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Software and systems engineering — Tools and methods for product line requirements engineering

Ingénierie du logiciel et des systèmes — Outils et méthodes pour l'ingénierie d'exigences pour gammes de produits

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and systems engineering*.

This second edition of ISO/IEC 26551 cancels and replaces the first edition (ISO/IEC 26551:2012), which has been technically revised.

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Introduction

The main purpose of this International Standard is to establish a baseline for the capabilities of tools and methods of software and systems product line (SSPL) requirements engineering. This International Standard defines how the tools and methods can support the software and systems product line specific requirements engineering processes.

A decision for the initial boundaries of domain is made to define a product line scope before initiating domain requirements engineering processes. Domain requirements engineering is carried out in a comprehensive manner because common and variable requirements and captured variabilities have consequential impacts on member products in a product line. The outcomes of domain requirements engineering processes are transferred into the requirements of a family of products at the application requirements engineering processes. Therefore, requirements engineering tools and methods are to be considered (both engineering processes), namely domain requirements engineering, and application requirements engineering.

Product line requirements engineering can be differentiated from a single product requirement engineering because of the following reasons:

— There are two core processes in requirements engineering, domain requirements engineering and application requirements engineering. The major aims of the domain requirements engineering processes are to analyse commonality and variability for a family of products and to prepare necessary variability information for variability modelling. The major aims of the application requirements engineering processes are to define application specific requirements and bind variability defined in domain requirements engineering processes;

— It is essential to analyse the costs and benefits estimate of a product line and thereby, an organization can make a go/no-go decision. Moreover, the costs and benefits estimate plays a pivotal role as an indicator for assessing the effectiveness and efficiency of a product line.

A detailed comparison showing the differences in requirements engineeing tasks between single product and product line is described in Annex A.

This International Standard can be used in the following modes:

— by the users of this International Standard: to benefit people who develop, operate, and manage requirements engineering for software and systems product lines;

— by a product line organization: to provide guidance in the evaluation and selection for tools and methods for product line requirements engineering;

— by providers of tools and methods: to provide guidance in implementing or developing tools and methods by providing a comprehensive set of the capabilities of tools and methods for product line requirements engineering.

The ISO/IEC 26550 family of standards addresses both engineering and management processes and covers the key characteristics of product line development. The ISO/IEC 26550 family of standards provides an overview of the consecutive International Standards (i.e. this International Standard through ISO/IEC 26599), as well as the structure of the model:

ISO/IEC 26550, ISO/IEC 26551 and ISO/IEC 26555 are published. ISO/IEC 26557, ISO/IEC 26558 and ISO/IEC 26559 are to be published. ISO/IEC 26552, ISO/IEC 26553, ISO/IEC 26554, ISO/IEC 26556, ISO/IEC 26560, ISO/IEC 26561, ISO/IEC 26562, ISO/IEC 26563 are planned International Standards.

— Processes and capabilities of methods and tools for domain requirements engineering and application requirements engineering are provided in this International Standard;

— Processes and capabilities of methods and tools for domain design and application design are provided in ISO/IEC 26552 (International Standard under development);

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— Processes and capabilities of methods and tools for domain realization and application realization are provided in ISO/IEC 26553 (International Standard under development);

— Processes and capabilities of methods and tools for domain testing and application testing are provided in ISO/IEC 26554 (International Standard under development);

— Processes and capabilities of methods and tools for technical management are provided in ISO/IEC 26555;

— Processes and capabilities of methods and tools for organizational management are provided in ISO/IEC 26556 (International Standard under development);

— Processes and capabilities of methods and tools for variability mechanisms are provided in ISO/IEC 26557;

— Processes and capabilities of methods and tools for variability modeling are provided in ISO/IEC 26558;

— Processes and capabilities of methods and tools for variability traceability are provided in ISO/IEC 26559;

— Processes and capabilities of methods and tools for product management are provided in ISO/IEC 26560 (International Standard under development);

— Processes and capabilities of methods and tools for technical probe are provided in ISO/IEC 26561 (International Standard under development);

— Processes and capabilities of methods and tools for transition management are provided in ISO/IEC 26562 (International Standard under development);

— Processes and capabilities of methods and tools for configuration management of asset are provided in ISO/IEC 26563 (International Standard under development);

— Others (ISO/IEC 26564 to ISO/IEC 26599): To be developed.

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Software and systems engineering — Tools and methods for product line requirements engineering

1 Scope

This International Standard, within the context of tools and methods of requirements engineering for software and systems product lines**:**

— provides the terms and definitions specific to requirements engineering for software and systems product lines and associated member products;

— defines process groups and their processes performed during product line requirements engineering (those processes are described in terms of purpose, inputs, tasks, and outcomes);

— defines method capabilities to support the defined tasks of each process;

— defines tool capabilities to automate/semi-automate tasks or defined method capabilities.

