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Systems and software engineering — Life cycle management —

Part 1: Guidelines for life cycle management

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

Partie 1: Lignes directrices pour la gestion du cycle de vie

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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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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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, SC 7, *Software and systems engineering*.

This first edition of ISO/IEC/TS 24748-1 cancels and replaces ISO/IEC/TR 24748-1, which has been technically revised.

ISO/IEC 24748 consists of the following parts, under the general title *Systems and software engineering — Life cycle management*:

— *Part 1: Guidelines for life cycle management* [Technical Specification]

— *Part 2: Guide to the application of* ISO/IEC 15288 *(System life cycle processes)*

— *Part 3: Guide to the application of* ISO/IEC 12207 *(Software life cycle processes)*

— *Part 4: Systems engineering planning* [ISO/IEC/IEEE]

— *Part 5: Software development planning* [ISO/IEC/IEEE]

The following parts are under preparation:

— *Part 6: Guide to system integration engineering*

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Introduction

The purpose of this Technical Specification is to facilitate the joint usage of the process content of the latest revisions of ISO/IEC/IEEE 15288 and ISO/IEC 12207, by providing unified and consolidated guidance on life cycle management of systems and software. This is to help ensure consistency in system concepts and life cycle concepts, models, stages, processes, process application, key points of view, adaptation and use in various domains as the two International Standards are used in combination. That will in turn help a project team design a life cycle model for managing the progress of their project.

This Technical Specification will also aid in identifying and planning use of life cycle processes described in ISO/IEC/IEEE 15288 and ISO/IEC 12207 that will enable the project to be completed successfully, meeting its objectives/requirements for each stage and for the overall project.

Besides the above, there is also increasing recognition of the importance of ensuring that all life cycle stages and all aspects within each stage are supported with thorough guidance to enable alignment with any process documents that might subsequently be created that focus on areas besides systems and software, including hardware, humans, data, processes (e.g. review process), procedures (e.g. operator instructions), facilities and naturally occurring entities (e.g. water, organisms, minerals).

By addressing these needs specifically in this Technical Specification, the users of the process-focused ISO/IEC 12207 and ISO/IEC/IEEE 15288 will not only benefit from having one document complementarily addressing the aspect of product or service life cycle: they will also benefit from a framework that links life cycle management aspects to more than just the systems or software aspects of products or services.

ISO/IEC/IEEE 15288 and ISO/IEC 12207 also have published guidelines (ISO/IEC/TR 24748-2 and ISO/IEC/TR 24748-3), respectively, to support use of the two revised International Standards individually.

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Systems and software engineering — Life cycle management —

Part 1: Guidelines for life cycle management

1 Scope

This Technical Specification provides guidelines for the life cycle management of systems and software, complementing the processes described in ISO/IEC/IEEE 15288 and ISO/IEC 12207. This Technical Specification:

— addresses systems concepts and life cycle concepts, models, stages, processes, process application, key points of view, adaptation and use in various domains and by various disciplines;

— establishes a common framework for describing life cycles, including their individual stages, for the management of projects to provide, or acquire either products or services;

— defines the concept and terminology of a life cycle;

— supports the use of the life cycle processes within an organization or a project. Organizations and projects can use these life cycle concepts when acquiring and supplying either products or services;

— provides guidance on adapting a life cycle model and the content associated with a life cycle or a part of a life cycle;

— describes the relationship between life cycles and their use in applying the processes in ISO/IEC/IEEE 15288 (systems aspects) and ISO/IEC 12207 (software aspects);

— shows the relationships of life cycle concepts to the hardware, human, services, process, procedure, facility and naturally occurring entity aspects of projects; and

— describes how its concepts relate to detailed process standards, for example, in the areas of measurement, project management and risk management.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
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.

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.2
acquisition
process of obtaining a system, product or service

[SOURCE: ISO/IEC/IEEE 15288:2015]

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2.3
activity
set of cohesive tasks of a process

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.4
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]

2.5
agreement
mutual acknowledgement of terms and conditions under which a working relationship is conducted

EXAMPLE Contract, memorandum of agreement.

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.6
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

Note 1 to entry: ISO/IEC 12207 and ISO/IEC/IEEE 15288 use the word “elements” instead of “components” and this Technical Specification follows that usage.

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

2.7
architecture framework
conventions, principles and practices for the description of architectures established within a specific domain of application and/or community of stakeholders

EXAMPLE 1 *Generalized 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]

2.8
architecture view
work product expressing the architecture of a system from the perspective of specific system concerns

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

2.9
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]

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2.10
audit
independent examination of a work product or set of work products to assess compliance with specifications, standards, contractual agreements, or other criteria

[SOURCE: ISO/IEC/IEEE 24765:2010]

2.11
baseline
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 828:2012]

2.12
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* (2.25).

