Consolidated product

Software Process Assessment – Part 8 : Guide for use in determining supplier process capability

Version 0.03

(Formerly PCDG 1.00)

PREAMBLE

In January 1993 a program of work was approved by ISO/IEC JTC1 for the development of an international standard for software process assessment. In June 1993 the SPICE Project Organisation was established with a mandate from JTC1/SC7 to:

- assist the standardisation project in its preparatory stage by developing initial working drafts;
- undertake user trials in order to gain early experience data which will form the basis for revision of the Technical Report prior to publication as a full International Standard;
- create market awareness and take-up of the evolving standard.

The SPICE Project Organisation completed its task of producing the set of working drafts in June 1995. The SPICE user trials commenced in January 1995. The working drafts have now been handed over to JTC1/SC7 for the normal process of standards development, commencing in July 1995.

So far as can be determined, intellectual property rights for these documents reside with the individuals and organisations that contributed to their development. In agreeing to take part in the Project, participants agreed to abide by decisions of the Management Board in relation to the conduct of the Project. It is in accordance with this understanding that the Management Board has now agreed to release the baseline set of documents. This introductory statement sets out the terms and conditions under which this release is permitted.

The documents as released are available freely from the SPICE Project File Server, sisyphus.cit.gu.edu.au, by anonymous ftp, or from approved mirrors of the server. A hypertext version of the documents is also available on the World Wide Web at URL http://www-sqi.cit.gu.edu.au/spice/

TERMS AND CONDITIONS

These terms and conditions apply to the set of documents developed by the SPICE Project, and published within the Project as Version 1.0, with the following titles:

– Part 1 : *Concepts and introductory guide*
– Part 2 : *A model for process management*
– Part 3 : *Rating processes*
– Part 4 : *Guide to conducting assessment*
– Part 5 : *Construction, selection and use of assessment instruments and tools*
– Part 6 : *Qualification and training of assessors*
– Part 7 : *Guide for use in process improvement*
– Part 8 : *Guide for use in determining supplier process capability*
– Part 9 : *Vocabulary*

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Acknowledgment:

Acknowledgment is made to all contributors of the SPICE project without whom the project could not have been conceived and carried through successfully.

Note on document formatting

Use the following margins for equivalent printing on A4 or US letter paper (these are NOT the SPICE standards)

Paper size	**A4**	**US letter (imperial)**
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SOFTWARE PROCESS ASSESSMENT Part 8

Guide for use in determining supplier process capability

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, which are documented in a Study Report (JTC1/SC7 N944R, 11 June 1992), came to the following major conclusions:

- there is international consensus on the needs and requirements for a standard for process assessment;
- 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;
- there is international commitment to resource the project with an international project team staffed by full time resource, with development being co-ordinated through four technical development centres in Europe, N America (2) and Asia Pacific;
- the standard should initially be published as a Technical Report Type 2 to enable the developing standard to stabilise during the period of the user trials, prior to its issuing as a full International Standard.

The new work item was approved in January 1993 by JTC1. In June 1993 the SPICE Project Organisation was established with a mandate from JTC1/SC7 to:

- assist the standardisation project in its preparatory stage to develop initial working drafts;
- undertake user trials in order to gain early experience data which will form the basis for revision of the published Technical Report prior to review as a full International Standard;
- create market awareness and take-up of the evolving standard.

The SPICE Project Organisation completed its task of producing the set of working drafts in June 1995. These working drafts have formed the basis for this Technical Report Type 2. The period of SPICE user trials commenced in January 1995 and is synchronised in phases to allow feedback to the stages of the technical work.

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.

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

- Part 1 : *Concepts and introductory guide*
- Part 2 : *A model for process management*
- Part 3 : *Rating processes*
- Part 4 : *Guide to conducting assessment*
- Part 5 : *Construction, selection and use of assessment instruments and tools*
- Part 6 : *Qualification and training of assessors*
- Part 7 : *Guide for use in process improvement*
- Part 8 : *Guide for use in determining supplier process capability*
- Part 9 : *Vocabulary*

This part of the standard (Part 8) is for guidance only.

1. Scope

This part of the International Standard provides guidance on how to utilize process assessment for the purposes of process capability determination

A process capability determination (PCD) is a systematic assessment and analysis of selected software processes within an organization, carried out with the aim of identifying the strengths, weaknesses and risks associated with deploying the processes to meet a particular specified requirement.

Process capability determination is applicable in a variety of situations; the specified requirement may involve a new or an existing task, a contract or an internal undertaking, a product or a service, or any other requirement which is to be met by deploying an organization's software processes.

This guidance is intended to be applicable across all software application domains, over all software organizational structures, within any software customer-supplier relationship, and to any organization wishing to determine the process capability of its own software processes.

This guide is primarily aimed at:

- the sponsor who initiates the process capability determination;
- the organization whose process capability is to be determined;
- the assessment team;
- tool and method developers.

2. Normative references

There are no normative references in this part of the International Standard.

3. Definitions

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

4. Introduction to process capability determination

4.1. Overview

4.1.1. Purpose

A process capability determination is a systematic assessment and analysis of selected software processes within an organization, carried out with the aim of identifying the strengths, weaknesses and risks associated with deploying the processes to meet a particular specified requirement.

