ISO/IEC JTC 1 N9671

2009-08-22

Replaces:

ISO/IEC JTC 1
Information Technology

Document Type: text for DTR ballot

Document Title: Text of DTR 24774, System and software engineering – Life cycle management - Guidelines for process description

Document Source: SC 7 Secretariat

Project Number:

Document Status: This document is circulated to JTC 1 National Bodies for a 3 month DTR ballot. National Bodies are asked to vote and submit their comments via the on-line balloting system by the due date indicated.

Action ID: VOTE

Due Date: 2009-11-23

No. of Pages: 23

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ISO/IEC JTC1/SC7
Software and Systems Engineering
Secretariat: CANADA (SCC)

ISO/IEC JTC1/SC7 /N4444

2009-08-05

Document Type	DTR
Title	DTR 24774, System and software engineering – Life cycle management - Guidelines for process description
Source	WG7
Project	24774
Status	Final
Reference	N4235, N4236, N4441, N4442, N4443
Action ID	FYI or ACT
Distribution	AG
No. of Pages	21
Note	Sent to JTC 1 for DTR processing

Address reply to: ISO/IEC JTC1/SC7 Secretariat
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ISO/IEC JTC 1/SC 7 ****

Date: 2009-07-21

ISO/IEC DTR 24774

ISO/IEC JTC 1/SC 7/WG 7 N1247

Secretariat: SCC

System and software engineering — Life cycle management — Guidelines for process description

Ingénierie du logiciel et des systèmes — Gestion du cycle de vie — Lignes directrices pour la description des procédés

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Document type: Technical Report
Document subtype:
Document stage: (40) Enquiry
Document language: E

C:\Documents and Settings\Anatol W. Kark\Desktop\W071247_ISO-IEC_DTR_24774_2_(E)_final.doc STD Version 2.1c2

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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.

In exceptional circumstances, the joint technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when the joint technical committee has collected data of a different kind from that which is normally published as an International Standard (“state of the art”, for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

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 TR 24774, which is a Technical Report of type 3, was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *System and software engineering*.

This second edition cancels and replaces the first edition (ISO/TR 24774:2006), clauses, subclauses, tables, figures, annexes of which have been technically revised.

Introduction

A number of international, national and industry standards describe process reference models. The process descriptions used in such models vary in format, content and level of prescription. The purpose of this document is to encourage uniformity in the description of processes. Uniform description of processes across process reference models allows the combination of processes from different reference models, eases the development of new models and facilitates comparison of models.

In order for future standards and revisions of current standards to select the appropriate forms of process description and apply them in a consistent fashion it is desirable to develop a common characterization of all of these forms of process description. This technical report presents guidelines for the description of processes in terms of their format, content and level of prescription.

The guidelines in this document can be applied to any process model developed for any purpose. The guidelines have been made publicly available as a Technical Report with the intention of establishing a uniform description of processes across all process models, from all sources, for all purposes.

System and software engineering — Life cycle management — Guidelines for process description

1 Scope

For an organization to function effectively, it has to determine and manage numerous linked activities. An activity or set of activities using resources, and managed in order to enable the transformation of inputs into outputs, can be considered as a process. Often the output from one process forms the input to the next.

This document provides guidelines for the description of processes by identifying descriptive elements and rules for their formulation. It characterizes the following elements of process description:

— Title;

— Purpose;

— Outcomes;

— Activities;

— Tasks;

— Information items.

In addition process views are described.

The document does not describe how processes are composed or otherwise aggregated into larger frameworks or architectures.

The intended audience for this document is the editors, working group members, reviewers and other participants in the development of process standards and technical reports. It is intended that they will select the process description elements suitable for their project from those described in this document. It is further intended, that having selected the appropriate elements, readers of this document will apply them in a manner consistent with the guidance provided by this document.

This document is also intended for use by all parties that define process models. For example, other international standards groups, national standards, sector or special interest groups, professional standards, researchers, process assessors. These process models may be for the purpose of process definition, implementation or assessment.

NOTE 1 The guidelines in this document are those applied in ISO/IEC JTC1/SC7. They align with those used in ISO TC176 (the committee responsible for ISO 9001).

NOTE 2 In order to encourage consistency between process models, users of ISO/IEC TR 24774 may freely reproduce all or part of this document; provided that the copyright of ISO/IEC is acknowledged.

