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Software engineering — Software life cycle processes — Maintenance

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Foreword

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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 ISO documents 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).

IEEE Standards documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. The IEEE develops its standards through a consensus development process, approved by the American National Standards Institute, which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and serve without compensation. While the IEEE administers the process and establishes rules to promote fairness in the consensus development process, the IEEE does not independently evaluate, test, or verify the accuracy of any of the information contained in its standards.

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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. ISO/IEC IEEE 14764 was prepared by Joint Technical Committee ISO/IEC JTC 1, Subcommittee SC 7.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Systems and software engineering*, in cooperation with the Systems and Software Engineering Standards Committee of the IEEE Computer Society, under the Partner Standards Development Organization cooperation agreement between ISO and IEEE.

The first edition of ISO/IEC 14764 was prepared by ISO/IEC JTC 1/SC 7. The second edition was the result of merging the original edition with IEEE 1219. ISO/IEC JTC 1/SC 7 and the IEEE Computer Society cooperated in this project to merge the two standards. This third edition cancels and replaces the second edition (ISO/IEC 14764:2006), which has been technically revised.

The main changes compared to the previous edition are as follows:

— alignment of the standard with the 2017 version of ISO/IEC IEEE 12207 and updates to other ISO/IEC JTC1/SC7 standards

— introduction of modern approaches to "maintenance"

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 www.iso.org/members.html.

Introduction

This document provides guidance on the Software Maintenence Process. Maintenance is a Technical process in the life cycle of a software product, as described in ISO/IEC IEEE 12207, "Systems and software engineering – Software life cycle processes." The Maintenance Process contains the activities and tasks of the maintainer. This document is the result of the harmonization of ISO/IEC 14764 and IEEE Std 1219, and the update for the 2017 version of ISO/IEC IEEE 12207.

Because maintenance consumes a major share of a software life cycle financial resources, it should be an important project consideration.

During operation of the software, problems may be detected that were not detected during verification, validation and acceptance. Therefore, a maintenance effort is needed to cope with these problems. This maintenance effort also covers software improvements needed to meet new or modified user requirements. Software maintenance is commonly needed when upgrading system components, such as operating systems and databases, as well as when changes are made to external software and systems' interfaces. Software maintenance is typically a significant portion of life cycle costs, even when a part of the system under maintenance includes COTS software.

Software maintainers use a number of specific tools, methods, and techniques. This document does not specify how to implement or perform the activities and tasks in the Software Maintenance Process since these are dependent upon the formal agreement and organizational requirements. Maintenance is required on all types of software, whatever the technology, technique, or tool used to create it.

Software engineering — Software life cycle processes — Maintenance

1 Scope

1.1 Overview

This document describes in greater detail the Maintenance Process described in ISO/IEC IEEE 12207. This document also establishes definitions for the various types of maintenance. This document provides guidance that applies to planning, execution and control, review and evaluation, and closure of the Maintenance Process. The scope of this document includes maintenance for multiple software products with the same maintenance resources. "Maintenance" in this document means software maintenance unless otherwise stated.

This document provides the framework within which generic and specific software maintenance strategies may be tailored, performed, and evaluated to the maintenance scope and magnitude of given software products.

This document provides the framework, precise terminology, and processes to allow the consistent application of technology (tools, techniques, and methods) to software maintenance.

This document provides guidance for the maintenance of software. The basis for the Maintenance Process and its activities comes from the Maintenance process 6.4.13 of ISO/IEC IEEE 12207. It defines the activities and tasks of software maintenance, and provides maintenance planning requirements. It does not address the operation of software and the operational functions, e.g. backup, recovery, system administration, which are normally performed by those who operate the software. However, it does include the related Disposal process 6.4.14 of ISO/IEC IEEE 12207.

This document is written primarily for managers and maintainers of software and additionally for those responsible for development and quality assurance. It may also be used by acquirers and users of systems containing software who may provide inputs to the maintenance strategy.

While the scope of this document is software maintenance, hardware and hardware costs are important considerations for maintenance.

1.2 Purpose

This document provides guidance on the the Maintenance Process. It identifies how the Maintenance Process can be invoked during acquisition and operation. This document also emphasizes the following in the Maintenance Process: the maintainability of software products; the need for maintenance service models; and the need for a maintenance strategy.

