
**Software and systems engineering —
Tools and methods for product line
product management**

*Ingénierie du logiciel et des systèmes — Outils et méthodes pour la
gestion des gammes de produits*

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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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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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at <https://www.iso.org/members.html>.

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. Strategic management and supports are provided by product line product management for a product family and its evolution. Product management should collaborate with product line scoping process for the detailed definition of a product family. Also markets, technologies and competitors are carefully and continuously observed for product family definition and its continuous evolution. Product management deals with the economic aspects of product family and in particular with the market strategy.

There are needs for defining product line-specific product management processes that integrate the involved product line disciplines with those for a single product. Furthermore, support of tools and methods are required so that a product line organization can perform product management under the systematic control of complexities. This document addresses the product line-specific processes in product management by dividing those into product management enablement, product management operation and product management support process areas with the guidance of a set of tools and methods capabilities for supporting tasks for product line product management.

This document is intended to benefit people who acquire, supply, develop, operate, and maintain tools and methods for product line product management. This document can be used in one or more of the following modes:

- By an organization intended to implement or operate product lines – to understand, adopt and enact the processes, tools and methods for product line product management. This also helps the organization to evaluate and select relevant tools and methods based on business and user-related criteria.
- By a tool vendor who facilitates or leverages product line engineering practices – to provide a set of tool capabilities that should be embodied in a tool for supporting product management enablement, product management operation and product management support.

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 mechanisms in product lines. Other standards in the ISO/IEC 26550 family are as follows:

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 are published. ISO/IEC 26561 and ISO/IEC 26562 are to be published. ISO/IEC 26563 is a planned International Standard.

- 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 mechanism 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 technical probe are provided in ISO/IEC 26561;
- 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.

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

1 Scope

This document, within the context of methods and tools for product line product management:

- defines product line-specific processes and their subprocesses for product management of software and systems product lines. 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:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

binding

task to make a decision on relevant variants, which will be application assets, from *domain* (3.3) assets using the *domain variability* (3.7) model and from application assets using the application variability model

3.2

commonality

set of functional and non-functional characteristics that is shared by all applications belonging to the *product line* (3.4)

3.3

domain

distinct scope, within which common and variable characteristics are exhibited, common rules and *binding* (3.1) mechanisms are observed, and over which a distribution transparency is preserved

3.4

product line

product family

software and systems product line

set of products and/or services sharing explicitly defined and managed common and variable features and relying on the same *domain* (3.3) architecture to meet the common and variable needs of specific markets

3.5 product roadmap

schedule when the products have to be ready for market launch

3.6 technology roadmap

outline of required and anticipated changes in technologies, with expected dates, which will enable achievement or transformation of a product or *product family* (3.4)

3.7 variability

set of functional and non-functional characteristics that may differ among members of the *product line* (3.4)

4 Abbreviated terms

COTS component off-the-shelf

SSPL software and systems product line

5 Reference model for product line product management

5.1 Overview

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The success of a product line depends on how well a product line management comprehends markets, technical trends and competitors' capability. Product management deals with the situation of markets, technical trends and competitors' capability, and defines a product family to deliver to markets. Product management should reflect the company's goals defined by top management. The company's objectives govern the whole decision made in product line product management. The initial product family definition shall be delivered to product line scoping for the detailed product family definition of a product line.

Product management provides strategic management for product families while organization management deals with managerial supports for implementing a successful product line. For this, product management is responsible for the economic and business concerns of product line engineering and management and the resulting product line(s). It deals particularly with the market strategy and the competitive strategy. Outcomes produced in product management are major inputs of organization management and product line scoping. Product management monitors markets, competitors and technical changes so as to cope proactively with market changes and new offerings from competitors, and to evolve product family continuously.

The reference model specifies the structure of product line-specific processes and subprocesses for product management. As shown in Figure 1, Product line product management can be structured into three processes: product management enablement, product management operation and product management support. In the rest of this document, tasks, methods and tools are described in terms of product line-specific processes and subprocesses defined in the reference model. [Annex A](#) describes key artefact flows between product management and other key roles of software and systems product line.

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;
- the capabilities of methods and tools required for performing the tasks effectively and efficiently.

NOTE 1 When the process, subprocess, outcomes and tasks are listed or described in a sentence, they are italicized to get noticed.

