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Software engineering — Guide for the application of ISO/IEC 24773:2008 (Certification of software engineering professionals — Comparison framework)

Ingénierie du logiciel — Guide pour l'application de l'ISO/CEI 24773:2008 (Certification des professionnels de l'ingénierie du logiciel — Cadre comparatif)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

In exceptional circumstances, when the joint technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide to publish a Technical Report. A Technical Report is entirely informative in nature and shall be subject to review every five years in the same manner as an International Standard.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC TR 29154 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Systems and software engineering*.

Introduction

ISO/IEC 24773:2008, *Software engineering — Certification of software engineering professionals — Comparison framework*, establishes a framework for comparison of schemes certifying software engineering professionals. ISO/IEC 24773:2008 (also referred to in this Technical Report as "The International Standard" or "the IS") will facilitate the portability of software engineering professional certifications by facilitating comparison of such certification schemes.

Many individual qualification and certification schemes exist in the area of software engineering; software development; or a related speciality. In order to evaluate and compare between software engineering certifications for individual professionals, it is necessary to define a common framework for comparison. For multi-national organizations that require software engineering professionals, ISO/IEC 24773:2008 will facilitate the evaluation and comparison between various certifications.

The International Standard has a number of intended users, including:

— Educators;

— Examining bodies;

— Industry and professional bodies;

— Government bodies.

This Technical Report contains guidance and elaboration of several clauses of ISO/IEC 24773:2008. It also contains a more extensive set of potential uses of the International Standard by various users.

Annex A to this Technical Report contains several detailed illustrations of sample uses of ISO/IEC 24773.

The IEEE Computer Society cooperated with ISO/IEC JTC 1/SC 7 as a Category A liaison in the production of this Technical Report and is the publisher of the Guide to the Software Engineering Body of Knowledge (SWEBOK Guide). Any reference to SWEBOK or SWEBOK Guide in this Technical Report can be interpreted as a reference to ISO/IEC TR 19759, the adoption of the SWEBOK Guide.

Software engineering — Guide for the application of ISO/IEC 24773:2008 (Certification of software engineering professionals — Comparison framework)

1 Scope

This Technical Report is a guide for the application of ISO/IEC 24773:2008. This guide addresses terminology used in ISO/IEC 24773:2008. It also includes interpretive guidance on several clauses of ISO/IEC 24773:2008, as well as a review of potential typical scenarios for use of ISO/IEC 24773:2008.

Annex A contains several more detailed examples of the application of ISO/IEC 24773:2008. They are examples of the most significant use cases identified in Clause 5.

2 Reference

ISO/IEC 24773:2008, *Software engineering — Certification of software engineering professionals — Comparison framework*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 24773:2008 and the following apply.

3.1
certification process
all activities by which a certification body establishes that a person fulfils specified competence requirements, including application, evaluation, decision on certification, surveillance and recertification, use of certificates and logos/marks

[SOURCE: ISO/IEC 17024]

3.2
certification scheme
specific certification requirements related to specified categories of persons to which the same particular standards and rules, and the same procedures apply

[SOURCE: ISO/IEC 17024]

3.3
competence
demonstrated ability to apply knowledge and/or skills, and where relevant, demonstrated personal attributes, as defined in the certification scheme

[SOURCE: ISO/IEC 17024]

3.4
continuing professional development
CPD
set of activities undertaken by an individual professional in order to maintain professional competence, knowledge, and skills

4 Concepts and interpretation guide

4.1 Concepts and background regarding ISO/IEC 24773:2008

The purpose of ISO/IEC 24773:2008 is to establish a framework which makes the comparison of software engineering professional certification schemes possible. ISO/IEC 24773:2008 specifies the items that a conformant certification scheme for software engineering professionals is required to contain. Figure 1 is adapted from Clause 4 of ISO/IEC 24773:2008, which summarizes what shall be included in a conformant certification scheme for software engineering professionals.

Items that shall be included in a conformant certification scheme include:

a) Title of software engineering professionals certified under that scheme;

b) List of tasks performed by software engineering professionals certified under that scheme;

c) Description of level of accountability, responsibility, autonomy, authority and complexity of the work associated with the title;

d) Description of competence including body of knowledge, cognitive levels, skills and performance levels;

e) Description of the minimum educational qualification or experience requirement for certification under that scheme;

f) Description of the competence evaluation method;

g) Description of code of ethics and professional practices;

h) Description of requirements under the scheme related to maintenance and renewal of certification;

i) Accreditation and/or quality control processes (if evaluation of competence is delegated to a qualification body).

Figure 1 — ISO/IEC 24773:2008 Extract - framework of certification scheme

The distinction between a certification body and a qualification body is discussed in ISO/IEC 24773:2008. Certification bodies shall address items a) to i) (shown in Figure 1) for a conformant certification scheme. On the other hand, qualification bodies will use items a) to f) (shown in Figure 1) to construct a qualification scheme. The category of qualification schemes includes examination schemes. A certification body may only delegate its evaluation of competence to a qualification body if that qualification body employs a scheme which conforms with items a) to f).

