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Information technology — Process assessment —

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

Technologies de l'information — Procédés d'évaluation —

Partie 4: Conseils sur l'utilisation pour l'amélioration de processus et la détermination de capacité de processus

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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

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

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

ISO/IEC 15504-4 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and system engineering*.

This first edition cancels and replaces ISO/IEC TR 15504-7:1998 and ISO/IEC TR 15504-8:1998, which have been technically revised.

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

— *Part 1: Concepts and vocabulary*

— *Part 2: Performing an assessment*

— *Part 3: Guidance on performing an assessment*

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

The following part is in preparation:

— *Part 5: An exemplar Process Assessment Model*

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

Introduction

ISO/IEC 15504 provides a framework for process assessment and sets out the minimum requirements for performing an assessment in order to ensure consistency and repeatability of assessment ratings. Process assessment is applicable in the following circumstances:

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

— by or on behalf of an organization with the objective of determining the capability of another organization's processes for a particular contract or class of contracts, or to determine the capability of its own processes for a particular requirement or class of requirements.

This informative part of ISO/IEC 15504 provides guidance on how to utilize a conformant process assessment within a process improvement programme or within either type of process capability determination.

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

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

ISO/IEC 15504-3 provides guidance for interpreting the requirements for performing an assessment.

ISO/IEC 15504-5 contains an exemplar Process Assessment Model that is mapped to ISO/IEC 12207:1995/Amd.1:2002 as a Process Reference Model.

Information technology — Process assessment —

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

1 Scope

This part of ISO/IEC 15504 provides guidance on how to utilize a conformant process assessment within a process improvement programme or a process capability determination. This part of ISO/IEC 15504 is for information only.

The guidance provided does not presume specific organizational structures, management philosophies, life cycle models or development methods, although some of the examples and tables within the text are based upon processes from ISO/IEC 12207.

In the case of process improvement, the concepts and principles are appropriate for the full range of different business goals, application domains and sizes of organization, so that all types of organizations may use them. In the case of process capability determination, this guidance is applicable within any customer–supplier relationship, and to any organization wishing to determine the process capability of its own processes.

2 Normative references

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

ISO/IEC 12207, *Information technology — Software life cycle processes*

ISO/IEC 15504-1, *Information technology — Process assessment — Part 1: Concepts and vocabulary*[1)]

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 15504-1 apply.

4 Introduction

4.1 Process improvement and process capability determination

Within ISO/IEC 15504, process assessment can be utilized:

— by or on behalf of an organization with the objective of understanding its own processes for *process improvement*;

1) To be published.

— by or on behalf of an organization with the objective of *determining the capability* of another organization's processes for a particular contract or class of contracts, or determining the capability of its own processes for a particular requirement or class of requirements.

Within a process improvement (PI) context, process assessment provides a means of characterizing an organizational unit in terms of the capability of selected processes. Analysis of the output of a conformant process assessment against an organizational unit's business goals identifies strengths, weaknesses and risks related to the processes. This, in turn, can help determine whether the processes are effective in achieving business goals, and provide the drivers for making improvements.

Process capability determination (PCD) is concerned with analysing the output of one or more conformant process assessments to identify the strengths, weaknesses and risks involved in undertaking a specific project using the selected processes within a given organizational unit. A process capability determination can provide a fundamental input to supplier selection, in which case it is often termed a 'supplier capability determination'.

4.2 PI and PCD sponsors and teams

Process improvement programmes and process capability determinations will usually be required and resourced by a *sponsor* – as described in ISO/IEC 15504-1. The sponsor has the authority to ensure that the programme is carried out effectively, and takes ownership of the results. The sponsor may have one or more staff working within a team – a PI Team or PCD Team – whose task is to plan and implement the actions required to achieve the objectives identified by the sponsor.

Sponsorship may be implemented in a variety of ways, according to the culture of the organization. In non-hierarchical or higher maturity organizations for example, both sponsorship and project management of process improvement activities may be delegated to working level, although authorities, roles and responsibilities should always be clearly defined.

4.3 Process, guidance and method

In order to achieve improvements to selected processes, PI Sponsors should deploy a PI *process* as outlined in 4.4. In order to determine the capability of selected processes, PCD Teams should deploy a PCD process, as outlined in 4.5. This part of ISO/IEC 15504 provides *guidance* on how to deploy such processes. In either case, organizations should deploy a suitably capable process, and either acquire or develop a suitable *method* — setting out appropriate roles, techniques and specific activities — with which to implement the process. Such a method should:

— take account of the guidance contained within this part of ISO/IEC 15504;

— include or reference an assessment process which satisfies the requirements set out within ISO/IEC 15504-2 and accords with the guidance set out in ISO/IEC 15504-3.

4.4 Process improvement – purpose and outcomes

The purpose of process improvement is to continually improve the organization's effectiveness and efficiency through the processes used and maintained aligned with the business need.

As a result of successful implementation of process improvement:

— commitment is established to provide resources to sustain improvement actions;

— issues arising from the organization's internal/external environment are identified as improvement opportunities and justified as reasons for change;

— analysis of the current status of the existing process is performed, focusing on those processes from which improvement stimuli arise;

— improvement goals are identified and prioritized, and consequent changes to the process are defined and implemented;

— the effects of process implementation are monitored and confirmed against the defined improvement goals;

— knowledge gained from the improvements is communicated within the organization; and

— the improvements made are evaluated and consideration given for using solutions elsewhere within the organization.

[ISO/IEC 12207:1995/Amd.2[2)], F.3.3.3]

NOTE 1 Information sources providing input for change may include: process assessment results, audits, customer's satisfaction reports, organizational effectiveness / efficiency, cost of quality.

NOTE 2 The current status of processes may be determined by process assessment.

4.5 Process capability determination — purpose and outcomes

The purpose of *process capability determination* is to identify the strengths, weaknesses and process-related risks associated with selected processes with respect to a particular specified requirement.

As a result of successful implementation of *process capability determination:*

— a target capability appropriate to the particular specified requirement is identified;

— reviews of the organization's processes are carried out to determine their suitability for the particular specified requirement in the light of process assessment results;

— strengths and weaknesses within the assessed processes are identified;

— any gaps between target and assessed capabilities are analysed;

— overall process-related risk is determined.

NOTE 1 The *selected processes* are chosen by the PCD Team as described in 7.2.2.

NOTE 2 The *specified requirement* may involve deploying an organization's processes for a new or an existing task, a contract or an internal undertaking, a product or a service, or any other business requirement.

NOTE 3 Reviews of the *organization's standard processes* are generally carried out following a process assessment of the organization's implemented processes, as described in ISO/IEC 15504-3.

NOTE 4 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 an organization's risk management process, but only with respect to *process-related risk* – as outlined in 5.5.

4.6 Process assessment output

The output of a conformant process assessment includes a set of process profiles, which express the process attribute ratings assigned for each process selected from the specified Process Reference Model(s) – as described in ISO/IEC 15504-2.

An example set of process profiles, with ISO/IEC 12207 as the Process Reference Model, might be presented as illustrated in Figure 1. The processes (F.1.3.1, etc.) are from ISO/IEC 12207, while the process attributes (PA 1.1, etc.) and ratings (Fully achieved, etc.) are defined in ISO/IEC 15504-2.

2) To be published.

