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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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Foreword

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

This first edition cancels and replaces ISO/IEC TR 24748-2:2011. The changes to this edition reflect changes in ISO/IEC/IEEE 15288:2015 from the 2008 edition, as well as the movement of concept material to ISO/IEC/IEEE 24748-1:2018.

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

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 and its companion, ISO/IEC TR 24748-3 *Guide to the application of ISO/IEC 12207 (Software life cycle processes)* specifically support use of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207, respectively. These two guidelines continue and make use of the alignment effort evident in the two revised International Standards. Terminology, structure and content in the guidelines are aligned consistent with that in the two International Standards. Consequently, the users of ISO/IEC/IEEE 12207 and ISO/IEC/IEEE 15288 will benefit from having documents complementarily addressing all aspects of services or products over their life cycle.

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 enabling alignment with process documents that focus on areas besides systems and software. This 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 is a guideline for the application of ISO/IEC/IEEE 15288:2015. It addresses system, life cycle, organizational, project, and process, concept application, principally through reference to ISO/IEC/IEEE 24748-1 and ISO/IEC/IEEE 15288:2015. It gives guidance on applying ISO/IEC/IEEE 15288:2015 from the aspects of strategy, planning, application in organizations, and application on projects. It also provides comparison of the differences between ISO/IEC/IEEE 15288:2015 and the prior versions, ISO/IEC 15288:2008.

This document is intended to be consistent with both ISO/IEC/IEEE 24748-1 and ISO/IEC/IEEE 15288:2015 in its treatment of life-cycle concepts and systems engineering processes.

NOTE Systems engineering for defense programs is addressed in IEEE Std 15288.1, *Application of Systems Engineering on Defense Programs*.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC/IEEE 15288:2015 apply.

ISO, IEC and IEEE 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://dictionary.ieee.org

4 Overview of ISO/IEC/IEEE 15288:2015

4.1 General

ISO/IEC/IEEE 15288:2015 *Systems and software engineering — System life cycle processes*, establishes a common framework for system life cycle processes, with well-defined terminology, that can be referenced by any party, particularly those having any involvement or interest in the system life cycle or performance of systems engineering activities. 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.

ISO/IEC/IEEE 15288:2015 may be used stand-alone or jointly with other International Standards, such as ISO/IEC/IEEE 12207:2017, and supplies a process reference model that supports process capability assessment in accordance with ISO/IEC 33002:2015 (Process assessment).

The purpose of ISO/IEC/IEEE 15288:2015 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 15288:2015 is written for acquirers of systems and for suppliers, developers, operators, maintainers, managers, quality assurance managers, and users of systems.

4.2 Structure of ISO/IEC/IEEE 15288:2015

ISO/IEC/IEEE 15288:2015 contains requirements in two clauses:

1) Clause 6, which defines the requirements for the system life cycle processes;

2) Annex A that provides requirements for tailoring of ISO/IEC/IEEE 15288:2015.

Six informative annexes support the use of ISO/IEC/IEEE 15288:2015 or its harmonization with ISO/IEC 12207:2008:

1) Annex B provides information on possible information items that may be associated with each process in ISO/IEC/IEEE 15288:2015.

2) Annex C provides information about use of the ISO/IEC/IEEE 15288:2015 system life cycle processes as a process reference model to support process assessment.

3) Annex D provides an informative description of the process constructs used in ISO/IEC/IEEE 15288:2015.

4) Annex E provides information on the process view concept and examples of its use from two different process viewpoints.

5) Annex F provides information on the Architecture Definition and Design Definition processes in ISO/IEC/IEEE 15288:2015 as they relate to the Architectural Design process in the 2008 version of ISO/IEC/IEEE 15288.

6) Annex G provides information on application of system life cycle processes to a system of systems.

Readers of ISO/IEC/IEEE 15288:2015 are advised to consult Clause 5 of that International Standard to gain understanding of the key concepts used.

4.3 Context of ISO/IEC/IEEE 15288:2015

ISO/IEC/IEEE 15288:2015 has a focus 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. A project is assigned responsibility that encompasses one or more life cycle stages of the system-of-interest. ISO/IEC/IEEE 15288:2015 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 context of ISO/IEC/IEEE 15288:2015 is illustrated in Figure 1. As the figure indicates, a single project may involve multiple organizations working together as partners. The project for the system-of-interest may also interact with other projects, either for other systems that will interoperate with the system-of-interest, or for enabling systems. Such a project should use ISO/IEC/IEEE 15288:2015 to establish common terminology, as well as information flows and interfaces among the several organizations, to enhance communications.