Please note that ISO/IEC 24773:2008 specifies the items required to be defined by a conformant scheme, but does not specify the content for or criteria to be used in writing the content for these items.

4.2 Relationship between ISO/IEC 24773:2008 and ISO/IEC 17024

Since ISO/IEC 24773:2008 uses the terminology that is defined in ISO/IEC 17024, it is recommended that new users read ISO/IEC 17024 first, in order to understand this terminology before reading ISO/IEC 24773:2008.

Those users seeking accreditation can begin by understanding the basic requirements for any certification body imposed by ISO/IEC 17024.

ISO/IEC 24773:2008 can be used widely with or without ISO/IEC 17024.

4.3 SWEBOK Guide and software engineering bodies of knowledge

ISO/IEC TR 19759:2005 (Guide to Software Engineering Body of Knowledge) is a guide to a set of software engineering sources that are generally accepted as authoritative and covering the scope of software engineering to a certain level of depth (reference SWEBOK Guide Preface). Topics are covered to a level of depth consistent with the knowledge of a professional with an undergraduate degree and four years

of experience. The SWEBOK Guide (2005 revision) is broken down into 10 Knowledge Areas (KAs), with each KA broken down further into sub-areas, topics and sub-topics. The source materials referenced by the SWEBOK Guide contain software engineering theory as well as professional standards and practices.

The SWEBOK Guide itself does not contain an actual body of knowledge for software engineering, but collectively the materials referenced by the SWEBOK Guide contain (or represent) such a body of knowledge. That body of knowledge is one particular body of knowledge termed the SWEBOK. Other bodies of knowledge with respect to software engineering may be constructed.

It is strongly recommended that users of ISO/IEC 24773:2008 who are constructing a certification scheme consider the significance of a body of knowledge (BOK) in general with respect to their specific certification scheme. While no standard is defined for a BOK by ISO/IEC 24773:2008, users of ISO/IEC 24773:2008 who are constructing a certification scheme are encouraged to construct (or reference) a BOK which is comprehensive with respect to knowledge areas covered:

— Containing both theory and practical knowledge such as standards;

— Containing topics and sub-topics in depth, beyond what the SWEBOK Guide terms the “Introductory” level of definition (e.g. that contained in the Introduction section of each Knowledge Area of the Guide).

Please see additional comments on mapping of a BOK to the SWEBOK Guide in Clause 4.4 below.

4.4 ISO/IEC 24773:2008, Clause 5.1.1 - mapping of bodies of knowledge to SWEBOK Guide

ISO/IEC 24773:2008, Clause 5.1.1 requires that any certification scheme claiming *conformance* to the International Standard be based on a body of knowledge; and that the software engineering component of that body of knowledge be mapped to the SWEBOK Guide. This clause does not impose a requirement that a given certification scheme covers every topic in the SWEBOK Guide; however it is required that whatever topics are covered by that certification scheme be mapped to the appropriate chapter in the SWEBOK Guide.

Mapping the software engineering component of the body of knowledge to chapters 2-11 in the SWEBOK Guide is a requirement of ISO/IEC 24773:2008. It is encouraged that users of ISO/IEC 24773:2008 document the mapping of the body of knowledge to a level of detail below the SWEBOK Guide KA. For example a mapping for one body of knowledge could describe that with respect to Software Quality, that body of knowledge maps to and covers the “Software Quality Fundamentals” sub-area within the SWEBOK Guide KA on Software Quality.

If the body of knowledge does not fully cover or is inconsistent with that SWEBOK Guide chapter, it is recommended that the reason be explained.

4.5 ISO/IEC 24773:2008, Clause 5.2 - cognitive levels

ISO/IEC 24773:2008, Clause 5.2 requires that for every knowledge component, a cognitive level be defined. The certification body can utilize existing models such as Bloom’s Taxonomy,[1] or define their own model for cognitive levels. The certification body may choose to use its own unique model for representing cognitive levels, or it may chose to reference an existing well known model. Regardless, it is recommended that the model used be well defined. The use of a well defined model of cognitive levels will allow other organizations to more easily compare their own certification scheme (and their own model of cognitive levels incorporated therein).

4.6 ISO/IEC 24773:2008, Clause 6 - concepts relating to skills and competences

ISO/IEC 24773:2008, Clause 6 requires that the certification body consolidate the description of the software engineering professional’s skills and knowledge as required by their scheme. ISO/IEC 24773:2008, Clause 5 identifies several kinds of knowledge and skills for the software engineering professional, but it does not impose specific minimum requirements for any of these. The certification body must enumerate the specific kinds and levels of knowledge and skills pursuant to Clause 5, and then pursuant to Clause 6, indicate how the cited skills and competence are evaluated.

5 Applying ISO/IEC 24773:2008

5.1 Overview

The clause contains usage scenarios and most typical use cases for the International Standard.

