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ISO/IEC 26566

Software and systems engineering — Methods and tools for product line texture

Ingénierie logiciel et système — Méthodes et outils pour la texture d'une ligne de produits

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Foreword

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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 a lower cost, with reduced time to market and better quality. As a result, it has gained increasing global attention since the 1990s.

SSPL engineering uses platforms to facilitate mass customization. To facilitate this, SSPL engineering establishes two distinct engineering processes: domain engineering and application engineering. Domain engineering process is responsible for producing a reusable platform, while application engineering process reuses the platform to derive planned member products. When application engineering derives a member product from the platform, it exploits the defined variability and adds application-specific variability not defined in domain engineering. For correct binding of variability and integrating application-specific variability, domain engineering provides detailed guidelines, rules, and restrictions, and application engineering should follow them to help ensure that the right member products will be derived. Product line textures indicates the guidelines, rules, and restrictions. They may be defined at any product line engineering processes. A texture defined at a specific domain engineering process takes effect on the subsequent processes as well as its related application engineering process. This document deals with methods and tools for product line textures that are aware of these aspects.

This document can be used in the following modes:

— by organizations that want to adopt SSPL for producing their products – to provide guidance on how to define and validate textures, and how to check conformance to textures;

— by a product line organization – to provide guidance on the evaluation and selection for methods and tools for product line textures;

— by providers of either methods or tools, or both – to provide guidance on implementing or developing either methods or tools, or both, by specifying a comprehensive set of methods and tools capabilities for supporting product line textures.

Documents on product line engineering and management developed by ISO/IEC JTC 1 address both engineering and management processes and capabilities of methods and tools in terms of the critical characteristics of product line development. This document provides processes and capabilities of methods and tools for product line textures. Standards in the ISO/IEC 26550 family include ISO/IEC 26550, ISO/IEC 26551, ISO/IEC 26552, ISO/IEC 26553, ISO/IEC 26554, ISO/IEC 26555, ISO/IEC 26556, ISO/IEC 26557, ISO/IEC 26558, ISO/IEC 26559, ISO/IEC 26560, ISO/IEC 26561, ISO/IEC 26562, ISO/IEC 26563, ISO/IEC 26564, and ISO/IEC 26565.

— 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 modelling 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 line product management are provided in ISO/IEC 26560;

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

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

— Processes and capabilities of methods and tools for product line configuration management are provided in ISO/IEC 26563;

— Processes and capabilities of methods and tools for product line measurement are provided in ISO/IEC 26564;

— Processes and capabilities of methods and tools for product line maturity framework are provided in ISO/IEC 26565 (International Standard under development);

— Others (ISO/IEC 26567 to ISO/IEC 26599): To be developed.

Software and systems engineering — Methods and tools for product line texture

1 Scope

This document, within the context of methods' and tools' capability for supporting product line texture, defines**:**

— processes for product line texture management, operationalization, and support; those processes are described in terms of purpose, inputs, tasks, and outcomes;

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

— tool capabilities that automate or semi-automate tasks and methods.

This document does not concern the 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 terminology databases for use in standardization at the following addresses:

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

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

3.1
product line platform
platform
product line architecture (3.2), a configuration management plan, and domain assets enabling application engineering to effectively reuse and produce a set of derivative products

[SOURCE: ISO/IEC 26550:2015, 3.18, modified — The preferred term "platform" has been added; note 1 to entry has been removed.]

3.2
product line architecture
core architecture that captures the high-level design of a software and systems product line including the architectural structure and texture (e.g. common rules and constraints) that constrains all member products within a software and systems product line

[SOURCE: ISO/IEC 26550:2015, 3.10, modified — The preferred terms "domain architecture" and "reference architecture" have been removed; note 1 to entry has been removed.]

3.3
product line texture
guidelines, rules, and restrictions, which are used throughout product line engineering, ensuring consistent approach of interpreting and applying domain engineering and application engineering

3.4
trace link
association between two trace artefacts or between an element of variability model and a development artefact

[SOURCE: ISO/IEC 26559:2017, 3.6]

4 Reference model for product line texture

4.1 Overview

SSPL develops a set of similar products from a common platform that define and implement commonalities and variabilities of a product line. The quality of the platform determines the quality of products developed within a product line. For quickly developing high-quality products based on the platform, the platform should enable the correct reuse and adaptation of its constituent elements. Product line textures provide commonalities that the platform defines as well as guidance, rules, and constraints related to variabilities that allow for platform extension, adaptation, substitution, and exclusion.

SSPL consists of two different lifecycle processes: domain engineering and application engineering. Domain engineering develops a common platform that will be reused in application engineering for developing each member product of a product line. Textures may be defined in application engineering to restrict the subsequent phase, but in SSPL most important textures are defined in domain engineering with the development of a common platform.