One of the main reasons for carrying out a process capability determination is to obtain information upon which to base a procurement-related decision. A procurer may initiate a process capability determination to assess the risk of entering into a contract with a particular supplier. The procurer may carry out process capability determinations on a number of competing suppliers as one element of a pre-contract selection activity. Conversely, suppliers may wish to carry out a process capability determination on their own processes before deciding whether to bid for a contract, as part of their own assessment of the business risks involved. A process capability determination may also be initiated for a number of other reasons; for example by a supplier during the course of a project to establish what the risks are to completing the work.

Process capability determination may be applied to a variety of situations: the specified requirement may involve a new or an existing task, a contract or an internal undertaking, a product or a service, or any other requirement which is to be met by deploying an organization's software processes.

4.1.2. Core and extended process capability determination

This guide presents two alternative approaches to process capability determination described below.

Core process capability determination is a minimum, streamlined set of activities applicable whenever a single organization proposes to meet a specified requirement by deploying its current process capability, without any partners or sub-contractors being involved.

Extended process capability determination is applicable when an enhanced capability is proposed, or when consortia or sub-contractors are involved.

In either case the conduct of process capability determination is described in three separate stages, as set out in clause 5 of this guide.

4.1.3. Basis of process capability determination

The output of a process assessment conducted according to the provisions of this International Standard is a process profile. This profile represents an organization's process capability in a particular assessment context and is reusable for both process capability determination and process improvement in that particular context or a similar context.

4.1.4. Assessment approaches

Part 4 of this International Standard describes two main approaches to process assessment: *self-assessment* and *independent assessment*. Either or both may be used during a process capability determination. In a two-party contractual situation, a procurer may wish to invite potential suppliers to provide a self-assessment profile when submitting a proposal for a contract. Such an approach offers the benefit of sharing both the cost and the benefit of the process assessment, since suppliers may also use the assessment results within their own process improvement programmes.

The procurer may choose to accept a self-assessment at face value, or alternately may reserve the right to initiate an independent assessment to verify that the self-assessment is a true representation of the supplier's process capability. Alternatively, the procurer may decide to rely entirely upon an independent assessment and make this a condition of contract award.

This International Standard thus offers the benefit of reducing disruption to suppliers' business activities caused by multiple process assessments, since the same assessment results may be offered to many procurers. It also provides procurers with a rigorous and defensible approach to supplier capability determination, and promises to reduce assessment costs through the reuse of results and the utilization of self-assessments.

4.1.5. Process-oriented risk

During a process capability determination, a selection of an organization's software processes are assessed, and the results analysed to identify strengths, weaknesses and risks. Process capability determination does not address all aspects of risk, which may include strategic, organizational, financial, personnel and many other factors. The output from a process capability determination feeds into this wider risk analysis, but confines itself to *process-oriented risk*.

The process architecture of this International Standard rests on a reference model contained within Part 2. This model sets out 35 processes defining the software engineering or management base practices of each, as well as a set of generic practices which apply to all processes. The generic practices are concerned with process management and are grouped into ordered capability levels, which progressively describe major enhancements to process capability. The single generic practice in the *Performed Informally* capability level summarizes the overall adequacy of the base practices of a process. Additional, user-defined processes can also be added if required.

During a process assessment, individual practices are rated by qualified and trained assessors against a four-point adequacy scale using an appropriate assessment instrument. Practices may be rated *fully, largely, partially* or *not* adequate with respect to the process purpose statement set out in the process model in part 2 of this International Standard. These ratings are then aggregated into a process capability profile that indicates, for each process assessed, and for each capability level for each process, how well the generic practices are achieving their intended purpose. Rating and the aggregation of ratings is described in parts 3 and 4 of this International Standard.

The key to process-oriented risk lies in the process model, the good process management practices it reflects through the generic practices, and the benefits that arise from deploying them. Process-oriented risk arises from inappropriate process management - i.e. not deploying appropriate generic practices, or from deploying them in a way which is assessed in the particular context as less adequate than required.

4.1.6. Target capability

Within this guide, the capability of a process is expressed in terms of the adequacy of its generic practices.

The process capability determination sponsor[1], who initiates the process capability determination, produces a target capability statement that defines which of the 35 processes in the process model are key to the specified requirement, which generic practices should be applied to each of the key processes, and what degrees of adequacy are required.

For example, the target capability statement could specify six or seven key processes, and indicate that all of the generic practices up to and including the *Well-Defined* capability level should be fully adequate for three of them. It could also indicate that for the remaining processes, all of the generic practices up to and including the *Planned And Tracked* level should be fully adequate.

The target capability is chosen to be that capability which the process capability determination sponsor judges will represent a minimal process risk to the successful implementation of the specified requirement.

4.1.7. Process-oriented risk analysis

Within this guide, process-oriented risk is assessed firstly from the *probability* of a particular problem occurring, and secondly from its potential *impact*, should it occur.

If the process capability determination sponsor's target capability statement indicates that a particular generic practice should be fully adequate for a particular process, while the assessed adequacy of the generic practice is less than fully adequate, then there is a gap between target and assessed capability which increases the probability that the process will not contribute satisfactorily towards meeting the specified requirement. For example, if the process capability determination sponsor believes that for a particular process, all of the generic practices up to and including the *Planned And Tracked* capability level should be fully adequate, and if the assessed process profile shows that capability level 1 is not fully adequate, then a major gap exists and there is a high probability of a problem occurring.

