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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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Contents

Page

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.

It is possible that an accreditation body may define specific criteria for certification schemes for professionals in software engineering. The accreditation body would not define a specific certification scheme, since it is the certification body (discussed in 5.2.1 above) that will define a specific certification scheme. The accreditation body however may define specific criteria in the various requirement categories defined in ISO/IEC 24773:2008. For example, the accreditation body may establish a criteria for the body of knowledge which must be included in a (certification) scheme. In this example, ISO/IEC 24773:2008 is used by the accreditation body to define basic requirements for conformance, but is also used as a framework for adding specific criteria or requirements.

6 Use of the International Standard

ISO/IEC 24773:2008 may be applied partially by users. However ISO/IEC 24773:2008 does not allow for tailoring by the user who is constructing a conformant certification scheme. The standard does not describe specific capabilities or target levels of competence in various areas of software engineering. It only requires that the user defines and documents, within a specific framework, whatever skills, knowledge and competencies *are* required by that particular certification scheme, as well as the respective levels for each skill/competency included in that scheme.

7 Certification of software engineering specialists

There are many existing professional certification schemes related to software engineering professionals, software development professionals and related specialities. As mentioned above, ISO/IEC 24773:2008 does *not* require that a given certification scheme implements (or requires) skills, knowledge and capabilities in all areas of software engineering. Instead, ISO/IEC 24773:2008 requires only that the scheme's coverage of the various areas be documented and mapped to SWEBOK Guide chapters.

This means that narrower certification schemes may be offered which are in fact conformant with ISO/IEC 24773:2008. For example, a conformant certification scheme for an Enterprise IT architect might not attempt to cover the broad set of software engineering topics in the SWEBOK Guide.

NOTE See example details of such a narrow specialist certification scheme in Annex A.

A narrow specialist certification scheme may be able to claim *conformance* with ISO/IEC 24773:2008. However in order to claim conformance to ISO/IEC 24773:2008 any such scheme must adhere to Clauses 4.1 to 4.10 of ISO/IEC 24773:2008, which states that the narrow certification scheme must not have a misleading title or inappropriate target group. Thus, such a narrow specialist scheme should not claim to be a broader software engineering certification.

An individual software engineering professional may indeed have knowledge in many areas of SWEBOK, but perhaps may be certified only to a narrow specialist scheme. In this case, the narrow specialist certification scheme cannot recognize such skills, experience and competencies beyond the areas formally covered in that scheme. Thus it is conceivable that an individual may hold more than one software engineering certificate; perhaps a basic (but broad) certificate, and in addition one or more narrow specialist certificates.

Annex A
(informative)

Case study details - application of ISO/IEC 24773

A.1 General

This annex provides users of ISO/IEC 24773:2008 with limited selected additional examples, and details concerning the use cases for ISO/IEC 24773:2008 described in Clause 5.

In the following sections, the examples are based on one or more *imaginary* certification or qualification schemes. For any scheme presented in this Annex, only a portion of that certification / qualification scheme is presented - that part needed to present an aspect of importance to the use case. The reader should be aware that the information presented in these examples for a given scheme is limited.

The limited data presented below for the fictitious example schemes do not represent the detailed and rigorous information that should be contained and documented in a fully-formed certification scheme, especially a certification scheme that claims conformance to the ISO/IEC 24773:2008. Because only a portion of an imaginary certification scheme can be shown in these examples, it is irrelevant whether the sample scheme is conformant with ISO/IEC 24773:2008.

Some aspects of the example schemes below may also be intentionally constructed so as to be non-conformant, in order to serve as a counter-example with appropriate explanation.

A.2 Example 1 – scheme set by examination body

In this example a qualification scheme is consisting largely of knowledge requirements and an examination. Table A.1 below shows a simple case where a qualification (*A* professional) can be evaluated or analysed using the ISO/IEC 24773:2008 framework.

In the case of this example, as illustrated in Table A.1, the qualification scheme has no provision for skills. The knowledge areas (topics) for the examination seem to address the various major topic areas of the SWEBOK Guide, however in this simple example one cannot presume that this qualification scheme fully or sufficiently covers each topic area in the SWEBOK Guide. This analysis must be performed by the users, for each qualification on an individual basis, since the ISO/IEC 24773:2008 framework itself carries no criteria which can be used to judge sufficient coverage of the respective topic areas in the SWEBOK Guide.

Note: It is possible that this sample qualification scheme may contain or define some cognitive levels (perhaps mapping them to Bloom's taxonomy[1]) for each topic covered by the examination. In this case the qualification scheme may incorporate a deep and thorough BOK, but as illustrated in Table A.1 it does not address practical skills. The ISO/IEC 24773:2008 framework is useful in examining and evaluating such a qualification.