1.3 Field of application

This document is intended to provide guidance for the planning for and maintenance of software products or services, whether performed internally or externally to an organization. It is not intended to apply to the operation of the software.

This document is intended to provide guidance for two-party situations and may be equally applied where the two parties are from the same organization. This document is intended to also be used by a single party as self-imposed tasks (ISO/IEC IEEE 12207).

This document is not intended for software products that are "throw-away" or a "short-term" solution.

It is intended for self-imposition by developers of off-the-shelf software products to maintain such products. Maintenance is applied to computer programs, code, data, documents, and records. It is intended to apply to software products created during the development of the software product. This may include such things as the test software, test databases, the Software Test Environment (STE), or the Software Engineering Environment (SEE).

This document is intended for use in all maintenance efforts, regardless of the life cycle model (e.g. incremental, waterfall, evolutionary, spiral, agile, continuous iterative development). This document is not restricted by size, complexity, criticality, reliability, or application of the software product.

1.4 Limitations

This document describes the framework of the Software Maintenance Process but does not specify the details of how to implement or perform the activities and tasks included in the process.

In this document, there are a number of lists. None of these is presumed to be exhaustive. They are intended as examples.

1.5 Conformance

This document provides guidance for the execution of the Maintenance Process of ISO/IEC IEEE 12207. The guidance in this document is completely consistent with ISO/IEC IEEE 12207. Conformance cannot be claimed to this standard but can be claimed to the ISO/IEC IEEE 12207 Maintenance Process and related tailoring. In this document, ISO/IEC IEEE 12207 refers to ISO/IEC IEEE 12207:2017. The only mandatory clauses in this document come from ISO/IEC IEEE 12207. The mandatory clauses contain shalls and each shall from ISO/IEC IEEE 12207 that is duplicated in this document is boxed. The related ISO/IEC IEEE 12207 clause number is listed after the boxed ISO/IEC IEEE 12207 shalls.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document the terms and definitions in ISO/IEC IEEE 12207 and the following terms and definitions apply.

ISO, IEC and IEEE 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/

— IEEE Standards Dictionary Online: available at http://dictionary.ieee.org

3.1.1
adaptive maintenance
modification of a software product, performed after delivery, to keep a software product usable in a changed or changing environment

Note 1 to entry: to Entry Adaptive maintenance provides enhancements necessary to accommodate changes in the environment in which a software product operates. These changes help keep pace with the changing environment, e.g. an upgrade to the operating system results in changes in the applications.

3.1.2
additive maintenance
modification of a software product performed after delivery to add functionality or features to enhance the usage of the product

3.1.3
corrective maintenance
modification of a software product performed after delivery to correct discovered problems

Note 1 to entry: to Entry: The modification repairs the software product to satisfy defined system requirements.

3.1.4
emergency maintenance
unscheduled modification performed to temporarily keep a system operational pending corrective maintenance

3.1.5
maintainability
degree of effectiveness and efficiency with which a product or system can be modified by the intended maintainers

Note 1 to entry: Modifications can include corrections, improvements or adaptation of the software to changes in environment, and in requirements and functional specifications. Modifications include those carried out by specialized support staff, and those carried out by business or operational staff, or end users.

Note 2 to entry: Maintainability includes installation of updates and upgrades.

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Note 3 to entry: Maintainability can be interpreted as either an inherent capability of the product or system to facilitate maintenance activities, or the quality in use experienced by the maintainers for the goal of maintaining the product or system.

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[SOURCE: ISO/IEC 25010:2011, 4.2.7]

3.1.6
enhancement
software change that is a new requirement

Note 1 to entry: There are three types of software enhancements, adaptive, perfective and additive. An enhancement is not a software correction.