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]

2.13
concern
<system> interest in a system relevant to one or more of its stakeholders

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.

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

2.14
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

[SOURCE: ISO/IEC/IEEE 24765:2010, modified — added "item or".]

2.15
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.

[SOURCE: ISO 9000:2015, modified — added "service".]

2.16
design
<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 elements".]

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2.17
design
result of the process in 2.15

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.

[SOURCE: ISO/IEC/IEEE 24765:2010]

2.18
design characteristic
design attributes or distinguishing features that pertain to a measurable description of a product or service

[SOURCE: ISO/IEC/IEEE 24765:2010]

2.19
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 When a system-of-interest enters the Production Stage, a production-enabling system is required.

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

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.20
environment
<system> context determining the setting and circumstances of all influences upon a system

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

2.21
facility
physical means or equipment for facilitating the performance of an action, e.g. buildings, instruments, tools

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.22
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

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.23
information item
separately identifiable body of information that is produced, stored, and delivered for human use

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

2.24
life cycle
evolution of a system, product, service, project or other human-made entity from conception through retirement

[SOURCE: ISO/IEC/IEEE 15288:2015]

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2.25
life cycle model
framework of processes and activities concerned with the life cycle that may be organized into stages, which also acts as a common reference for communication and understanding

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.26
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* (2.11).

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

2.27
operator
individual or organization that performs the operations of a system

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

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

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

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.28
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.

[SOURCE: ISO 9000:2015, modified — Note 1 to entry has been added.]

2.29
party
organization entering into an agreement

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

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.30
problem
difficulty, uncertainty, or otherwise realized and undesirable event, set of events, condition, or situation that requires investigation and corrective action

[SOURCE: ISO/IEC/IEEE 15288:2015]

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2.31
process
set of interrelated or interacting activities that transforms inputs into outputs

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.32
process outcome
observable result of the successful achievement of the process purpose

[SOURCE: ISO/IEC 12207:2008]

2.33
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.

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.34
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), 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.

[SOURCE: ISO 9000:2015]

2.35
project
endeavour with defined start and finish criteria undertaken to create a product or service in accordance with specified resources and requirements

Note 1 to entry: A project is sometimes viewed as a unique process comprising co-coordinated and controlled activities and composed of activities from the Project Processes and Technical Processes defined in the referenced International Standards.

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.36
qualification
process of demonstrating whether an entity is capable of fulfilling specified requirements

[SOURCE: ISO/IEC 12207:2008]

2.37
quality assurance
part of quality management focused on providing confidence that quality requirements will be fulfilled

[SOURCE: ISO 9000:2015]

2.38
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.

[SOURCE: ISO 9000:2015, modified — Note 1 to entry added.]

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2.39
quality management
coordinated activities to direct and control an organization with regard to quality

[SOURCE: ISO 9000:2015]

2.41
requirement
statement that translates or expresses a need and its associated constraints and conditions

[SOURCE: ISO/IEC/IEEE 29148:2011]

2.42
resource
asset that is utilized or consumed during the execution of a process

Note 1 to entry: Includes diverse entities, such as funding, personnel, facilities, capital equipment, tools and utilities, such as power, water, fuel and communication infrastructures.

Note 2 to entry: Resources include those that are reusable, renewable, or consumable.

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.43
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

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.44
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).

Note 3 to entry: Risk is often characterized by reference to potential events and consequences, or a combination of these.

Note 4 to entry: Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood of occurrence.

Note 5 to entry: Uncertainty is the state, even partial, of deficiency of information related to understanding or knowledge of an event, its consequence, or likelihood.

[SOURCE: ISO Guide 73:2009, 1.1]

2.45
security
protection against intentional subversion or forced failure, containing a composite of four attributes: confidentiality, integrity, availability and accountability, plus aspects of a fifth, usability, all of which have the related issue of their assurance

[SOURCE: NATO AEP-67]

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2.46
service
performance of activities, work, or duties

Note 1 to entry: A service is self-contained, coherent, discrete and can be composed of other services.

Note 2 to entry: A service is generally an intangible product.

[SOURCE: ISO/IEC 12207:2008]

2.47
software item
source code, object code, control code, control data, or a collection of these items

Note 1 to entry: A software item can be viewed as a system element of the referenced International Standard and of ISO/IEC/IEEE 15288:2015.

[SOURCE: ISO/IEC 12207:2008]

2.48
software product
set of computer programs, procedures, and possibly associated documentation and data

[SOURCE: ISO/IEC 12207:2008]

2.49
software unit
atomic level software component of the software architecture that can be subjected to stand-alone testing

[SOURCE: ISO 26262-1:2011]

2.50
stage
period within the life cycle of an entity that relates to the state of its description or realization

Note 1 to entry: As used in this Technical Specification, stages relate to major progress and achievement milestones of the entity through its life cycle.

