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Systems and software engineering — Software life cycle processes

Ingénierie des systèmes et du logiciel — Processus du cycle de vie du logiciel

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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.

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.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO, IEC, and IEEE shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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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 on 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 the following URL www.iso.org/iso/foreword.html.

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 IEEE Computer Society Systems and Software Engineering Standards Committee, under the Partner Standards Development Organization cooperation agreement between ISO and IEEE.

This first edition of ISO/IEC/IEEE 12207 cancels and replaces ISO/IEC 12207:2008 (second edition), which has been technically revised.

Changes in this revision of ISO/IEC/IEEE 12207 were developed in conjunction with a corresponding revision of ISO/IEC/IEEE 15288:2015, *Systems and software engineering – System life cycle processes*. The purpose of these revisions is to accomplish the harmonization of the structures and contents of the two documents, while supporting the requirements of the engineering and assessment communities.

This document was developed with the following goals:

- provide a common terminology between the revision of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207;
- where applicable, provide common process names and process structure between the revision of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207; and
- enable the user community to evolve towards fully harmonized standards, while allowing backward compatibility.

This revision is intended to achieve a fully harmonized view of the system and software life cycle processes.

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Introduction

The complexity of software systems has increased to an unprecedented level. This has led to new opportunities, but also to increased challenges for the organizations that create and utilize systems. These challenges exist throughout the life cycle of a system and at all levels of architectural detail. This document provides a common process framework for describing the life cycle of systems created by humans, adopting a Software Engineering approach. Software Engineering is an interdisciplinary approach and means to enable the realization of successful software systems. It focuses on defining stakeholder needs and required functionality early in the development cycle, documenting requirements, and performing design synthesis and system validation while considering the complete problem. It integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation and maintenance. It considers both the business and the technical needs of all stakeholders with the goal of providing a quality product that meets the needs of users and other applicable stakeholders. This life cycle spans the conception of ideas through to the retirement of a system. It provides the processes for acquiring and supplying systems. It helps to improve communication and cooperation among the parties that create, utilize and manage modern software systems in order that they can work in an integrated, coherent fashion. In addition, this framework provides for the assessment and improvement of the life cycle processes.

The processes in this document form a comprehensive set from which an organization can construct software life cycle models appropriate to its products and services. An organization, depending on its purpose, can select and apply an appropriate subset to fulfill that purpose.

This document can be used in one or more of the following modes:

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a) By an organization — to help establish an environment of desired processes. These processes can be supported by an infrastructure of methods, procedures, techniques, tools and trained personnel. The organization may then employ this environment to perform and manage its projects and progress software systems through their life cycle stages. In this mode, this document is used to assess conformance of a declared, established environment to its provisions.

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b) By a project — to help select, structure and employ the elements of an established environment to provide products and services. In this mode, this document is used in the assessment of conformance of the project to the declared and established environment.

c) By an acquirer and a supplier — to help develop an agreement concerning processes and activities. Via the agreement, the processes and activities in this document are selected, negotiated, agreed to and performed. In this mode, this document is used for guidance in developing the agreement.

d) By process assessors — to serve as a process reference model for use in the performance of process assessments that may be used to support organizational process improvement.

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Systems and software engineering — Software life cycle processes

1 Scope

1.1 Overview

This document establishes a common framework for software life cycle processes, with well-defined terminology, that can be referenced by the software industry. It contains processes, activities, and tasks that are applicable during the acquisition, supply, development, operation, maintenance or disposal of software systems, products, and services. These life cycle processes are accomplished through the involvement of stakeholders, with the ultimate goal of achieving customer satisfaction.

This document applies to the acquisition, supply, development, operation, maintenance, and disposal (whether performed internally or externally to an organization) of software systems, products and services, and the software portion of any system, Software includes the software portion of firmware. Those aspects of system definition needed to provide the context for software products and services are included.

This document also provides processes that can be employed for defining, controlling, and improving software life cycle processes within an organization or a project.

The processes, activities, and tasks of this document can also be applied during the acquisition of a system that contains software, either alone or in conjunction with ISO/IEC/IEEE 15288:2015, *Systems and software engineering—System life cycle processes*.