3.1.7
Modification Request (MR)
information item that identifies and describes proposed changes(s) to a product or service

Note 1 to entry: The MR may later be classified as a correction or enhancement and identified as corrective, preventive, adaptive, additive or perfective maintenance. MRs are also referred to as change requests.
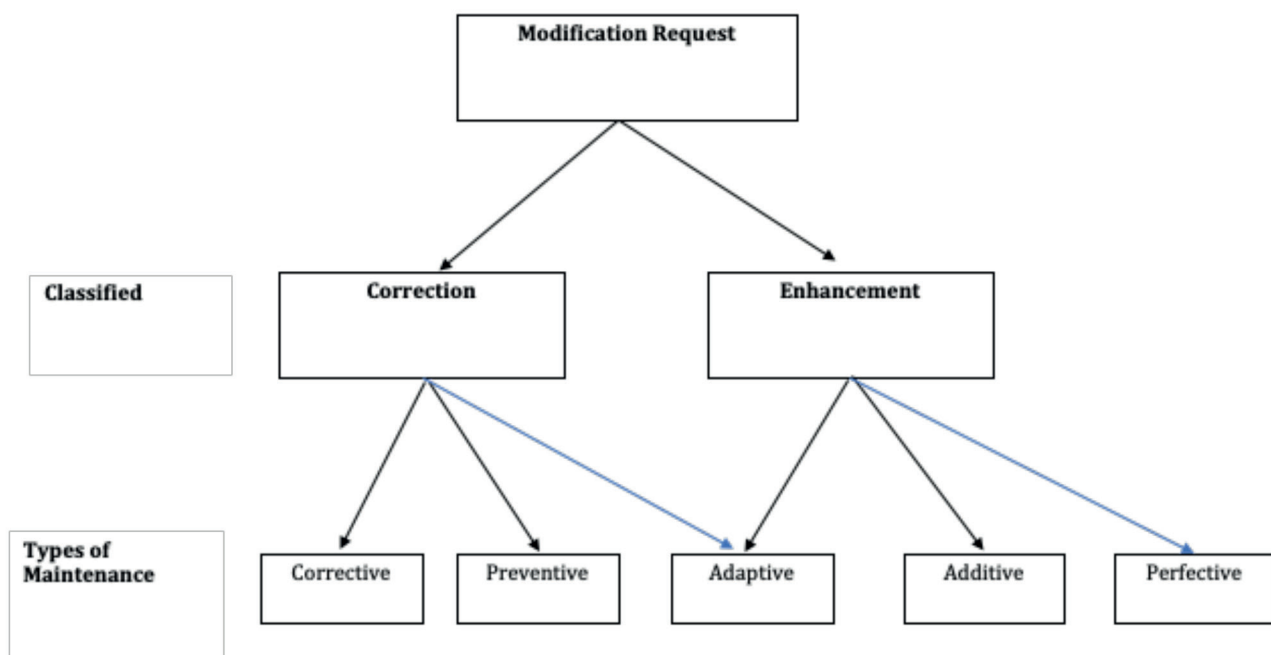
Figure 1 — Modification Request

Note 2 to entry: to Figure 1 – In some organizations Adaptive maintenance is not considered to be an enhancement.

Note 3 to entry: to Figure 1 – Additive is an enhancement type that some organizations use and different from perfective in that little or no change to existing software or systems is made

Note 4 to entry: to Figure 1 – Some organizations sub-divide each type into "Scheduled", "Unscheduled" and "Emergency" types.

3.1.8
perfective maintenance
modification of a software product to provide enhancements for users, improvements of program documentation, and recording to improve software performance, maintainability or other software attributes

3.1.9
preventive maintenance
modification of a software product after delivery to correct latent faults in the software product before they occur in the live system

3.1.10
Problem Report (PR)
term used to identify and describe problems detected in a software product

Note 1 to entry: PRs are either submitted directly to denote faults, or they are established after impact analysis is performed on Modification Requests and faults are found.

3.1.11
software maintenance
totality of activities required to provide support to a software system. Activities are performed during the pre-delivery stage as well as the post-delivery stage

Note 1 to entry: to Entry: Pre-delivery activities include for example, planning for post-delivery operations, supportability, and logistics determination. Post-delivery activities include for example, software modification, training, and operating a help desk.

3.1.12
software sustainment
activities to support, maintain and operate a software system

Note 1 to entry: Software sustainment includes processes, procedures, people, material and information required to support, maintain and operate the software aspects of a system (SEI definition).