2 Background

Within the international standards arena the definition of life cycle processes for systems and software falls within the scope of ISO/IEC JTC 1/SC 7/WG 7. The existing standards in this area are ISO/IEC 12207 *Software lifecycle processes* and ISO/IEC 15288 *System lifecycle processes*. The information items associated with these process definitions are given in ISO/IEC 15289 *Content of systems and software life cycle process information products (Documentation)*. Other standards, such as ISO/IEC 15939 *Measurement process* and ISO/IEC 16085 *Risk management*, provide further characterization of a single life cycle process by elaborating the process elements and levying specific requirements on the execution of the process. The decomposition is described by use of the activity element. When instantiated for an organization or project, other details are added (entrance/exit criteria, actors, artefacts).

NOTE 1 The distinction between a process and a procedure is a simple one. A procedure is a set of steps to be followed that, when completed, might or might not achieve the intended objective. This is similar to following a recipe when cooking. On the other hand, a process is executed with knowledge of the intended purpose and outcomes to achieve the desired result.

Not all elements need to be treated in all standards. Some standards will treat only process Title, Purpose, and Outcomes, for example, leaving the activities for further elaboration by other standards.

The goals and objectives of performing a process can be described by using the elements of Title, Purpose, and Outcomes. These elements are used to describe intended results without the necessity of performing structural decomposition of the process. Processes defined using Title, Purpose, and Outcomes provide a common starting point for process implementation and process assessment.

The assessment of process capability falls within the scope of ISO/IEC JTC 1/SC 7/WG 10. The existing standard in this area is ISO/IEC 15504-2 *Process assessment – Performing an assessment*. This standard provides requirements for assessing capability of processes defined in external process models; processes may be assessed providing there is a description of them in terms of Title, Purpose, and Outcomes and the description satisfies the criteria for a "process reference model" as stated in 15504-2.

NOTE 2 In addition to the elements described in this document ISO/IEC 15504 defines and uses the element Assessment Indicator. An assessment indicator is a source of objective evidence used to support an assessor's judgement in rating process elements. Examples include work products, practices and resources.

ISO/IEC JTC 1/SC 7/WG 19 covers the fields of Open Distributed Processing and Modelling Languages. The standards developed in that working group provide notations that may be useful in detailed process description for other purposes.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
activity
set of cohesive tasks of a process

[ISO/IEC 15288:2008]

3.2
information item
separately identifiable body of information that is produced and stored for human use during a system or software life cycle

[ISO/IEC 15289:2006]

3.3
life cycle
evolution of a system, product, service, project or other human-made entity from conception through retirement

[ISO/IEC 15288:2008]

3.4
life cycle model
framework of processes and activities concerned with the life cycle that may be organized into stages, which also acts as a common reference for communication and understanding

[ISO/IEC 15288:2008]

3.5
process
set of interrelated or interacting activities which transforms inputs into outputs

[ISO 9000:2005]

3.6
process purpose
high level objective of performing the process and the likely outcomes of effective implementation of the process

NOTE The implementation of the process should provide tangible benefits to the stakeholders.

[ISO/IEC 12207:2007]

3.7
process outcome
observable result of the successful achievement of the process purpose

[ISO/IEC 12207:2007]

3.8
product
result of a process

[ISO 9000:2005]

3.9
system
combination of interacting elements organized to achieve one or more stated purposes

[ISO/IEC 15288:2008]

3.10
task
requirement, recommendation, or permissible action, intended to contribute to the achievement of one or more outcomes of a process

[ISO/IEC 15288:2008]

3.11
view
a representation of a whole system from the perspective of a related set of concerns

[ISO/IEC 42010:2007, IEEE Std 1471-2000]

NOTE In standards being developed in ISO/IEC SC7, the "system" (system of processes) referenced in the definition is the collection of system and software life cycle processes provided by ISO/IEC 15288 and ISO/IEC 12207.

3.12
viewpoint
a specification of the conventions for constructing and using a view. A pattern or template from which to develop individual views by establishing the purposes and audiences for a view, and the techniques for its creation and analysis

[ISO/IEC 42010:2007, IEEE Std 1471-2000]

NOTE For a detailed explanation of view and viewpoint and how they can be defined and used see ISO/IEC 42010 *Recommend practice for architectural description of software-intensive systems*.