The potential impact of the problem depends upon the capability level within which it occurs. For example, if the base practices of a key process are assessed less than fully adequate, as reflected by the rating for the single generic practice in the *Performed Informally* capability level, then the process is incomplete and this may lead to missing work products, or unacceptable product quality, or both.

4.1.8. Output

The output of a process capability determination is the process capability report, which summarizes the strengths and weaknesses, expressed in terms of capability level gaps, and the risks associated with each key process included within the target capability statement.

[1]The process capability determination sponsor may be a procurer initiating a process capability determination to determine whether a potential supplier's processes are suitable for a particular requirement, or an organisation initiating a process capability determination to determine whether its own processes are suitable.

4.2. Target capability

Process capability determination sponsors may wish to develop or purchase an appropriate method or tool for defining target capability. A number of approaches are possible, but most will be based on the following principles.

The target capability is chosen to be that capability which the process capability determination sponsor judges will represent a minimal process risk to the successful implementation of the specified requirement.

Target capability is expressed within a target capability statement, which lists processes key to meeting the specified requirements and states, for each such key process, the required adequacy of each generic practice.

Only generic practice adequacy targets of *fully*, or *largely*, or *not required* should be set.

For each key process, process capability determination sponsors should identify which generic practices are required, and set the degree of adequacy for each. Generic practice adequacy may be set in several ways; for example the same degree of adequacy may be allocated to:

- all of the generic practices within a capability level;
- all of the generic practices within a common feature.

4.2.1. Setting target capability

A number of approaches to setting target capability are possible. One approach is to:

- identify an initial set of key processes;
- set default generic practice adequacy targets for the initial set of key processes;
- review and adjust the default generic practice adequacy targets;
- add further processes, and set adequacy targets for the further processes.

These steps are described in the following paragraphs.

4.2.2. Initial key processes

The processes in the process model which contribute most directly to the delivery of products and services are those within the *Customer-Supplier* and *Engineering* process categories. Processes from the *Project, Support* and *Organization* process categories provide a more indirect contribution.

Key processes are identified starting with the processes in the *Customer-Supplier* and *Engineering* process areas. Any processes in these categories which are not relevant to the specified requirement should be eliminated, and the remainder designated as the initial set of key processes.

4.2.3. Default generic practice adequacy targets

A good starting position is to state, for each key process, that all of the generic practices in the first three capability levels - *Performed Informally, Planned and Tracked,* and *Well Defined* - should be fully adequate; all of the other generic practices will not be required.

This approach ensures firstly that processes are complete with fully adequate base practices; secondly that generic practices are in place to eliminate unpredictability, missed deadlines, budget overspend and reduced output quality; and thirdly that processes are deployed following organization-wide standard process definitions, thus providing confidence that future performance will be consistent with past accomplishments.

4.2.4. Adjusting generic practice adequacy targets

Requiring that generic practices in the *Quantitatively Controlled* capability level should also be fully or largely adequate for a given process may reduce performance risks. For instance, a particular specified requirement may demand that some processes be controlled quantitatively. Generic practices within the *Continuously Improving* capability level may occasionally also be needed, but for many organizations, this degree of process management may not yet be practical. Alternatively, process capability determination sponsors may feel that for a particular key process, only generic practices within the first two capability levels are appropriate.

4.2.5. Adding further processes

Many generic practices are related to processes within the *Project, Support* and *Organization* process categories.

For example, if the generic practice *2.2.2 '...Do configuration management..'* has been included for a process within the *Engineering* process category, then the *Configuration Management* process within the *Support* process category may also be included as a key process.

The target capability for processes in the *Project, Support* and *Organization* process categories is determined by the extent to which they support generic practices applying to the initial set of key processes. Other processes from the *Project, Support* and *Organization* process categories may also be included in the target capability statement where they are relevant to the specified requirement.

Note that the specified requirement may be for an *organizational capability*, rather than a product or service. The specified requirement may be to establish a strong configuration management process as an end in itself. This class of specified requirement would arise from an organization's business goals and priorities.

4.3. Process-oriented risk analysis

Within this guide, process-oriented risk is inferred from the existence of gaps between target capability and assessed capability. Such gaps are identified at the practice level: if the target capability statement indicates that a particular generic practice should be fully adequate, while the assessed practice adequacy rating is less than fully adequate, then a gap is said to exist.

Process-oriented risk is assessed firstly from the probability of a particular problem occurring, and secondly from the nature of its impact. The probability is derived from the extent of any gaps between an assessed capability profile and a target capability statement. The nature of the impact depends upon the capability level within which the gap occurs.

4.3.1. Assessed capability profile

The assessed capability profile will be in the form of an output from a process assessment conducted according to the provisions of this International Standard. This will show, for each process assessed and for each capability level, the proportions of practices which have been assessed fully, largely, partially or not adequate. Figure 1 illustrates how an example assessed capability might be illustrated.