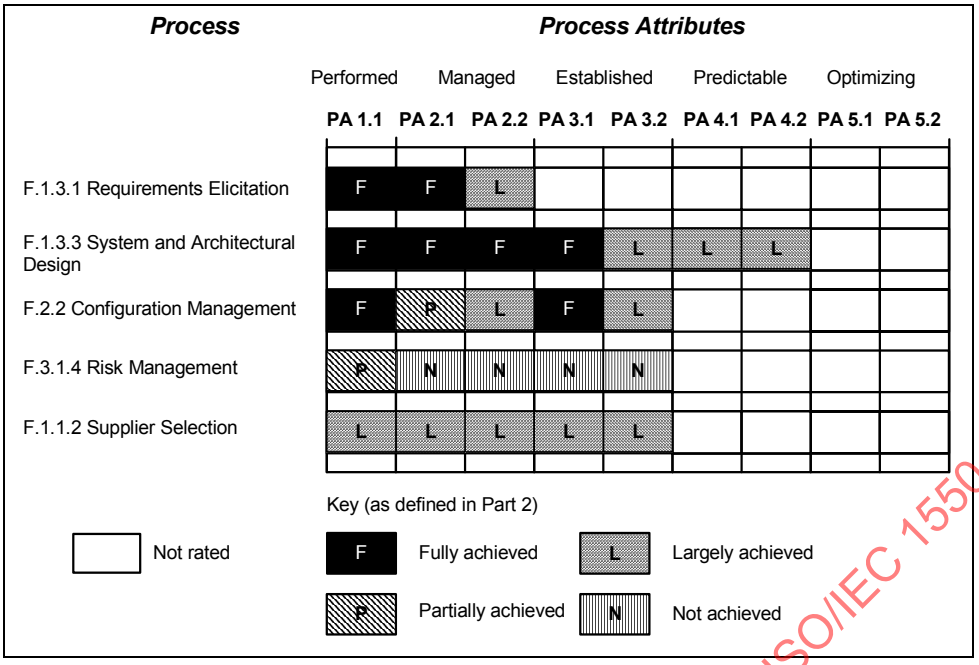

Figure 1 — Example assessment output set of process profiles

The guidance contained in this part of ISO/IEC 15504 is intended to apply to the output from a conformant process assessment.

5 Utilizing process assessment

5.1 General

This clause provides guidance upon issues common to both process improvement and process capability determination.

5.2 Selecting Process Reference Model(s)

Both process improvement and process capability determination require that the sponsor select a suitable Process Reference Model or Models.

A Process Reference Model describes a set of processes in terms of purpose and outcomes as defined in ISO/IEC 15504-2. A Process Reference Model is generally a recognized domain standard. ISO/IEC 12207, Annex F, and ISO/IEC 15288:2002 are Process Reference Models within the domains of software engineering and systems engineering, respectively.

The sponsor should determine which Process Reference Model(s) will best suit the specified requirement (for PCD) or business goals (for PI), following the guidance in ISO/IEC 15504-3 on the selection of suitable Process Reference Models.

Where improvements are planned for processes that do not align with any recognized domain standard, appropriate process models can still be defined and used, but this could not then be considered to be based upon a conformant process assessment.

5.3 Setting target capability

The sponsor should determine which processes from the chosen Process Reference Model(s) are most important to meeting the specified requirement (for PCD) or business goals (for PI).

The sponsor should then specify, for each selected process, a target process profile showing which process attributes are required, and – for each process attribute – what rating is judged necessary. Only process

attribute ratings of Fully achieved or Largely achieved should be set; Not required should be noted for any process attributes deemed not necessary. Partially achieved should not be set since this would indicate that some aspects of achievement would be unpredictable – as defined in ISO/IEC 15504-2.

The set of target process profiles expresses the *target capability* which the sponsor judges to be adequate, subject to an acceptable process risk, for meeting the specified requirement (for PCD) or business goals (for PI).

Table 1 — Example target capability

Selected process from Process Reference Model	Process attributes	Required process attribute rating
F.1.3.1 Requirements elicitation	PA 1.1 PA 2.1, PA 2.2	Fully achieved Largely achieved
F.1.3.3 System and Architectural Design	PA 1.1, PA 2.1, PA 2.2, PA 3.1, PA 3.2 PA 4.1, PA 4.2	Fully achieved Largely achieved
F.2.2 Configuration management	PA 1.1, PA 2.1, PA 2.2 PA 3.1, PA 3.2	Fully achieved Largely achieved
F.3.1.4 Risk Management	PA 1.1, PA 2.1, PA 2.2, PA 3.1, PA 3.2	Fully achieved
F.1.1.2 Supplier Selection	PA 1.1, PA 2.1 PA 2.2 PA 3.1, PA 3.2	Fully achieved Not required Largely achieved

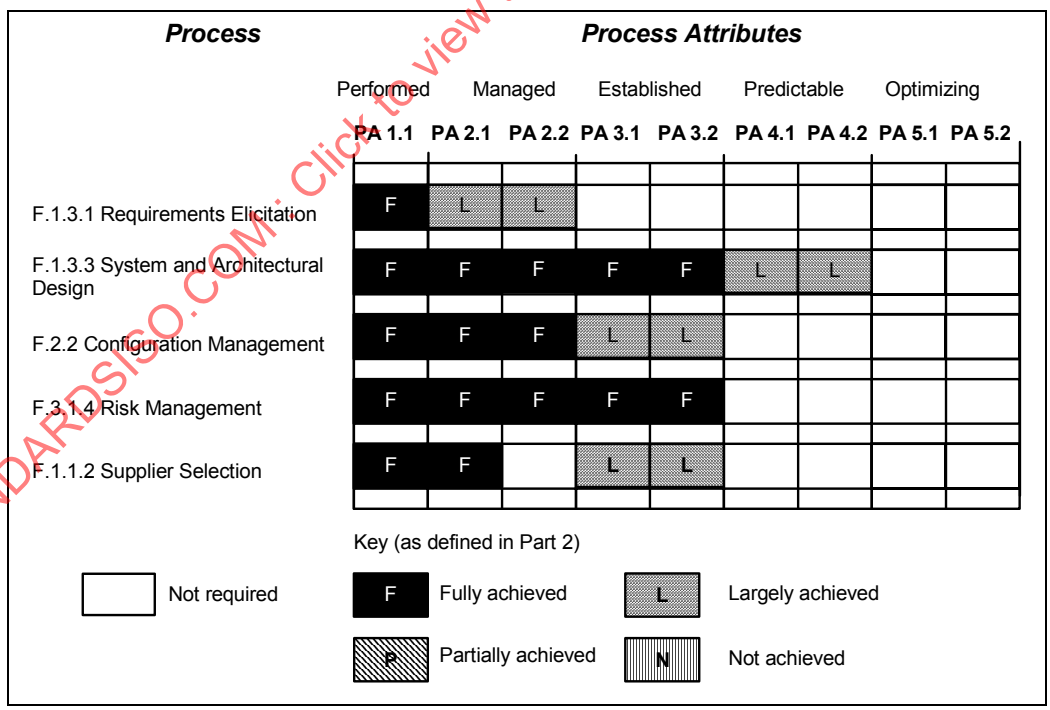

Figure 2 — Example target capability presented as a set of target process profiles

Table 1 and Figure 2 illustrate an example target capability. The processes shown (F.1.3.1, etc.) are from ISO/IEC 12207, while the process attributes (PA 1.1, etc.) and ratings (Fully achieved, etc.) are defined in ISO/IEC 15504-2. Figure 2 illustrates a target capability where required ratings have been specified for individual process attributes.

Target capability can also be expressed by specifying a required capability level rating for each selected process, using the required process attribute ratings shown in ISO/IEC 15504-2, Table 1. This approach is also illustrated in Figure 2, where the required process attribute ratings for F.1.3.1 Requirements Elicitation correspond to level 2, the required ratings for F.2.2 Configuration Management correspond to level 3, and the required ratings for F.1.3.3 System and Architectural Design correspond to level 4.

A defined PI method should include a means of deriving a target capability from analysis of the organization's business goals. A defined PCD method should include a means of setting target capability from analysis of the specified requirement.

One simple approach to establishing target capability – based on ISO/IEC 12207 as the Process Reference Model – is set out in Table 2.