4 Characterizing the elements

4.1 Introduction

To enable uniform description additional characterization of the elements is helpful. The remainder of this document provides that characterization.

This Technical Report describes the following process elements:

— The title is a descriptive heading for a process;

— The purpose describes the goal of performing the process;

— The outcomes express the observable results expected from the successful performance of the process;

— The activities are a list of actions that may be used to achieve the outcomes. Each activity may be further elaborated as a grouping of related lower level actions;

— The tasks are specific actions that may be performed to achieve an activity. Multiple related tasks are often grouped within an activity;

— The information items are separately identifiable bodies of information produced and stored for human use during a system or software life cycle.

To prevent confusion and to encourage consistency the use of alternative terms for these elements is strongly discouraged.

Figure 1 is a UML representation adapted from ISO/IEC 15288:2008 showing the relationship between these elements.

Annex A presents an example of a process described using the guidelines in this document.

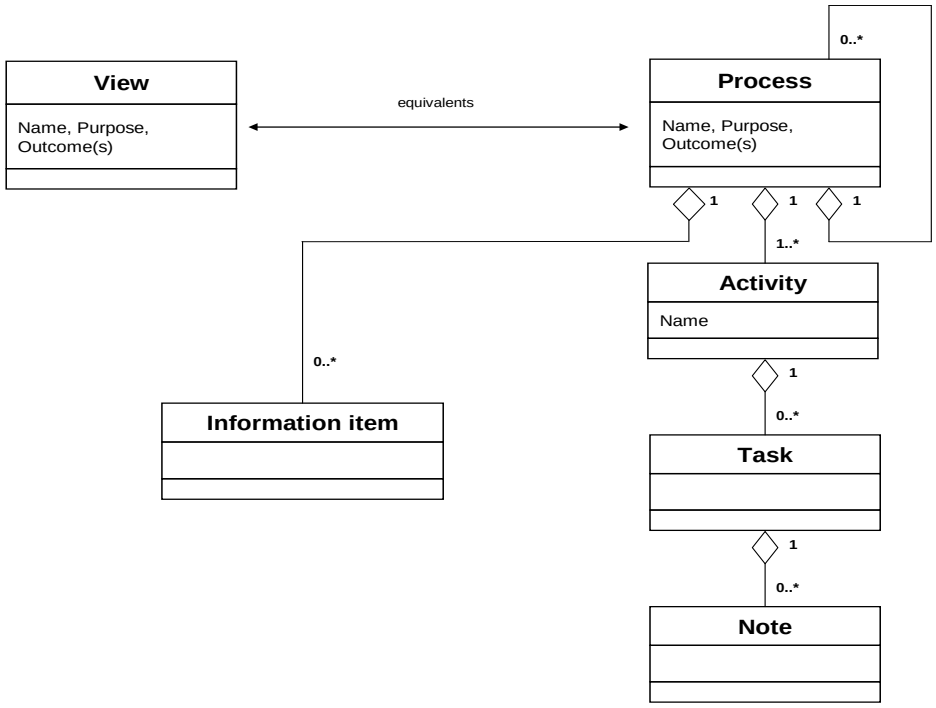

Figure 1 — UML representation of the process elements

4.2 The title element

The title of a process description is a short noun phrase that presents a descriptive heading for the process. The title identifies the principle concern of the process and distinguishes the process from other processes in the model. Because of the latter criterion, it may sometimes be necessary to change the title of a process. For example, one might have a "software design process" which is later renamed as a "software detailed design process" to distinguish it from a newly-invented "software architectural design process".

NOTE Process descriptions may be used both to describe generic objects of a particular type (for example "project management process"), and to describe a particular instance of a generic type (for example "project management process for project A"). For a process model or a standard the type description is sufficient, but in other cases (for example project planning) generic process types are instantiated with respect to resources and time. When both generic types and particular instances are described, in order to differentiate between the two a typographical convention may be adopted (for example the title of the specific instance may be set in italic font).

NOTE The intent is to give a title not a summary. Noun-verb or verb-noun phrases lead to an attempt to summarise the purpose or process so that the title can stand for the purpose. This is often misleading. A descriptive noun phrase - the name of the process - is less open to misinterpretation and the temptation to let it stand in for the purpose.