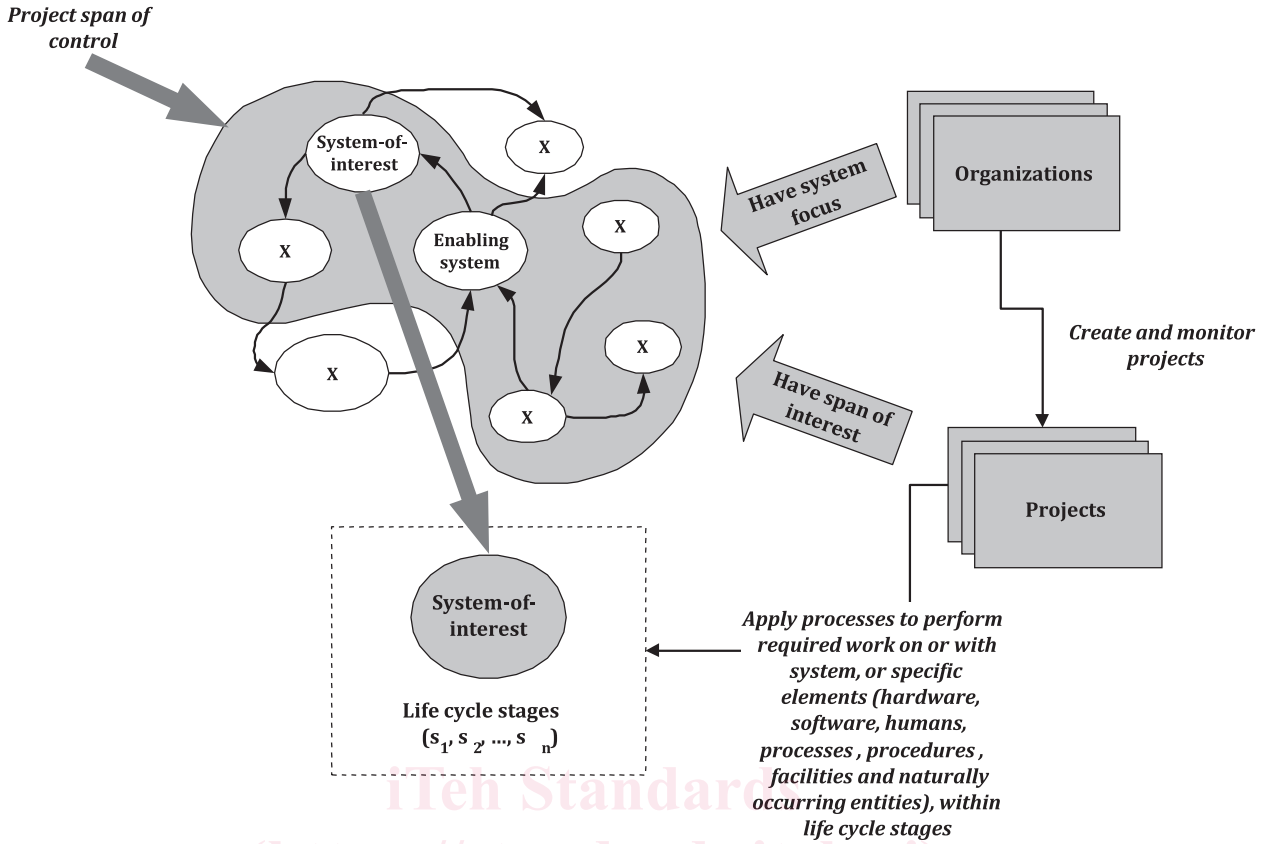

Figure 1 — Context of ISO/IEC/IEEE 15288:2015

When an organization applies ISO/IEC/IEEE 15288:2015 to a particular system that system becomes the system-of-interest. The system-of-interest has a life cycle that consists of multiple stages through which the system passes during its lifetime, denoted in the figure as s_1, s_2, ... s_n. These stages are not necessarily sequential and their execution can be completely or partially in parallel, as well as iterative or recursive. An example of typical stages is:

— s_1: concept;

— s_2: development;

— s_3: production;

— s_4: utilization;

— s_5: support; and

— s_6 retirement.

