INTERNATIONAL STANDARD

ISO/IEC 26561

First edition
2019-11

Software and systems engineering — Methods and tools for product line technical probe

Ingénierie du logiciel et des systèmes — Méthodes et outils destinés à la vérification technique des gammes de produits

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Reference number
ISO/IEC 26561:2019(E)

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Published in Switzerland

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

Product line technical probe diagnoses an organization's ability necessary to successfully adopt product line engineering and management. Product line engineering and management require abilities to deal with markets, competitors, costs, benefits, two different and closely related domain and application engineering processes, and the distribution of different domain and application engineering over organizations. Before transitioning to product line engineering, an organization should assess its ability from these aspects and decide whether or not to switch to product line engineering. Based on the results of product line technical probe, an organization can establish plans to continuously improve its abilities.

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 probe the organization's capabilities necessary to adopt or improve product line engineering;

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

— by providers of methods and/or tools – to provide guidance on implementing or developing methods and/or tools by specifying a comprehensive set of methods and tools capabilities for supporting product line technical probe.

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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 standards in the ISO/IEC 26550 family are as follows:

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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 and ISO/IEC 26560 are published. ISO/IEC 26562 is to be published. ISO/IEC 26563 and ISO/IEC 26564 are planned International Standards.

— 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;

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— 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 product line 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 (planned International Standard);

— Processes and capabilities of methods and tools for product line measurement are provided in ISO/IEC 26564 (planned International Standard);

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

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Software and systems engineering — Methods and tools for product line technical probe

1 Scope

This document, within the context of methods and tools for supporting the diagnosis of the organization's capability to adopt or improve software and systems product line engineering**:**

— defines processes for product line technical probe; those processes are described in terms of purpose, inputs, tasks and outcomes;

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

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

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.

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3 Terms and Definitions

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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 http://www.iso.org/obp

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

3.1
aspect
special consideration within *product line* (3.9) engineering process groups and tasks to which one can associate specialized methods and tools

3.2
main probe
phase to perform repetitive cycle for gathering and analysing data for finding strengths and challenges of an organization

3.3
post-probe
optional phase to prepare action plans for addressing challenges

3.4
pre-probe
phase to understand an organization's basic context such as current structure, terminology, product maturity level, implementation and documentation

3.5
product line adoption plan
plan that describes the changes in process, organization structure, and product building methods to get from the current to *product line* (3.9) engineering

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3.6
product line adoption scenario
scenario that gives concrete sequence of actions related to *product line* (3.9) adoption

3.7
product line technical probe
technical probe
probe
diagnostic process for investigating the organization's readiness to adopt, or ability to succeed with, *product line* (3.9) engineering and management

3.8
product line transition
transition
switching to *product line* (3.9) engineering through the right procedures, so as to achieve business objectives that lead an organization to product line engineering

3.9
software and systems product line
SSPL
product line
paradigm for the creation, exploitation, and management of a common platform for a family of products

Note 1 to entry: Typical goals of product lines are to lower costs, reduce time to market, and improve quality.

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4 Abbreviated terms

CONOPS concept of operations

MCDM multiple condition decision method

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5 Reference model for product line technical probe

5.1 Overview

A product line technical probe diagnoses an organization's readiness to adopt product line engineering. The technical probe includes whether an organization has abilities to succeed with product line engineering. When an organization considers the adoption of product line engineering, a product line technical probe informs an organization whether the organization has essential capabilities necessary to adopt product line engineering and at which maturity level the organization is based on the essential organizational, technical and software engineering framework. A product line technical probe provides overall pictures about an organization's current capability level compared with essential capabilities necessary to successfully provide products that conform to market and customer needs.

In accordance with the results of a product line technical probe, an organization can make a go/no-go decision about product line adoption; or in the case that an organization determines product line adoption, it establishes and implements action plans for resolving weaknesses found, so an organization can shift to product line engineering after it has the essential capabilities. During product line engineering and management, a product line technical probe supports continuous improvements of an organization's product line capability.

