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Software and systems engineering — Methods and tools for variability traceability in software and systems product line

Ingénierie des systèmes et du logiciel — Méthodes et outils pour modéliser la traçabilité dans les gammes de produits des logiciels et systèmes

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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).

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and systems engineering*.

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Introduction

Software and Systems Product Line (SSPL) engineering and management creates, exploits and manages a common platform to develop a family of products (e.g. software products, systems architectures) at lower cost, reduced time to market and with better quality. As a result, it has gained increasing global attention since the 1990s.

Variability, which differentiates a member product from other products within a product line, plays an important role in SSPL; and hundreds of variabilities are introduced throughout the whole SSPL domain engineering stages. Those variabilities are defined, refined, newly added as domain engineering stages go forward. Variabilities thus are modelled carefully so as to manage and control them in a systematic way. This document deals with methods and tools capability for supporting variability modelling using consistent notations and for managing and/or utilizing variability models in domain and application engineering lifecycle processes.

This document can be used in the following modes:

— by the users of this document: to benefit people who want to adopt SSPL for producing their products by guiding how to model variabilities among member products;

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

— by providers of tools and methods: to provide guidance in implementing or developing methods and tools by providing a comprehensive set of methods and tools capabilities for supporting variability modelling.

The ISO/IEC 26550 family of standards addresses both engineering and management processes and capabilities of methods and tools in terms of the key characteristics of product line development. This document provides processes and capabilities of methods and tools for variability modelling in product lines. Other ISO/IEC 26550 family of standards are as follows:

— processes and capabilities of methods and tools for domain requirements engineering and application requirements engineering are provided in ISO/IEC 26551;

— processes and capabilities of methods and tools for domain design and application design are provided in ISO/IEC 26552;

— processes and capabilities of methods and tools for domain realization and application realization are provided in ISO/IEC 26553;

— processes and capabilities of methods and tools for domain testing and application testing are provided in ISO/IEC 26554;

— 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;

— 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 traceability are provided in ISO/IEC 26559;

— processes and capabilities of methods and tools for product management are provided in ISO/IEC 26560;

— processes and capabilities of methods and tools for technical probe are provided in ISO/IEC 26561;

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— processes and capabilities of methods and tools for transition management are provided in ISO/IEC 26562;

— processes and capabilities of methods and tools for configuration management of asset are provided in ISO/IEC 26563;

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

ISO/IEC 26550, ISO/IEC 26551 and ISO/IEC 26555 are published. ISO/IEC 26557 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.

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Software and systems engineering — Methods and tools for variability traceability in software and systems product line

1 Scope

This document, within the context of the tools and methods of variability traceability for software and system product lines**:**

— provides the terms and definitions specific to variability traceability for software and systems product lines;

— defines process groups and their processes for establishing and managing variability traceability at product line lifecycle processes. 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 document does not concern processes and capabilities of tools and methods for a single system but rather deals with those for a family of products.

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.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
aspect
special consideration within product line engineering process groups and tasks to which we can associate specialized methods and tools

3.2
instantiated trace link
trace link (3.6) derived by applying binding in a member product

3.3
texture
architectural texture
collection of common development rules and constraints for realising the applications of a product line

3.4
traceability
discernible association among two or more logical entities, such as requirements, system elements, verifications, or tasks

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3.5
traceability with different abstraction level
level of detail for established *traceability* (3.4)

EXAMPLE The finer level of detail, the more general level.

3.6
trace link
association between two trace artefacts or between an element of variability model and a development artefact

3.7
trace link semantics
purpose or meaning of the *trace link* (3.6), specified in the trace link types

EXAMPLE 'Implements', 'refines', 'requires' and 'excludes'.

3.8
variability traceability
traceability (3.4) among variability definition, variability implementation in domain engineering and application engineering, and thereafter tracing impacts due to variability changes

3.9
variant
instance or value of a *variation point* (3.10)

3.10
variation point
indication of product differentiation based on particular variable characteristics of products, domain assets, and application assets in the context of a product line

4 Abbreviated terms

CRUD create, read, update, delete

OVM orthogonal variability model

SSPL software and systems product line

5 Reference model for variability traceability in software and systems product line

5.1 Overview

Variability is a key differentiator between single-system engineering and management and product line engineering and management. Product line engineering and management has to take explicitly into account the variations within and between multiple products. The product line variabilities are introduced and defined during product management, domain engineering and application engineering processes defined in ISO/IEC 26550. Explicitly defined variability is represented or implemented by different development artifacts, and it should be traced for the proper management. Variability traceability enables tracing variabilities defined in variability models from their introduction stage to binding stage. Variability tracing should be able to trace variability with all of relevant development artefacts of domain engineering and application engineering processes of ISO/IEC 26550.

SSPL traceability provides a set of linkages of artefacts in a product line. Compared to the traceability of single product development, SSPL traceability is more complex because SSPL has two separate but intimately related development processes, i.e. domain engineering and application engineering. SSPL traceability includes trace links between artefacts within the same stages, trace links between

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