NOTE 1 Stages are described in ISO/IEC/IEEE 15288:2015, 5.4.2 and in ISO/IEC/IEEE 24748-1:2018, 4.3.2 and 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 system-of-interest with support as needed. Each life cycle stage can require one or more enabling systems. It is important to note that an enabling system has its own life cycle and that when ISO/IEC/IEEE 15288:2015 is applied to it, it then becomes a system-of-interest.

NOTE 3 The role and use of enabling systems are described in 6.3.4 and 6.7.4.6 of this document.

NOTE 4 For related material on enabling systems, see also ISO/IEC/IEEE 15288:2015, 5.2.3 and ISO/IEC/IEEE 24748-1:2018, 4.2.4.

ISO/IEC/IEEE 15288:2015 is applicable at any level of the structure associated with a system-of-interest. As a system is decomposed recursively into its system elements, the processes of ISO/IEC/IEEE 15288:2015 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 15288:2015, 5.2.2 and ISO/IEC/IEEE 24748-1:2018, 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 system-of-interest 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 24748-1:2018, 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 system-of-interest and its related enabling systems. Some enabling systems are under direct control of the project. The system-of-interest and those enabling systems make up the project span of control.

The work performed by projects is on or with the system-of-interest within one or more life cycle stages. ISO/IEC/IEEE 15288:2015 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 15288:2015 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 15288:2015 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 24748-1:2018, Clause 5 and tailoring described in ISO/IEC/IEEE 15288:2015, Annex A.

4.4 Comparison of ISO/IEC/IEEE 15288:2015 to prior versions

This clause compares the 2008 and 2015 versions of International Standard ISO/IEC/IEEE 15288. Changes have been made to the processes at the structural level (i.e., processes have been added, renamed, or combined with others, with resultant renumbering). These structural changes in the ISO/IEC/IEEE 15288 process set are summarized in Table 1 and the reasons for each structural change are given in Table 2.

Table 1 — Mapping of process sets between ISO/IEC 15288:2008 and ISO/IEC/IEEE 15288:2015

ISO/IEC 15288:2008		ISO/IEC/IEEE 15288:2015		
Clause	**Process**	**Clause**	**Process**	**Structural Changes**
6.2.3	Project Portfolio Management Process	6.2.3	Portfolio management process	Title changed
		6.2.6	Knowledge management process	Added process
6.3	Project Processes	6.3	Technical management processes	Title changed

Table 1 *(continued)*

ISO/IEC 15288:2008		ISO/IEC/IEEE 15288:2015		
Clause	**Process**	**Clause**	**Process**	**Structural Changes**
		6.3.8	Quality assurance process	Added process
		6.4.1	Business or mission analysis process	Added process
6.4.1	Stakeholder Requirements Definition Process	6.4.2	Stakeholder needs and requirements definition process	Title changed; numbering;
6.4.2	Requirements Analysis Process	6.4.3	System requirements definition process	Title changed; numbering;
6.4.3	Architectural Design Process	6.4.4	Architecture definition process	Title changed; numbering
		6.4.5	Design definition process	Added process
		6.4.6	System analysis process	Added process
6.4.4	Implementation Process	6.4.7	Implementation process	Numbering
6.4.5	Integration Process	6.4.8	Integration process	Numbering
6.4.6	Verification Process	6.4.9	Verification process	Numbering
6.4.7	Transition Process	6.4.10	Transition process	Numbering
6.4.8	Validation Process	6.4.11	Validation process	Numbering
6.4.9	Operation Process	6.4.12	Operation process	Numbering
6.4.10	Maintenance Process	6.4.13	Maintenance process	Numbering
6.4.11	Disposal Process	6.4.14	Disposal process	Numbering

Table 2 — Basis for change of process set in ISO/IEC/IEEE 15288:2015

Title change between ISO/IEC 15288:2008 and ISO/IEC/IEEE 15288:2015	Reason for change
6.2.3 Project Portfolio Management Process (2008) Changed to: 6.2.3 Portfolio management process (2015)	The purpose of the Portfolio Management process is to initiate and sustain necessary, sufficient and suitable projects in order to meet the strategic objectives of the organization. Accordingly, it is done outside the scope of any one project and further, it is inappropriate to speak of the project portfolio of a single project.
6.2.6 Knowledge management process (2015) [ADDED]	This was activity 6.2.4.3 d) under process 6.2.4 Human Resource Management Process in the 2008 version. The change to a process in ISO/IEC/IEEE 15288:2015 reflects the greater appreciation that an organizations knowledge is more than what its human resources possess and that the outcomes, activities and tasks need to be more inclusive to reflect this fact.
6.3 Project Processes (2008) Changed to 6.3 Technical Management Processes (2015)	Reflects that the processes under this heading relate to the technical management of a project, but are not the full set of processes involved in managing a project.
6.3.8 Quality assurance process (2015) [ADDED]	In the 2008 version of 15288, quality assurance was task 6.3.2.3 a) 2) under process 6.3.2, Project Assessment and Control Process. It is now recognized as having a broader contribution, under process group 6.3, Technical processes, to the successful realization of the system over its life cycle.