Note 2 to entry: Stages often overlap.

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.51
stakeholder
individual or organization having a right, share, claim, or interest in a system or in its possession of characteristics that meet their needs and expectations

EXAMPLE End users, end user organizations, supporters, developers, producers, trainers, maintainers, disposers, acquirers, supplier organizations and regulatory bodies.

Note 1 to entry: Some stakeholders can have interests that oppose each other or oppose the system.

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.52
supplier
organization or an individual that enters into an agreement with the acquirer for the supply of a product or service

Note 1 to entry: Other terms commonly used for supplier are contractor, producer, seller, or vendor.

Note 2 to entry: The acquirer and the supplier sometimes are part of the same organization.

[SOURCE: ISO/IEC/IEEE 15288:2015]

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2.53
system
combination of interacting elements organized to achieve one or more stated purposes

Note 1 to entry: A system is sometimes considered as a product or as the services it provides.

Note 2 to entry: In practice, the interpretation of its meaning is frequently clarified by the use of an associative noun, e.g. aircraft system. Alternatively the word "system" is substituted simply by a context-dependent synonym, e.g. aircraft, though this potentially obscures a system principles perspective.

Note 3 to entry: A complete system includes all of the associated equipment, facilities, material, computer programs, firmware, technical documentation, services and personnel required for operations and support to the degree necessary for self-sufficient use in its intended environment.

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.54
system element
member of a set of elements that constitutes a system

EXAMPLE Hardware, software, data, humans, processes (e.g. processes for providing service to users), procedures (e.g. operator instructions), facilities, materials and naturally occurring entities, or any combination.

Note 1 to entry: A system element is a discrete part of a system that can be implemented to fulfill specified requirements.

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.55
system-of-interest
system whose life cycle is under consideration in the context of this document

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.56
systems engineering
interdisciplinary approach governing the total technical and managerial effort required to transform a set of stakeholder needs, expectations, and constraints into a solution and to support that solution throughout its life

[SOURCE: ISO/IEC/IEEE 24765:2010]

2.57
task
required, recommended, or permissible action, intended to contribute to the achievement of one or more outcomes of a process

[SOURCE: ISO/IEC/IEEE 15288:2015]

2.58
technical management
application of technical and administrative resources to plan, organize and control engineering functions

[SOURCE: ISO/IEC 12207:2008]

2.59
trade-off
decision-making actions that select from various requirements and alternative solutions on the basis of net benefit to the stakeholders

[SOURCE: ISO/IEC/IEEE 15288:2015]

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2.60
user
individual or group that interacts with a system or benefits from a system during its utilization

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

[SOURCE: ISO/IEC 25010:2011]

2.61
validation
confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled

Note 1 to entry: A system is able to accomplish its intended use, goals and objectives (i.e. meet stakeholder requirements) in the intended operational environment. The right system was built.

Note 2 to entry: In a life cycle context, validation involves the set of activities for ensuring and gaining confidence that a system is able to accomplish its intended use, goals and objectives in an environment like the operational environment.

[SOURCE: ISO 9000:2015, modified — Note 1 to entry and Note 2 to entry have been added.]

2.62
verification
confirmation, through the provision of objective evidence, that specified requirements have been fulfilled

Note 1 to entry: Verification is a set of activities that compares a system or system element against the required characteristics. This includes, but is not limited to, specified requirements, design description and the system itself. The system was built right.

[SOURCE: ISO 9000:2015 modified — Note 1 to entry has been added.]

3 Life cycle-related concepts

3.1 System concepts

3.1.1 General

This subclause is included to highlight and explain essential concepts on which this Technical Specification is based. These concepts are directly applicable to software, as addressed in ISO/IEC 12207, systems, as addressed in ISO/IEC/IEEE 15288, and to hardware, facilities, services, humans, processes and procedures, data and naturally occurring entities.

3.1.2 Systems

The systems considered in this Technical Specification are man-made and utilized to provide services in defined environments for the benefit of users and other stakeholders. These systems may be configured with one or more of the following: hardware, software, services, humans, data, processes (e.g. processes for providing services to users), procedures (e.g. operator instructions), facilities and naturally occurring entities (e.g. water, organisms, minerals).

The perception and definition of a particular system, its architecture and its system elements depend on an observer's interests and responsibilities. One person's system-of-interest can be viewed as a system element in another person's system-of-interest. Conversely, it can be viewed as being part of the environment of operation for yet another person's system-of-interest.

Figure 1 exemplifies the multitude of perceivable systems-of-interest in an aircraft and its environment of operation. First, Figure 1 in its entirety comprises a transportation system with air, ground and

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