

FINAL  
DRAFT

INTERNATIONAL  
STANDARD

ISO/IEC  
FDIS  
24773-3

ISO/IEC JTC 1/SC 7

Secretariat: BIS

Voting begins on:  
**2021-05-25**

Voting terminates on:  
**2021-07-20**

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## Software and systems engineering — Certification of software and systems engineering professionals —

### Part 3: Systems engineering

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Reference number  
ISO/IEC FDIS 24773-3:2021(E)

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Published in Switzerland

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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.

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](http://www.iso.org/directives) or [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs)).

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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*.

A list of all parts in the ISO/IEC 24773 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](http://www.iso.org/members.html) and [www.iec.ch/national-committees](http://www.iec.ch/national-committees).

## Introduction

The ISO/IEC 24773 series addresses the certification of professionals in software and systems engineering. ISO/IEC 24773-1 contains general requirements for such certification schemes. This document contains requirements specific to certification schemes for systems engineering professionals.

The concepts, and requirements for certification schemes contained in ISO/IEC 24773-1 and ISO/IEC 17024 apply to this document.

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# Software and systems engineering — Certification of software and systems engineering professionals —

## Part 3: Systems engineering

### 1 Scope

This document elaborates requirements and recommendations for certifications schemes based on ISO/IEC 24773-1, which are specific to the domain of systems engineering.

### 2 Normative reference

The following documents are referred to in the text in such a way that some or all 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 17024, *Conformity assessment — General requirements for bodies operating certification of persons*

ISO/IEC 24773-1:2019, *Software and systems engineering — Certification of software and systems engineering professionals — Part 1: General requirements*

ISO/IEC TS 17027, *Conformity assessment — Vocabulary related to competence of persons used for certification of persons*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 17024, ISO/IEC TS 17027, ISO/IEC 24773-1 and the following 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/>

#### 3.1 system

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

Note 1 to entry: A system is an integrated set of elements, subsystems, or assemblies that accomplish a defined objective. These elements include products (hardware, software, firmware), processes, people, information, techniques, facilities, services, and other support elements in combination organized to achieve one or more stated purposes (see INCOSE Systems Engineering Handbook<sup>[2]</sup>).

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.46, modified — The original notes 1, 2 and 3 to entry have been removed; a new note 1 to entry has been added.]

### 3.2 systems engineering SE

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 15288:2015, 4.1.49, modified — The abbreviate term "SE" has been added.]

## 4 Conformance

This document contains requirements for conformant certification schemes which are specific to systems engineering. General requirements for conformant schemes also apply; and these are defined in ISO/IEC 24773-1 and incorporated by reference into this document.

A certification scheme for professionals in systems engineering may claim conformance to this document if it satisfies all requirements contained in this document, ISO/IEC 24773-1; and ISO/IEC 17024.

A conformant certification scheme may be created and owned by one body, and subsequently utilized or applied by a separate certification body. For the purposes of this document, the requirements in [Clause 5](#) apply to the certification scheme itself, unless otherwise noted as specifically applying to a certification body.

## 5 Requirements for certification of systems engineering professionals

### 5.1 General

This clause contains requirements and recommendations specific to the certification of systems engineering professionals. The following requirements and associated criteria may also be used to compare certification and qualification schemes.

### 5.2 Fundamental components of a conformant scheme

**5.2.1** A list of skills that the professional to be certified in systems engineering is expected to exhibit shall be mapped by the scheme to the knowledge areas of the reference body of knowledge (BOK), and to the defined competencies.

NOTE An exemplar mapping is shown in [Table D.1](#) and [Table D.2](#) in [Annex D](#).

**5.2.2** For baseline education the recommended benchmark is for a formal engineering degree (in any engineering field) recognized under the Washington Accord<sup>[4]</sup>; or an equivalent technical degree and/or verifiable on-the-job professional training specifically in systems engineering. Equivalences to formal engineering education shall be explicitly declared by the scheme with accompanying rationale.

### 5.3 Knowledge — Identification of a body of knowledge (BOK)

#### 5.3.1 General

The necessary knowledge areas required by the scheme shall be based on a BOK. The scheme shall document the source and authority of that BOK.