Software and systems product line requires mature capability level in both system and software engineering. In adopting a product line engineering approach, an organization extends the portfolio management process of ISO/IEC/IEEE 15288 and applies specializations of its product development, technical management, and infrastructure processes. Thus, a product line technical probe should diagnose an organization's ability from architecture and organizational management viewpoints as well as process capability. For successful product line adoption, an organization should continuously diagnose and improve its process, architecture, business, and organizational management capabilities.

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5.2 Reference model for product line technical probe

The reference model specifies the structure of supporting processes and subprocesses for a product line technical probe. As shown in Figure 1, a product line technical probe can be structured into three processes: technical probe management, technical probe operationalization and technical probe support. In the rest of this document, tasks, methods and tools are described in terms of 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; and

— the outcomes of the subprocess.

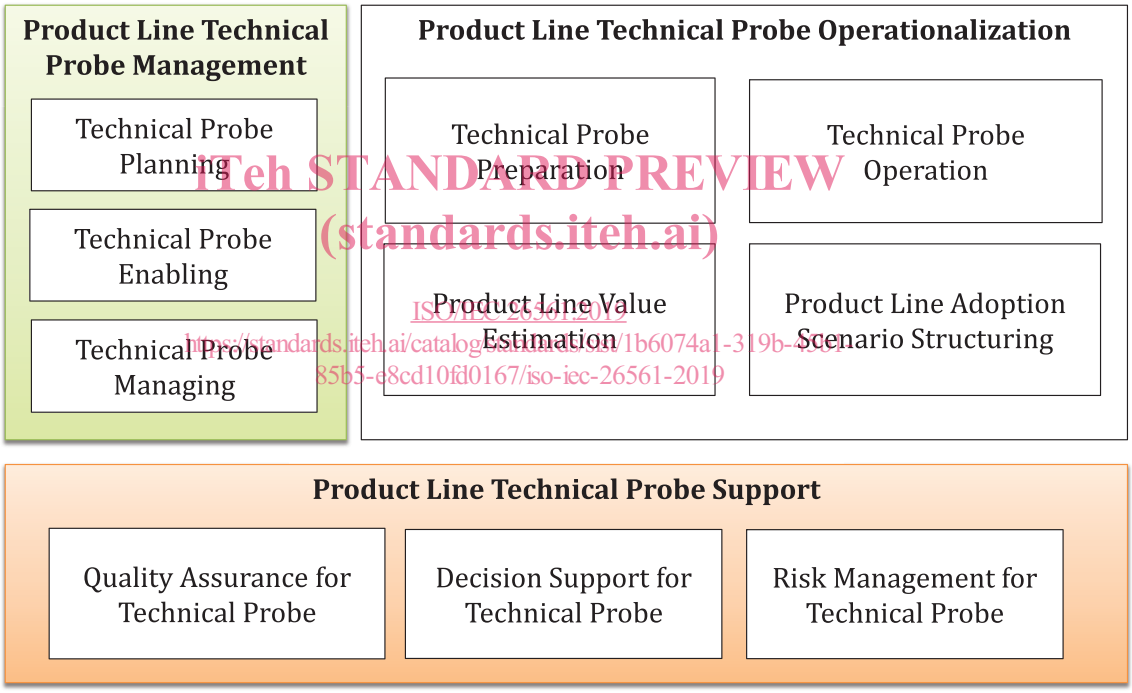

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Figure 1 — Reference model for the product line technical probe

The product line technical probe management process provides managerial supports for planning technical probe (e.g. resource estimation, responsibility allocation, success measures), supports for providing necessary resources, tools and infrastructures for realizing technical probe plans and supports for analysing the plan versus actual status of technical probing. The product line technical probe management shall do the following:

— *technical probe planning* establishes plans for initiating, operationalizing and supporting product line technical probe;

— *technical probe enabling* defines, maintains and assures the availability of environments, guidance, and measurement necessary to performing product line technical probe; and

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— *technical probe managing* provides integrated management for the technical probe operationalization; this subprocess reviews the technical probe operationalization's actual status against plans, controls issues and takes corrective actions if necessary.