Table 2 *(continued)*

Title change between ISO/IEC 15288:2008 and ISO/IEC/IEEE 15288:2015	Reason for change
6.4.1 Business or mission analysis process (2015) [ADDED]	This is a critical precursor to determining needs and defining requirements. It was not explicitly addressed in ISO/IEC 15288:2008 and has now been added as a separate process in the 2015 version.
6.4.1 Stakeholder Requirements Definition Process (2008) Changed to: 6.4.2 Stakeholder needs and requirements definition process (2015)	The change clarifies that stakeholder needs must first be determined, then used as a basis for deriving stakeholder requirements. That is: a) needs and requirements are related but different b) that both must be addressed to provide a system that responds to stakeholders, c) the stakeholders' views of what they desire that the system provide them in terms of products and services drives the requirements that express the intended interaction the system will have with its operational environment, and d) the stakeholders' requirements are derived by analysis of the stakeholder needs This is consistent with ISO/IEC/IEEE 29148:2011, Systems and software engineering — Life cycle processes — Requirements engineering, Clause 5.2.3, paragraph 1, Transformation of needs into requirements.
6.4.2 Requirements Analysis Process (2008) Changed to: 6.4.3 System requirements definition process (2015)	The process title in the 2008 version of 15288 did not reflect the full scope of what must be done to define system requirements: analysis is only a part of it. In addition, the scope of the process itself is broadened in the 2015 version of 15288 to include the preparation and maintenance of system requirements, not just the initial definition itself.
6.4.3 Architectural Design Process (2008) Changed to: 6.4.4 Architecture definition process (2015)	The process in the 2015 version of 15288 gives a more encompassing view of all the activities and tasks required to architect a system, whereas the 2008 version focuses on the narrower aspect of architecture design.
6.4.5 Design definition process (2015) [ADDED]	Design was inferred in ISO/IEC 15288:2008 process 6.4.3, Architectural Design Process. However, the 2015 version treats architecting (process 6.4.4) and design (6.4.5) as two distinct sets of effort, with outcomes, activities and tasks appropriate to each.
6.4.6 System analysis process (2015) [ADDED]	System analysis was inferred in ISO/IEC 15288:2008 process 6.4.3, Architectural Design Process. In the 2015 version, it is treated explicitly. Further, the process in the 2015 version of 15288 recognizes that system analysis can be performed in conjunction with more processes than just system design.

In addition to the above, the preponderance of changes in the 2015 edition of ISO/IEC/IEEE 15288 are refinements to the purpose, outcomes, activities and tasks of the processes in the International Standard. All of these changes reflect further experience with the International Standard since publication of the 2008 edition. Table 3 illustrates the extent of these changes for one process, using the Purpose, Outcomes and the first part of the Activities and Tasks in the Acquisition Process as an example, highlighting the specific changes with an underline. It is critical that the user of 15288 conduct a detailed comparison of each process in ISO/IEC/IEEE 15288:2015 compared to ISO/IEC 15288:2008.

Table 3 — Illustration of detail level process changes from ISO/IEC 15288:2008 to ISO/IEC/IEEE 15288:2015