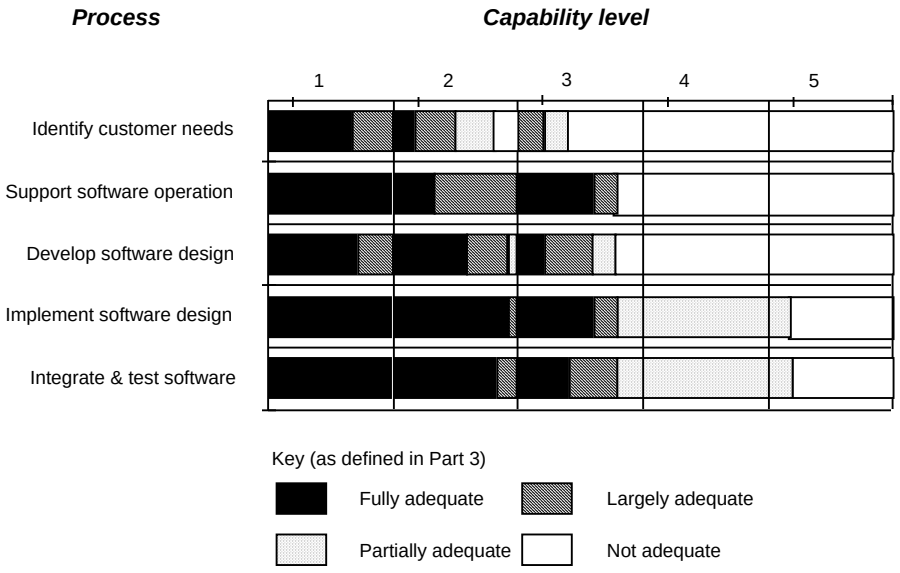

Figure 1 - Assessed capability profile

Generic practice adequacy is defined as a judgement, within the process context, of the extent to which the implemented generic practice satisfies its purpose.

Because practice adequacy is defined in this way, process assessment is highly context-sensitive. For example, an organization developing a large, complex and safety-critical software system would need to deploy a highly refined process in order to be assessed fully adequate at the *Performed Informally* level. In contrast an organization working on straightforward, non-critical applications would need far less sophistication to attain a similar assessment result. Therefore process capability ratings are meaningful only within their stated process context.

4.3.2. Target capability statement

Figure 2 shows one way that a target capability statement might be illustrated, along with the example assessed capability profile from figure 1.

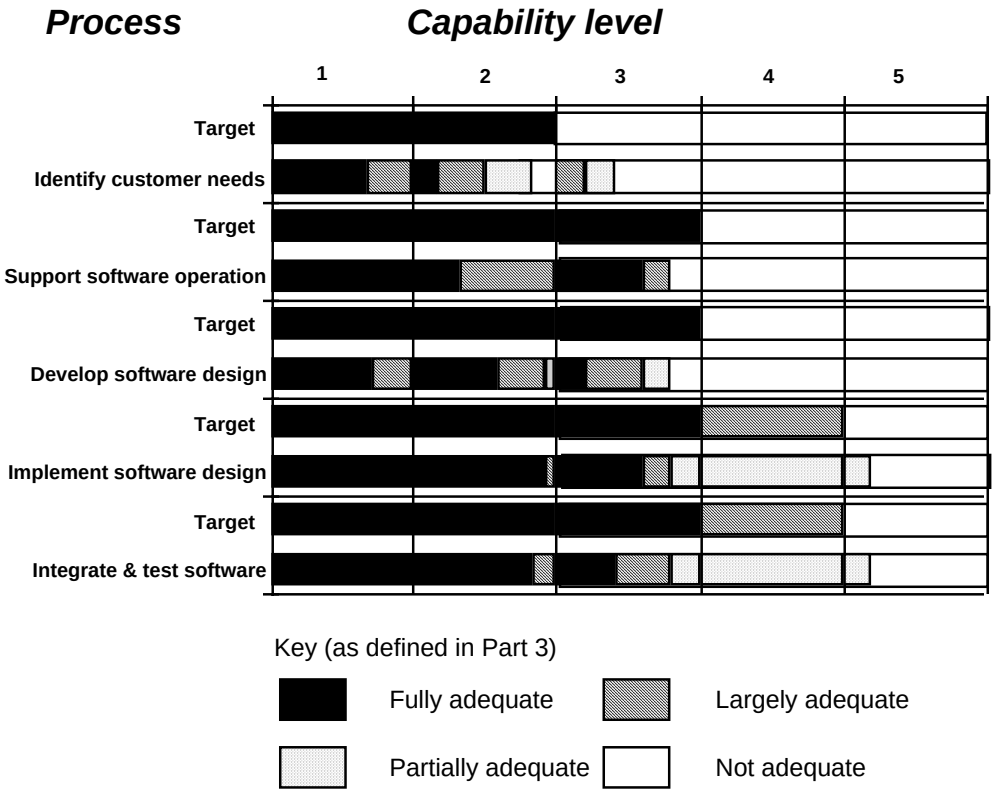

Figure 2 - Target capability with assessed capability

In this example the process capability determination sponsor has deemed that for the first process, *Identify Customer Needs,* all of the generic practices up to and including the *Planned and Tracked* level should be fully adequate. For the next two processes, all generic practices up to an including the *Well-Defined* level should be fully adequate. For the final two processes, not only should the generic practices up to and including the *Well-Defined* level be fully adequate, but in addition those of the *Qualitatively Controlled* level should also be largely adequate.