4.3 The purpose element

The purpose of the process is stated as a high level, overall goal for performing the process. In cases where processes might be thought to overlap, the purpose should be used to characterize the scope or bounds of the process.

Whenever possible, the purpose should be succinctly captured in a single sentence. Summarizing the activities or outcomes of the process in the purpose statement should be avoided. Use of the conjunction "and" to connect multiple clauses should be avoided as it would indicate that the description is being written as an aggregation of marginally-related outcomes rather than as a statement of a single purpose. The

purpose element shall begin with the words, "The purpose of the xxx process is … ". The phrase, "in order to" may be useful in recording the objective of the process.

If any further explanation of the purpose of a process is desirable, it should be placed in informative Notes.

4.4 The outcomes element

An outcome is an observable result of the successful achievement of the process purpose. Outcomes are measurable, tangible, technical or business results that are achieved by a process, for example the results that are used by other processes. Outcomes are observable and assessable.

Outcomes should be differentiated from benefits, which are positive achievements from the execution of a process, often spread broadly across the business and not necessarily related to the technical or business intent of executing a process. Benefits are not usually assessable, or at least not assessable using process assessment approaches. A benefit might provide the motivation to execute a process, but it might not be the primary reason to do so. Benefits may be described in an informative note to the purpose statement.

a) The list of outcomes associated with a process shall be prefaced by the text, "As a result of successful implementation of this process...".

b) An outcome shall be phrased as a declarative sentence using a verb in the present tense. For example, if the preceding sentence was phrased as an outcome, it might read, "Outcomes are phrased as declarative sentences using verbs in the present tense." Typically, the verb is "is" or "are" although others may be used when appropriate.

c) Outcomes should be expressed in terms of a positive, observable objective, e.g. the production of an artefact, the provision of a service, a significant change of state, the successful maintenance of a desired state (e.g. safety), or the meeting of specified constraints (such as requirements, goals, etc).

d) Outcome statements should be no longer than two lines of text, about twenty words.

e) The number of outcomes for a process should fall within the range 3 to 7.

f) Although an outcome should express an observable result, it is not necessary to express the outcome as the production of a document, record of other item of information.

g) An outcome should express a single result. Hence, the use of the word "and" or "and/or" to conjoin clauses should be avoided; such constructions are better expressed as multiple outcomes.

h) Outcomes should be written so that it should not require the implementation of a process at any capability level higher than 1 to achieve all of the outcomes, considered as a group.

NOTE 1 Capability levels are defined in ISO/IEC 15504-2 as points on the six-point ordinal scale of process capability that represents the capability of the process; each level builds on the capability of the level below.

NOTE 2 In some cases (for example when the process goals and requirements are set by other standards, such as ISO 20000) the process outcomes cannot cover all of the process requirements and remain at level 1. In these cases the higher level outcomes can be indicated (for example by placement in a separate list, or in notes, or described in an annex) such that it is possible to identify and exclude or otherwise account for these outcomes in process assessments.

i) Outcomes should be written in a manner that is meaningful for any scope of applicability, e.g., for organizations of any relevant domain or size.

j) Outcomes should avoid requiring any specific method, technique or tool.

k) Outcomes should avoid requiring any specific process measures or management methods.

l) Outcomes should avoid presuming any particular sequence of execution and the reader should not be expected to presume any sequence.

m) There is no need to make a one-to-correspondence between outcomes and activities; in particular, it is not necessary to specify an activity for every outcome of a process or an outcome for every activity. The desired relationship is that the execution of the activities, considered as a group, should produce the set of outcomes, considered as a group.

n) Although outcomes should be meaningful and understandable when viewed in isolation, they should be based on terminology and concepts that are further explained by other material in the document.

o) As a test of completeness, the set of outcomes should be sufficient to achieve the stated purpose of the process.

p) As a test of relevancy, each outcome should be phrased so that it is necessary to the achievement of the purpose of the process.

A before-and-after example of applying these guidelines is shown in Figure 1.

