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Systems and software engineering — Life cycle management —

Part 2: Guidelines for the application of ISO/IEC/IEEE 15288 (system life cycle processes)

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

Partie 2: Lignes directrices pour l'application de l'ISO/IEC/IEEE 15288 (processus du cycle de vie du système)

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Contents

Page

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 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 or www.iec.ch/members_experts/refdocs).

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This document was prepared by Joint Technical Committee ISO/JTC 1, *Information technology,* Subcommittee SC 7, *Software and systems 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 second edition cancels and replaces the first edition (ISO/IEC/IEEE 24748-2:2018), which has been technically revised.

The main changes are as follows:

— updated 4.4 to reflect changes to ISO/IEC/IEEE 15288;

— reworked interfacing, enabling and interoperating systems;

— added considerations on agile and DevOps;

— reworked 6.5;

— reworked 6.7 to reflect changes to ISO/IEC/IEEE 15288;

— reworked 6.8 to reflect changes to ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 24748-1;

— removed the former Annex A (guide on transitioning from former version);

— added a new Annex B to include an example on interfacing, enabling and interoperating systems;

— removed the former Annex C (engineering views and the Vee);

— added a new Annex C on model-based systems engineering.

A list of all parts in the ISO/IEC/IEEE 24748 series can be found on the ISO and IEC websites.

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 and www.iec.ch/national-committees.

Introduction

This document and its companion, ISO/IEC/IEEE 24748-3, specifically support the use of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207, respectively. This document and ISO/IEC/IEEE 24748-3 reflect the alignment effort evident in ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207. Terminology, structure and content in this document and ISO/IEC/IEEE 24748-3 are aligned consistent with those in ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207. Consequently, the users of ISO/IEC/IEEE 12207 and ISO/IEC/IEEE 15288 benefit from having documents complementarily addressing all aspects of services or products over their life cycle.

This document is intended to be consistent with both ISO/IEC/IEEE 24748-1 and ISO/IEC/IEEE 15288 in its treatment of life cycle concepts and systems engineering processes.

NOTE Systems engineering for defence projects is addressed in ISO/IEC/IEEE 24748-7.

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 enabling alignment with process documents that focus on areas besides systems and software. These can include hardware, humans, data, processes (e.g., review process), procedures (e.g., operator instructions), facilities and naturally occurring entities (e.g., water, organisms, minerals). The concept and structure of the ISO/IEC/IEEE 24748 series is intended to allow its extension to such additional domains where that will provide value to users.

Systems and software engineering — Life cycle management —

Part 2: Guidelines for the application of ISO/IEC/IEEE 15288 (system life cycle processes)

1 Scope

This document provides guidance on the application of ISO/IEC/IEEE 15288. It addresses the application of system, life cycle, organizational, project, process, and conformance and adaption concepts, principally through references to ISO/IEC/IEEE 24748-1[1)] and ISO/IEC/IEEE 15288. This document gives guidance on applying ISO/IEC/IEEE 15288 from the aspects of strategy, planning, application in organizations and application on projects. It also provides a comparison of the differences between ISO/IEC/IEEE 15288:2023 and ISO/IEC/IEEE 15288:2015.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC/IEEE 15288, *Systems and software engineering — System life cycle processes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC/IEEE 15288 apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

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

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

NOTE Definitions for other systems and software engineering terms typically can be found in ISO/IEC/IEEE 24765, available at www.computer.org/sevocab.

4 Overview of ISO/IEC/IEEE 15288

4.1 General

ISO/IEC/IEEE 15288 defines a set of processes to facilitate system development and information exchange among acquirers, suppliers and other stakeholders in the life cycle of a system. It applies to the acquisition of systems, which can be comprised of products, services or both, as well as to the supply, development, operation, maintenance and disposal of systems, whether performed internally or externally to an organization.

1) Under preparation. Stage at the time of publication: ISO/IEC/IEEE FDIS 24748-1:2023.

In the context of this document, ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207, 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. When software is the predominant system or element of interest, ISO/IEC/IEEE 12207 should be used. Both documents have the same process model, share most activities and tasks and differ primarily in descriptive notes. The determination of the applicability of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207 should be decided by the nature of the system and its enabling systems. Often, a mixed tailoring of each standard can be appropriate.

