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

Part 2: Guidance regarding description of knowledge, skills, and competencies contained in schemes

Ingénierie du logiciel et des systèmes — Certification des professionnels de l'ingénierie du logiciel et des systèmes —

Partie 2: Recommandations relatives à la description des connaissances, aptitudes et compétences contenues dans les programmes

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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/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 and www.iec.ch/national-committees.

Introduction

The ISO/IEC 24773 series replaces and expands upon ISO/IEC 24773:2008.

The ISO/IEC 24773 series consists of the following parts.

— ISO/IEC 24773-1 serves as the basis for the ISO/IEC 24773 series. It contains terminology, concepts, and requirements which are common to the remaining parts.

— This document contains guidance which can be used by certification bodies regarding the definition of knowledge, skills and competencies that are to be incorporated into a certification scheme for professionals in software and systems engineering.

— ISO/IEC 24773-3 provides specific requirements for certification schemes for professionals in systems engineering.

— ISO/IEC 24773-4 provides specific requirements for certification schemes for professionals in software engineering.

The ISO/IEC 24773 series is applicable across all organizations and for conducting assessments using a variety of methods, techniques and tools.

This document also contains additional discussion and guidance concerning the requirements for certification schemes defined in ISO/IEC 24773-1. It contains general guidance concerning the elements of a certification scheme, particularly as they apply within the domain of software and systems engineering. It contains guidance for the description of several key elements of certification schemes which are generated or referenced by the certification body:

— body of knowledge (BOK);

— skills;

— competency.

In addition to addressing technical skills, knowledge and competence, ISO/IEC 24773-1:2019, 6.3.1 requires that a conformant certification scheme address other aspects of professionalism, such as professional skills/attributes and a code of ethics. This document provides additional descriptions and guidance regarding these other aspects of professionalism to be addressed by a conformant scheme.

This document is useful to certification bodies offering schemes for the certification of professionals in the domain of systems or software engineering. It offers guidance for certification bodies when defining or designing the various elements of their respective certification schemes, as well as guidance for description of these scheme elements.

Annex A contains further explanation about the distinction between certification and professional licensure. Annex A also contains additional guidance to encourage harmonization between a certification scheme and the requirements of regulators.

By considering the guidance contained in this document, certification bodies can provide a clearer and more precise description of their certification schemes. This in turn benefits the other stakeholders (potential certificants, accreditation bodies, professional and technical groups, and employers), allowing them to more accurately assess the certification scheme and compare to other schemes. This document is also useful to (potential) applicants or candidates of certification schemes, in that they can obtain additional background information concerning the requirements for certification schemes claiming conformance to the ISO/IEC 24773 series. Understanding the requirements for a certification scheme (as expressed in ISO/IEC 24773-1, ISO/IEC 24773-3, and ISO/IEC 24773-4) along with the guidance contained in this document, helps the candidate to compare various schemes, and understand where/how such guidance is reflected in and incorporated into the various schemes. Similarly, employers; evaluators of professional personnel who are certificants; and evaluators of certification schemes in the domain of software and systems engineering can also use the contents of this document to better understand the requirements, as well as the differences between various schemes.

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

Part 2: Guidance regarding description of knowledge, skills, and competencies contained in schemes

1 Scope

This document contains guidance for certification that can be used by certification or qualification bodies regarding the description of knowledge, skill and competence within their particular schemes based on ISO/IEC 24773-1.

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 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*

3 Terms and definitions

For the purposes of this document, the terms and definitions in ISO/IEC 17024, 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
KA
knowledge area
sub-area or grouping of related topics within a body of knowledge (BOK)

Note 1 to entry: See 5.2 and 5.3.

4 Major elements of certification and qualification scheme

This clause introduces the major elements of a certification and qualification scheme as listed in ISO/IEC 24773-1.

Clauses 5 to 8 discuss the various elements in greater detail.

Conforming certification schemes have the following major elements at a minimum:

— body of knowledge (BOK);

— skills;

— competencies.

Figure 1 depicts these elements and the relationship between them within the context of a certification scheme.

The body of knowledge (BOK) associated with a certification scheme contains items of knowledge which are relevant to the engineer or professional in the domain being targeted by that certification scheme. Recommendations for describing the BOK for use in a certification scheme are explained in detail in Clause 5.

NOTE 1 Also see ISO/IEC 24773-1:2019, 5.3 for the explanation of knowledge, BOK and cognitive level.

Skills defined for a certification can represent various abilities of the certificant, such as the ability to apply specific knowledge in the performance of an action, or a single step within a sequence. Recommendations for describing skills are explained in detail in Clause 6. Since skills are defined based on a certain set of knowledge topics, Clause 6 also contains recommendations about relationship between knowledge and skills.