4.3.3. Probability

The probability of problems occurring is inferred from the extent of gaps between the target capability statement and the assessed capability profile.

For a particular process, individual gaps are identified by comparing individual assessed practice adequacy ratings to the corresponding adequacy targets specified in the target capability statement. Gaps are designated as shown in table 1.

Table 1 - Gaps associated with individual practices

Target	Assessed	Gap
Fully Adequate	Fully Adequate	None
	Largely Adequate	Minor
	Partially Adequate	Major
	Not Adequate	Major
Largely Adequate	Fully Adequate	None
	Largely Adequate	None
	Partially Adequate	Major
	Not Adequate	Major

Gaps within a capability level, and the corresponding probability of a problem occurring, are designated as shown in table 2.

Table 2 - Gaps associated with capability levels

Number of Individual Gaps within Capability Level	Capability Level Gap	Probability of problems occurring
No major or minor gaps	None	Very Low
Minor gaps only	Slight	Low
A single major gap concerning a generic practice	Significant	Medium
A single major gap concerning a base practice or more than one major gap concerning a generic practice	Substantial	High

Note that because of the way *largely* adequate is defined (see part 3), any number of *minor* gaps within a single capability level constitute only a *slight* gap at the capability level.

4.3.4. Impact

The previous section showed how the probability of problems occurring is inferred from the extent of the gap at a capability level.

The nature of the potential *impact* of a particular problem depends only upon the *capability level* within which it occurs, as shown in table 3.

Table 3 - Nature of potential impact of problems at each capability level

Capability Level where problem occurs	**Nature of Impact**				
	Missing work products, unacceptable product quality	Cost or time overruns	Reduced cost effectiveness, reduced spatial and temporal uniformity of performance	Inability to predict performance or timely detect problems	Reduced cost/time optimization-reduced ability to cope with changes in technology.
Continuously Improving	**No identifiable Impact**	**No identifiable Impact**	**Low Impact**	**Medium Impact**	**High Impact**
Quantitatively Controlled	**No identifiable Impact**	**Low Impact**	**Medium Impact**	**High Impact**	**High Impact**
Well-Defined	**Low Impact**	**Medium Impact**	**High Impact**	**High Impact**	**High Impact**
Planned and Tracked	**Medium Impact**	**High Impact**	**High Impact**	**High Impact**	**High Impact**
Performed Informally	**High Impact**	**High Impact**	**High Impact**	**High Impact**	**High Impact**

4.3.5. Overall risk

The overall process-oriented risk associated with a single process may be summarized as shown in table 4.

Table 4 - Overall process-oriented risk

	Extent of Capability Level Gap			
Capability Level	None	Slight	Significant	Substantial
Continuously Improving	**No Identifiable Risk**	**Low Risk**	**Low Risk**	**Low Risk**
Quantitatively Controlled	**No Identifiable Risk**	**Low Risk**	**Low Risk**	**Medium Risk**
Well-Defined	**No Identifiable Risk**	**Low risk**	**Medium risk**	**Medium Risk**
Planned and Tracked	**No Identifiable Risk**	**Medium Risk**	**Medium Risk**	**High Risk**
Performed Informally	**No Identifiable Risk**	**Medium Risk**	**High Risk**	**High Risk**

To use tables 1 to 4, consider each key process in turn, and then, for each process, consider each capability level in turn. Categorize individual gaps at the practice level using table 1, and then determine the capability level gap and probability of a problem occurring using table 2. The potential impact of the problem is then obtained from table 3. For example, a substantial gap within the *Planned and Tracked* level implies a high probability of problems occurring, which, should they occur, will have potentially high impact on product quality and a medium impact on budget and schedule. According to table 4, this then constitutes a *high risk.*

If gaps exist at more than one capability level, then the overall risk is determined from whichever row of table 4 which shows the greater risk.

It is emphasized that table 4 is merely a guide to overall risk; nominal risk levels should always be confirmed by a critical review against experience and reality.

It should be noted that a particular row from table 4 is relevant only if the generic practices of the particular capability level have been included in the target capability statement.

4.4. The process capability report

The process capability report is the final output of process capability determination. It consists of a summary and a detailed report. The summary consists of three parts:

(i) an introduction that describes the context of the process capability determination, who carried it out, and where, when and why it took place;

(ii) a statement of the process capability determination sponsor's confidence that the proposed capability is realistic and likely to be brought to bear in meeting the specified requirement. This confidence may be derived from the results of an independent process assessment, or from some other aspect of the process capability determination sponsor’s relationship with the organization;

(iii) a report, for each key process, of any gap between target capability and proposed capability, and of the process-oriented risk arising from this gap.

Figure 3 illustrates how a summary process capability report might be presented showing the assessed overall risk associated with each process.

The summary report should be supported by a detailed report showing, for each process within the target capability statement, the target and proposed adequacy of every generic practice, listing individual gaps (designated according to table 1) and summarizing capability level gaps (designated according to table 2).