Acquisition process in ISO/IEC 15288:2008	Acquisition process in ISO/IEC/IEEE 15288:2015
6.1.1.1 Purpose The purpose of the Acquisition Process is to obtain a product or service in accordance with the acquirer's requirements.	**6.1.1.1 Purpose** The purpose of the Acquisition process is to obtain a product or service in accordance with the acquirer's requirements. NOTE As part of this process, the agreement is modified when a change request is agreed to by both the acquirer and supplier.
6.1.1.2 Outcomes As a result of the successful implementation of the Acquisition Process: a) A strategy for the acquisition is established. b) One or more suppliers are selected. c) Communication with the supplier is maintained. d) An agreement to acquire a product or service according to defined acceptance criteria is established. e) A product or service complying with the agreement is accepted. f) Payment or other consideration is rendered.	**6.1.1.2 Outcomes** As a result of the successful implementation of the Acquisition process: a) A request for supply is prepared. b) One or more suppliers are selected. c) An agreement is established between the acquirer and supplier. d) A product or service complying with the agreement is accepted. e) Acquirer obligations defined in the agreement are satisfied. f) [DELETED]
6.1.1.3 Activities and tasks The acquirer shall implement the following activities and tasks in accordance with applicable organizational policies and procedures with respect to the Acquisition Process. NOTE The activities and tasks in this process can apply to one or more suppliers. a) **Prepare for the acquisition**. This activity consists of the following tasks: 1) Establish a strategy for how the acquisition will be conducted. NOTE This strategy includes reference to the life cycle model, a schedule of milestones and selection criteria if the supplier is external to the acquiring organization.	**6.1.1.3 Activities and tasks** The acquirer shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Acquisition process. NOTE The activities and resulting agreement from this process often apply to suppliers in the supply chain, including subcontracted suppliers. a) **Prepare for the acquisition.** This activity consists of the following tasks: 1) Define a strategy for how the acquisition will be conducted. NOTE This strategy describes or references the life cycle model, risks and issues mitigation, a schedule of milestones, and selection criteria if the supplier is external to the acquiring organization. It also includes key drivers and characteristics of the acquisition, such as responsibilities and liabilities; specific models, methods, or processes; level of criticality; formality; and priority of relevant trade factors.

Besides thoroughly reviewing all processes in ISO/IEC/IEEE 15288:2015 versus those in the 2008 edition, it may be useful for the user to recognize that a number of the processes changes reflect a significant change in the thoroughness with which the processes for requirements identification, architecting, design, and analysis are treated. Table 4 shows the overall scope of this major change in the "front end" processes.

Table 4 — Comparison of requirements, architecting, design and analysis processes between ISO/IEC 15288:2008 and ISO/IEC/IEEE 15288:2015

Requirements, architecting, design and analysis processes in ISO/IEC 15288:2008	Requirements, architecting, design and analysis processes in ISO/IEC/IEEE 15288:2015
	6.4.1 Business or mission analysis process
6.4.1 Stakeholder Requirements Definition Process; 6.4.2 Requirements Analysis Process	6.4.2 Stakeholder needs and requirements definition process (includes analysis of stakeholder requirements); 6.4.3 System requirements definition process (includes analysis of system requirements)
6.4.3 Architectural Design Process	6.4.4 Architecture definition process;
	6.4.5 Design definition process
	6.4.6 System analysis process

5 Application concepts

5.1 Overview

This document provides guidelines for life cycle management in the field of systems. This clause highlights and explains essential concepts on which this document is based, and introduces key concepts useful in reading and applying ISO/IEC/IEEE 15288:2015.

NOTE ISO/IEC/IEEE 24748-1 provides more information on concepts related to life cycle management in general.

5.2 System concepts

Application of ISO/IEC/IEEE 15288 presupposes an understanding of system concepts.

NOTE System concepts for systems that are any mix of products and services are introduced in ISO/IEC/IEEE 15288:2015, 5.2. Additional discussion is in ISO/IEC/IEEE 24748-1:2018, 4.2.

5.3 Life cycle concepts

Application of ISO/IEC/IEEE 15288 presupposes an understanding of life cycle concepts.

NOTE 1 Life cycle concepts are introduced in ISO/IEC/IEEE 15288:2015, 5.4. Additional discussion is in ISO/IEC/IEEE 24748-1:2018 4.3.

NOTE 2 ISO/IEC/IEEE 24748-1 provides more information on concepts related to life cycle management in general.

5.4 Process concepts

Application of ISO/IEC/IEEE 15288 presupposes an understanding of process concepts.

NOTE Process concepts are introduced in ISO/IEC/IEEE 15288:2015, 5.5. Additional discussion is in ISO/IEC/IEEE 24748-1:2018, Annex A.

5.5 Organizational concepts

Application of ISO/IEC/IEEE 15288 presupposes an understanding of organizational concepts.

NOTE Organizational concepts are introduced in ISO/IEC/IEEE 15288:2015, 5.3. Additional discussion is in ISO/IEC/IEEE 24748-1:2018, Annex B.