3.1.13
transition
activities involved in moving a new or changed service, system, or component to or from an environment

3.2 Abbreviated terms

CM   configuration management

COTS   commercial-off-the-shelf software

IEC   International Electrotechnical Commission

IEEE   Institute of Electrical and Electronics Engineers

ISO   International Organization for Standardization

JTC   Joint Technical Committee

MBSE   Model-based systems engineering

MR   modification request

PR   problem report

SEE   software engineering environment

STE   software test environment

4 Application of this document

4.1 General

This clause presents the Maintenance process that is required to maintain software products.

4.2 Maintenance process

Maintenance is one of the technical life cycle processes that may be performed during the life cycle of software (ISO/IEC IEEE 12207). The Acquisition and Supply agreement life cycle processes of ISO/IEC IEEE 12207 may initiate the process implementation activity of the Maintenance life cycle process through an agreement or contract. The Operation process may call for maintenance through a Modification Request or Problem Report. The Maintenance life cycle process invokes the techncal life cycle processes of ISO/IEC IEEE 12207 to develop any required enhancement when part of the maintenance strategy. The techncal management processes, such as project planning, configuration management and quality assurance of ISO/IEC IEEE 12207 are used by theMaintenance life cycle process.

NOTE   Significant maintenance changes can be treated as a software development project using the design definition, implementation, integration, and transition processes, among others.

Figure 2 below shows the connection of the maintenance process in ISO/IEC IEEE 12207 to other maintenance related processes and the elaboration of the maintenance process into its defined activities. These maintenance activities are discussed in detail in Clause 5.
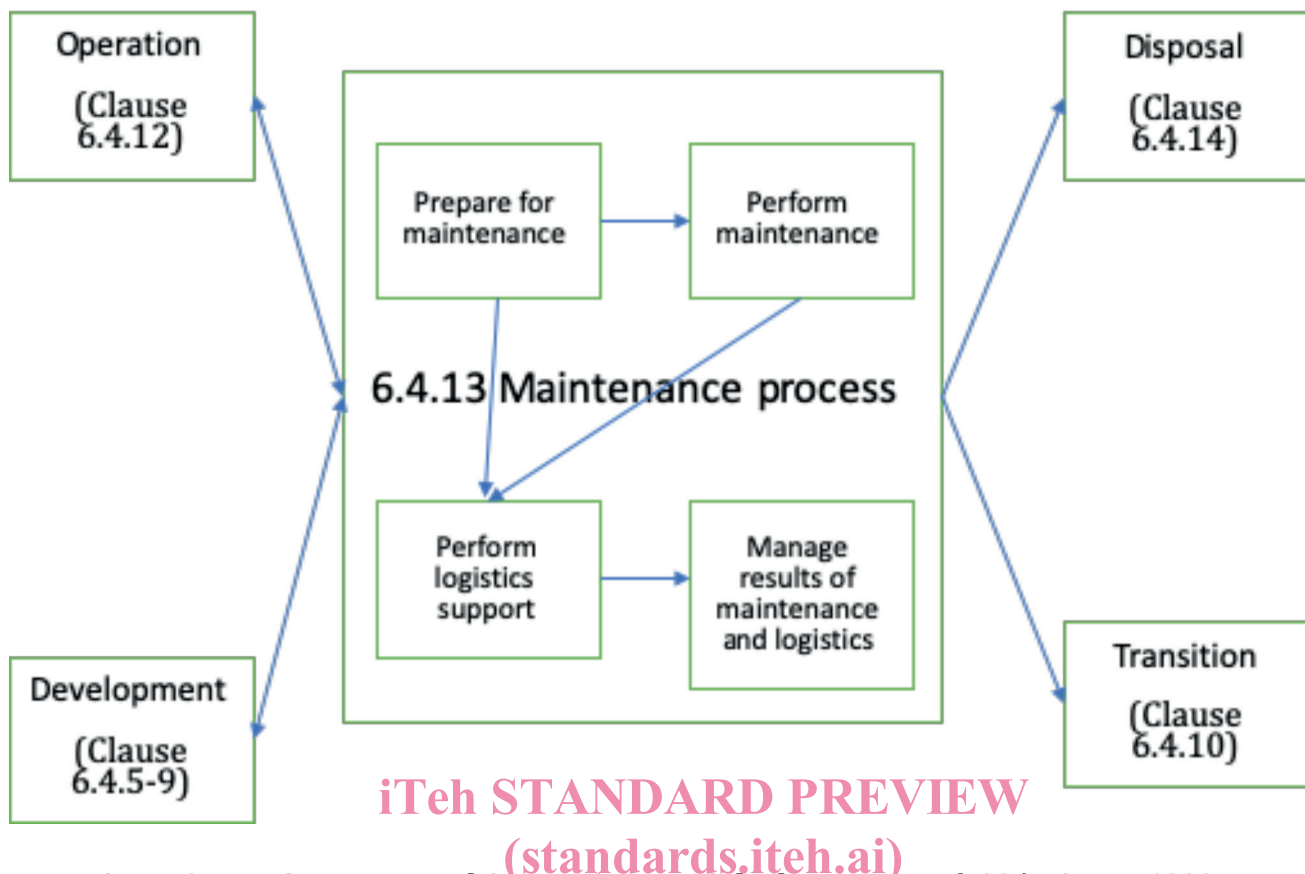
Figure 2 — Maintenance and Connections to Linked Processes of ISO/IEC IEEE 12207