The purpose of ISO/IEC/IEEE 15288 is to provide a defined set of processes to facilitate communication among acquirers, suppliers and other stakeholders in the life cycle of a system. ISO/IEC/IEEE 15288 is written for acquirers of systems and other stakeholders like suppliers, developers, operators, maintainers, managers, quality assurance managers and users of systems.

4.2 Structure of ISO/IEC/IEEE 15288

ISO/IEC/IEEE 15288 contains requirements in two clauses:

a) ISO/IEC/IEEE 15288:2023, Clause 6 defines the requirements for the system life cycle processes;

b) ISO/IEC/IEEE 15288:2023, Annex A provides requirements for tailoring of ISO/IEC/IEEE 15288.

See ISO/IEC/IEEE 15288:2023, Clause 5 for key concepts used in that International Standard.

Three informative annexes support the use of ISO/IEC/IEEE 15288:

— ISO/IEC/IEEE 15288:2023, Annex B provides information on possible information items that can be associated with each process in ISO/IEC/IEEE 15288;

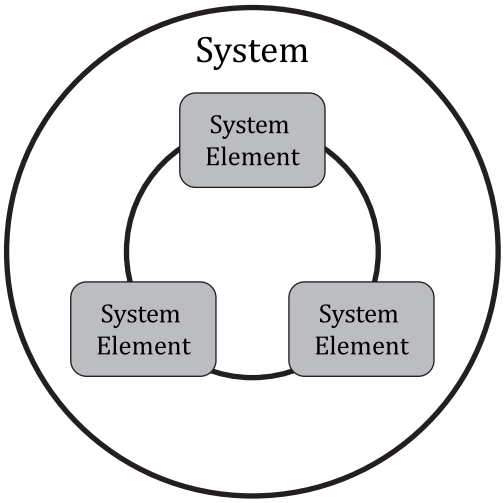
— ISO/IEC/IEEE 15288:2023, Annex C provides information about use of the ISO/IEC/IEEE 15288 system life cycle processes as a process reference model to support process assessment;

— ISO/IEC/IEEE 15288:2023, Annex D provides an informative description of the implementation of system life cycle processes in an MBSE approach.

4.3 Context of ISO/IEC/IEEE 15288

ISO/IEC/IEEE 15288 focuses on the processes that are used by or for a project that exists in a defined relationship with the organization, other projects and enabling systems. Typically, a project is assigned responsibility that encompasses one or more life cycle stages of the system-of-interest (SoI). ISO/IEC/IEEE 15288 is applicable to organizations and projects whether they act as the acquirer or the supplier of a system and whether the system is comprised of products, services or a combination of both.

The ISO/IEC/IEEE 15288 processes are described in relation to a system, see Figure 1. As shown in Figure 1, a system is composed of a set of interacting system elements. System elements may include software elements, hardware elements, services, and utilization and support resources.



NOTE See ISO/IEC/IEEE 15288:2023, Figure 1.

Figure 1 — System and system element relationship

When an organization applies ISO/IEC/IEEE 15288 to a particular system that system becomes the SoI. The SoI has a life cycle that consists of multiple stages through which the system passes during its lifetime. These stages are not necessarily sequential and their execution can be completely or partially in parallel, as well as iterative or recursive. Examples of typical stages are:

— concept;

— development;

— production;

— utilization;

— support;

— retirement.

NOTE 1 Stages are described in ISO/IEC/IEEE 15288:2023, 5.5.2 and in ISO/IEC/IEEE 24748-1:—, 4.3.2 and Clause 5.

NOTE 2 The management of the transition from one stage to another is not necessarily a linear, sequential, progression and engineering activities are associated with providing appropriate work products and decision-making information in each stage.

A number of enabling systems are deployed throughout the system life cycle to provide the SoI with support as needed. Each life cycle stage can require one or more enabling systems. An enabling system has its own life cycle and when ISO/IEC/IEEE 15288 is applied to it, it then becomes an SoI.

NOTE 3 The role and use of enabling systems are described in 6.3.5.

NOTE 4 For related material on enabling systems, see also ISO/IEC/IEEE 15288:2023, 5.2.3 and ISO/IEC/IEEE 24748-1:—, 4.2.4.