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In the context of this document and ISO/IEC/IEEE 15288, there is a continuum of human-made systems from those that use little or no software to those in which software is the primary interest. It is rare to encounter a complex system without software, and all software systems require physical system components (hardware) to operate, either as part of the software system-of-interest or as an enabling system or infrastructure. Thus, the choice of whether to apply this document for the software life cycle processes, or ISO/IEC/IEEE 15288:2015, *Systems and software engineering—System life cycle processes*, depends on the system-of-interest. Processes in both documents have the same process purpose and process outcomes, but differ in activities and tasks to perform software engineering or systems engineering, respectively.

1.2 Purpose

The purpose of this document is to provide a defined set of processes to facilitate communication among acquirers, suppliers and other stakeholders in the life cycle of a software system.

This document is written for acquirers, suppliers, developers, integrators, operators, maintainers, managers, quality assurance managers, and users of software systems, products, and services. It can be used by a single organization in a self-imposed mode or in a multi-party situation. Parties can be from the same organization or from different organizations and the situation can range from an informal agreement to a formal contract.

The processes in this document can be used as a basis for establishing business environments, e.g., methods, procedures, techniques, tools and trained personnel. Annex A provides normative direction regarding the tailoring of these software life cycle processes.

1.3 Field of application

This document applies to the full life cycle of software systems, products, and services, including conception, development, production, utilization, support and retirement, and to their acquisition and supply, whether performed internally or externally to an organization. The life cycle processes of this document can be applied concurrently, iteratively and recursively to a software system and incrementally to its elements.

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There is a wide variety of software systems in terms of their purpose, domain of application, complexity, size, novelty, adaptability, quantities, locations, life spans and evolution. This document describes the processes that comprise the life cycle of man-made software systems. It therefore applies to one-of-a-kind software systems, software systems for wide commercial or public distribution, and customized, adaptable software systems. It also applies to a complete stand-alone software system and to software systems that are embedded and integrated into larger, more complex and complete systems.

This document provides a process reference model characterized in terms of the process purpose and the process outcomes that result from the successful execution of the activity tasks. Annex B lists examples of artifacts and information items that may be associated with various processes. This document can therefore be used as a reference model to support process assessment as specified in ISO/IEC 33002:2015. Annex C provides information regarding the use of the software life cycle processes as a process reference model. Annex D describes the process constructs for use in the process reference model. Annex I provides the correspondence between this document and ISO/IEC/IEEE 12207:2008 at the level of process name and process outcome.

1.4 Limitations

This document does not prescribe a specific software life cycle model, development methodology, method, modelling approach, or technique. The users of this document are responsible for selecting a life cycle model for the project and mapping the processes, activities, and tasks in this document into that model. The parties are also responsible for selecting and applying appropriate methodologies, methods, models and techniques suitable for the project.

This document does not establish a management system or require the use of any management system standard. However, it is intended to be compatible with the quality management system specified by ISO 9001, the service management system specified by ISO/IEC 20000-1 (IEEE Std 20000-1), and the information security management system specified by ISO/IEC 27000.

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This document does not detail information items in terms of name, format, explicit content and recording media. ISO/IEC/IEEE 15289 addresses the content for life cycle process information items (documentation).

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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 following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org
- ISO Online browsing platform: available at http://www.iso.org/obp
- IEEE Standards Dictionary Online: available at http://ieeexplore.ieee.org/xpls/dictionary.jsp

Definitions for other terms typically can be found in ISO/IEC/IEEE 24765, *System and software engineering — Vocabulary*, available at <www.computer.org/sevocab>.

3.1.1
acquirer
stakeholder that acquires or procures a product or service from a supplier

Note 1 to entry: Other terms commonly used for an acquirer are buyer, customer, owner, purchaser or internal/organizational sponsor.

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3.1.2
acquisition
process of obtaining a system, product or service

3.1.3
activity
set of cohesive tasks of a process

3.1.4
agile development
software development approach based on iterative development, frequent inspection and adaptation, and incremental deliveries, in which requirements and solutions evolve through collaboration in cross-functional teams and through continual stakeholder feedback

[SOURCE: ISO/IEC/IEEE 26515: 2011]

3.1.5
agreement
mutual acknowledgement of terms and conditions under which a working relationship is conducted

EXAMPLE Contract, memorandum of agreement.

3.1.6
architecture
<system> fundamental concepts or properties of a system in its environment embodied in its elements, relationships, and in the principles of its design and evolution

[SOURCE: ISO/IEC/IEEE 42010:2011]

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3.1.7
architecture framework
conventions, principles and practices for the description of architectures established within a specific domain of application and/or community of stakeholders

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EXAMPLE 1 Generalised Enterprise Reference Architecture and Methodologies (GERAM) [ISO 15704] is an architecture framework.