5.2 Application cases / use cases for the IS

5.2.1 Professional societies

A professional society may be a certification body. If this is the case, the professional society may use ISO/IEC 24773:2008 in order to construct its own certification scheme to be applied to some or all of its members. The professional society may also use ISO/IEC 24773:2008 to compare their own certification scheme to that of other bodies, perhaps in order to offer some recognition of the other certifications. The professional society may use ISO/IEC 24773:2008 as a checklist for ensuring that key factors related to certification are considered in planning a scheme. The professional societies may use ISO/IEC 24773:2008 in order to assist in determining and describing the intended characteristics and attributes of their certified members.

5.2.2 Training course providers and examination bodies

A training course provider or an examination body may be a qualification body as defined in ISO/IEC 24773:2008. Note that a qualification body is not identical to a certification body, as discussed in Clause 4.1 above and in ISO/IEC 24773:2008. A qualification body operates a qualification scheme which may address some portion of the scheme requirements defined in ISO/IEC 24773:2008.

A training course developer will have an interest in designing a course which meets certain needs or covers certain topics. A training course developer can make use of the framework defined in ISO/IEC 24773:2008 when designing such a course.

Further, both training course providers and examination bodies can make use of ISO/IEC 24773:2008 framework when constructing examinations or assessments.

Certification bodies may delegate evaluation of competencies to examination bodies. In this circumstance the certification body and the delegated examination body can make use of the ISO/IEC 24773:2008 framework to clearly document and map a examination or qualification scheme to the certification scheme.

5.2.3 Universities and academic programs

University faculties plan programs in software engineering which must produce graduates with certain skills and capabilities. The programs also may be designed in order to meet accreditation requirements established by regulators. University faculties may use ISO/IEC 24773:2008 to assist in organizing and documenting the required attributes and competencies of their graduates. University faculties may also use ISO/IEC 24773:2008 to assist in planning; using the framework of ISO/IEC 24773:2008 to compare curriculum and program outcomes against those of other university programs.

Universities may also use the framework defined in ISO/IEC 24773:2008 to describe and document their respective education programs in software engineering.

Individuals who are considering several possible university programs will also benefit if various universities utilize the framework structure to describe their respective examinations. The individual may compare the various university programs more easily if the descriptions are based on the framework defined in ISO/IEC 24773:2008.

5.2.4 Governments

Governments may use ISO/IEC 24773:2008 as a framework to help organize and collect statistics about the skills of professionals, their capabilities, and other attributes. A government can use such statistical data as a skills inventory for workforce planning and immigration policies, training initiatives, or other investments.

5.2.5 Workforce planners, industry groups

Workforce planners in industry may use the framework in ISO/IEC 24773:2008 to help construct a more standard and consistent set of job competencies, skills and attributes, tied to standardized job descriptions. This will in turn facilitate the exchange of data related to these standardized job and skills descriptions. As with the case of governments, the framework in ISO/IEC 24773:2008 may ultimately assist workforce planners in gathering and exchanging workforce statistical data based on a well developed standard model for professional skills and attributes.

5.2.6 Individual software engineering professionals

Individual software engineers (whether certified or not) may use a particular certification scheme based on ISO/IEC 24773:2008 to measure their own professional capabilities, skills and knowledge. This information can be used for professional development, where gaps exist between the professional's capabilities and those required by that certification scheme. An individual professional may use the certification scheme definition, as required by ISO/IEC 24773:2008, to perform a specific gap analysis with respect to needed skills, knowledge or training. The individual professional may then more readily select specific training packages, targeted at specific skills or knowledge areas, based on the gaps identified through the use of the certification scheme description.

An individual experienced professional may also be in a position of choosing between software engineering certifications. In this case, if the candidate certification schemes are defined in conformance with ISO/IEC 24773:2008, the individual professional will be able to make an accurate and meaningful comparison between specific certifications, allowing him/her to choose the certification that best suits his/her needs.

5.2.7 Competency based hiring or procurement

Firms hiring software engineers may use certification schemes based on ISO/IEC 24773:2008. The hiring or procuring company may review the framework defined in ISO/IEC 24773:2008 in order to establish its own target competencies, minimum skills, knowledge or other required attributes. Then the hiring or procuring company can also use ISO/IEC 24773:2008 as a framework for comparison between certifications, where the candidates for hiring or procurement make claims of competency based on differing certifications.

Firms acquiring services or products from other firms may use the International Standard as a skills and competency framework, a structure within which they may define and document their own requirements for certified personnel. The framework defined in ISO/IEC 24773:2008 helps the acquiring firm to organize and document their desired skills, knowledge, and other attributes, in a form which can readily be handed to potential suppliers of personnel. Once proposals are obtained from potential suppliers the firm can use the same requirements structure to assist in assessing and comparing the skills, capabilities and certifications of personnel put forward by supply firms.

5.2.8 Accreditation bodies

An accreditation body evaluates the certification process of any organization issuing certificates. The accrediting body issues a certificate of accreditation to that certifying organization. The general requirements for bodies operating a process for the certification of persons are defined in ISO/IEC 17024, and these requirements apply to any kind of certification. ISO/IEC 24773:2008 is specific to software engineering professionals, but it is a comparison framework only. ISO/IEC 24773:2008 does not define a normative standard for conformance with respect to certification of professionals in software engineering.