ISO/IEC/IEEE 15288 is applicable at any level of the structure associated with an SoI. As a system is decomposed recursively into its system elements, the processes of ISO/IEC/IEEE 15288 may be used for each system and system element in the system structure, including enabling systems. Each system and system element has a life cycle of its own and its own set of enabling systems.

NOTE 5 For related material on system structure, see ISO/IEC/IEEE 15288:2023, 5.2.2 and ISO/IEC/IEEE 24748-1:—, 4.2.3.

In order to perform needed operations and transformations upon systems during their life cycles, the organization creates and monitors projects. Projects have a defined scope, resources (including time) and focus. The scope can involve managing all of the stages of the life cycle, a subset of the stages, one or more defined processes or one or more process activities. The time scale can be of varying duration, for example a few weeks or tens of years. The focus of the project is related to the SoI and its systems and system elements in some form of system structure or stage partitioning.

NOTE 6 System life cycle concepts are described in ISO/IEC/IEEE 24748-1:—, 4.3.

Organizations focus on systems that are created or transformed by projects within the organization or in conjunction with other organizations. Projects have a span of interest that includes the SoI and its related enabling systems. Some enabling systems are under direct control of the project. The SoI and those enabling systems make up the project span of control.

The work performed by projects is on or with the SoI within one or more life cycle stages. ISO/IEC/IEEE 15288 includes the requirement to define an appropriate life cycle for a system, the selection of processes to be applied throughout the life cycle and the application of these processes to fulfil agreements and achieve customer satisfaction.

ISO/IEC/IEEE 15288 can be applied to all types of product- or service-focused systems and system elements consisting of one or more of the following: hardware, software, humans, processes, procedures, facilities and naturally occurring entities. The use of ISO/IEC/IEEE 15288 for systems within this broad scope is one of its main advantages.

The use of the standard may be adapted to accommodate the varying project requirements in treating system life cycles.

NOTE 7 This can be performed by adapting the life cycle as described in ISO/IEC/IEEE 24748-1:—, Clause 5 and tailoring described in ISO/IEC/IEEE 15288:2023, Annex A.

4.4 Comparison of ISO/IEC/IEEE 15288 to prior version

This subclause compares ISO/IEC/IEEE 15288:2023 with ISO/IEC/IEEE 15288:2015. For a more detailed comparison, see Annex A. The main changes are:

— improvements to selected technical processes including business or mission analysis process, system architecture definition process (renamed from architecture definition process), design definition process, implementation process, integration process and maintenance process;

— improvements to selected technical management processes, including risk management process and configuration management process;

— except for these changes, the process groups and life cycle processes are the same as the prior version;

— emphasized importance of system of systems (SoS), moved content from ISO/IEC/IEEE 15288:2015, Annex G to ISO/IEC/IEEE 15288:2023, 5.4 and added several notes throughout the document;

— addition of ISO/IEC/IEEE 15288:2034, Annex D addressing model-based systems engineering (MBSE);

— updates to ISO/IEC/IEEE 15288:2015, Clause 5, including a better description of iteration and recursion and expanded content on process application and system concepts;

— new content in ISO/IEC/IEEE 15288:2023, Clause 5 on collaborative activities, concept and system definition, assurance and quality characteristics;

— updates to the terms and definitions;

— removed ISO/IEC/IEEE 15288:2015, Annex D “Process integration and process constructs”, Annex E “Process views”, Annex F “Architecture modelling” and Annex G “Application of system life cycle processes to a system of systems”.

5 Application concepts

This document provides guidelines for life cycle management in the field of systems. This clause lists essential concepts on which this document is based and provides references for further reading and applying. Essential concepts are:

— life cycle management: ISO/IEC/IEEE 24748-1 provides more information on concepts related to life cycle management in general;

— system concepts: system concepts for systems that are any mix of products and services are introduced in ISO/IEC/IEEE 15288:2023, 5.2; additional discussion is in ISO/IEC/IEEE 24748-1:—, 4.2;

— organizational concepts: organizational concepts are introduced in ISO/IEC/IEEE 15288:2023, 5.3; additional discussion is in ISO/IEC/IEEE 24748-1:—, Annex B;