EXAMPLE 2 Reference Model of Open Distributed Processing (RM-*ODP) [ISO/IEC* 10746] is an architecture framework.

[SOURCE: ISO/IEC/IEEE 42010:2011]

3.1.8
architecture view
work product expressing the architecture of a system from the perspective of specific system concerns

[SOURCE: ISO/IEC/IEEE 42010:2011]

3.1.9
architecture viewpoint
work product establishing the conventions for the construction, interpretation and use of architecture views to frame specific system concerns

[SOURCE: ISO/IEC/IEEE 42010:2011]

3.1.10
audit
independent examination of a work product or set of work products to assess compliance with specifications, standards, contractual agreements, or other criteria

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3.1.11
baseline
formally approved version of a configuration item, regardless of media, formally designated and fixed at a specific time during the configuration item's life cycle

[SOURCE: IEEE Std 828-2012]

3.1.12
business process
partially ordered set of enterprise activities that can be executed to achieve some desired end-result in pursuit of a given objective of an organization

3.1.13
concept of operations
verbal and/or graphic statement, in broad outline, of an organization's assumptions or intent in regard to an operation or series of operations

Note 1 to entry: The concept of operations frequently is embodied in long-range strategic plans and annual operational plans. In the latter case, the concept of operations in the plan covers a series of connected operations to be carried out simultaneously or in succession. The concept is designed to give an overall picture of the organization operations. See also operational concept (3.1.28).

Note 2 to entry: It provides the basis for bounding the operating space, system capabilities, interfaces and operating environment.

[SOURCE: ANSI/AIAA G-043A-2012e]

3.1.14
concern
<system> interest in a system relevant to one or more of its stakeholders

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Note 1 to entry: A concern pertains to any influence on a system in its environment, including developmental, technological, business, operational, organizational, political, economic, legal, regulatory, ecological and social influences.

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[SOURCE: ISO/IEC/IEEE 42010:2011]

3.1.15
configuration item
item or aggregation of hardware, software, or both, that is designated for configuration management and treated as a single entity in the configuration management process

EXAMPLE Software, firmware, data, hardware, humans, processes (e.g., processes for providing service to users), procedures (e.g., operator instructions and user manuals), facilities, services, materials, and naturally occurring entities

3.1.16
customer
organization or person that receives a product or service

EXAMPLE Consumer, client, user, acquirer, buyer, or purchaser.

Note 1 to entry: A customer can be internal or external to the organization.

3.1.17
design, verb
<process> to define the architecture, system elements, interfaces, and other characteristics of a system or system element

[SOURCE: ISO/IEC/IEEE 24765:2010, modified, changed 'components' to 'system element']

3.1.18
design, noun
result of the process in 3.1.17

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Note 1 to entry: Information, including specification of system elements and their relationships, that is sufficiently complete to support a compliant implementation of the architecture

Note 2 to entry: Design provides the detailed implementation-level physical structure, behavior, temporal relationships, and other attributes of system elements.

3.1.19
design characteristic
design attributes or distinguishing features that pertain to a measurable description of a product or service

3.1.20
enabling system
system that supports a system-of-interest during its life cycle stages but does not necessarily contribute directly to its function during operation

EXAMPLE A configuration management system used to control software elements during software development.

Note 1 to entry: Each enabling system has a life cycle of its own. This document is applicable to each enabling system when, in its own right, it is treated as a system-of-interest.

3.1.21
environment
<system> context determining the setting and circumstances of all influences upon a system

[SOURCE: ISO/IEC/IEEE 42010:2011]

3.1.22
facility
physical means or equipment for facilitating the performance of an action, e.g., buildings, instruments, tools

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3.1.23
incident
anomalous or unexpected event, set of events, condition, or situation at any time during the life cycle of a project, product, service, or system

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3.1.24
information item
separately identifiable body of information that is produced, stored, and delivered for human use

[SOURCE: ISO/IEC/IEEE 15289:2015]

3.1.25
infrastructure
hardware and software environment to support computer system and software design, development, and modification

3.1.26
life cycle
evolution of a system, product, service, project or other human-made entity from conception through retirement

3.1.27
life cycle model
framework of processes and activities concerned with the life cycle, which can be organized into stages, acting as a common reference for communication and understanding

3.1.28
operational concept
verbal and graphic statement of an organization's assumptions or intent in regard to an operation or series of operations of a system or a related set of systems

Note 1 to entry: The operational concept is designed to give an overall picture of the operations using one or more specific systems, or set of related systems, in the organization's operational environment from the users' and operators' perspective. See also concept of operations (3.1.13).

