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# Software and systems engineering — Methods and tools for product line maturity framework

*Ingénierie logiciel et système – Outils et méthodes pour un cadre de maturité d'une ligne de produits*



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# Foreword

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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.

To achieve the objectives of SSPL adoption, the performance of SSPL engineering and management should be evaluated and improved based on the results. The product line maturity framework guides to adopt and construct required constituents of product line process assessment and improvement, and it operates, appraises, and improves product line processes to align with the product line objectives. The product line maturity framework deals with a product family, so its focuses are on SSPL specific aspects such as domain and application engineering, variability management, business involvement, and collaboration among these aspects. Processes, activities, and tasks are necessary to utilize the product line maturity framework, and methods and tools to support them are required for enhancing the efficiency, collaboration, and application quality of the maturity framework.

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 adopt, construct, operate, appraise, and improve product line maturity framework;

— by a product line organization – to provide guidance on the evaluation and selection of methods and tools for adopting, constructing, operating, appraising, and improving product line maturity framework;

— 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 adopting, constructing, operating, appraising, and improving product line maturity framework.



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 adopting, constructing, operating, appraising, and improving product line maturity framework. 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 26566.



— 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 texture are provided in ISO/IEC 26566 (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 maturity framework

## 1 Scope

This document, within the context of methods and tools that support adoption, construction, operation, and management of product line maturity framework, specifies:

— processes for managing, operationalizing, and supporting product line maturity framework adoption (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 methods and tools 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**
**application engineering**
life cycle consisting of a set of processes in which the application assets and member products of the product line are implemented and managed by reusing domain assets in conformance to the domain architecture and by binding the *variability* (3.10) of the platform

[SOURCE: ISO/IEC 26550:2015, 3.4, modified — Note 1 to entry has been removed.]

**3.2**
**binding**
task to make a decision on relevant variants, which can be application assets, from domain assets using the domain *variability* (3.10) model and from application assets using the application variability model

[SOURCE: ISO/IEC 26550:2015, 3.8, modified — "will be" has been replaced by "can be"; note 1 to entry has been removed.]

**3.3**
**commonality**
set of functional and non-functional characteristics that is shared by all applications belonging to the product line

[SOURCE: ISO/IEC 26550:2015, 3.9]

**3.4**
**domain engineering**
life cycle consisting of a set of processes for specifying and managing the *commonality* (3.3) and *variability* (3.10) of a product line

[SOURCE: ISO/IEC 26550:2015, 3.12, modified — Notes to entry have been removed.]

**3.5**
**process capability**
characterization of the ability of a process to meet current or projected business goals

[SOURCE: ISO/IEC 33020:2019, 3.4]

**3.6**
**product line appraisal component**
personnel or organizational unit of *domain engineering* (3.4), *application engineering* (3.1), core asset management, technical management, or organizational management, which is the subject of a *product line maturity framework* (3.8) appraisal

**3.7**
**product line maturity**
organization's possession of software and systems product line (SSPL) stable and repeatable capabilities in *domain engineering* (3.4), *application engineering* (3.1), and organizational and technical management

**3.8**
**product line maturity framework**
model for appraising product line capabilities in various dimensions and progressively defined levels

**3.9**
**product line operational component**
sponsors of appraisal, change agents, the appraisal team, and personnel involved in product line transition or product line institutionalization



**3.10**
**variability**
set of functional and non-functional characteristics that may differ among members of the product line

[SOURCE: ISO/IEC 26550:2015]

## 4 Abbreviated terms

BAPO business, architecture, process, and organization

FEF family evaluation framework

PL product line

SSPL software and systems product line

## 5 Reference model for product line maturity framework

### 5.1 Overview

SSPL engineering develops domain assets including common platforms that allow variabilities for member products of a product line in domain engineering processes and derive individual products based on the domain assets and by resolving the values of variabilities in application engineering processes. Because of these unique engineering processes, product line maturity framework subdivides processes into the following three subprocesses: domain engineering processes, application engineering processes, and collaboration processes between the two processes. SSPL also requires an SSPL organization to change its

business strategies. Therefore, product line maturity framework has additional dimensions: business and organization dimension.

Product line maturity framework deals with a consistent process capability that enables the development of high-quality domain assets that continually evolve with changes in technologies and customer needs as well as a process capability that configures member products by reusing the domain assets. The framework serves as a basis of assessing the SSPL engineering capabilities of departments, business units, divisions, and the organization. Product line maturity framework is used to assess the organization's readiness before product line adoption, assess the current competencies and deficiencies of an organization, and derive the organization's SSPL competency level and improvement items for successful SSPL settlement and continuous evolution.

A product line can be adopted incrementally, either starting from the specific business units and gradually expanding organization-wide, or it can be initially structured as a whole. Consequently, product line maturity framework can be customized or extended to meet the requirements of different business domains or integrated with specific disciplines as needed. The evaluations take place following the adaptation or extension of product line maturity framework to address these specific situations. The evaluation can involve integrating it with other maturity frameworks.

Within the product line (PL) maturity framework, the organization may adapt, extend, or combine activities being evaluated to improve efficiency, collaboration, and overall quality. Therefore, the organization shall incorporate suitable processes, activities, tasks, and supporting methods and tools to improve and guarantee the efficiency, collaboration, and overall quality of adopting the product line maturity framework.

NOTE Annex A provides an exemplary product line maturity framework that an organization can utilize.

