Technical Report.

Further guidance on types of tools and their characteristics is provided in annex A.

7.5 Using assessment instruments and tools

Assessors participating in the assessment shall have access to appropriate guidance on how to conduct the assessment and the necessary competence to use any instruments or tools chosen to support the assessment.

[Software Process Assessment Part 3: Performing an assessment, 4.4]

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

Assessors should gather data about applicable indicators within the defined scope, for example, by recording the existence, absence or non-applicability of each indicator.

Assessors should use all the data captured about indicators, the context of the assessment, and the organizational unit characteristics to support their judgements of the levels of achievement of the capabilities measured by each process attribute.

Annex A (informative) – Instruments and tools

A.1 Concepts

A.1.1 Indicators

A.1.1.1 Introduction

The reference model in part 2 of this Technical Report is defined in two dimensions: the process or functional dimension and the process capability dimension which are characterized respectively by the statements of process purpose and process attributes. The process purposes and process attributes are the criteria against which an assessment is performed.

The process purpose statements and attributes represent good practice, but in order to make them applicable to all software applications and domains, they are defined as abstract, high level concepts without constraining the ways in which they may be implemented. Consequently, these purpose statements and attributes could be subject to wide interpretation, which could have an adverse effect on the repeatability and reliability of assessment results.

In order to reduce the level of subjectivity and variation of interpretation, a compatible model for assessment (clause 7 of part 2 of this Technical Report) must be elaborated through a set of indicators of process performance related to the process purpose, and a set of indicators of process capability related to the process attributes. These assessment indicators describe a set of detailed tangible work products (inputs and outputs associated with the performance and management of processes), work product characteristics or characteristics of process capability. Indicators are used during an assessment to gather objective evidence about the satisfaction of a particular process purpose or process attribute. As implied by their name, indicators do not represent requirements on a process. They represent a common starting point for assessment, which increases the consistency of assessor judgement and enhances the repeatability of the results. Since organizations use different techniques to create software, the absence of some indicators in some situations may not be significant.

The output of the assessment, in the form of a set of process profiles, shows the ratings of each of the nine process attributes for each process instance assessed, but it does not show why a particular rating was assigned. Indicators help to identify what is present or missing from a process or work product and provide guidance to the assessor when assigning a rating to a process or attribute. The detailed information captured during the assessment about the presence or absence of specific indicators provides the valuable input into analysis and process improvement planning.

The indicators provide a framework for assessment that helps to ensure that:

- assessors have the ability to interpret the organization's instantiation of a process consistently against the reference model in part 2;
- the data are captured for subsequent analysis;

– the information needed for the organizational unit to plan and perform process improvement is captured;
– assessment results are representative, reliable and repeatable.

A.1.1.2 Indicators of process performance

Indicators of process performance provide guidance to the assessor on how to judge how well a process is meeting its purpose as defined in the reference model. These indicators can be tasks or practices that are performed within a specific process, as well as the work products and the characteristics of the work products produced by the tasks.

The performance of relevant tasks provides the first indication that an implemented process meets the purpose statement. The second indication is the existence of work-products from the performance of the tasks. The characteristics of the work products assist the assessor in understanding what elements to expect in a meaningful instantiation of a particular work products type.

The apparent execution of the task alone does not provide evidence of a sufficient implementation. The further evidence that the execution of the tasks is meeting the purpose of the process is gained from the existence of the appropriate work products and their content, or work-product characteristics. The indicators should help the assessor to recognize an appropriate work product. For example, in assessing the process Develop Software Design (ENG.3), an assessor may find four work products (Functional Framework, Signal Specification, Flow Diagram and Interface Specification) and from the indicators recognize that collectively these four products contain the characteristics expected of a high level software design.

A.1.1.3 Indicators of process capability

Indicators of process capability are associated with each process attribute in capability levels 2-5. Similar to indicators of process performance, they complement the assessor's ability to judge the attainment of the capability described by the process attributes. They help to identify the ability of the organization to manage a process effectively. Indicators of process capability provide a structured way of recording in the assessment record what was found in a particular implementation of a process attribute.

A.1.1.4 Relationship of indicators to ratings

Figure 1 shows how the indicators of process performance and process capability are brought together to support the rating of the nine process attributes within capability levels 1 to 5.