Table 2 — Setting target capability

Step	Action	Rationale
Step 1 – Select an initial set of processes	Select the Primary Lifecycle Processes, excluding any processes not relevant to the specified requirement	The Primary Lifecycle Processes within the ISO/IEC 12207 Process Reference Model contribute most directly to the delivery of products and services
Step 2 – Set default required process attribute ratings for the initial set of processes	Set all process attribute ratings for capability levels 1, 2 and 3 to *Fully achieved*	This approach ensures that selected processes are fully performed; that practices are in place to avoid missed deadlines, budget overspend and product quality problems; and that processes are deployed following proven best practice, thus providing confidence that future performance will be consistent with past accomplishments
Step 3 – Review and adjust the required process attribute ratings for each initial process	Add attribute ratings for level 4 or level 5; or remove attribute ratings for level 3	Adding level 4 and level 5 process attributes for some processes may sometimes be justified to reduce process–related risks, as illustrated in Figure 2 where the target process profile for F.1.3.3 System and Architectural Design includes process attributes from capability level 4 Sometimes, deleting process attributes from level 3 may be justified, as illustrated in Figure 2, where the target process profile for F.1.3.1 Requirements Elicitation includes process attribute from capability levels 1 and 2 only
Step 4 – Add further processes, plus required process attribute ratings for each	Add supporting Lifecycle Processes and Organizational Lifecycle Processes	The supporting Lifecycle Processes and Organizational Lifecycle Processes are critical to establishing high levels of process capability within an organization Many process attributes are related to Supporting Lifecycle Processes and Organizational Lifecycle Processes For example, if the *Performance Management* attribute (PA 2.1) has been included for a Primary Lifecycle Process, then the *Project Management* process should also be included The target capability for Supporting Lifecycle Processes and Organizational Lifecycle Processes is driven by the extent to which they support process attributes applying to the initial set of selected processes Other Supporting Lifecycle Processes and Organizational Lifecycle Processes should also be included in the target capability statement where they are relevant to the specified requirement (for PCD) or business goals (for PI)

Note that the target capability may need to address organizational capability, rather than a product or service. The requirement may, for example, be to establish a strong configuration management process as an end in itself, and the selected process set would then include this single process.

5.4 Defining the assessment input

The sponsor should generate the input for a process assessment – as specified in ISO/IEC 15504-2 – according to the guidance set out in ISO/IEC 15504-3 and the additional guidance set out below.

At a minimum, the assessment input shall specify:

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

[ISO/IEC 15504-2, 4.4.2]

The identity of the assessment sponsor will be either the PCD Sponsor or the PI Sponsor.

e) the assessment constraints considering, at minimum:

...

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

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

[ISO/IEC 15504-2, 4.4.2]

The quantity and type of objective evidence needed to support each process attribute rating will depend upon the assessment purpose and scope.

— For an initial process improvement programme, a sponsor or method may for example require that every process attribute rating be supported by a minimum of two verbal assertions collected at distinct data collection sessions – but with possibly no documentary evidence required.

— For a supplier capability evaluation, a sponsor or method may for example require that every process attribute rating be supported by a minimum of three verbal assertions collected at different data collection sessions plus at least one piece of documentary evidence. The sponsor or method may also specify that if a document has been formally requested by a competent assessor but the organizational unit has stated that it cannot be produced, then this assertion may be counted in lieu of the documentary evidence required.

The ownership of the assessment outputs and any restrictions on their use, plus any controls on information resulting from a confidentiality agreement, must be defined within the assessment input, reflecting any confidentiality agreements in place that affect the overall process improvement programme or process capability determination.

5.5 Evaluating process-related risk

5.5.1 Inferring process-related risk from assessment output

The quality of a product or service is greatly influenced by the processes deployed to provide it. Process capability is measured via the process attributes described in ISO/IEC 15504-2. Process-related risk arises from inappropriate process management, i.e. not deploying appropriate processes, or from deploying them in a way which does not achieve required process attribute ratings.

The output of a conformant process assessment includes a set of process profiles as described in 4.6 and illustrated in Figure 1. Required process attributes can be represented as a set of target process profiles, as described in 5.3 and illustrated in Figure 2.

Both target and assessed process profiles can be presented within a single diagram, as illustrated in Figure 3. Again, the processes shown (F.1.3.1, etc.) are from ISO/IEC 12207, while the process attributes (PA 1.1, etc.) and ratings (Fully achieved, etc.) are defined in ISO/IEC 15504-2.

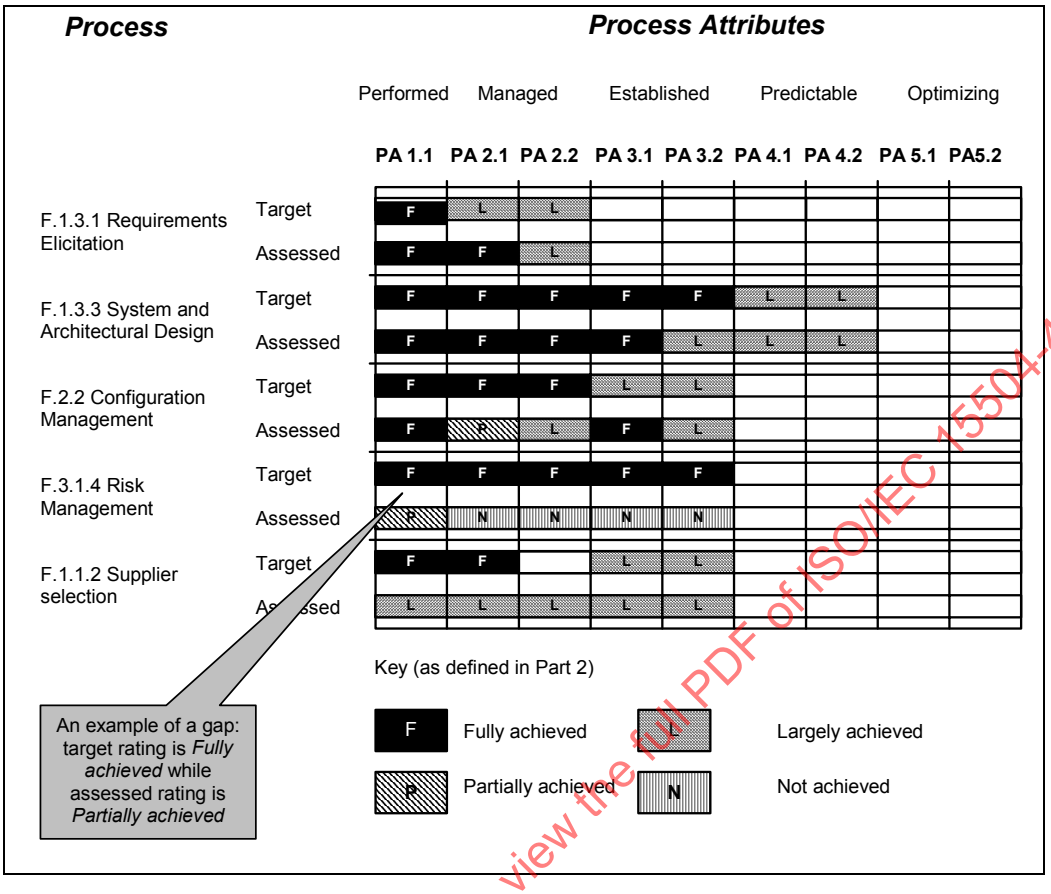

Figure 3 — Target and assessed process profiles

Process-related risk can be inferred from the existence of gaps between a target process profile and an assessed process profile. A gap is said to exist:

— if the target process profile requires that a particular process attribute be Fully achieved, while the assessed process attribute rating is less than Fully achieved;

— if the target process profile requires that a particular process attribute be Largely achieved, while the assessed process attribute rating is less than Largely achieved.

The potential consequence of a gap depends upon the capability level and process attribute where the gap occurs – as illustrated in Table 3, where the process attributes (PA 1.1, etc.) are defined in ISO/IEC 15504-2.