NOTE 2 Also see ISO/IEC 24773-1:2019, 5.4 for the explanation of skill and performance level.

Competencies represent the ability to successfully complete tasks that certified persons are expected to undertake. Each competency required by the certification scheme is associated with appropriate proficiency levels (see ISO/IEC 24773-1:2019, 6.5.3). A competency area may be defined and may include various related competencies. Recommendations for describing competencies for use in a certification scheme are explained in detail in Clause 7. Since competencies are defined based on a certain set of knowledge topics and skills, Clause 7 also contains recommendations about relationship among knowledge, skills and competencies.

NOTE 3 Also see ISO/IEC 24773-1:2019, 5.5 for the explanation of competence and proficiency level.

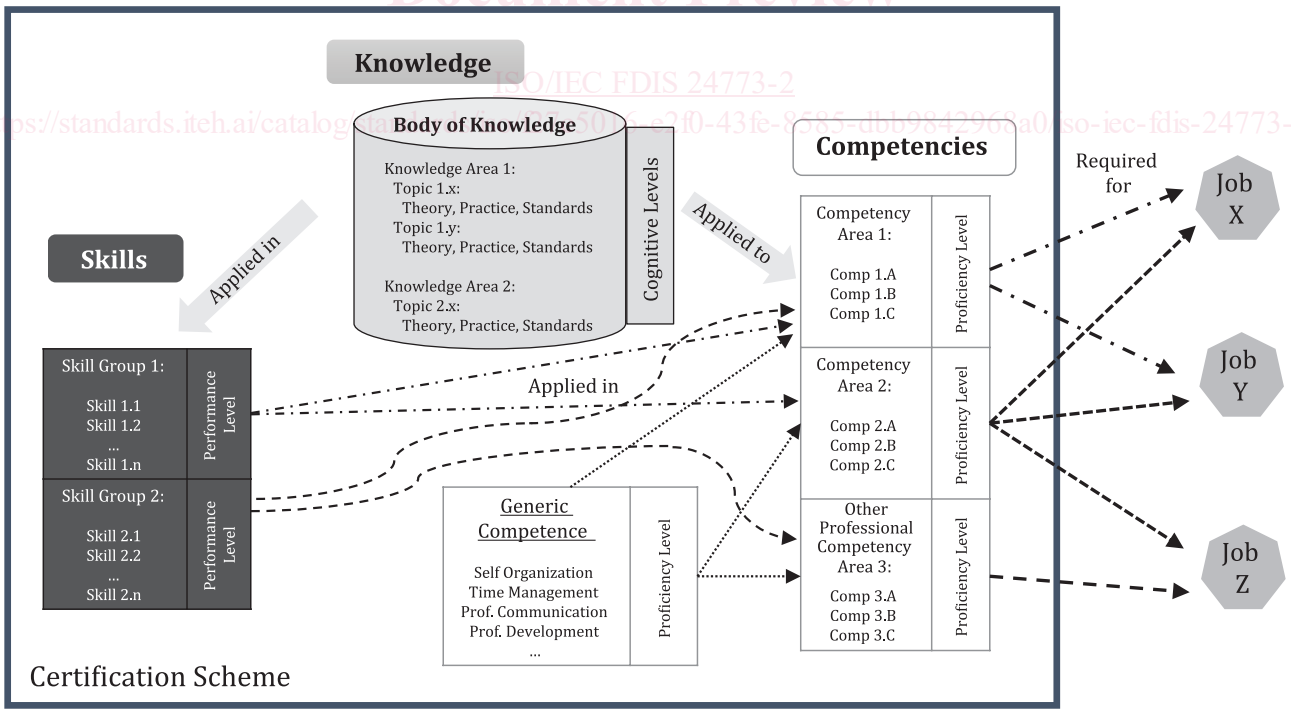

Figure 1 — Major elements of certification scheme and relationships among them

Other relevant elements of a professional certification scheme are not depicted in Figure 1:

— individual attributes (refer to 8.1);

— pre-requisite education or other pre-requisite qualifications;

— other KAs not in the reference BOK (refer to Clause 5).

Clauses 5 to 8 in this document provide additional guidance related to these elements.

The CASCO document "How to Develop Schemes for the certification of persons"[11] provides useful introductory information about and general guidance concerning certification schemes and certification bodies.

5 Recommendations — Body of knowledge (BOK)

5.1 General

The following recommendations apply to the BOK as used within a certification scheme for professionals in the domains of software and systems engineering.

Within ISO/IEC 24773-1 and ISO/IEC 17024, a BOK is a required element of a certification scheme.