— system of systems concepts: SoS concepts are introduced in ISO/IEC/IEEE 15288:2023, 5.4; additional discussion is in ISO/IEC/IEEE 21839, ISO/IEC/IEEE 21840 and ISO/IEC/IEEE 21841;

— life cycle concepts: life cycle concepts are introduced in ISO/IEC/IEEE 15288:2023, 5.5; additional discussion is in ISO/IEC/IEEE 24748-1:—, 4.3;

— process concepts: process concepts are introduced in ISO/IEC/IEEE 15288:2023, 5.6; additional discussion is in ISO/IEC/IEEE 24748-1:—, Annex A;

— project concepts: project concepts are introduced in ISO/IEC/IEEE 15288:2023, 5.3.2; additional discussion is in ISO/IEC/IEEE 24748-1:—, Annex C.

6 Applying ISO/IEC/IEEE 15288

6.1 Overview

Throughout ISO/IEC/IEEE 15288, “shall” is used to express a provision that is binding between two or more parties, “should” to express a recommendation among possibilities and “may” to indicate a course of action permissible within the limits of ISO/IEC/IEEE 15288. This document provides guidance to assist in understanding how the provisions of ISO/IEC/IEEE 15288 apply. No new requirements are introduced in the guidance text (no “shall”). Where “should” is used, it is a recommendation of a requirement of ISO/IEC/IEEE 15288.

Understanding concepts does not give the ability to immediately apply them without further thought and work. 6.2 to 6.8 give guidance on what should be done to bridge the gap between concept and practical use in different organizational, life cycle and project environments, starting with planning the application of ISO/IEC/IEEE 15288.

Modern organizations strive to develop a robust set of life cycle processes that are applied repeatedly to the projects of the organization. To accommodate that need, ISO/IEC/IEEE 15288 is intended to be useful for application at either the organization level or at the project level. An organization should adopt the standard and supplement it with appropriate policies, life cycle processes, life cycle models and procedures. A project of the organization should typically conform to the organization's processes rather than conform directly to ISO/IEC/IEEE 15288.

In some cases, projects can be executed by an organization that does not have an appropriate set of processes adopted at the organizational level. Such a project may directly adopt the provisions of ISO/IEC/IEEE 15288.

6.2 Application strategy

6.2.1 Overview

ISO/IEC/IEEE 15288 can be applied for a variety of reasons, such as to:

a) define the processes, activities and tasks required for use on a specific project;

b) improve processes used by an organization across multiple projects;

c) provide guidance on system life cycle processes usable within a larger process, such as an organization's acquisition process or maintenance process.

Whatever the reason for application of ISO/IEC/IEEE 15288 is, a suggested application strategy consists of the following:

— plan the application;

— adapt ISO/IEC/IEEE 15288, if applicable;

— conduct pilot project(s);

— formalise the approach;

— institutionalise the approach.

This strategy is typical of the approach that should be followed when introducing changes into an organization or project. The application strategy can be repeated several times across an organization or within a project as additional processes are addressed or improved.

Whether the basis for the existing system life cycle processes is ISO/IEC 15288:2015 or some other reference point, the fundamental starting point is to identify all the changes to go from that basis to ISO/IEC/IEEE 15288.

Coordinating with stakeholders in this effort is critical: even one area left out that should have been in the planning can materially disrupt applying the new basis. One way of proceeding is for a small group to develop a high-level list of items that should be considered and changed in applying ISO/IEC/IEEE 15288. This may include, and possibly will not be limited to:

— process and procedure changes, including flow and nomenclature;

— staff training needs;

— responsibility changes, including need for new or modified agreements;

— impacts on procedures and tools;

— an approach applied across the organization

— improved processes.

A more detailed set of changes should then be developed by a wide group of affected stakeholders.

Once there is a detailed listing of the changes, the time and cost impacts of each should be assessed and adjusted for the risks of each change and various groupings of change. Changes should be phased to minimise cost, project disruption and the potential for adverse human reactions. Readiness criteria should be developed for the phase-in, as well as checks for successful completion of the changes. Quantitative and qualitative measures should be developed and used.

Throughout, a core group should be maintained to oversee the change from one basis to another, with periodic coordination with the entire group of stakeholders. This coordination is very important to repeatedly communicate the goals of the change, to show progress and to recognise progress.