This description of a process is taken from PDAM1 of ISO/IEC 12207	**Supplier monitoring** Purpose: The purpose of *Supplier monitoring* is to track and assess performance of the supplier against agreed requirements. Outcomes: — joint activities between customer and supplier shall be performed as needed; — information on technical progress shall be exchanged regularly with the supplier; — performance of the supplier shall be monitored against the agreed requirements.
Applying these rules, the statement could be improved as shown here.	**Supplier Monitoring** Purpose: The purpose of *Supplier Monitoring* is to keep up communication with the supplier in order to maintain visibility of progress, risks and commitments. Outcomes: As a result of successful implementation of this process: — Joint activities between customer and supplier are performed. — Information on technical progress is exchanged regularly with the supplier. — Performance of the supplier is monitored against the agreed requirements.

Figure 1. Example of application of the guidelines for drafting of outcomes

4.5 The activities element

Rather than describing the results of executing a process, activities describe a set of actions that might be undertaken to execute the process.

Activities are constructs for grouping together related tasks (see below). The activities provide a means to look at related tasks within the process to improve understanding and communication of the process. If an activity is cohesive enough, it can be converted to a lower-level process by defining a purpose and a set of outcomes.

NOTE Decompositions of more than three levels of process are likely to be confusing and hard to use.

The set of lower-level processes and activities associated with a process should "cover" the process. In other words, the set of lower-level processes and activities should, when considered as a group, address the achievement of all process outcomes and the satisfaction of the purpose of the process. Alternatively stated, any action falling within the scope of a process must fall within the scope of one of the lower-level processes or activities of the process.

Ideally, the definition of the activities of a process achieves a goal of "cohesion" in the same sense as that term applies to software design. The tasks within a single activity should be strongly related to each other and weakly related to those of other activities.

Placing timing or sequencing requirements on activities should be avoided because it limits application of the standards in alternative life cycle models. However, if timing or sequencing constraints are necessary, they should be explicitly stated. In the absence of any explicit statements, the reader should not be expected to assume any timing or sequencing. Thus, activities are not to be regarded as "steps" in performing a procedure. Instead, they are to be regarded as continuing responsibilities, but with a scope smaller than that of the entire process.

4.6 The task element

Tasks are written to define specific requirements, or provide recommendations on the execution of a conforming process.

A task is expressed in the form of a requirement, recommendation, or permissible action, intended to support the achievement of the outcomes of a process. For this purpose, the statement of a task employs certain auxiliary verbs (shall, should, and may) to differentiate between the distinct forms of a task. The verb "shall" is used to express a provision required for conformance (i.e. performance of the task is required), "should" to express a recommendation among other possibilities (i.e. performance of the task is recommended), and "may" to indicate a course of action permissible within the limits of the standard.

Unlike the process/activity relationship, the set of tasks within an activity is not required to "cover" the activity. (If it were, then the writers of process models would have to write a task regarding every item conceivable within the scope of an activity.) If we think in terms of Venn diagrams, then the total areas of all of the lower-level processes and activities equal the area of the process. The tasks, however, are points within the processes.

In specifying a set of tasks, the developers may wish to specify the achievement of capabilities beyond those associated with a Level 1 capability. The set of tasks defined for a process may thus go beyond the minimal achievement of process purpose. In other words, the set of tasks for a process should be sufficient to address all of the process outcomes, but may go beyond the minimum set necessary for this. For example, the set of tasks may include those associated with planning, monitoring and controlling process performance – reflecting Level 2 capability.

When additional tasks are provided, it may be helpful to provide informative mappings or other information explaining the role of the additional tasks. Examples include conformance requirements and achievement of higher levels of capability (on any scale).

Placing timing or sequencing requirements on tasks should be avoided because it limits application of the standards in alternative life cycle models. However, if timing or sequencing constraints are necessary, they

should be explicitly stated. In the absence of any explicit statements, the reader should not be expected to assume any timing or sequencing.

NOTE The descriptions in process models used for assessment may use the term "practice" or "base practice" in place of "task".

4.7 The information item element

Information items are process products that are of particular interest to life cycle management. Information items are separately identifiable bodies of information that are produced and stored for human use during a system or software life cycle. In other words they are the outputs from and inputs to system and software life cycle processes and are transformed by these processes.

NOTE Normative documents cannot specify inputs because there is no way to check conformance, i.e. there is no way for one to prove that they did not ignore specified inputs. So, normative requirements can, at best, describe only outputs.