The indicators of process performance provide the evidence to support the rating of the single attribute *Process Performance* at capability level 1 which is concerned with how well the practices and work products of the process achieve the process purpose.

The indicators of process capability provide the evidence to support the ratings of the other eight process attributes of capability levels 2 to 5 which measure aspects of process management capability.

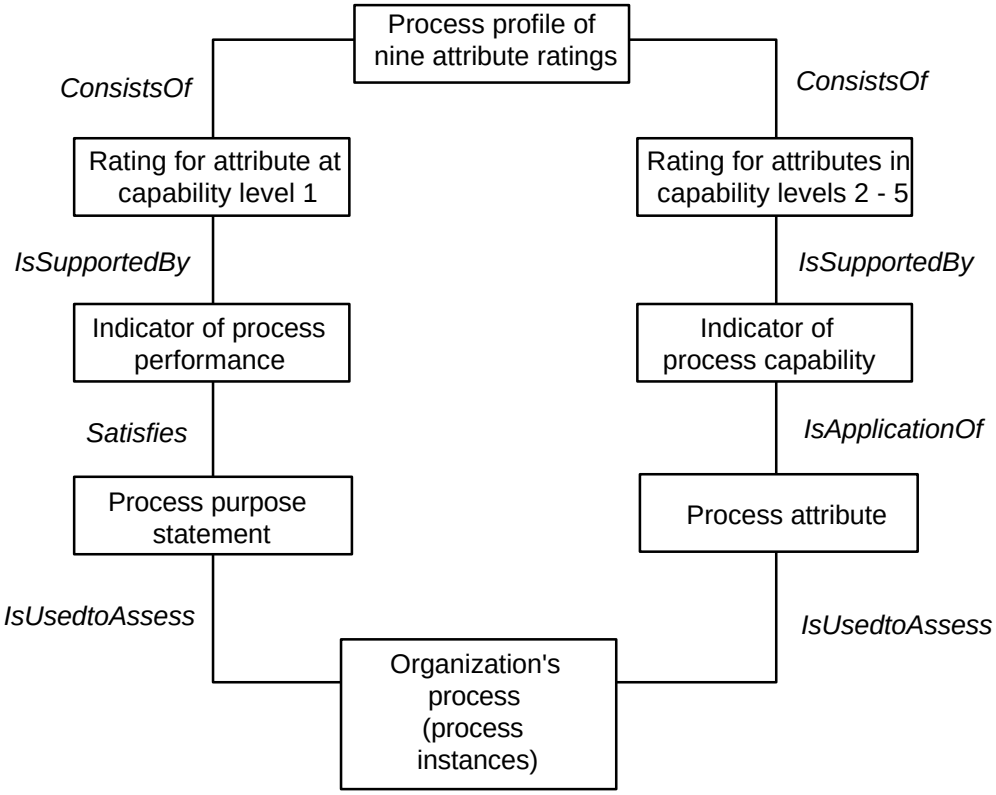

Figure 1 – Putting the elements together to determine ratings

A.1.2 Indicators and data gathering

There are many approaches that can be used to gather data. The method and approach will depend on many factors including:

- the size of the organization being assessed;
- the number of organizational units involved in the assessment;
- the level of organizational participation in performing the assessment (collecting the data, demonstrating conformance);
- the maturity of the supplier-sponsor relationship (the level of trust between the organization and sponsor);
- the needs of the sponsor;
- the expertise and ability of the assessor(s);
- the needs of the organization.

Whatever method is used, the defined set of indicators in the compatible model should form the basis for data gathering and must be used to support the assessors' judgement in rating process attributes. Unless the assessment is small and limited in scope, it will generally be found useful to incorporate the indicators within an instrument or tool. In this way, the compatible model and its indicators can be made accessible to assessors during the assessment. The instrument or tool can also provide support for recording and organizing the data and evidence collected.

A.1.3 Rating support and presentation of results

Assessment ratings are assigned for process attributes according to the requirements for rating in parts 2 and 3 of this Technical Report. The output is represented as a set of process profiles. For each process instance assessed, a rating is assigned for each process attribute up to and including the highest capability level defined in the assessment scope. Where more than one instance of a process is assessed, the process attribute ratings of the instances may be aggregated to show frequency distributions of each process attribute rating.

Instruments and tools may be useful in providing support for assigning ratings or for performing the translation from the data gathered against the compatible model to the form of ratings required by this standard.