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[SOURCE: ANSI/AIAA G-043A-2012e]

3.1.29
operator
individual or organization that performs the operations of a system

Note 1 to entry: The role of operator and the role of user can be vested, simultaneously or sequentially, in the same individual or organization.

Note 2 to entry: An individual operator combined with knowledge, skills and procedures can be considered as an element of the system.

Note 3 to entry: An operator can perform operations on a system that is operated, or within a system that is operated, depending on whether or not operating instructions are placed within the system boundary.

3.1.30
organization
group of people and facilities with an arrangement of responsibilities, authorities and relationships

EXAMPLE company, corporation, firm, enterprise, institution, charity, sole trader, association, or parts or combination thereof.

Note 1 to entry: An identified part of an organization (even as small as a single individual) or an identified group of organizations can be regarded as an organization if it has responsibilities, authorities and relationships. A body of persons organized for some specific purpose, such as a club, union, corporation, or society, is an organization.

3.1.31
party
organization entering into an agreement

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Note 1 to entry: In this document, the agreeing parties are called the acquirer and the supplier.

3.1.32
problem
difficulty, uncertainty, or otherwise realized and undesirable event, set of events, condition, or situation that requires investigation and corrective action

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3.1.33
process
set of interrelated or interacting activities that transforms inputs into outputs

3.1.34
process outcome
observable result of the successful achievement of the process purpose

3.1.35
process purpose
high-level objective of performing the process and the likely outcomes of effective implementation of the process

Note 1 to entry: The purpose of implementing the process is to provide benefits to the stakeholders.

3.1.36
product
result of a process

Note 1 to entry: There are four agreed generic product categories: hardware (e.g., engine mechanical part); software (e.g., computer program procedures, and possibly associated documentation and data); services (e.g., transport); and processed materials (e.g., lubricant). Hardware and processed materials are generally tangible products, while software or services are generally intangible.

3.1.37
project
endeavour with defined start and finish criteria undertaken to create a product or service in accordance with specified resources and requirements

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Note 1 to entry: A project is sometimes viewed as a unique process comprising coordinated and controlled activities and composed of activities from the Technical Management processes and Technical processes defined in this document.

3.1.38
<project> **portfolio**
collection of projects that addresses the strategic objectives of the organization

3.1.39
qualification
process of demonstrating whether an entity is capable of fulfilling specified requirements

3.1.40
quality assurance
part of quality management focused on providing confidence that quality requirements will be fulfilled

[SOURCE: ISO 9000:2015]

3.1.41
quality characteristic
inherent characteristic of a product, process or system related to a requirement

Note 1 to entry: Critical quality characteristics commonly include those related to health, safety, security assurance, reliability, availability and supportability.

3.1.42
quality management
coordinated activities to direct and control an organization with regard to quality

iTeh STANDARD PREVIEW
(standards.iteh.ai)

3.1.43
release
particular version of a configuration item that is made available for a specific purpose

EXAMPLE Test release.

ISO/IEC/IEEE 12207:2017
https://standards.iteh.ai/catalog/standards/sist/6b5ad16c-6696-447d-aa76-18202d695a05/iso-iec-ieee-12207-2017

3.1.44
requirement
statement that translates or expresses a need and its associated constraints and conditions

[SOURCE: ISO/IEC/IEEE 29148:2011, modified, NOTE has been removed.]

3.1.45
resource
asset that is utilized or consumed during the execution of a process

Note 1 to entry: Resources include those that are reusable, renewable or consumable.

EXAMPLE diverse entities such as funding, personnel, facilities, capital equipment, tools, and utilities such as power, water, fuel and communication infrastructures.

3.1.46
retirement
withdrawal of active support by the operation and maintenance organization, partial or total replacement by a new system, or installation of an upgraded system

3.1.47
risk
effect of uncertainty on objectives

Note 1 to entry: An effect is a deviation from the expected — positive or negative. A positive effect is also known as an opportunity.

Note 2 to entry: Objectives can have different aspects (such as financial, health and safety, and environmental goals) and can apply at different levels (such as strategic, organization-wide, project, product and process).

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