Product line textures tell relevant roles and responsibilities how to work out the elements of the platform in detail, how to reuse, adapt, extend, or evolve the elements of the platform. Product line texture is used throughout product line engineering, ensuring consistent approach of interpreting and applying the platform. To enable the platform's predictable performance, product line textures should be clearly defined, focusing solely on elements to help ensure compatibility, reusability, ease of member product development, as well as the robustness and flexibility of a platform. Product line texture helps ensure the platform remains cohesive throughout all product line lifecycle phases.

Product line texture also defines common approaches to deal with product line variability in domain and application engineering. Product line texture should guide how to model variabilities, how to refine variabilities from feature level to internal variabilities, how to combine correct variabilities to the right places. Variability mechanisms used for expressing or implementing variabilities in analysis models, design models, and realization are product line textures that relevant roles and responsibilities should adhere to deal with variabilities at the relevant phases. As an example, architecture texture tells how product line architecture works out and solve given domain problems, guides domain realization and member product development by providing common approaches used to perform their tasks and solve problems. Architectural texture includes architectural style, patterns, tactics, coding conventions, and algorithms. The architectural texture also helps ensure a coherent evolution of product line architecture over time.

4.2 Constituents of reference model for product line texture

The reference model specifies the structure of supporting processes and subprocesses for a product line texture. Figure 1 shows that a product line texture is structured into three processes: product line texture management, product line texture operationalization, and product line texture support. In the rest of this document, tasks, methods, and tools are described for processes and subprocesses defined in the reference model.

Each process is divided into subprocesses, and each subprocess is described in terms of the following attributes:

— the title of the subprocess;

— the purpose of the subprocess;

— the inputs to produce the outcomes;

— the tasks to achieve the outcomes;

— the outcomes of the subprocess.