Table 3 — Potential consequence of process attribute gaps

Process attribute where gap occurs	Potential consequence
PA 1.1 Process performance	• missing work products; process outcomes not achieved
PA 2.1 Performance management	• cost or time overruns; inefficient use of resources • unclear responsibilities, uncontrolled decisions, and uncertainty over whether time and cost objectives will be met
PA 2.2 Work product management	• unpredictable product quality and integrity, uncontrolled versions, increased support costs, integration problems and increased re-work costs
PA 3.1 Process definition	• identified best practice and lessons learned from previous projects not defined, published and available within organization • no foundation for organization-wide process improvement
PA 3.2 Process deployment	• implemented process not incorporating identified best practice and lessons learned from previous projects; inconsistent process performance across organization • lost opportunities to understand process and identify improvements.
PA 4.1 Process measurement	• no quantitative understanding of how well process performance objectives and defined business goals are being achieved • no quantitative ability to detect performance problems early
PA 4.2 Process control	• process not capable and/or stable (predictable) within defined limits • quantitative performance objectives and defined business goals not met
PA 5.1 Process innovation	• process improvement objectives not clearly defined • opportunities for improvement not clearly identified
PA 5.2 Process optimization	• inability to change process effectively to achieve relevant process improvement objectives • inability to evaluate effectiveness of process changes

Process-related risk is assessed from the *probability* of a problem arising from an identified gap, and from its potential *consequence*, should it occur. A chosen PI or PCD method should contain a defined approach to analysing process-related risk. An example approach is illustrated at Annex A.

5.5.2 Analysing weaknesses

Whenever a gap is identified, a weakness is said to exist. For each identified gap, the analysis team may determine and record, with respect to the specified requirement or business goals:

— the nature of the weakness;

— the source or cause of the weakness;

— the potential consequences of the weakness;

— what would have to be done to correct the weakness;

— what the cost, benefit and risk of correcting the weakness would be.

6 Process improvement

6.1 Overview

Figure 4 illustrates the steps of process improvement utilizing a conformant process assessment – as described in ISO/IEC 15504-2 and ISO/IEC 15504-3.

The ovals in Figure 4 represent steps in the process, and the arrows represent information being passed between steps.

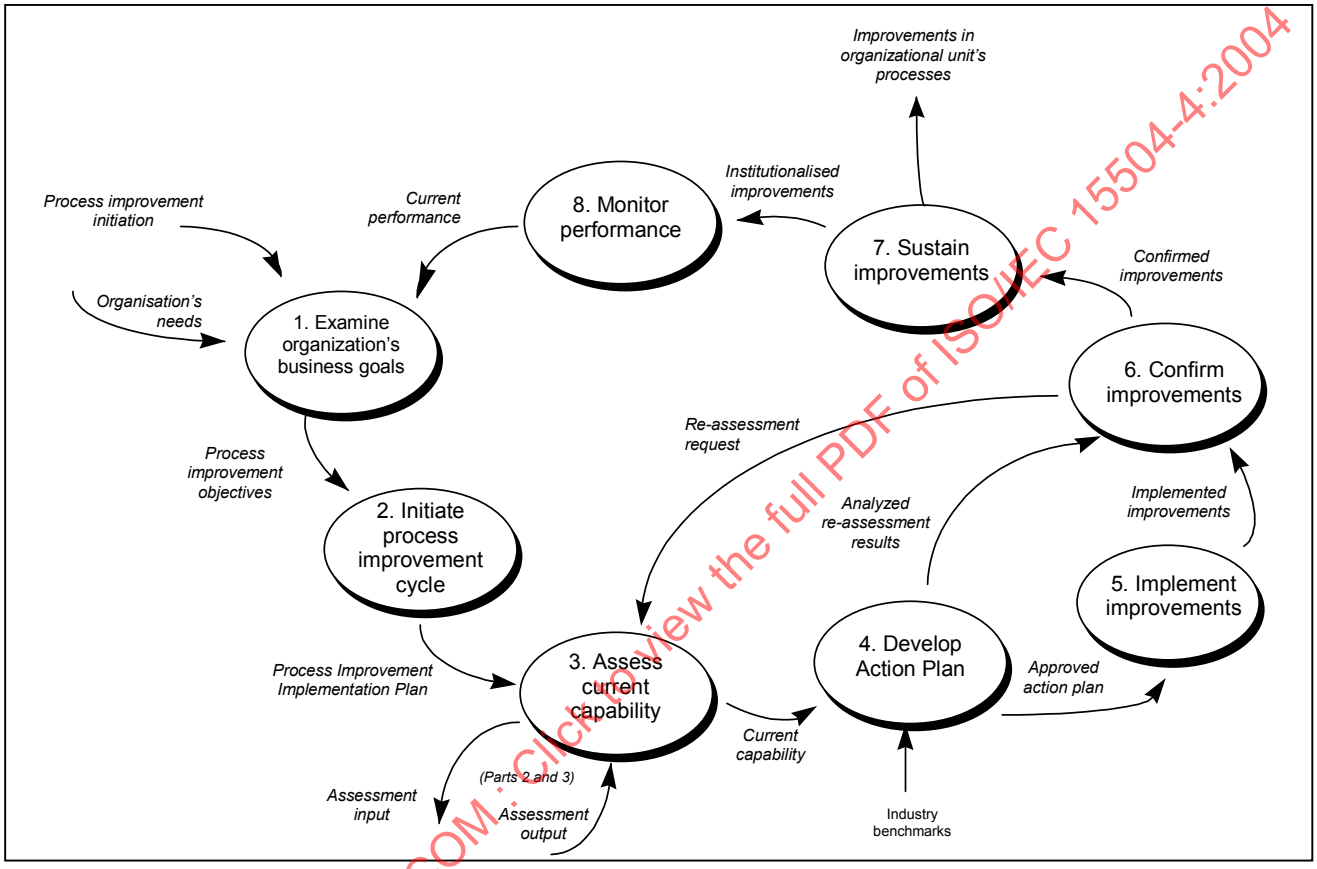

Figure 4 — Steps of process improvement

Each of these steps is elaborated below.

6.2 Steps of process improvement

6.2.1 Step 1 – Examine organization's business goals

The business goals of an organization are often centred around:

— achieving customer satisfaction;

— achieving greater competitiveness;

— achieving improved business value associated with delivery of products or services.

These key management concerns become drivers that initiate process improvement throughout the organization with objectives of:

— increasing product and service quality;

— decreasing development and maintenance costs;

— decreasing time to market;

— increasing predictability and controllability of processes;

— decreasing variability between projects.

From an analysis of the organization's business goals and existing stimuli for improvement, the objectives of process improvement are set.

Setting improvement objectives involves firstly determining which Process Reference Model(s) will best address the organization's business goals, as described in 5.2. It also includes defining a set of target process profiles, as described in 5.3, which present the choice of the processes to be assessed and the improvement targets set, and which will guide identification of the most effective improvement actions.

Following analysis of the organization's business goals, it is essential to build executive awareness of the necessity for a process improvement programme, which requires both managerial and financial commitments. The objectives of such a process improvement programme should be clearly stated and understood, and expressed using measurable objectives. The process improvement programme should form part of the organization's overall strategic business plan.

The executive decision to undertake the process improvement programme, together with the identification of a preliminary process improvement programme budget and the main process improvement priorities, enable the improvement process to progress.

6.2.2 Step 2 – Initiate process improvement cycle

The process improvement programme should be implemented as a project in its own right, with defined sponsorship, project management, budget, milestones and accountability. In short, the project should be managed according to a project management process, aligned to the Process Assessment Model being used.

Sponsorship may be implemented in a variety of ways, according to the culture of the organization. In non-hierarchical or higher maturity organizations for example, sponsorship and project management may both be delegated to working level, although authorities, roles and responsibilities should always be clearly defined.

A Process Improvement Programme Plan should be produced and used to monitor progress. The plan should include:

— background, history and current status of organizational process improvement activities;

— improvement objectives derived from organizational business goals;

— organizational scope – the organizational boundaries for the improvement programme;

— process scope – the processes to be improved;

— process improvement lifecycle;

— key roles and responsibilities;

— resources;

— appropriate milestones, review points and reporting mechanisms;

— risks associated with the programme, and the selected risk management process;

— activities to be performed to keep all those affected by the improvement programme informed of progress.

The Process Improvement Programme Plan should show how process change is to be implemented with least disruption to the ongoing business of the company. It should show how the progressive implementation is to be introduced into existing organizational systems, and identify training required as a prerequisite to implementation of the change.