This International Standard concerns processes and capabilities of requirements tools and methods for a family of products, not for a single system.

This International Standard is not applicable to physical artefacts. Instead, system-level artefacts and software lifecycle artefacts such as requirements documents, architectural data, validation plans, behavioural models, etc. are produced using methods and tools in this International Standard. In the case of the software components of a system, this International Standard can apply twice: once to handle the system elements of the product line and a second time to handle the software elements of the product line, if any. The product line processes are recursive within the different levels of products.

NOTE The requirements in this International Standard apply to the family of systems, software or services.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

3.1
application assets in requirements
application specific artefacts produced during application requirements engineering such as *application requirements specifications* (3.4) and application requirements models

3.2
application requirements elicitation
subprocess for identifying stakeholders relevant to an application, eliciting application specific requirements, and binding the appropriate variants

3.3
application requirements analysis
subprocess that understands all *application specific requirements* (3.8), scrutinizes incorrect and inconsistent application requirements through modelling, and then analyses and negotiates application requirements that cannot be satisfied through the domain requirements

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3.4
application requirements specification
subprocess that documents the *application specific requirements* (3.8) and integrates it with the *domain requirements specification* (3.12) whose variants are bound

3.5
application requirements verification and validation
subprocess that confirms that the *application specific requirements* (3.8) are consistent and feasible and ensures that the bound variants satisfy the specific product's requirements

3.6
application requirements management
subprocess that manages traceability and changes on application requirements

3.7
aspect
special consideration within product line engineering process groups and tasks to which we can associate specialized methods and tools

3.8
asset proposal
artefact that includes major assets (functional areas and high-level common and variable features of all applications) that can be included in a product line with their quantified costs and benefits, and estimate results

3.9
application specific requirements
requirements specific to an application or requirements not covered in domain requirements

3.10
domain assets in requirements
reusable artefacts produced during domain requirements engineering such as *asset proposals* (3.7), *domain requirements specifications* (3.12), and domain requirements models

3.11
domain requirements elicitation
subprocess that identifies initial requirements from domain stakeholders for a product line

3.12
domain requirements analysis
subprocess that models domain requirements so as to analyse and scrutinize commonality/variability of a product line in requirements

3.13
domain requirements specification
subprocess that documents domain requirements for a product line based on domain analysis results

3.14
domain requirements verification and validation
subprocess that confirms that domain requirements are correct, consistent, and complete

3.15
domain requirements management
subprocess that manages traceability and changes with respect to domain requirements and their relevant domain/application artefacts

3.16
functional domain
categorized functions that are generally used together

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3.17
production plan
description of how domain assets are to be used to develop member products in a product line

3.18
requirements traceability
traceabilities in domain and application requirements respectively and those between them

3.19
texture
architectural texture
collection of common development rules and constraints for realising the applications of a product line

3.20
variability in requirements
external and internal variability in requirements engineering

Note 1 to entry: Variability modelling and traceability with domain requirements artefacts are also addressed.

4 Reference model for product line requirements engineering

The methods and tools for product line requirements engineering should support systematic management and interaction of the domain and application requirements engineering processes. They also need to be adequately integrated with the other product line engineering lifecycle processes in order to enable traceability between all requirements artefacts and the related design, realization, and testing artefacts. In the rest of this International Standard, product line requirements engineering practices, methods, and tools are described in accordance with a framework focusing on product line requirements engineering (Figure 1).

Product line scoping leads and controls all work on a product line by creating and maintaining the product line scope through ongoing interactions with the domain and application requirements engineering.

Domain requirements engineering serves to:

— decompose features defined in product line scoping into initial requirements and elicit additional requirements and derived requirements from stakeholders and domain experts;

— analyse domain requirements with variabilities in requirements;

— model and simulate the static and behavioural constructs of domain requirements;

— document domain requirements specifications that can be bound by specific member products of a product line.

The complexity of variability grows in accordance with the complexity of a product line. Separating variability from domain requirements engineering mitigates this problem. Defining variability in requirements independently leads to a clear understanding of the necessary capabilities of tools and methods, and thus helps in selecting tools that support product line requirements engineering.

Application requirements engineering serves to:

— identify gaps between domain features and application specific features;

— reuse domain requirements from the asset repository and elicit application specific requirements;

— define application variability model by binding domain variability model and adding application specific variability;

— analyse and document application specific requirements;

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