Information items are a subset of work products (defined in ISO/IEC 15504-1 and used for the description of process assessment indicators). A work product is an artefact associated with the execution of a process. There are four generic work product categories: services (e.g. operation); software (e.g. computer program, documents, information, contents); hardware (e.g. computer, device); processed materials.

The description of an information item consists of a name and a set of characteristics.

Information item name The name associated with the information item characteristics. This name is provided as an identifier of the type of information item that the practice or process might produce. Organizations may call these information items by different names. The name of the information item in the organization is not significant. Similarly, organizations may have several equivalent information items which contain the characteristics defined in one information item type. The formats for the information items can vary.

Information item characteristics The potential characteristics associated with the information item type. Characteristics may relate to the purpose and use of an information item, and its contents, format and quality.

The use of generic types to classify information items simplifies the application of consistent structure, content and format of similar information items, and supports the usability of process models. The set of generic types used in ISO/IEC 15289:2006 to describe the information items implied or named in ISO/IEC 12207:1995 and 15288:2002 is given in Table 1.

Information Item name	Information item characteristics
Description	An account or representation of a proposed or actual object or concept. It may be a textual, pictorial, graphical or mathematical representation. It may be in a standardised form for human or machine interpretation. It may be a static or dynamic model or a simulation representing reality. It may establish order, structure, grouping or classification.
Plan	A proposed scheme or systematic course of action for achieving a declared purpose. It predicts how to successfully accomplish objectives in terms of specific actions, undertaken at defined times and employing defined resources. It may apply to technical, project or enterprise actions. At a high level of abstraction it may be a policy or, with reference to assets and their disposition, a strategy.
Procedure	A declared way of formally conducting a customary course of action. It defines an established and approved way or mode of conducting business in an organization. It may detail permissible or recommended method in order to achieve technical or managerial goals or outcomes.

Information Item name	Information item characteristics
Record	A permanent, readable form of data, information or knowledge. Accessible and maintained evidence of the existence or occurrence of facts, events or transactions. It may take the form of a journal chronicle, register or archive. It may contain the information to confirm achievement of performance, fiscal or legal conditions or obligations.
Report	An account prepared for interested parties in order to communicate status, results or outcomes. It is a result of information gathering, observation, investigation or assessments, and it may impart situation, affects, progress or achievement. It serves to inform so that decisions or subsequent actions can be taken.
Request	A communication that initiates a defined course of action or change in order to fulfil a need. This may originate or control on-going action based on an agreed plan or procedure. It may result in a proposal or plan of action. It may take the form of a solicitation, requisition, instruction or demand for a resource, product, service or an approval to act.
Specification	Criteria or conditions that place limits or restrictions on actions, attributes or qualities. It establishes measures or qualities for determining acceptability, conformance or merit. It may be required as part of an agreement or contract.

Table 1. ISO/IEC 15289 Generic information item types

4.8 Use of notes

Notes are used when there is a need for explanatory information to better describe the intent or mechanics of a process or process element. Notes provide insight regarding potential implementation or areas of applicability such as lists, examples and other considerations.

5 Using process views

5.1 Introduction

ISO/IEC 15288 and ISO/IEC 12207 provide the life cycle process reference models for systems and software in which outcomes are defined and activities grouped from the viewpoint of generic life cycle process definition. There are cases where those representing a particular sub-, related or special interest would like to see their set of relevant activities and particular outcomes grouped in a single place. This clause provides a means of defining such a point of view and organizing the resulting view of a reference set of processes in a manner consistent with a process reference model. Using process views reduces the proliferation of special-interest process models and supports consistency of implementation and assessment.

5.2 The process view concept

There may be cases where a unified focus is needed for activities and tasks that are selected from disparate processes to provide visibility to a significant concept or thread that cuts across the processes employed across the life cycle. It is useful to advise users of the standards how to identify and define these activities for their use, even though they cannot locate a single process that addresses their specific concern.

For this purpose, the concept of a **process view** has been formulated. Like a process, the description of a process view includes a statement of purpose and outcomes. Unlike a process, the description of a process view does not include activities and tasks. Instead, the description includes guidance explaining how the outcomes can be achieved by employing the activities and tasks of the various processes in and existing process model or models. In the case of SC7 these models are ISO/IEC 15288 and ISO/IEC 12207.