The term "body of knowledge" is used within many contexts, both in industry, academia and professional bodies. The scope and meaning of a BOK should be clarified, especially since any particular BOK may be used for many purposes.

Accordingly, the certification body may choose to construct and define a BOK specifically for its own certification scheme. It may choose to adopt another (externally defined and controlled) BOK for use in its certification scheme. In a pragmatic approach, the certification body may construct a unique BOK by assembling reference material from existing sources.

5.2 Scope and depth of a BOK

The purpose and scope of any BOK should be clarified – whether that BOK is utilized as an element of a certification scheme; as a foundation for academic syllabus or curriculum; or as a basis for professional regulation.

A BOK, for the purpose of this document, provides the underlying knowledge contained within an appropriate set of topics grouped into KAs (illustrated in Figure 1). The enumeration of topics, in a sound structure or hierarchy, is essential.

A certification body may choose to assemble a BOK using several approaches (see subclauses in Clause 5). However, the BOK should always be managed and treated as a whole; and the certification body should ensure the integrity, accuracy and currency of the BOK as a whole.

The scope of the BOK should be consistent with the purpose and intended use of the BOK. In the case of a BOK associated with a profession or a professional discipline, the BOK should at least cover the essential knowledge of the discipline. That is, the scope of the BOK should include all relevant KAs. See additional suggestions in Clause 5 concerning coverage of "related disciplines" and "supporting disciplines".

The scope and depth of knowledge contained in the BOK should be consistent with and sufficient to support the various skills and competencies defined as other elements of the certification scheme. This completeness and sufficiency should be validated.

The depth of the material covered by the BOK should also be consistent with the purpose and intended use of the BOK. For the purpose of a professional discipline, if a KA is deemed essential and necessary for the understanding and practice of that discipline, then the material provided may be extensive in order to provide more detail. The knowledge provided in a given KA in the BOK should be provided in depth sufficient for professional practice.

A BOK may include or reference supporting KAs. Supporting KAs should be included in a BOK where such knowledge is directly required for professional practice, or where such knowledge is originating in another discipline (such as discrete mathematics, quality assurance or economics) and underlies the knowledge contained in the primary KAs. The information included in these supporting KAs may not necessarily be provided in depth and does not need to be repeated in the BOK if they are referenced to authoritative external sources.

Existing reports of BOK development projects such as "The Guide to the Software Engineering Body of Knowledge"[12] and "Towards a distinctive body of knowledge for Information Systems experts: coding ISD process knowledge in two IS journals"[13] may help design the purpose, scope, and depth of a BOK.

See 5.6 concerning "supporting or related disciplines".

5.3 Construction or assembly of BOK: content hierarchy and guides to BOK

A BOK may consist of many KAs. A KA may in turn consist of specific topics, and even sub-topics, arranged in a hierarchy.

The BOK should present information or knowledge for each defined KA. See further guidance in 5.4 concerning the quality of the knowledge sources referenced or used within a BOK.

However, the assembly or presentation of the knowledge content for a given KA or topic within that KA may be via reference to an external source.

Thus, the BOK itself may contain source knowledge material for some KAs, or it may provide references to external knowledge sources and not contain the referenced external source knowledge material directly. This approach has the advantages of:

— modularity – new references may be added or substituted easily when the content for a KA (or topics within) evolve;

— efficiency – external knowledge sources (provided they also meet criteria for source information quality) are already written and do not need to be re-written for the purposes of the BOK which incorporates them;

— external reviews and validation – in seeking to adhere to the highest standards of information quality and integrity, an external knowledge source may indeed have the benefit of thorough peer review and widespread recognition.

However, regardless of whether the BOK contains knowledge which is specifically written for a given topic, or whether a topic is covered by an appropriate external knowledge source, the integrity and accuracy of the BOK remains the responsibility of the BOK developer.

The BOK topic section should describe or summarize the objective knowledge inherent in the topic and contain citations which permit the reader to obtain more detailed information.

In the case where a BOK is broad and contains many distinct KAs, and where the depth of a BOK is significant, an overview or a summary should be included within each KA, before going into detail or citing references for sub topics. This summary provides a useful overview of the scope and depth of each major topic area. This is of great value for at least the following reasons:

— practitioners in the discipline (or users of that BOK) may not require all of the in-depth knowledge of every topic, but for the purposes of professional certification may need a certain amount of knowledge;

— the summary presents the nature and scope of the topic being treated (presumably by one or more external knowledge sources) and provides a rationale for inclusion of each of the external knowledge sources; this is helpful as a validation tool for readers and reviewers (and future maintainers) of the content for that KA.

A BOK document does not need to be one self-contained, encyclopaedic work. It may achieve depth and breadth by referring to other works, particularly when the cited works and their references are well organized and structured.