4.3 Organization of this document

The Clauses 5-7 provide an elaboration of the maintenance process from ISO/IEC IEEE 12207. The boxed text preceding elaboration text contains the numbered clauses from ISO/IEC IEEE 12207.

Clause 5 provides the details of the Maintenance Process including tasks and steps needed to implement the Maintenance Process. Clause 6 provides execution considerations, and issues to be considered when planning for maintenance. Clause 7 provides comprehensive strategy and planning information.

5 Maintenance and disposal processes

5.1 Maintenance process

6.4.13 Maintenance process

6.4.13.1 Purpose

The purpose of the Maintenance process is to sustain the capability of the system to provide a service.

This process monitors the system's capability to deliver services, records incidents for analysis, takes corrective, adaptive, perfective and preventive actions and confirms restored capability.

ISO/IEC IEEE 12207:2017

Software maintenance may be considered part of Software sustainment, where support, maintenance and operation processes are managed and performed together.

6.4.13.1 Purpose (cont'd)

For software systems, the Maintenance process makes corrections, changes, and improvements to deployed software systems and elements. The software systems maintenance approach differs for systems that are freely available, in wide commercial distribution, or operating in a small number of controlled environments.

The need for software system maintenance can arise from multiple causes other than latent system defects, such as changes to interfaced systems or infrastructure, evolving security threats, and technical obsolescence of system elements and enabling systems over the system life cycle. Often the extension of capability, mid-life upgrade, or evolution of legacy systems becomes a new software system development project that will apply the set of processes within an appropriate life cycle. If so, the Portfolio Management process is the starting point to initiate the work. In other cases, software system maintenance is performed as a continuing series of prioritized work items, possibly on a level of effort basis. Maintenance of software system elements can include hardware, software, and services, such as communication or web services. Maintenance is closely connected with the Configuration Management process and software asset management and is performed concurrently with the other Technical processes.

NOTE   ISO/IEC IEEE 14764-2006 Software Engineering – Software Life Cycle Processes – Maintenance and ISO/IEC 16350, Information technology – Systems and software engineering—Application management, provide additional detail. The SWEBOK, Guide to the Software Engineering Body of Knowledge, Software Maintenance knowledge area discusses software maintenance fundamentals, key issues, measurement, techniques, maintenance process and support activities, and tools. The guide also discusses models, techniques and measures that support software reliability.

ISO/IEC IEEE 12207:2017

The boxed text and notes from ISO/IEC IEEE 12207 are considered sufficient guidance for this sub-clause.

6.4.13.2 Outcomes

As a result of the successful implementation of the Maintenance process:

a)   Maintenance constraints that influence system requirements, architecture, or design are identified.

b)   Any enabling systems or services needed for maintenance are available.

c)   Replacement, repaired, or revised system elements are made available.

d)   The need for changes to address corrective, perfective, or adaptive maintenance is reported.

e)   Failure and lifetime data, including associated costs, is determined.

ISO/IEC IEEE 12207:2017

No specific guidance for this sub-clause