6.2.3 Step 3 – Assess current capability

The assessment input is prepared as described in 5.4 and a process assessment initiated following the guidance set out within ISO/IEC 15504-3. This assessment may either be a self-assessment or an independent assessment – as described in ISO/IEC 15504-3.

6.2.4 Step 4 – Develop action plan

The assessment output is analysed against the organization's business goals to:

— identify, analyse and list improvement areas;

— define specific improvement objectives and set targets;

— derive an action plan.

6.2.4.1 Identify improvement areas

Process improvement should be strongly supported by leadership, communication and motivation throughout the whole organization. Improvement actions can only be carried out efficiently if the appropriate cultural issues are acknowledged and addressed at all levels – as elaborated in Annex C.

Improvement areas should be identified and prioritized based on a number of factors:

— analysis of the assessment output identifying strengths, weaknesses and risks related to the assessed processes;

— the organization's business goals, which provide general improvement objectives to be achieved through the improvement programme;

— client and customer expectations, which provide opportunities for improving customer satisfaction;

— industry norms and benchmarks that provide a basic comparison framework for assessment results;

— measurement results which, if already in place, identify improvement opportunities for the organization generally related to the improvement drivers;

— any risks associated with not achieving the stated improvement objectives or not successfully implementing identified improvement actions.

6.2.4.2 Analyse assessment strengths and weaknesses

Analysis of the current strengths and weaknesses of the process identifies process-related risk and indicates opportunities for improvement.

Strengths are identified as the processes with the highest process capability level ratings. Strengths may support process improvement as follows:

— strong processes may provide experience of good practices that could be adopted and institutionalized in the organization;

— processes with the highest process capability level rating within a process category or a set of interrelated processes may show an opportunity for improving the effectiveness of the rest of the process category or set of interrelated processes.

Weaknesses are identified and analysed as described in 5.5.2, and derive from the following:

— processes with low process attribute ratings;

— processes with missing practices that are needed to enable the process to achieve a process purpose aligned with a specific need of the organization;

— unbalanced process attribute ratings within capability levels that are necessary to achieve a specific business goal;

— low process attribute ratings across assessed processes that may indicate weakness in specific process categories (for example low scores at process capability level 2 may show weaknesses in the Management and Support process categories).

Similarly, the process attribute ratings of related processes should be compared. Improvement actions may be needed to correct any imbalance.

6.2.4.3 Review organizational improvement objectives

The processes and their relationships should be analysed in order to evaluate which processes have direct impact on the organizational improvement objectives identified in the Process Improvement Programme Plan. Specific relationships between single processes should be considered in order to identify processes which should be addressed together to fulfil certain improvement objectives. In this way, a priority list of processes to be improved may be derived. The processes in this list with low process capability level ratings may provide the best opportunity for improvement.

6.2.4.4 Analyse effectiveness measurements

Organizations with previous experience in process improvement may already have measurement in place. Where these are related to the existing organization's business goals and derived improvement objectives, it may be beneficial to analyse the current measurements to better understand what improvement is needed.

6.2.4.5 List improvement areas

A prioritized list of improvement areas should be compiled from all of the factors listed above. The selected improvement areas define the scope of the improvement actions. The scope could include:

— processes to be included;

— organizational boundaries for improvement;

— processes or projects to be either included or excluded.

6.2.4.6 Define detailed improvement objectives and set targets

Targets for improvement should be set for each improvement area. These may be either quantitative objectives for process performance, or target process profiles, or a combination of the two. They should be set with regard to the organization's business goals. This will typically require the iteration of a number of steps until a set of targets has been identified which meet the organization's business goals, which can be objectively measured, and which can reasonably be achieved. The key steps are:

— to define detailed objectives for each priority area for improvement;

— to devise suitable metrics to measure achievement of these objectives;

— to set appropriate target values for these metrics, taking due account of risks.

Higher maturity organizations, and those which have already carried out previous improvement cycles, may already have established objectives, metrics and targets. These should be reviewed for their continuing suitability and adjusted as appropriate with regard to a current assessment of the organization's business goals.

When setting capability levels as targets for processes, the following points should be considered:

— it is desirable for related processes to be at the same capability level, unless there are over-riding considerations;

— it is generally unrealistic to seek to increase the capability of a process by more than one level in a single cycle of improvement, since each level builds on the capabilities of the ones below it.

6.2.4.7 Derive action plan

A set of actions to improve processes should be developed to meet the objectives and targets set in the previous step. Care should be taken to select a set of actions that support each other in achieving the complete set of objectives and targets. It is also desirable to include some improvement actions which yield clear short term benefits, particularly if the organization is new to process improvement, in order to encourage acceptance of the process improvement programme.

When carrying out this task the organization should:

— evaluate a number of scenarios to arrive at a set of actions which best meets the organization's business goals (risk reduction and incremental approach should be considered);

— use the indicators of process performance or process capability in the conformant Process Assessment Model being used, as a basis for improvement actions;

— define success criteria for each action and state how progress will be measured (the metrics used to set the targets may provide suitable measurements);

— evaluate initial estimates of costs and benefits, schedule and risks for the proposed actions;

— identify responsibilities for the actions, and agree the responsibilities with those affected by the actions;

— identify recruitment and training needs.

The set of agreed actions should be documented as an Action Plan containing the following information:

— improvement actions with associated process objectives and improvement targets;

— responsibilities for actions;

— initial estimates of costs, benefits and schedule;

— risks to products and to the organization if actions are taken or not taken, and the implications for any schedule changes.

The Action Plan is a tactical plan, developed to meet the organization's business goals, which supplements the Process Improvement Programme Plan established at Step 2. The Process Improvement Programme Plan should be reviewed at this point and updated if necessary. Management should approve the updated Process Improvement Programme Plan and Action Plan, thereby committing the organization to undertake the planned improvements. The Action Plan should be communicated clearly to all affected staff.

6.2.5 Step 5 – Implement improvements

The Action Plan is next implemented in order to improve the organization's processes. Implementation may be simple or complex depending on the contents of the Action Plan and the characteristics of the organization. In general several implementation projects may be initiated, each concerned with implementing one or more actions from the Action Plan. Four main tasks are involved in each implementation project:

— selecting the implementation strategy;

— preparing and agreeing a detailed Implementation Plan;

— putting the Implementation Plan into effect;

— monitoring progress against plan.

6.2.5.1 Implementation strategy

Where alternative implementation strategies are feasible, they should be evaluated and the most suitable selected. For instance, it may be possible to implement a given action either in small steps through piloting in a selected unit, or throughout the whole organization at the same time, or somewhere between these two extremes. Among the factors to consider are costs, time scales, and risks.

6.2.5.2 Detailed implementation planning

An Implementation Plan should be developed to identify:

— the objectives of the implementation project;

— the selected implementation strategy;

— the organization, responsibilities and organization change champions;

— the schedule for the progressive introduction of the process improvement;

— the resources needed;

— changes to the job descriptions of employees who are expected to implement, monitor, maintain or supervise the process change;

— risk management, including assessment, monitoring and mitigation;

— arrangements for monitoring progress;

— specification of success criteria, including process objectives and improvement targets.

The implementation project may need to carry out further analysis of improvement opportunities; where appropriate, the Implementation Plan should include:

— any further data collection and analysis needed to establish the underlying causes of unsatisfactory current measures of effectiveness and process profiles;

— evaluation of alternative proposals for corrective action, including analysis of costs and benefits;

— arrangements to capture cost and resource usage data, for instance if it is desired to carry out cost-benefit analysis.

Staff who will be required to implement the actions or be affected by them should be involved or consulted during development of the Implementation Plan and during evaluation of alternative approaches, in order to draw on their expertise and enlist their co-operation.

6.2.5.3 Implementing improvement actions

It is critical for successful improvement that due account is taken of human and cultural factors as described further in Annex C. In particular the following should be considered:

— how management can give support and leadership;

— what changes may be needed in values, attitudes and behaviour;

— how to establish commitment to objectives and targets;

— how to foster open communication and teamwork, including implications for organizational structures and reporting lines;

— whether changes are needed to recognition and reward systems;

— what education and training is required.