In its basic form, a process profile is a vector of ratings. For presentation purposes, however, process profiles and aggregated ratings are typically presented graphically using tool support.

Guidance on the factors which affect the usability of various types of instruments and tools is given later in this annex.

A.2 Selection and use of instruments and tools

A.2.1 Introduction

This section gives guidance on the selection and use of instruments and tools to support the objectives specified in this Technical Report. It describes various types of instruments and tools and the impact of the associated features and functions on effectiveness and usability. This section

- describes the two basic types of instrument;
- sets out the modes of use and usability for both types;
- identifies some of the issues to consider in selecting instruments and tools to support an assessment.

The tables at the end of this annex summarize the quality characteristics and other desirable attributes and features of instruments and tools.

A.2.2 Types of instrument

There are two basic types of instrument, paper-based manual instruments and automated computer-based instruments, which have different characteristics. An understanding of the benefits and limitations of each type helps to ensure that a chosen instrument supports the assessment purpose and scope. The appropriateness of an instrument depends on the planned mode of use and assessment methodology. To ensure optimum performance (effectiveness and efficiency), instruments and tools should be selected or designed to match the assessment approach.

A.2.2.1 Paper-based

Using a paper-based instrument in an assessment demands careful foresight and planning. A paper-based tool may be adequate for an assessment of limited scope where only a few processes are to be assessed, but may become unwieldy for an assessment of broader scope. Using the indicators to assess the nine process attributes for each process, and generally for more than one instance of each process, generates a significant amount of data to record, track and manage.

There are a variety of formats for paper-based instruments which can be used effectively, depending on the approach, style of assessor or methodology. A paper-based instrument may be implemented, for example, as a questionnaire, a checklist, or an assessment recording form. The usability of a paper-based instrument has a strong relationship to its effectiveness in a particular assessment mode.

In an assessment, a paper-based instrument is most effectively used

- for collection of a limited amount of data in an assessment of a few processes;
- in a distributed approach using forms for self-assessment throughout an organization;
- when sampled work-products and process data are collected incrementally and reviewed prior to the commencement of on-site assessment activities, such as interviews;
- when sampling an organization to obtain a pre-assessment of the potential level of capability;

The benefits of using a paper-based instrument include low initial cost, portability and relative ease of construction.

The limitations associated with paper-based assessment instruments include

- the inability to support automated scoring and the aggregation of results across multiple instances;
- the inability to change content dynamically to suit the scope of the assessment or to tailor for organizational characteristics discovered during the assessment;
- the limited ability to select indicators dynamically to suit individual assessment interview needs;
- the limited ability to store and retrieve assessment results for subsequent use in process improvement or capability determination;
- the inability to generate result profiles or help in the performance of gap analysis;
- the volume of paper to be managed;
- the difficulty in providing adequate configuration control of the instrument and the results collected;
- the potential insecurity of the data collected.

A.2.2.2 Computer-based

A computer based instrument may be implemented using technologies and techniques such as spreadsheets, data base applications , expert systems, or integrated into a CASE tool application. A computer-based instrument has several advantages over a paper-based design, including

- the ability to handle large volumes of data;
- the ability to perform dynamic scoping and tailoring to support specific cultural, organizational, sponsor, or assessment team needs;

– the ability to assist the assessor with the processing of the assessment data collected;

– the ability to store and retrieve assessment results, making the results more usable for process improvement planning or capability determination analysis;

– the ability 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;

– the ability to aggregate and generate results in a variety of formats to suit individual sponsor needs. For example: reports, charts, profiles, lists of practice conformance attributes, etc.;

– the ability to keep the captured data secure to meet confidentiality constraints;

– the ability to build assessment expertise directly into the tool, allowing a less qualified assessor to perform the assessment;

– the ability to be implemented and used in a distributed manner, to collect data incrementally at set milestone check points in the performance of a process or when a number of organizational units are to be assessed incrementally;

The major limitations associated with an automated assessment tool involve its high initial cost and the cost of training in the use of the instrument.