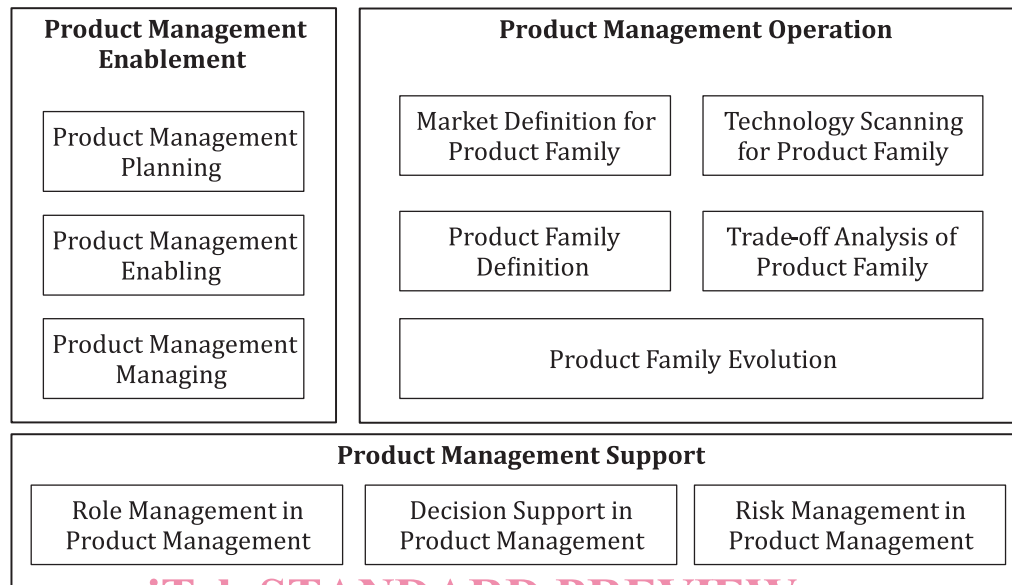


Figure 1 — Product line product management reference model

5.2 Product management enablement

The product management enablement shall serve to do the following and to define the capabilities of tools and methods for supporting them:

- *Product management planning* specifies how to monitor, measure and control the effectiveness of a product family. This subprocess also defines schedules and required resources for product management;
- *Product management enabling* establishes the governance policy for overall product management. This subprocess identifies the infrastructure and resource needs for product management operation and product management support, mobilizes qualified human resources for product management, enables quality assurance measurement for product management and improves product management process continuously;
- *Product management managing* monitors, measures and controls product management operation and product management support.

5.3 Product management operation

The product management operation shall serve to do the following and to define the capabilities of tools and methods for supporting them:

- *Market definition for product family* defines types of market segmentation for a product family, analyses competitors' profile and market opportunities for each market segment;
- *Technology scanning for product family* identifies and analyses key technologies for a product family so as to formulate the technology roadmap for product line product management;

- *Product family definition* identifies domains with initial product family member products, and thereafter analyses the high-level commonality and variability for the defining initial product family;
- *Trade-off analysis for product family* provides a formal way required for performing trade-off analysis for viable product family compositions. Vested stakeholders, key decision factors and ways to generate scenarios are addressed;
- *Product family evolution* achieves continuous evolution of a product family through monitoring changing trends in markets, technologies and competitiveness related to a product family. This subprocess includes tasks for evaluating evolution results and triggering follow-up actions.

5.4 Product management support

The product management support shall serve to do the following and to define the capabilities of tools and methods for supporting them:

- *Role management in product management* establishes and maintains roles and responsibilities for performing product management. Roles and responsibilities are monitored and controlled for improvement after they are identified, assigned and coordinated;
- *Decision support in product management* supports decision making concerning product line product management. Decision procedure, guidance for decision execution and assimilating lessons from decision results are dealt in this subprocess, and helps share decisions among relevant roles and responsibilities;
- *Risk management in product management* deals with risks for the platform and variability (e.g., business, technology, competitiveness) of a product family and develops a mitigation plan for the risks.

NOTE 2 This document is related to ISO/IEC/IEEE 15288 that is directly applicable to a single system. The processes and capabilities of methods and tools of this document correspond to the development of product families.

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

Table 1 — Key aspects for identifying product line-specific product management tasks

Category	Aspects
Reuse management	application engineering, domain assets, domain engineering, product management, platform, reusability
Variability management	binding, variability
Complexity management	collaboration, configuration, enabling technology support, reference architecture, texture, traceability
Quality management	measurement and tracking, cross functional verification and validation

The following are the descriptions for each aspect concerning product line product management. The product line product management relevant processes and tasks shall be identified on the basis of these aspects. The concerns specific to product line product management enable an organization to understand the product line product management relevant processes, subprocesses, tasks, methods and tools' capabilities:

- *Application engineering*: Product line product management defines a product family at the strategic level; thus, consisting member products that will be produced are decided by product management.
- *Binding*: Variability binding is an aspect that distinguishes product management of the product line development from that of the single product development.