## 5.2 Constituents of reference model for product line maturity framework



The reference model is divided into three processes: management, operationalization, and support for product line maturity framework, each with a set of subprocesses. The management process deals with planning, enabling, and managing the operationalization of product line maturity framework to evaluate capability or performance in SSPL engineering. The operationalization process supports an SSPL organization in adopting, constructing, operating, and improving product line maturity framework as needed by its users. The support process resolves technical or operationalization issues and responds to requests for information needs encountered during the operationalization of product line maturity framework.

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.

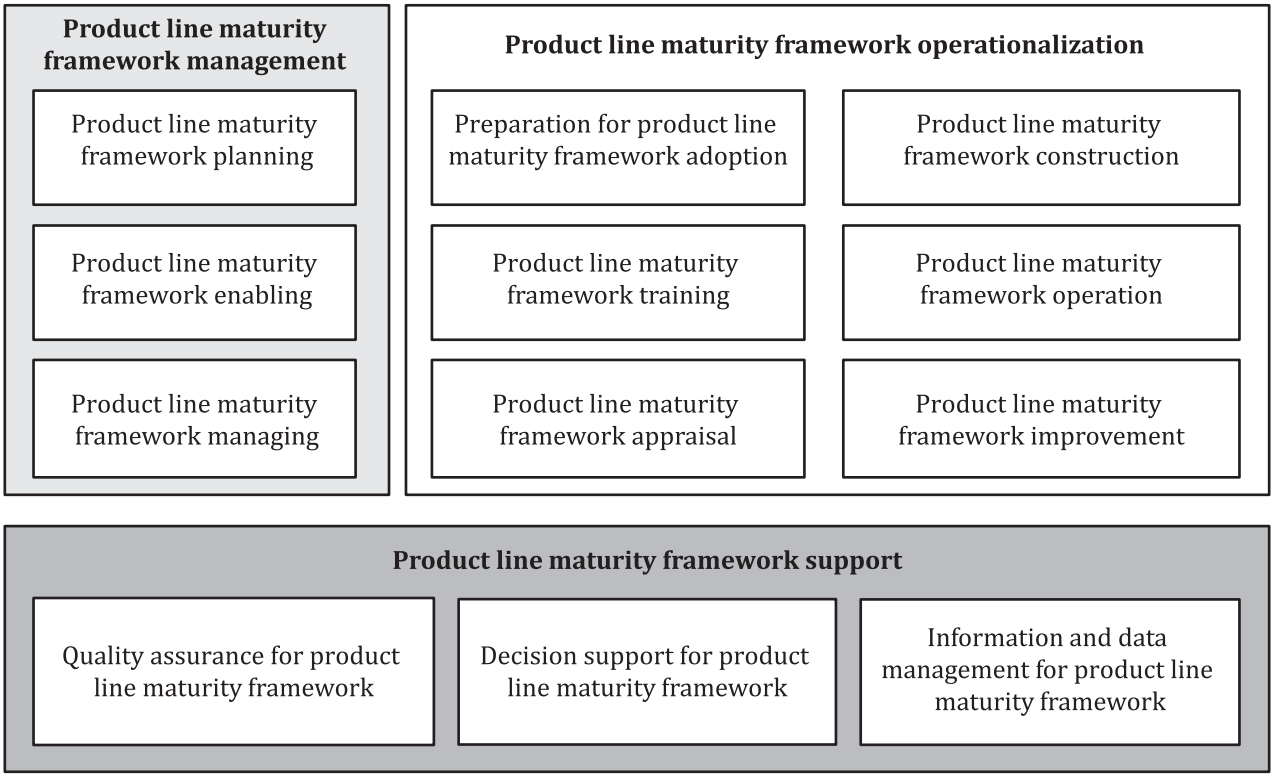


**Figure 1 — Reference model for product line maturity framework**



The product line maturity framework management process supports the planning of product line maturity framework operationalization (e.g. strategy, participant identity and responsibilities, criteria for conformity verification). It also enables the allocation of necessary resources, tools, and infrastructures for plan implementation, and conducts an analysis of the plan versus the actual status of product line maturity framework operationalization. The product line maturity framework management includes the following:

— product line maturity framework planning establishes plans for operationalizing product line maturity framework and supporting its operationalization; product line maturity framework operationalization plan includes product line maturity framework adoption strategy, identity and responsibilities of participants, criteria for verifying conformance to the requirements of product line maturity framework, schedule, and required resources.

— product line maturity framework enabling maintains and helps ensure the availability of resources, including participants, guidance, and measurement environment necessary for product line maturity framework operationalization; the guidance provided by product line maturity framework supports its use in product line maturity framework adoption, appraisal, and process improvement; the measurement environments support the collection, transformation, dissemination of information from product line maturity framework operationalization.

— product line maturity framework managing provides integrated management for product line maturity framework operationalization; this subprocess reviews the actual status of operationalization against plans, controls issues, and takes corrective actions if necessary.

The product line maturity framework operationalization process deals with subprocesses, ranging from the adaptation of product line maturity framework to the improvements of its operationalization in accordance with SSPL adoption situations within an SSPL organization. The adapted product line maturity framework is well-suited to evaluation needs of the organization. The product line maturity framework operationalization includes the following:

— preparation for product line maturity framework adoption involves selecting and composing suitable product line maturity framework. This subprocess identifies and mobilizes participants for product line maturity framework operationalization; It also analyses the reasons for conducting product line maturity