6.2.5.4 Monitoring implementation

Implementation projects should be monitored by the organization's management against Implementation Plans in order to:

— ensure that tasks progress as planned, and that appropriate corrective action is taken when necessary;

— check that achievement of the planned objectives and targets continues to be both realistic and relevant to the organization's business goals;

— gather data on effort and resources expended, in order to improve estimates for future process improvement projects;

— evaluate the impact of the implemented improvement actions on the process attribute ratings and capability level ratings;

— determine the extent to which the defined success criteria for the improvement project have been achieved.

Records should be kept for use both to confirm the improvements, and to improve the process improvement process itself (refer to ISO/IEC 12207:1995/Amd.2[3)], F.3.3.3.

6.2.6 Step 6 – Confirm improvements

When the implementation projects have been completed, the organization should:

— confirm that the planned objectives and targets have been achieved and that the expected benefits have been delivered;

— check that appropriate processes and practices have been adopted;

— confirm that the organizational culture has changed where appropriate;

3) To be published.

— consider initiating a process assessment to confirm that the desired process capability has been established;

the organization should also:

— re-evaluate risks associated with the process improvement programme;

— re-evaluate costs and benefits.

Management should be involved both to approve the results and to evaluate whether the organization's business goals have been met.

If, after improvement actions have been taken, measurements show that process objectives and improvement targets have not been achieved, it may be desirable to redefine the process improvement project by returning to an appropriate earlier step.

6.2.7 Step 7 – Sustain improvements

After improvement has been confirmed, the processes need to be sustained at the new level of capability. The improved processes should be used by all staff for whom they are applicable. This requires management to monitor institutionalization of the improved process, and to give encouragement when necessary. Responsibilities for monitoring should be defined, as well as how this will be done, for instance by using appropriate measurements.

If an improved process has been piloted in a specific area or on a specific project or group of projects, it should now be deployed across all areas or projects in the organization where it is applicable. This deployment should be properly planned, resourced, and documented as part of the Process Improvement Programme Plan as appropriate. Consideration should be given to:

— who is affected;

— how to communicate both the changed process and the benefits expected from it (note: changes should be properly documented and approved);

— what education and training are necessary;

— when to introduce changes to the different areas of the organization, taking business goals into account;

— how to ensure that the changes have been made (for instance by conducting audits);

— how to ensure that the improved process performs as expected.

6.2.8 Step 8 – Monitor performance

The performance of the organization's processes should be continuously monitored, and new process improvements should be initiated as part of the continuing process improvement programme.

The measures used for process monitoring should be chosen to suit the organization's business goals. Management should regularly review their continuing suitability. The risks to the organization and its products from using the processes should also be monitored and action taken as risks materialize or become unacceptable.

The process improvement programme should be reviewed regularly by management to ensure that:

— both the improvement programme and individual improvement projects, including their objectives and targets, remain appropriate to the organization's business goals;

— further improvement projects are initiated when and where appropriate as previous improvement projects have been completed;

— the process improvement process is itself improved based on experience;

— continuous improvement becomes and remains a feature of the organization's values, attitudes and behaviour.

Further process assessments can be an important component of the continuing improvement programme, for instance in the following circumstances:

— where a long term goal to achieve higher process capability levels is to be approached by stages;

— when changing organizational business goals indicate a requirement to achieve higher capability levels;

— when there is a need to give a fresh impetus to improvement.

The extent to which improved processes have been institutionalized should be considered before scheduling further process assessments. It may be more cost-effective to delay assessing a process until improvements have been fully deployed, rather than expend resources assessing a process which is in transition, when the results can be difficult to interpret.

7 Process capability determination

7.1 Overview

Figure 5 illustrates the steps of process capability determination utilizing a conformant process assessment – as described in ISO/IEC 15504-2 and ISO/IEC 15504-3.

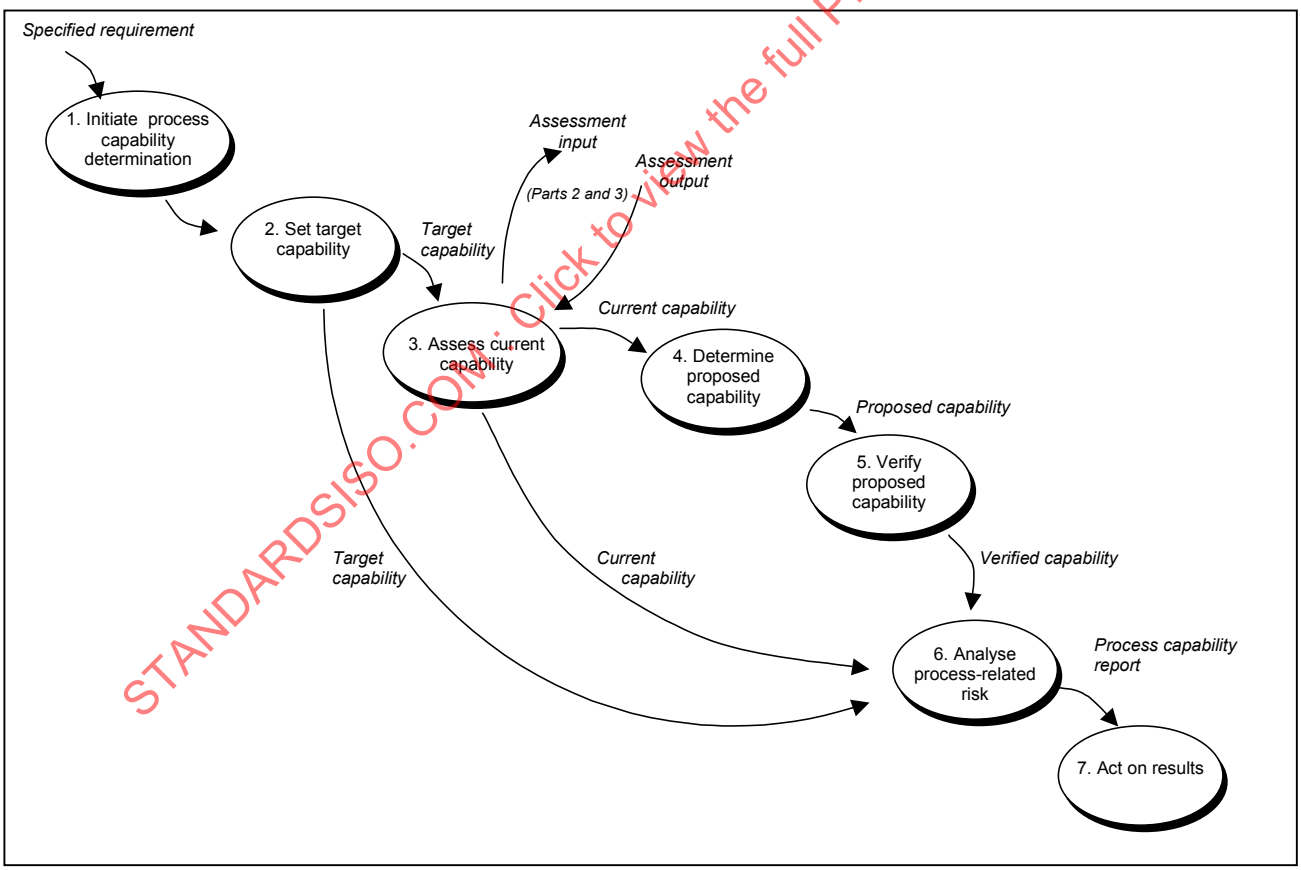

Figure 5 — Steps of process capability determination

The ovals in Figure 5 represent steps in the process, and the arrows represent information being passed between steps.

A process capability determination can provide a fundamental input to a supplier selection process, for example as described in ISO/IEC 12207:1995/Amd.1:2002, F.1.1.2. One of the outcomes of this process is that *'…the supplier shall be selected based upon evaluation of the supplier's proposals, process capability, and other factors…'.* An acquirer may initiate a process capability determination to assess the risk of entering into a contract with a single supplier, or an acquirer may carry out process capability determinations on a number of competing suppliers during a supplier selection activity.