- *Collaboration*: Stakeholders of product line product management include marketing experts, product managers, representative customers, domain experts, application experts and so on. Close collaborations among them are essential for the success of product management.
- *Configuration*: Configurations of assets for domain engineering and application engineering are distinguished aspects of the product line development. Maintaining integrity of assets is an important aspect. Configurations of products and artefacts of a product line can be multidimensional, i.e., exist in time and space.
- *Domain asset*: A platform consists of a collection of domain assets. Those domain assets may be tangible subsystems or components, or they may be engineering artefacts such as use cases, logical principles, architectural design patterns, etc. A product which is a member of a product family is engineered using domain assets specific but not necessarily unique to that product family. This is an aspect that distinguishes product management of the product line development from management of a single product development.
- *Domain engineering*: Domain engineering processes are product line-specific aspects that do not exist in the single product development.
- *Enabling technology support*: Enabling technologies for supporting efficient reuse and management of variability and assets distinguish from the single product development.
- *Measurement and tracking*: The performance of the product line processes should be measured aligning with the overall product line objectives. The measurement results should be collected, and they should be used to control product lines to achieve the business goals of the product family.
- *Platform*: Product line product management enables the development of a platform and the development of applications based on the platform.
- *Product management*: Product line product management should have the capability for defining and analysing the measures that make it possible to evaluate planned reusability and productivity and thereafter coordinate a product line towards achieving its business goals.
- *Reference architecture*: Reference architecture should be defined toward supporting the business goal achievement and the reusability. This is an aspect that distinguishes product management of the product line development from that of the single product development.
- *Reusability*: Product line product management monitors, evaluates and controls whether the desired level of reusability is achieved in a product family engineering endeavour. Providing managerial support for achieving desired level of reusability is a key aspect peculiar to product line development.
- *Texture*: Product line product management monitors and controls whether domain engineering and application engineering are following the rules defined in textures.
- *Traceability*: There exist trace links for business goal achievement, plan versus actual status, issue management, etc. in product line product management.
- *Cross functional validation and verification*: There exist cross functional assessments on business goal achievement, plan versus actual status, issue management, etc. in product line product management.
- *Variability*: Product line product management provides managerial capabilities for variability. Variability management is a distinguished aspect of product line development.

6 Product management enablement

6.1 General

Product management enablement supports the following subprocesses:

- *Product management planning.*
- *Product management enabling.*
- *Product management managing.*

6.2 Product management planning

6.2.1 Principal constituents

6.2.1.1 Purpose

The purpose of this subprocess is to analyse and establish product management needs and goals and define schedules and required resources for satisfying them.

6.2.1.2 Inputs

The following inputs should be available to perform the product management planning process:

- Product line goals (objectives).
- Existing product definition strategy used for a single product definition.
- Organizational level plans for a product line (from ISO/IEC 26556).
- Historical documents and data related to product family planning.

6.2.1.3 Outcomes

The following outcomes shall be available as a result of the successful implementation of the product management planning process:

- *Product management goal* is established.
- *Product definition strategy* is defined.
- *Product management plan, including key procedures, schedules and required resources and measures* is documented.
- *Changes of plans* are traced and maintained.

6.2.1.4 Tasks

The organization shall implement the following tasks with respect to the product management planning process:

- *Establish product management goals:* Define product management goals and strategies for offering such products that ensure the organization's continuous market leads.
- *Define key procedures for product management:* Tailor or define product management procedures and share the procedures with product management participants.
- *Define schedules and required resources for product management:* Schedule product management, including milestones and required resources.

- *Specify how to monitor, measure and control the effectiveness of product family:* Define ways to governing the monitoring, measuring and controlling of the effectiveness of a product family.
- *Document the product management plan:* Document and share the product management plans.

6.2.2 Establish product management goals

The goal of this task is to define product management goals and strategies for the successful achievement of organizational goals and for the provision of products that meet customer's needs on time.

The goal of product management is to contribute to the success of a product line organization by governing the product family endeavour as a whole.

The method should support establishing product management goals with the following capabilities:

- identifying the relationship between product management and product line goals;
- formulating product management goals;
- establishing the product definition strategy that describes how new products are defined.

A tool should support establishing product management goals by allowing the user to do the following:

- access product line goals and organizational level plans;
- communicate product management goals and strategies with key stakeholders by supporting channels and implemented mechanisms.

6.2.3 Define key procedures for product management

The goal of this task is to tailor and define product management procedures based on product line processes and to share the defined procedures with key stakeholders.

The method should support defining key procedures for product management with the following capabilities:

- tailoring procedures for product management based on the organizational product management process;
- defining decision-making procedures related to product management;
- defining integration and calibration procedures for product management;
- defining monitoring, measuring and controlling procedures for product management;
- defining procedures that guide the collaboration activities among key stakeholders of product management.

A tool should support defining key procedures for product management by allowing the user to do the following:

- access the existing procedures for product management;
- share key procedures with relevant key stakeholders;
- make decisions under the supports of decision-making procedures;
- integrate and calibrate procedures;
- document the defined procedures electronically.