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Software and systems 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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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.

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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, *Software and systems engineering*.

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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 Technical Report 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 Technical Report can be applied to any process model developed for any purpose. They 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.

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Software and systems engineering — Life cycle management — Guidelines for process description

1 Scope

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

— title;

— purpose;

— outcomes;

— activities;

— tasks.

This Technical Report does not describe how processes are composed or otherwise aggregated into larger frameworks or architectures.

NOTE Future work may set out rules for guiding standards developers in formulating the definition, scope, granularity, decomposition, scale and number of processes.

The intended audience for this Technical Report 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 attributes suitable for their project from those described in this Technical Report. It is further intended that, having selected the appropriate attributes, readers of this Technical Report will apply them in a manner consistent with the guidance provided by this Technical Report.

This Technical Report 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 and process assessors. These process models may be for the purpose of process definition, implementation or assessment.

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 International Standards in this area are ISO/IEC 12207, *Information technology — Software life cycle processes*, and ISO/IEC 15288, *Systems engineering — System life cycle processes*. Other International Standards, such as ISO/IEC 15939, *Systems and software engineering — Measurement process*, and ISO/IEC 16085, *Systems and software engineering — Life cycle processes — Risk management*, provide further characterization of a single life cycle process by elaborating the process attributes and levying specific requirements on the execution of the process. The decomposition is described by use of the activity attribute. When instantiated for an organization or project, other details are added (entrance/exit criteria, actors, artefacts).

The assessment of process capability falls within the scope of ISO/IEC JTC 1/SC 7/WG 10. The existing International Standard in this area is ISO/IEC 15504-2, *Information technology — Process assessment — Part 2: Performing an assessment*. ISO/IEC 15504-2 provides requirements for assessing capability of

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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 ISO/IEC 15504-2.

NOTE 1 In addition to the attributes described in this Technical Report, ISO/IEC 15504 defines and uses the attribute Work Product. A work product is an artefact associated with the execution of a process (ISO 9000). There are four generic product categories as follows: services (e.g. operation); software (e.g. computer program, documents, information, contents); hardware (e.g. computer, device); processed materials.

NOTE 2 In addition to the attributes described in this Technical Report, ISO/IEC 15504 defines and uses the attribute Assessment Indicator. An assessment indicator is a source of objective evidence used to support an assessor’s judgement in rating process attributes. 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 International Standards developed in that working group provide notations that may be useful in detailed process description for other purposes.

The goals and objectives of performing a process can be described by using the attributes of title, purpose and outcomes. These attributes 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.

Not all attributes need to be treated in all standards. Some standards will treat only process title, purpose and outcomes, leaving the activities for further elaboration by other standards.

3 Characterizing the attributes

3.1 Introduction

To enable uniform description additional characterization of the attributes is helpful. The remainder of this Technical Report provides that characterization.

The process attributes to be used by International Standards developed by SC 7 are as follows.

— The title conveys the scope of the process as a whole.

— 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.

3.2 The title attribute

The title of a process is a short noun phrase intended to summarize the scope of the process, identify the principal concern of the process, and distinguish it from other processes within the scope of a process 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 “design screen layout”), and to describe a particular instance of a generic type (for example “design layout of screen 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).

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3.3 The purpose attribute

The purpose of the process is stated as a high level, overall goal for performing the process. The implementation of the process should provide measurable, tangible benefits to the stakeholders through the expected outcomes. 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 attribute shall begin with the words "The purpose of the xxx process is …". The phrase "in order to" may be useful in recording the benefit of the process.

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

3.4 The outcomes attribute

An outcome is an observable result of the successful achievement of the process purpose. An outcome is often phrased in terms of the benefit of executing the process. Although any kind of result may be observable, it is the benefit that motivates the party to execute the process.

a) Outcomes should be expressed in terms of a positive, observable objective or benefit, 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 (requirements, goals, etc.).

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

c) 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.

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 or 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 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.

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.

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m) There is no need to make an explicit linkage between outcomes and activities; in particular, it is not necessary to specify an activity for every outcome of a process.

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.

A before-and-after example of the application of 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

3.5 The activities attribute

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.

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,

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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.

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

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 actions within a single activity should be strongly related to each other and weakly related to those of other activities.

It should not be assumed that the reader of a set of activities will make any presumption about time-sequencing or other dependencies among the activities. Any assumptions or requirements of time-sequence or other dependencies must be explicitly stated. 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.

3.6 The task attribute

Tasks are written as sub-clauses 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, “should” to express a recommendation among other possibilities, 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).

It is not to be assumed that the reader of a set of tasks will make any presumption about time-sequencing or other dependencies among the tasks. Therefore, any assumptions of time-sequencing or other dependencies should be explicitly stated.

3.7 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 attribute. Notes provide insight regarding potential implementation or areas of applicability such as lists, examples and other considerations.

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