PROCESS CAPABILITY SUMMARY REPORT

Confidence in Proposed Capability

Confidence that proposed capability is realistic	Largely confident

Process-Oriented Risk

Key Process	Strength/Weakness	Process-oriented risk
ENG.5	Process capability falls slightly short of target capability at the Well-Defined capability level.	Low risk
CUS.4	Process capability falls slightly short of target capability at the Performed Informally level, substantially short at the Planned and Tracked level, and substantially short at the Well-Defined level.	High risk
SUP.2	Process capability falls slightly short of target capability at the Planned and Tracked level, and significantly short of target capability at the Well-Defined level.	Medium risk
ENG.4	Process capability meets or exceeds target capability in all respects.	No identifiable risk

Figure 3 - Illustration of process capability summary report

5. Conducting a process capability determination

Process capability determination sponsors may wish to develop or purchase an appropriate method or tool to support the conduct of a process capability determination. A number of approaches are possible, but most will be based on either core or extended process capability determination as explained in the following sections.

5.1. Core process capability determination

Core process capability determination is a minimum, streamlined set of activities applicable whenever a single organization proposes to meet a specified requirement by deploying its current process capability, without any partners or sub-contractors being involved.

Core process capability determination comprises three stages as illustrated in figure 4. The ovals in figure 4 represent activities, the arrows represent information being passed between activities, and the clouds represent comment.

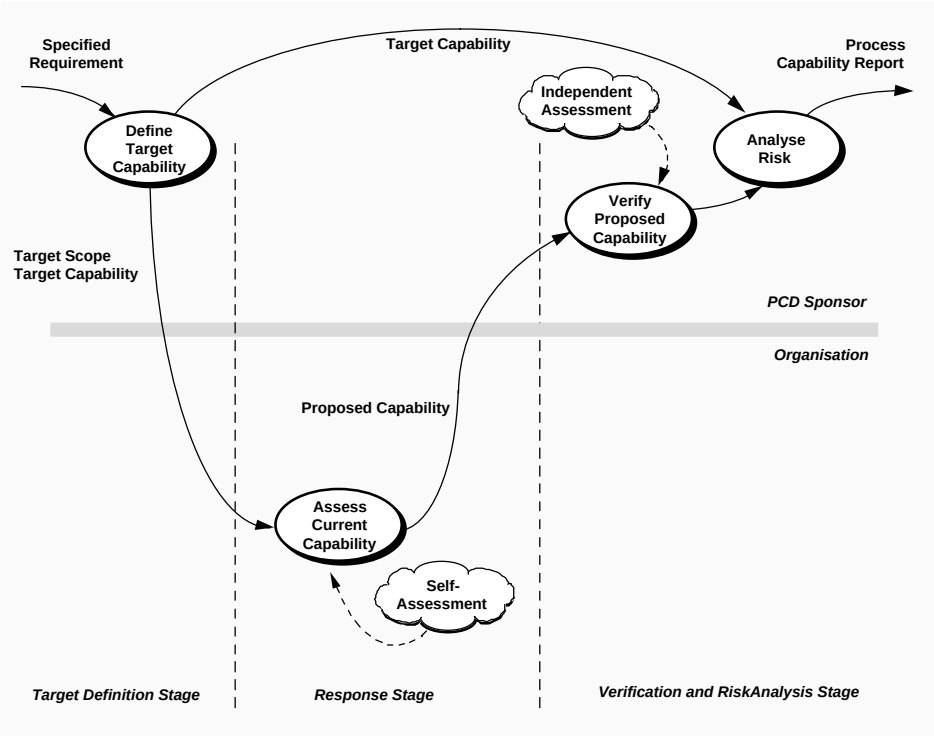

Figure 4 - Core process capability determination

Throughout clause 4 of this guide the term *assessed capability* was used to refer to the output of a process assessment. This clause introduces the term *proposed capability* to represent that process capability which the organization proposes to bring to bear in meeting the specified requirement. For core process capability determination, the proposed capability is the organization's current assessed capability, represented as the output of a recent, relevant process assessment conducted according to the provisions of this International Standard.

5.1.1. The target definition stage

The process capability determination sponsor is responsible for the target definition stage. The process capability determination is carried out with respect to a specified requirement, which may be expressed in a high-level or detailed form, and may involve a new or existing task, a contract or class of contracts, an internal undertaking, a product or a service, or any other requirement which is to be met by the organization's proposed processes.

During the target definition stage, the process capability determination sponsor:

- plans and initiates the process capability determination;
- develops the target capability statement;
- defines the target scope – i.e. the process assessment context implied by the specified requirement. This may include the minimum number of separate process instances which should be included to represent overall organizational capability. It may also include any extended processes, as described in part 2 of this International Standard, which the process capability determination sponsor wishes to include;
- passes the target scope and, optionally, the target capability statement to potential suppliers.

When initiating the process capability determination, sponsors may wish to request supporting details of current similar projects undertaken by the organization.

Process capability determination sponsors may choose to disclose the target capability statement to potential suppliers, or not as they see fit.

5.1.2. The response stage

During the response stage, the organization assesses its current capability with respect to the target scope. The proposed capability profile is aggregated from assessments of a number of current or recent projects, as described in parts 3 and 4 of this International Standard. This capability profile:

- should be based on a number of process assessments, conducted according to the provisions of this International Standard;
- should correspond to the target scope;
- should be a true representation of the organization's current process capability;
- should be owned by the organization;
- will most likely have been the product of self-assessment, but could also have been produced by a previous independent assessment.