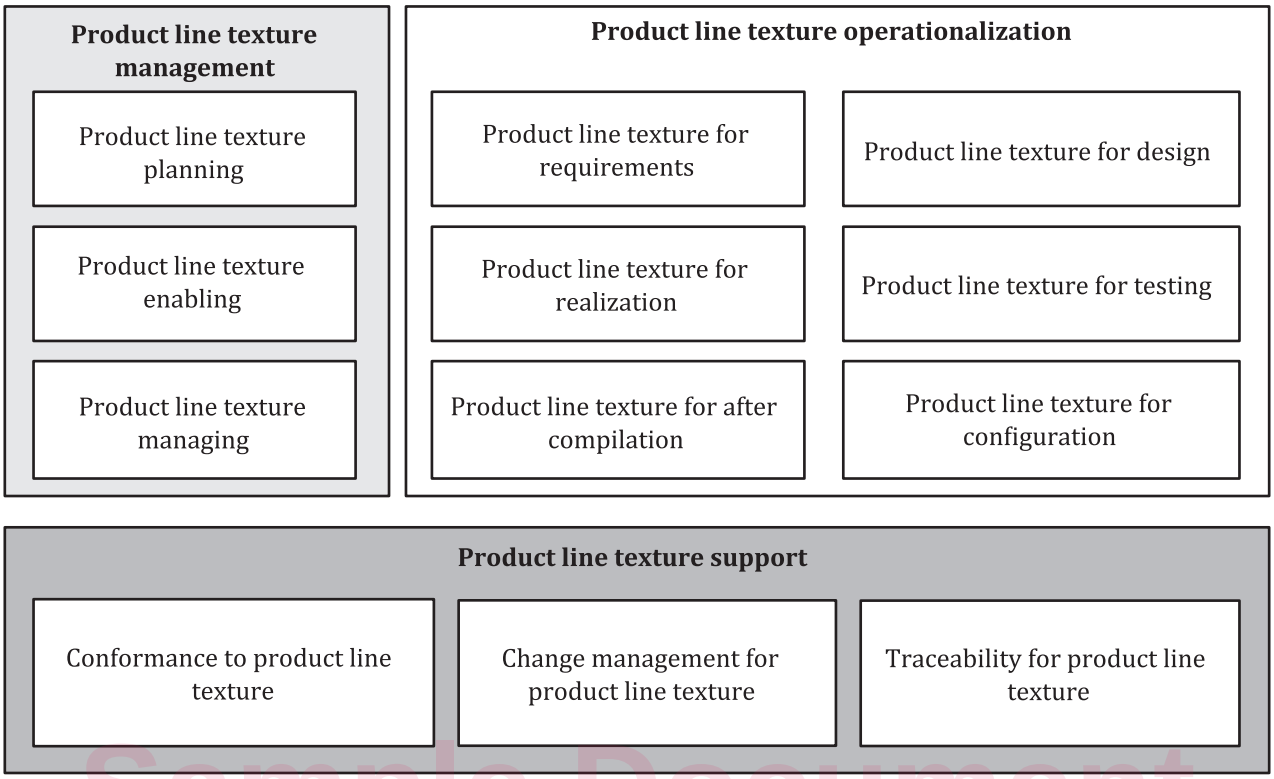

Figure 1 — Reference model for product line texture

The product line texture management process serves three essential subprocesses: planning of product line texture, encompassing aspects like strategy, resource estimation, responsibility allocation, and defining measures and validation criteria; facilitating the provision of necessary resources, tools, and infrastructures required to deploy the product line texture plan effectively; analysing and comparing the actual status of product line texture with the plan. The product line texture management includes the following subprocesses:

— product line texture planning involves establishing plans for defining, operationalizing and maintaining product line texture; The product line texture plans include validation for the conformance of a platform and application engineering processes with the relevant product line texture; adequacy to business goals, strategies, responsibilities and authorities, criteria for defining and validating product line texture, applicable policies, effectiveness measures of product line texture, and required tools and resources.

— product line texture enabling helps ensure the availability of environments and resources necessary for defining, operationalizing and maintaining product line texture; Environments for product line texture should support the unambiguous definition and conveyance of product line texture in domain engineering and application engineering processes, enabling providers and users of product line texture to fulfill their roles and responsibilities coherently; Guidance on defining the suitable extent of product line texture in the suitable placement helps prevent it excessive use.

— product line texture managing provides integrated management for the operationalization of product line texture; this subprocess involves reviewing the current status of product line texture operationalization against the established plans, addressing any issues, and taking corrective actions as needed.

The product line texture operationalization process encompasses subprocesses for defining, formulating, and maintaining of product line texture throughout the product line lifecycle phases. This process involves

identifying common rules and constraints, performing analysis, formulating, and verifying product line textures for each phase. The product line texture operationalization includes the following subprocesses:

— product line texture for requirements defines common guides for requirements engineering and its associated processes, as well as for addressing challenges encountered during these processes. The texture within the subprocess includes principles and guidelines for defining, expressing, and binding variabilities in requirements.

— product line texture for design defines common guides for architecture design and its associated processes, as well as for resolving challenges encountered during architecture design and its associated processes. The texture of this subprocess contains coding conventions, design patterns, architectural tactics/strategies, architecture styles, and relations defined in product line architecture. Addressing commonalities and variabilities in product line architecture constitutes a fundamental aspect of architectural guidelines at the subsequent subprocesses.

— product line texture for realization defines common guides for standard practices in product line realization and its associated processes, as well as for resolving challenges encountered during realization and its relevant processes. The texture in this subprocess contains detailed design decisions aimed at achieving specific quality attribute requirements, such as design patterns and tactics. Additionally, it defines variability implementation mechanisms.

— product line texture for testing defines product line texture for guiding common ways to perform testing and its relevant processes or for solving problems faced with during testing and its relevant processes. product line texture at this subprocess includes test adequacy criteria commonly applied to domain and application testing, rules and constraints for test artefact reuse, and guidelines for testing variabilities.

— product line texture for after compilation defines product line texture for guiding common ways to perform after compilation processes and its relevant processes or for solving problems faced with after compilation processes and its relevant processes.

— product line texture for configuration defines product line texture for guiding common ways to perform configuration and its relevant processes or for solving problems faced with during configuring a member product and its relevant processes. Member products are derived based on the common platform of a product line, and thereafter participants of member product development perform adaptations for satisfying member product-specific features. Rules, constraints, and guidance for deriving the correct configurations of member products should be provided as parts of product line textures.

The product line texture support process provides supports required for assuring the adherence of product line texture in relevant product line lifecycle phases. The process manages changes and traceability for product line textures. To achieve these, the product line texture support includes the following:

— conformance to product line texture objectively evaluates the activities and artefacts of product line engineering processes for conformance to the guidance, rules, and constraints. Product line texture conformance analysis detects the flaws due to the inconsistencies between the product line texture and its relevant work products.

— change management *for product line texture* evaluates and manages change requests of product line texture in accordance with product line evolution.

— traceability for product line texture establishes and manages trace links between product line textures and their corresponding and conforming tasks and artefacts.

Identifying and analysing the key differentiators between single-system engineering and management and product line engineering and management can help the organizations understand the product line and formulate a strategy for the successful implementation of product line engineering and management. The key aspects are defined in ISO/IEC 26550; and Table 1 shows the category of the key aspects.