Suppliers may also wish to carry out a process capability determination on their own processes before deciding whether to bid for a contract, as part of their 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 the risks involved in completing the work.

Both self-assessment and independent assessment approaches may be used to assess current capability during Step 3 of a process capability determination. In a two-party contractual situation, an acquirer may invite the potential suppliers to provide a self-assessment set of process profiles when submitting a proposal for a contract. The set of process profiles should have been produced from a conformant assessment against a specified Process Reference Model.

The acquirer may then choose to:

— accept the self-assessment at face value;

— initiate and rely entirely upon a full independent assessment, possibly using assessors from his own organization, following the guidance in ISO/IEC 15504-3, 5.8.2, and make this a condition of contract award;

— initiate a limited independent assessment to verify that the self-assessment is a true representation of the supplier's current process capability. This approach offers the benefit of reducing disruption to suppliers' business activities caused by multiple process assessments, since the same assessment output may be offered to many acquirers. It also provides acquirers with a rigorous and defensible approach to supplier process capability determination, and the potential to reduce assessment costs through the reuse of results and the utilization of self-assessments.

7.2 Steps of process capability determination

7.2.1 Step 1 – Initiate process capability determination

The PCD Sponsor first decides whether or not to carry out a process capability determination.

The process capability determination should be implemented as a project in its own right, with defined sponsorship, project management, budget, milestones and accountability. In short, the project should be managed according to a project management process, aligned to the Process Assessment Model being used.

A process capability determination plan should be produced, approved by the PCD Sponsor, and used to monitor progress. The plan should include:

— the purpose of the process capability determination;

— the process assessment method to be used;

— the organizational scope, i.e. the organizational unit whose processes are to be the subject of the process capability determination;

— the target capability (inserted after it has been defined in Step 2);

— key roles and responsibilities;

— resources;

— appropriate milestones, review points and reporting mechanisms;

— risks associated with the PCD and the selected risk management process.

When carrying out the PCD as part of a supplier selection activity, the PCD Sponsor may decide either to disclose the target capability to the potential suppliers, or not, as appropriate.

The PCD Sponsor may also invite the organizational unit to submit a statement of the process capability that it proposes to bring to bear in meeting the specified requirement.

7.2.2 Step 2 – Set target capability

The PCD Team sets the target capability, as described in 5.3.

The target capability comprises a set of target process profiles that express the capability which the PCD Team judges to be adequate, subject to an acceptable process risk, for meeting the specified requirement.

7.2.3 Step 3 – Assess current capability

The assessment input is prepared as described in 5.4.

The PCD Sponsor may invite the organizational unit to submit the output of a conformant self-assessment of current process capability.

Alternatively, the PCD Sponsor may decide to initiate an independent process assessment, bearing in mind the nature, cost and importance of the specified requirement.

In either case, the output from the assessment of current capability will take the form of a set of process profiles as defined in ISO/IEC 15504-2.

7.2.4 Step 4 – Determine proposed capability

If invited to do so, the organizational unit may optionally submit to the PCD Team a statement of the capability that it proposes to bring to bear in meeting the specified requirement. The proposed capability should be based on one or more process assessments which:

— satisfy the requirements of ISO/IEC 15504-2;

— are a true representation of the organizational unit's current process capability;

— may been produced specially for the PCD, or generated during a recent self-assessment, or produced following a recent independent assessment.

A key feature of ISO/IEC 15504 is that process assessment outputs are re-useable. Many organizational units 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 organizational unit may use the outputs as the basis of a proposed capability. If not, then the organization may carry out a self-assessment in accordance with the requirements of ISO/IEC 15504-2.

If the organizational unit has a process improvement programme underway, then it may optionally propose to bring an *improved capability* to bear in meeting the specified requirement. The improved capability may be justified via a set of current process profiles plus a process improvement plan. The process improvement plan may in turn be supported by a process improvement track record.

If the proposed capability does not meet the requirements of the target capability, the organizational unit may optionally submit a *mitigation plan*, setting out the organization's view of any capability level gaps, and proposing measures to mitigate them.

The organization may therefore wish to pass to the PCD Team a proposed capability, justified by:

— the output of a current, conformant process assessment;

— a process improvement plan;

— a process improvement track record;

— a mitigation plan.

7.2.5 Step 5 – Verify proposed capability

If the organizational unit has submitted a statement of the capability that it proposes to bring to bear in meeting the specified requirement, then the PCD Team should review 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 proposed capability is based on one or more conformant process assessments;

— checking the credibility of any improved capability and process improvement plans.

The PCD Sponsor may accept the proposed capability, or decide to initiate an appropriate degree of independent process assessment. This may involve a sample of selected processes, or a comprehensive independent assessment of all processes specified in the target capability. Having carried out the verification assessment, the PCD Team will be able to compare this output with the organization's proposed capability and derive a profile to be used for subsequent risk analysis.

If the process capability determination involves a number of competing suppliers, then the PCD Sponsor may wish to verify each supplier's proposed capability by using an independent assessment team, the same assessment method and the same conformant Process Assessment Model. This should not only provide the PCD Sponsor with greater confidence in the consistency with which each supplier is assessed, but also provide the suppliers with greater confidence in the fairness of the selection process.

7.2.5.1 Subcontractors and consortia

If several organizational units – i.e. subcontractors, partners in a joint venture, or distinct divisions of an organization – will be involved in meeting a specified requirement, then the proposed process capability will comprise contributions from each of the organizational units. This situation is addressed further in Annex B.

7.2.6 Step 6 – Analyse process-related risk

Process-related risk is assessed from the *probability* of a particular problem occurring, and from its potential *consequence*, should it occur as outlined in 5.5.

The chosen process capability determination method should contain a defined approach to analysing risk. One possible approach is outlined in Annex A.

7.2.7 Step 7 – Act on results

If the process capability determination has been carried out to determine the suitability of another organization's processes for a particular contract or class of contracts, then the PCD Sponsor will wish to take into account the assessment of process-related risk not only in making contract award decisions, but also when establishing contractual commitments related to ongoing risk management activities.

If the process capability determination has been carried out by an organization to determine the capability of its own processes for a particular requirement or class of requirements, then the PCD Sponsor may wish to initiate a process improvement programme to address any process-related risk issues identified.

7.3 Comparability of assessment output analysis

If the process capability determination is part of a supplier selection process involving a number of competing suppliers, then the PCD Team may need to compare the process-related risk associated with each supplier's process capability.

Comparison of the outputs of different conformant process assessments is always carried out by comparing process profiles, and is only possible if they all include the same selected processes from the same Process Reference Model(s).

A number of factors also need to be considered carefully in order to determine whether a comparison of the outputs of different conformant assessments is valid, as described in ISO/IEC 15504-3. These factors also affect the validity of comparing process-related risks identified from analysis of the outputs of different conformant assessments – as described in this clause.

These factors include but are not limited to:

— the conformant Process Assessment Model used;

— the assessment process used;

— the quantity and type of objective evidence used to determine the set of process profiles;

— the identity, skills, knowledge and experience of the assessors.

Annex A
(informative)

Analysing process-related risk

A.1 Introduction

In the example approach to analysing process-related risk described within this annex, process-related risk is assessed on a process-by-process basis, and inferred from the existence of gaps between a target process profile and an assessed process profile.

For each process, a gap is said to exist:

— if the target process profile requires that a particular process attribute be Fully achieved, while the assessed process attribute rating is less than Fully achieved;

— if the target process profile requires that a particular process attribute be Largely achieved, while the assessed process attribute rating is less than Largely achieved.

Overall risk associated with each process is then derived from the probability of a problem arising from an identified gap, and from its potential consequence, should it occur.

A.2 Probability

The probability of a problem occurring is derived from the extent of any gaps between a target process profile and an assessed process profile.

Process attribute gaps occur whenever an assessed process attribute rating falls short of a required process attribute rating. Process attribute gaps can be designated as shown in Table A.1.