A.2.3 Modes of use

Instruments may be used in a number of ways to support assessments. Examples of modes of use within an assessment include:

– by an assessor or assessment team capturing data by a paper-based instrument, or a lap-top computer;

– by process owners and/or organizational unit representatives during preparation for and prior to an assessment capturing data for subsequent processing, or for validation by an independent assessor, thereby reducing the time and cost associated with an assessment;

– by organizational unit representatives continuously throughout the software development life cycle, and at defined milestones to measure process adherence, process improvement progress or to gather data to facilitate a future assessment;

  NOTE 1 - This type of distributed approach is most effective when using automated tools integrated into the life cycle such as performance monitoring tools, project management tools or CASE tools.

– after the assessment to retrieve or organize the assessment data to facilitate process improvement planning or analysis for capability determination.

  NOTE 2- The detailed data captured during the assessment are valuable inputs to an organization and enhances the organization's understanding of the ratings of practices and process.

A.2.4 Quality and design attributes

The following tables summarize some of the criteria that should be considered in selecting instruments and tools to support an assessment.

Table 1 addresses quality characteristics as defined in ISO/IEC 9126:1991 (Functionality, Reliability, Usability, Efficiency, Maintainability and Portability) and some factors to be considered in relation to each.

Tables 2 to 4 lists design considerations, benefits and drawbacks of different types of instrument (manual, on-line and expert systems).

Tables 5 to 8 lists desirable instrument attributes associated with different assessment purposes, types, approaches and scopes.

Table 1 -Quality attributes of instruments

Quality attribute	Factors to consider
Functionality	Does the instrument or tool provide the requisite functionality as described in other parts of this document?
Security	Is there a need to protect the data gathered during an assessment and to meet obligations of confidentiality? Security capabilities may include, for example, preventing unauthorized access, providing audit trails, and placing security markings on documents.
Reliability	Is the instrument or tool reliable in terms of providing repeatable results during rating and aggregation and its ability to store data indefinitely without corruption or loss?
Usability	Consider issues such as:
• **Ease of use**	Is the instrument easy to use? Does it have an appropriate user interface? Does it provide natural ways of assembling, organizing, finding, collating, and viewing the data? Does the tool provide automatic prompts for missing data?
• **User documentation, instruction and help facilities**	Is the user documentation clear, concise and easy to understand? Does it provide information on the operation, use, features, and limitations of the instrument or tool? For a computer-based tool, does it provide on-line or context-sensitive help? Is the documentation and/or help correct and consistent with the operation of the instrument or tool?
• **Availability of training and support**	Is there an adequate provision or source of training and support? Training could include on-line tutorials, instructor lead courses, or self-study.
• **Flexibility**	Is the instrument or tool sufficiently flexible to allow tailoring to meet specific circumstances or use, or is it built for specific usage in specific assessment contexts?
Efficiency	Is the instrument or tool efficient in use (e.g. performance, speed of operation, resources required)? Does its use provide efficiency gains during the assessment (reduces time or effort, automates and speeds up clerical or repetitive tasks, etc.)? Does it support the intended assessment type and approach to data collection?
Maintainability	Is the instrument easy to modify and maintain? Does it allow easy tailoring for specific circumstances or to add new or extended processes? Can it be easily upgraded to keep pace with evolution in the standard (this Technical Report)
Portability	Is there a need for portability? Does the instrument or tool need to be transferred from one environment to another? Is there a need for distributed data collection and joint analysis? Is there a need to use the instrument or tool in a remote location?

Table 2 - Attributes of manual instruments (questionnaires, checklists)

Design considerations	– distributed input capabilities – ability to split by process, job function – ability to maintain records – how ratings will be aggregated together from different forms – how it will be used
Benefits	– low initial development cost – no training on operational attributes – portable – location independent
Drawbacks	– difficult to scope for organizational characteristics once created – pre-assessment preparation required – assessors may need more training on the concepts associated with the standard process and practices – more difficult to add, change or delete indicators once created – more difficult to analyze results of multiple organizational units – manual aggregation of results of multiple organizational units – little or no support for rating – difficult to store and use past results for follow-up – security of data – may result in a large amount of paper for large assessments.