### 5.3.2 Reference body of knowledge

The reference BOK is the INCOSE Systems Engineering Handbook<sup>[2]</sup>, which describes the following knowledge areas (i.e., processes, methods and activities) in systems engineering:

- a) Generic Life Cycle Stages
- b) Agreement Processes
- c) Technical Processes
- d) Technical Management Processes
- e) Organizational Project Enabling Processes
- f) Tailoring process and Application of Systems Engineering
- g) Cross-Cutting Systems Engineering Methods
- h) Specialty Engineering Activities

Refer to [Annex A](#) for elaboration of these knowledge areas. See [Table A.1](#).

### 5.3.3 Alternate body of knowledge

If the scheme contains another BOK (i.e. “alternative BOK”) other than the reference BOK identified in [5.3.2](#), the knowledge areas of the alternate BOK identified in the scheme shall be mapped to knowledge areas of the reference BOK. The Scheme shall demonstrate that the alternative BOK covers the scope of the reference BOK as defined by the knowledge areas in [5.3.2](#), with rationale supporting any reduction in depth of coverage.

### 5.3.4 Other technical knowledge

Where additional technical knowledge is required by the professional targeted by the scheme, beyond the core systems engineering knowledge defined in the reference BOK, the scheme shall define it, and address these topics with an additional or augmented BOK.

The other elements of the scheme (statement of target professionals; their typical tasks; skills; and competencies) should be consistent with the expanded knowledge requirements of the scheme.

### 5.3.5 Domain knowledge

In addition to the knowledge of system engineering, the scheme may address domain knowledge which is appropriate to the defined scope of the certification. That is, when a certification scheme targets professionals to be certified in systems engineering operating in a particular domain (industry or technical domain), it shall include knowledge items and knowledge content for that domain in the scheme's BOK (ISO/IEC 24773-1:2019, 6.4.2.5).

The scheme shall document all related domain specific knowledge and any differences or distinctions from the reference BOK.

### 5.3.6 Verification of knowledge

The scheme shall document the method for verifying an applicant's understanding of the BOK. Understanding of the reference BOK may be examined by prescribed testing or accredited coursework.

## 5.4 Skills

### 5.4.1 Identification of skills

The scheme shall identify and define the specific skills by a professional to be certified in systems engineering. These may be drawn from the following list of skills:

- a) Requirements Engineering
- b) System and Decision Analysis
- c) Architecture/ Design Development
- d) Systems Integration
- e) Verification and Validation
- f) System Operation and Maintenance
- g) Technical Planning
- h) Technical Monitoring and Control
- i) Acquisition and Supply
- j) Information and Configuration Management
- k) Risk and Opportunity Management
- l) Lifecycle Process Definition and Management
- m) Specialty Engineering
- n) Organizational Project Enabling Activities

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Refer to [Annex B](#) for elaboration of these skills. See [Table B.1](#).

### 5.4.2 Assessment of skills

The scheme shall document the method for assessment of the skills identified in [5.4.1](#). This may include any combination of the methods cited in ISO/IEC 24773-1:2019, 5.6.

The Scheme shall define measures for depth and breadth of coverage of the identified skill sets needed to be demonstrated to certify a professional systems engineer.

## 5.5 Competence

The scheme shall identify systems engineering specific competencies required for the target SE professional. These may be drawn from the competencies defined in the INCOSE Systems Engineering Competency Framework<sup>[3]</sup> or an equivalent framework. These competencies are grouped into the following competency areas:

- a) Core – underpin engineering as well as systems engineering.
- b) Management – the ability to perform tasks associated with controlling and managing systems engineering activities. This includes tasks associated with the management processes identified in INCOSE Systems Engineering Handbook<sup>[2]</sup>.
- c) Technical - the ability to perform tasks associated with the suite of technical processes identified in INCOSE Systems Engineering Handbook<sup>[2]</sup>.

- d) Integrating - recognize systems engineering as an integrating discipline, joining activities and thinking from specialists in other disciplines to create a coherent whole.

Refer to [Annex C](#) for elaboration of these competency areas. See [Table C.1](#).

## 5.6 Professional attributes

The scheme shall identify the generic competencies of ISO/IEC 24773-1:2019 6.5.6. These may be augmented by the professional competencies identified in the INCOSE Systems Engineering Competency Framework<sup>[3]</sup> that are well-established within the human resources (HR) domain.

## 5.7 Certification renewal

Pursuant to ISO/IEC 24773-1:2019, 6.7.2 and 6.7.3, the Scheme shall require periodic assessment of evidence of continuing professional development (CPD) that is related to the competencies defined in [5.4](#) and [5.5](#) as the basis of recertification.

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