Table A.1 — Process attribute gaps

Required process attribute rating	Assessed process attribute rating	Process attribute gap
Fully achieved	Fully achieved	None
	Largely achieved	Minor
	Partially achieved	Major
	Not achieved	Major
Largely achieved	Fully achieved	None
	Largely achieved	None
	Partially achieved	Major
	Not achieved	Major

The probability of a problem occurring depends upon the extent of the process attribute gaps, and upon the capability levels where they occur, as designated in Table A.2.

As shown in the table, the highest probability of a problem occurring is associated with a substantial capability level gap, arising from either a major process attribute gap at level 1, or more than one major gap within levels 2 to 5. A single minor gap at level 1, or a single major gap within levels 2 to 5, represents a significant capability level gap and a moderate chance of a problem occurring. Minor gaps within levels 2 to 5 represent a slight capability level gap and a lower probability of a problem occurring.

Table A.2 — Capability level gaps

Number of process attribute gaps and capability level	Capability level gap	Probability of problem occurring
No major or minor gaps	**None**	Lowest
No gap for level 1, and only minor gaps within levels 2, 3, 4 or 5	**Slight**	
A minor gap for level 1, or a single major gap within levels 2, 3, 4 or 5	**Significant**	
A major gap at level 1, or more than one major gap within levels 2, 3, 4 or 5	**Substantial**	Highest

A.3 Consequence

The potential consequences associated with individual process attribute gaps are illustrated at Table 3 in 5.5. However, for the purposes of analysing process-related risk as described within this Annex, the seriousness of the consequences depends on the capability level within which the gaps occur, as shown in Table A.3.

For example, if a selected process is assessed less than fully performed, i.e. PA 1.1 is not Fully achieved, then process outcomes may not be achieved – the most serious consequence.

Table A.3 — Consequence of a problem occurring

Capability level where gap occurs	Nature of consequence	Seriousness of Consequence
5 – Optimizing process	inability to achieve or evaluate process improvements	Lowest
4 – Predictable process	inability to quantify performance or detect problems early	
3 – Established process	inconsistent process performance across organization	
2 – Managed process	cost or time overruns; unpredictable product quality	
1 – Performed process	missing work products; process outcomes Not achieved	Highest

A.4 Process-related risk

The process-related risk associated with each process depends upon the *probability* of problem arising from an identified gap, and upon the potential *consequence*, should it occur.

The highest risk arises from a substantial gap at a lower capability level – as shown in Table A.4.

If risks are identified within more than one capability level, then the highest capability level risk is taken to be the process-related risk for the process.

Table A.4 — Risk associated with each capability level

Consequence indicated by capability level where gap occurs	*Probability indicated by extent of capability level gap*		
	Slight	**Significant**	**Substantial**
5 – Optimizing process	Low Risk	Low Risk	Low Risk
4 – Predictable process	Low Risk	Low Risk	Medium Risk
3 – Established process	Low Risk	Medium Risk	Medium Risk
2 – Managed process	Medium Risk	Medium Risk	**High Risk**
1 – Performed process	Medium Risk	**High Risk**	**High Risk**

A.5 Determining which processes represent greatest risk

The process-related risk associated with each process can now be tabulated as illustrated in A.7, and the process or processes representing the greatest degree of risk can be identified.

If several processes represent the same high degree of risk, then professional judgement will be required to determine, with respect to the specified requirement, which processes will be most critical to success. Although primary lifecycle processes will often be most critical, this should not be taken for granted, since there may be occasions when support processes will be as critical, if not more critical.

A.6 Analysis approach

For each process, the analysis team:

— examines each process attribute within the target process profile, and designates any process attribute gaps using Table A.1;

— considers the process attribute gaps and designates any capability level gaps using Table A.2;

— identifies the potential process-related risk associated with each capability level gap from Table A.4;

— identifies which capability level gap constitutes the highest degree of risk, and takes this to represent the process-related risk for the process.

The analysis team then determines which process or processes represent the greatest degree of risk. If more than one process represents the same degree of risk, then the analysis team judges, with respect to nature of the specified requirement, which processes are most critical, and prioritizes them in order of overall risk.

A.7 Example risk analysis

This example analysis uses the set of output process profiles illustrated in 4.6 and the set of target process profiles illustrated in 5.3, as shown in Figure A.1.

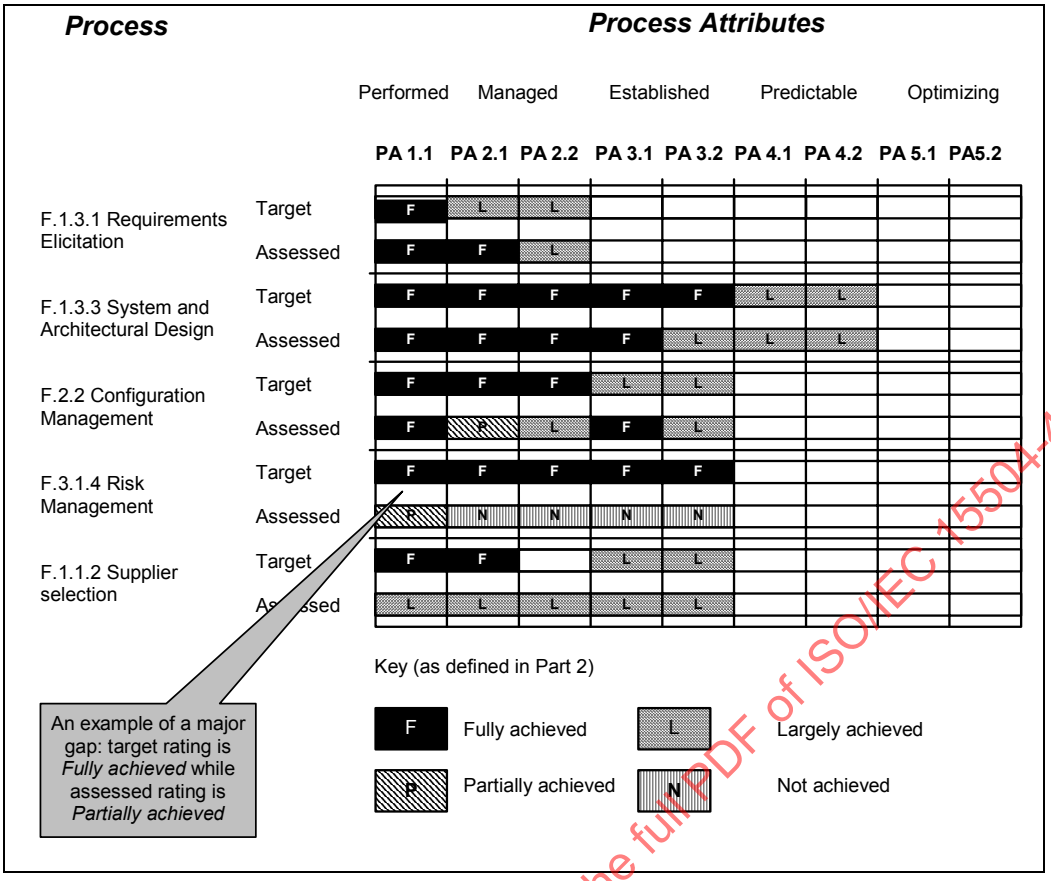

Figure A.1 — Target and assessed process profiles

A.7.1 F.1.3.3 System and Architectural Design

Table A.5 — System and Architectural Design process risk analysis

	Level 1	Level 2		Level 3		Level 4	
	PA 1.1	PA 2.1	PA 2.2	PA 3.1	PA 3.2	PA 4.1	PA 4.2
Target profile	F	F	F	F	F	L	L
Assessed profile	F	F	F	F	L	L	L
Process attribute gap	-	-	-	-	minor	-	-
Capability level gap	-	-		slight		-	
Capability level risk	-	-		low		-	
Process-related risk	low						

— The profiles show that the only process attribute gap is at PA 3.2.

— According to Table A.1 this is designated as a minor process attribute gap.

— According to Table A.2, a single minor process attribute gap at level 3 constitutes a slight capability level gap.

— According to Table A.4, a slight gap at level 3 represents a low capability level risk.

— The process-related risk associated with the System and Architectural Design process is therefore low.