A key feature of this International Standard is that process assessment results are re-usable. Many organizations will have a repository of process assessment outputs generated as part of a process improvement programme. If a number of suitable process assessments are available, then the organization may use the outputs as the basis of the proposed capability. If not, then the organization carries out a self-assessment in accordance with parts 3 and 4 of this International Standard.

5.1.3. The verification and risk analysis stage

5.1.3.1. Verification

The process capability determination sponsor reviews the proposed capability to establish how much credibility it merits, and decides what further action is needed to establish confidence in it. This will typically involve:

- checking that the assessed capability is the result of an assessment conducted according to the provisions of this International Standard;
- checking that the context of the proposed capability matches the target scope;
- carrying out an independent assessment of one or more processes.

A process capability determination sponsor may accept the proposed capability or may wish to initiate an appropriate degree of independent assessment, bearing in mind the nature, cost and importance of the specified requirement. This independent assessment may involve, for example, a sample of key processes, or a comprehensive independent assessment of all key processes specified in the target capability statement. Having carried out the independent assessment, the process capability determination sponsor will be able to compare this independent output with the organization's proposed capability and record the level of confidence in the organization's proposed capability in the terms shown in table 5.

Table 5 - Terminology for expressing confidence in proposed capability

Correspondence of independent assessment to proposed capability	Degree of confidence
The process capability determination sponsor has no reason to doubt the proposed capability, or the results of an independent assessment correspond to the proposed capability.	Fully confident
The results of an independent assessment have fallen slightly short of the organization's proposed capability	Largely confident
The results of an independent assessment have fallen significantly short of the organization's proposed capability	Partially confident
The results of an independent assessment have fallen substantially short of the organization's proposed capability	Not confident

The terms *slightly, significantly* and *substantially* are used here as defined in table 2.

If a process capability determination sponsor is carrying out process capability determinations on a number of competing suppliers, then to ensure consistency, the same independent assessment team should be used to verify each supplier's proposed capability.

Following appropriate verification, the proposed capability becomes an input to risk analysis.

5.1.3.2. Risk analysis

Risk analysis is carried out by the process capability determination sponsor as described in clause 4 of this guide:

For each key process within the target capability statement, the following steps are followed:

- examine the practice adequacy rating for each generic practice within the target capability statement, and designate any individual gaps according to table 1.
- consider each capability level in turn and designate any capability level gaps according to table 2.
- identify the risk corresponding to each capability level gap by referring to table 4.
- record this risk in the process capability report.

5.2. Extended process capability determination

This section provides outline guidance on the additional activities covered within extended process capability determination.

Extended process capability determination is applicable whenever:

- the proposed capability is greater than currently assessed capability; or
- the proposed capability involves a constructed capability (as explained below) with partners or sub-contractors.

Extended process capability determination comprises three stages as illustrated in figure 6. The target definition stage is the same for both core and extended process capability determination. Hence, the following descriptions relate to the *Response* stage and the *Verification And Risk Analysis* stage only.

5.2.1. The response stage

5.2.1.1. Proposing an enhanced capability

The organization's assessed capability may meet or exceed the target capability, but if not, the organization may wish to develop a proposed capability which lies somewhere between the assessed capability and the target capability as illustrated in figure 5.

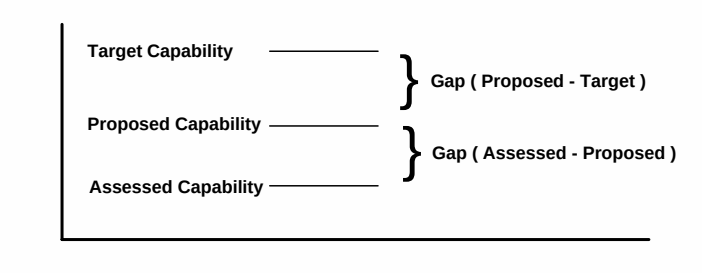

Figure 5 - Target, proposed and assessed capability

Since the specified requirement relates to work to be undertaken in the future, the organization may wish to propose an enhanced capability, justified by a currently assessed capability and a process improvement plan. The process improvement plan may in turn be supported by a process improvement track record if the organization already has a process improvement programme in place.

If the organization's proposed capability falls short of the target capability the organization may wish to submit a shortfall plan, addressing each area where process capability falls short of the target capability, setting out the organization's assessment of the shortfall, and proposing measures to mitigate it.

The proposed capability may be derived by examining the gap between the current and target capabilities and interacting with a process improvement process. The process improvement process will balance previously planned improvements with those necessary to close the gap between the current and target capabilities, but may be constrained by available resources.

The process improvement process may return a process improvement plan, setting out details of what has to be done and what resources are required (see part 7 of this International Standard). If they exist, any process improvement records which add credibility to the plan may also be included, showing what has been achieved in the past.

The organization may therefore wish to pass to the process capability determination sponsor a proposed capability, justified by:

- an assessed capability;
- a process improvement plan;
- a process improvement track record;
- a capability shortfall plan.

This additional information is illustrated in figure 6.