5.3 Process viewpoint

A process view conforms to a process viewpoint. The process viewpoint provided here can be used to create process views. It is important to establish the set of concerns being addressed by the process viewpoint (and therefore by a process view), and the likely ("generic") stakeholders for such a view who would have these concerns.

The requirements for documenting viewpoints can be found in ISO/IEC 42010:2007, sub-clause 5.3. The following description is consistent with those requirements.

The Process viewpoint is defined by:

— its stakeholders, the users of the standard (generic stakeholders include: process authors, process users, process evaluators);

— the concerns it frames, the processes needed to reflect a particular engineering interest (the concerns here would be: What are the set of processes we have? How do they connect (outputs of one to inputs of the next)? Where do they come from (i.e. which are from 12207, which are from 15288, which are added/modified by this organization?)).

5.4 Process view

Process views can be constructed using the process viewpoint template found in sub-sub-clause 3.8.3 of ISO/IEC 42010:2007.

The contents of resulting process views should include:

— process view name;

— process view purpose;

— process view outcomes; and

— identification and description of the processes, activities and tasks which implement the process view, and sufficient reference to the sources for these processes, activities and tasks in other standards to ensure traceability of each element.

A clear, bounding (process) system of interest should be defined for any set of process views. This is analogous to the scope of a process model.

An example of a process view, for specialty engineering, is given in Annex B.

Annex A Example process description

A.1 Introduction

The following text has been derived from ISO/IEC 15288 as an example of a process described using the guidelines.

A.2 Disposal process

A.2.1 Purpose

The purpose of the Disposal Process is to end the existence of a system entity.

This process deactivates, disassembles and removes the system and any waste products, consigning them to a final condition and returning the environment to its original or an acceptable condition…

A.2.2 Outcomes

As a result of the successful implementation of the Disposal Process:

a) A system disposal strategy is defined.

b) Disposal constraints are provided as inputs to requirements.

c) The system elements or waste products are destroyed, stored, reclaimed or recycled.

d) The environment is returned to its original or an agreed state.

e) Records allowing knowledge retention of disposal actions and the analysis of long-term hazards are available.

A.2.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Disposal Process.

a) **Plan disposal**. This activity consists of the following tasks:

1) Define a disposal strategy for the system, to include each system element and any resulting waste products.

2) Unavoidable constraints on the system design arising from the disposal strategy are communicated.

3) Specify containment facilities, storage locations, inspection criteria and storage periods if the system is to be stored.

b) **Perform disposal**. This activity consists of the following tasks:

1) Acquire the enabling systems or services to be used during disposal of a system.

2) Deactivate the system to prepare it for removal from operation.

3) Withdraw operating staff from the system and record relevant operating knowledge.

NOTE This is conducted in accordance with relevant safety, security, privacy and environmental standards, directives and laws.

4) Disassemble the system into manageable elements to facilitate its removal for reuse, recycling, reconditioning, overhaul, archiving or destruction.

5) Remove the system from the operational environment for reuse, recycling, reconditioning, overhaul or destruction.

6) Conduct destruction of the system, as necessary, to reduce the amount of waste treatment or to make the waste easier to handle.

c) **Finalize the disposal**. This activity consists of the following tasks:

1) Confirm that no detrimental health, safety, security and environmental factors exist following disposal.

2) Archive information gathered through the lifetime of the system to permit audits and reviews in the event of long-term hazards to health, safety, security and the environment, and to permit future system creators and users to build a knowledge base from past experiences.

Annex B Example process view

B.1 Introduction

This section provides an example of applying the process viewpoint to yield a process view for specialty engineering, intended to illustrate how a project might assemble processes, activities and tasks of ISO/IEC 15288 to provide focused attention to the achievement of product characteristics that have been selected as being of special interest.

The process viewpoint for this example is the cluster of interests, generally called specialty engineering, which includes but is not limited to such areas as availability, maintainability, reliability, safety, security, human factors, and usability. These "-ilities" are sometimes referred to as "quality characteristics". These characteristics determine how well the product meets its specified requirements in an area selected for focus.

NOTE This is a generalized example that is provided for illustrative purposes and covers a broad set of functional and non-functional characteristics. It provides a broad perspective across the processes in 15288. For actual usage, a process viewpoint should be created for the specific specialty engineering concern.