The product line technical probe operationalization process performs operations for analysing an organization's readiness for adopting product line engineering and finding improvements required for successful and suitable product line adoption. This process deals from the organization's readiness for technical probe to producing product line adoption scenarios. The product line technical probe operationalization shall do the following:

— *technical probe preparation* initiates the product line technical probe by mobilizing participants and resources; this subprocess performs preliminary technical probe for coordinating participants and resources;

— *technical probe operation* performs the product line technical probe in accordance with the technical probe plans;

— *product line value estimating* determines returns on investments in order to decide whether an organization initiates product line transition or quits product line adoption; and

— *product line adoption scenario structuring* establishes the product line adoption strategy based on the findings delivered in technical probe operation.

The product line technical probe support process provides supports required for producing correct technical probe findings and product line adoption scenarios so as to achieve the organization's values through product line engineering. To achieve these, the product line technical probe support shall do the following:

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— *quality assurance for technical probe* objectively evaluates the activities and artefacts of the implemented product line technical probe;

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— *decision support for technical probe* supports decision making for producing findings and recommendations of the product line technical probe and structuring product line adoption plan and scenarios; and

— *risk management for technical probe* identifies and mitigates risks related to product line technical probe.

The identification and analysis of the key differentiators between single-system engineering and management and product line engineering and management can help the organizations to understand the product line and to formulate a strategy for 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 technical probe 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 is the description for each aspect concerning product line technical probe. The product line technical probe processes and tasks shall be identified on the basis of these aspects. The concerns

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for the product line technical probe will enable the organization to understand technical probe processes, subprocesses, tasks, methods and tools' capabilities.

— Application engineering: A technical probe diagnoses the organization's capability from the essential application engineering practices,

— Binding: A product line organization should be able to deal with a complete range of variability binding times, so a product line technical probe diagnoses this ability.

— Collaboration: Participants of a technical probe should closely collaborate with the probe team because a technical probe uses a series of interviews and reviews for data analysis as in software capability assessment.

— Configuration: Because member products are configured during the application engineering based on domain assets, a product line organization should have the capabilities required for configuring member products.

— Domain asset: A product line technical probe investigates an organization's ability for developing and maintaining all domain assets that will be commonly used by member products of a product line.

— Domain engineering: A product line technical probe diagnoses an organization's capability from the essential domain engineering practices.

— Enabling technology support: Technical probe-enabling supports provide resources and infrastructure necessary to initiate, support and control technical probe tasks.

— Measurement and tracking: Measurement and tracking have two aspects in a technical probe. One is the organization's capability to measure and control its product line processes, and another is its capability to measure and trace the status of action plans defined to adopt or improve product line engineering.

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— Platform: A product line technical probe diagnoses the organization's capability to design and realize platforms that will be used by member products of a product line.

— Product management: The results of a product line technical probe are used when the product management process takes the direction of a product line evolution.

— Reference architecture: Product line engineering relies on a reference architecture, and the reference architecture is a key success factor of a product line. Thus, a product line technical probe investigates an organization's architecture capability.

— Reusability: Reusability that will be expected through the product line is initially estimated.

— Texture: For developing a family of products by using common assets, it is important to define rules and constraints for implementing architecture and evolving it over time. A product line technical probe investigates an organization's ability to select and define texture.

— Traceability: Product line technical probe assures a product line organization's ability to relate the assets of the different development roles, such as domain engineering, application engineering, and each of their different development stages.

— Cross functional validation and verification: Artefacts, processes, and tasks related to product line technical probe should be validated and verified when the needs arise.

— Variability: Variations among member products of initial product line portfolio defined for conducting product line pilot are analysed to use as an input for go/no-go decision.

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