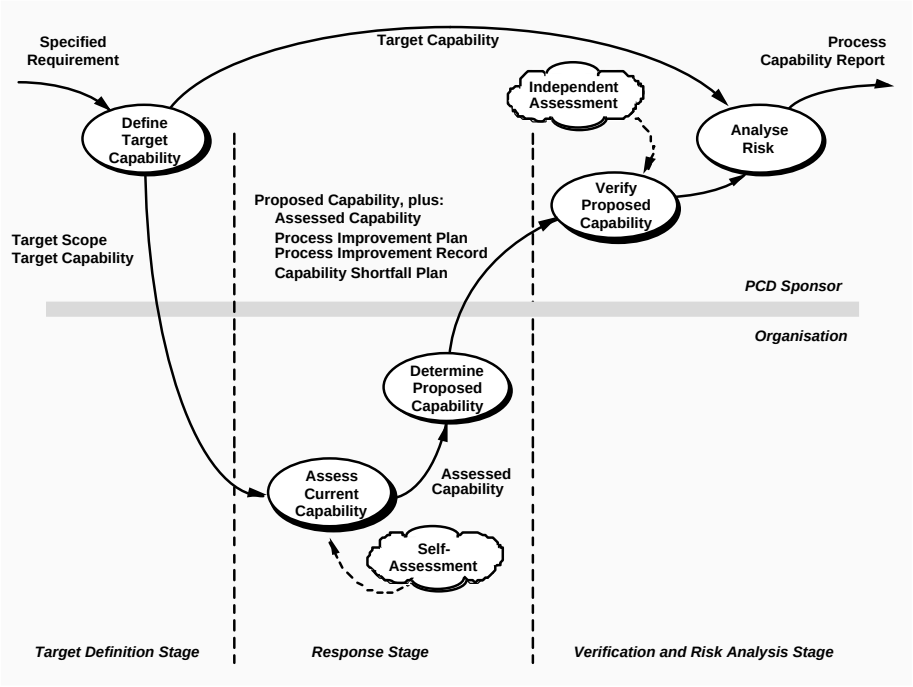

Figure 6 - Extended process capability determination

5.2.1.2. Proposing a constructed capability

The process capability determination will be carried out with respect to a specified requirement which will be worked on in the future. Although the process capability determination will be firmly based on one or more current or recent process assessments, the organization may wish to - or have to - propose a capability which has not yet been constructed. The organization which will undertake the work may not yet exist, and may have to be constructed from existing organizational elements plus sub-contractors, consultants, partners etc. A typical example is illustrated in figure 7.

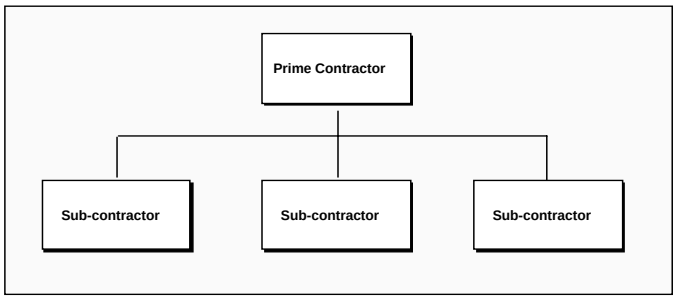

Figure 7 - Constructed capability

There are two different modes that need to be considered when generating a constructed capability from a number of sources.

- **Disjoint mode.** Each key process is deployed uniquely by an individual organization and the constructed capability simply consists of a set of processes that are selected from two or more organizations.
- **Conjoint mode.** A number of organizations deploy the same process or processes in parallel e.g. several organizations developing different sub-systems of an overall requirement.

It is also possible in large or complex contracts to have a mixture of both modes at the same time.

Disjoint mode is used to construct a capability by mixing and matching two or more key processes (processes from the CUS and ENG process categories) to meet (or come as close as is possible/deemed appropriate) to a target capability. Each process is performed uniquely by one organization, and the supporting processes that support it are also provided by that organization.

Under these circumstances, each key process is operating in its own environment, and although for instance, project planning might be performed differently in each organization, it should not affect the ability of each key process to continue to perform to its assessed capability.

It is not possible to construct a capability, however, for the supporting processes. One organization could not provide the 'Plan the Project' process for a number of key processes from different organizations, unless the process was identical in its implementation (not just identical in capability) across those different organizations, which is improbable.

Conjoint mode covers the more complex situation where two or more organizations are deploying the same key process(es) in parallel. It is not valid to average the practice ratings across different organizations. Hence either the worst capability, representing the weakest link in the chain, may be proposed, or, if this is deemed to be inappropriate, then alternatives such as providing all of the ratings or a representation of minimum, maximum and median may be used to provide a more informative representation of capability.

Once again, the inclusion of processes from the Project, Support and Organization process categories, other than those needed to support generic practices applying to individual key processes, is likely to be confusing unless each is clearly identified as to which instance of a key process each is intended to relate to.

Although the constructed capability generated should be representative of the capability of each process in isolation, because two or more organizations are involved, this may lead to unexpected interface issues. Both the organization proposing a constructed capability and the process capability determination sponsor should ensure that suitable mechanisms have been identified to ensure that these issues can be addressed. The more complex the constructed capability and the more disparate the implementation of the processes within the organizations, the more probable that interfacing problems will occur.

5.2.2. The verification and risk analysis stage

Verification within the core process capability determination model is concerned merely with checking that the assessed capability is a true representation of the organization's processes. Within the extended process capability determination model, extended verification also involves checking:

– the credibility of the process improvement plans upon which the proposed capability is based;

– the integrity of the constructed capability.