B.2 Specialty engineering process view

B.2.1 Purpose

The purpose of the Specialty Engineering Process View is to provide objective evidence that the system achieves satisfactory levels of certain characteristics selected for special attention.

B.2.2 Outcomes

a) Product quality characteristics are selected for special attention.

b) Requirements for the achievement of the characteristics are defined.

c) Measures for the requirements are selected and related to the desired characteristics.

d) Approaches for achieving the desired characteristics are designed and implemented.

e) The extent of achievement of the requirements is continuously monitored and communicated to stakeholders and managers.

f) The artefacts for documenting and communicating the extent of achievement are specified, developed and maintained.

NOTE The outcomes permit the possibility that the desired characteristics cannot be directly measured but instead might be argued and inferred based on other product or process characteristics that can be measured.

B.2.3 Processes, activities and tasks

This process view can be implemented using the following processes, activities, and tasks from ISO/IEC 15288:

g) The Stakeholder Requirements Definition Process (6.4.1) provides for the selection and definition of characteristics, including quality characteristics, and an artefact for documenting them. The activities and the documentation are useful in defining and recording requirements for special characteristics. Relevant activities and tasks include (a)(1) and (2); (b)(2) and (4); and (c)(5).

NOTE ISO/IEC 25030, *Software Engineering — Software product quality requirements and evaluation (SQuaRE) —* Quality requirements, may be useful in specifying software product quality requirements.

h) The Requirements Analysis Process (6.4.2) provides for the selection of measures for the specialty requirements. Relevant activities and tasks include (a)(4) and (5).

NOTE ISO/IEC 25030, *Software Engineering — Software product quality requirements and evaluation (SQuaRE) — Quality requirements*, may be useful in specifying software product quality requirements.

i) The Architectural Design Process (6.4.3) provides for the creation of design criteria for the specialty characteristics and the evaluation of alternative designs with respect to those criteria. Relevant activities and tasks include (b)(1) and (4).

j) The Implementation Process (6.4.4) provides for recording the evidence that specialty requirements have been met. Relevant activities and tasks include (b)(2).

k) The Integration Process (6.4.5) provides for planning the integration, including the considerations for specialty characteristics, and the assurance that the achievement of the characteristics is verified and recorded. Relevant activities and tasks include (a)(1); and (b)(3) and (5).

l) The Verification process (6.4.6) provides for the planning and execution of a strategy to perform verification, including the specialty properties. The selected verification strategy may introduce design constraints that could affect the achievement of the properties. Relevant activities and tasks include (a)(1) and (3); and (b)(2), (3), and (4).

m) The Transition Process (6.4.7) provides for installing the system in its operational environment. Because some specialty properties involve a trade-off between design constraints and operational constraints, attention to installation is often important. Relevant activities and tasks include (b) (2), (3), (5), and (6).

n) The Validation Process (6.4.8) provides evidence that the services provided by the system meet the stakeholders' needs, including the specialty properties. Relevant activities and tasks include (b)(3) and (5).

o) The Operation Process (6.4.9) provides for usage of the system. Assuring that the specialty requirements are appropriately achieved involves monitoring the operation of the system. Relevant activities and task include (c)(2); and (d)(1) and (2).

p) The Maintenance process (6.4.10) sustains the capabilities of the system, including its specialty properties. Relevant activities and tasks include (b)(3), (4), and (8).

q) The Disposal Process (6.4.11) ends the existence of a system. The inherent need to anticipate disposal may place constraints on its development. In fact, these constraints may themselves be the subject of specialty engineering. Relevant activities and tasks include (a)(2) and (c)(2).

r) The Project Assessment and Control Process (6.3.2) provides for monitoring the extent of achievement of the requirements and communicating the results to stakeholders and managers. Relevant activities and tasks include (a)(8) and (9).

s) The Information Management Process (6.3.6), in its entirety, provides for the specification, development and maintenance of artefacts for documenting and communicating the extent of achievement. It should be noted that artefacts used for the purpose of specialty engineering are sometimes specialized in nature. Sources for the description of these artefacts include industry associations, regulators, and specific standards.

t) The Measurement Process (6.3.7), in its entirety, provides for defining an approach that relates measures to the desired specialty characteristics.