Table 3 - Attributes of on line instruments (databases, CASE tools)

Design considerations	– ability to add extended processes as required – during assessment, ability to scope the assessment to the context information – ability to provide automated help with ratings – ability to automate the presentation of the results – assessment result storage and retrieval – distributed processing desirable – portability considerations (usability for team interviews, distributed inputs, simultaneous inputs) – ability to handle multiple assessors' inputs – ability to download large amounts of data – performance considerations (access speed, update speed) – usability for team interviews, self-assessment
Benefits	– medium development cost – easy assessment result storage and retrieval – ease of scoping during the assessment – ability to support rating – ability to generate results, reports, etc.
Drawbacks	– additional training required on how to use an instrument – assessor training or expertise needed – performance considerations (access speed, update speed) – cost of maintenance and improvement as standard evolves – portability is by design – distributed usage is by design

Table 4 – Attributes of expert system tools

Design considerations	– level of assessor expertise to build into the instrument – ability to add extended processes as required – ability to scope the assessment to the context information – portability (usability for team interviews, distributed inputs, simultaneous inputs) – ability to provide automated help with ratings – ability to automate the presentation of the results – storage and retrieval capabilities – ability to integrate with other tools (metrics, case, etc.)
Benefits	– less training required for the person performing the assessment – expertise of assessor is built into the instrument – ability to support rating – ability to automatically generate reports, profiles, presentation of results – storage and retrieval capabilities
Drawbacks	– higher development cost – additional training required on how to use instrument – portability is by design only – distributed usage is by design – performance considerations (access speed, update speed) – maintenance and improvement of tools as knowledge base grows

Table 5 – Attributes associated with assessment purpose

Assessment Purpose	**Desirable instrument attributes**
Process improvement	– capture whether practices are or are not implemented – determine how well the implemented process meets its purpose – capture process information about what needs to be improved – ability to capture information by organizational unit – record scope of the assessment as defined in the assessment input – capture history to demonstrate improvement
Capability determination	– capture whether practices are or are not implemented – determine how well the implemented process meets its purpose – aggregation of attribute ratings for multiple process instances – record scope of the assessment as defined in the assessment input

Table 6 – Attributes associated with assessment type

Assessment type	Desirable instrument attributes
Full assessment	– contains indicators for all processes and process attributes
Focused assessment	– contains indicators of process performance for processes within the scope of the assessment and indicators of process capability for all process attributes
Initial assessment	– ability to record / store assessment results – ability to record context information – ability to handle a full assessment of all process to baseline the organizational unit
Follow-up assessment	– ability to record assessment results, perhaps incrementally – ability to access historical information – ability to use stored historical data – ability to use past results – ability to perform sampling of processes – ability to display profile changes from previous to current assessment

Table 7 - Attributes associated with assessment approach

Assessment approach	Desirable instrument attributes:
Tool based	– ease of data entry and retrieval – expertise of assessor built into the tool: process model architectural concepts may be needed because the user may have less experience with assessment concepts – documentation on how to use tool, install the tool etc. – human factors: table of contents, help screens, tutorials – contains indicators for process being assessed – results may need to be stored for subsequent validation by third party or for process improvement planning – ability to be distributed throughout an organization – ability to input data from multiple sources simultaneously – ability to be distributed by job function of the organizational unit representative, or process owner – ability to maintain an audit trail of access to data input – security to restrict assess to organizational unit or process owner – output capability: results generation capabilities (profile generation) – output capability: report generation capabilities segregated by organizational unit/process owner – ability to scope the context by attributes (i.e., process area, job function, etc.)
Team based	– needs to contain indicators for processes being assessed – ability to scope to context attributes of the organization or interview (processes assessed, job function of the interviewee, etc.) – ability to be used in a distributed fashion by multiple team members – ability to assimilate results from multiple sources – portability of the tool to go to remote sites – real-time performance: speed of data input and retrieval – ability to call up practices required for specific interviews – ability to load data prior to the interview (documentation review information, organization model, types of interviews, etc.) – output capability: formal presentation of the results may be required – output capability: interim feedback to participants may be required – output capability: results generation capabilities (profile generation) – output capability: report generation – security considerations if used on-site – restrict access to the results to organizational unit and appropriate representatives

Table 8 – Attributes associated with assessment scope

Assessment scope	Desirable instrument attributes
Single organizational unit/single process instances	– usually one process profile per process – usually one process instance per process to assess – ability to store past scores – ability to record ratings from more than one person
Multiple organizational units or multiple process instances	– ability to aggregate ratings from various instances of the same process – ability to store past scores – ability to merge the results recorded by different tools for the same instance. – ability to record ratings from more than one person – ability to record ratings from more than one process instance – ability to record results more than once, multiple profiles may be required