Table A.1 — ISO/IEC 24773:2008 framework and a sample qualification scheme by examination body

ISO/IEC 24773:2008 Framework				Qualification
Title				*A* professional
List of Tasks				None specified
Level of Accountability, Authority or Responsibility				None specified
Competencies				
	Skills			
		SW Engineering Skills		None specified
		Professional Skills		None specified
	Performance Levels			None specified
	Body of Knowledge Required			
		Knowledge mapped to SWEBOK Guide		
			Software Requirements	Requirement analysis
			Software Design	Object-oriented design
			Software Construction	UML, C++ programming
			Software Testing	Test level Unit test design Test oracle
			Software Maintenance	Categories of maintenance Maintenance process
			Software Configuration Management	Configuration item identification Change control
			Software Engineering Management	Software project planning Risk management
			Software Engineering Process	Software life cycle Software process improvement
			Software Engineering Tools and Methods	Software design tools
			Software Quality	Definition of quality and relationship between quality and testing
		Domain Knowledge		None specified
		Standards Knowledge		None specified
Minimum Education and Experiences				University degree Five years of work experience
Evaluation				150 min. written test
Code of Ethics				Not required – Qualification
Renewal of Certificate and CPD Requirement(s)				Not required – Qualification

A.3 Example 2 – scheme set by certification body

In this example, a specialist certification (*B* specialist) has been created with specific depth in one SWEBOK Guide knowledge area, but not covering other SWEBOK Guide knowledge areas.

Table A.2 below uses the ISO/IEC 24773:2008 framework to illustrate that the certification scheme for *B* specialist does include requirements related to experience, professional and technical skills and other aspects beyond knowledge. The table depicts the mapping of the knowledge areas covered by the scheme and it is clear that this certification does not cover other areas of the SWEBOK Guide.

Table A.2 — ISO/IEC 24773:2008 framework and sample certification scheme by certification body

ISO/IEC 24773:2008 Framework	Certification
Title	*B* specialist
List of Tasks	Define configuration items Implement CM process
Level of Accountability, Authority or Responsibility	Responsible for all CM planning and activities
Competencies	
Skills	
SW Engineering Skills	Define CM polices Specify CM tools
Professional Skills	Communication skills
Performance Levels	Practitioner level
Body of Knowledge Required	
Knowledge mapped to SWEBOK Guide	
Software Requirements	None specified
Software Design	None specified
Software Construction	None specified
Software Testing	None specified
Software Maintenance	None specified
Software Configuration Management	Configuration item identification Change control Build management Version control strategies
Software Engineering Management	None specified
Software Engineering Process	None specified
Software Engineering Tools and Methods	None specified
Software Quality	None specified
Domain Knowledge	None specified
Standards Knowledge	IEEE Std 828
Minimum Education and Experiences	University degree or equivalent working experience
Evaluation	Review of experience report
Code of Ethics	(basic code specified)
Renewal of Certificate and CPD Requirement(s)	Renew every 2 years Require 30 hours CPD

A.4 Example 3 – training course provider *use* of a scheme

Table A.3 shows a sample qualification in software testing, presented using a simple view based on the ISO/IEC 24773:2008 framework. In this simple example, the sample qualification (*C* specialist) does not cover all knowledge areas of the SWEBOK Guide, and in fact does not address other aspects of qualification scheme in the ISO/IEC 24773:2008 framework, such as domain knowledge and professional skills.

Figure A.1 shows in a simple way how a training course provider could make use of the qualification (*C* specialist) and the ISO/IEC 24773:2008 framework. If skills, knowledge areas and other aspects of the *C* specialist are organized and documented with respect to the ISO/IEC 24773:2008 framework, the training course provider can easily understand the knowledge topics and skills to be addressed in the course, and map the course (module) contents (and outcomes) back to the various elements of the qualification (*C* specialist) .

Table A.3 — ISO/IEC 24773:2008 framework and a sample qualification

ISO/IEC 24773:2008 Framework				Qualification
Title				*C* specialist
List of Tasks				None specified
Level of Accountability, Authority or Responsibility				None specified
Competencies				
	Skills			
		SW Engineering Skills		Design test case Implement test case
		Professional Skills		None specified
	Performance Levels			None specified
	Body of Knowledge Required			
		Knowledge mapped to SWEBOK Guide		
			Software Requirements	None specified
			Software Design	None specified
			Software Construction	None specified
			Software Testing	Various testing topics including definition of different test types Test case design Test case implementation Test execution Test management
			Software Maintenance	None specified
			Software Configuration Management	None specified
			Software Engineering Management	None specified
			Software Engineering Process	None specified
			Software Engineering Tools and Methods	None specified
			Software Quality	Definition of quality and relationship between quality and testing
		Domain Knowledge		None specified
		Standards Knowledge		IEEE Std 1008 – Unit Testing
Minimum Education and Experiences				University degree
Evaluation				Written test
Code of Ethics				Not required – Qualification
Renewal of Certificate and CPD Requirement(s)				Not required – Qualification

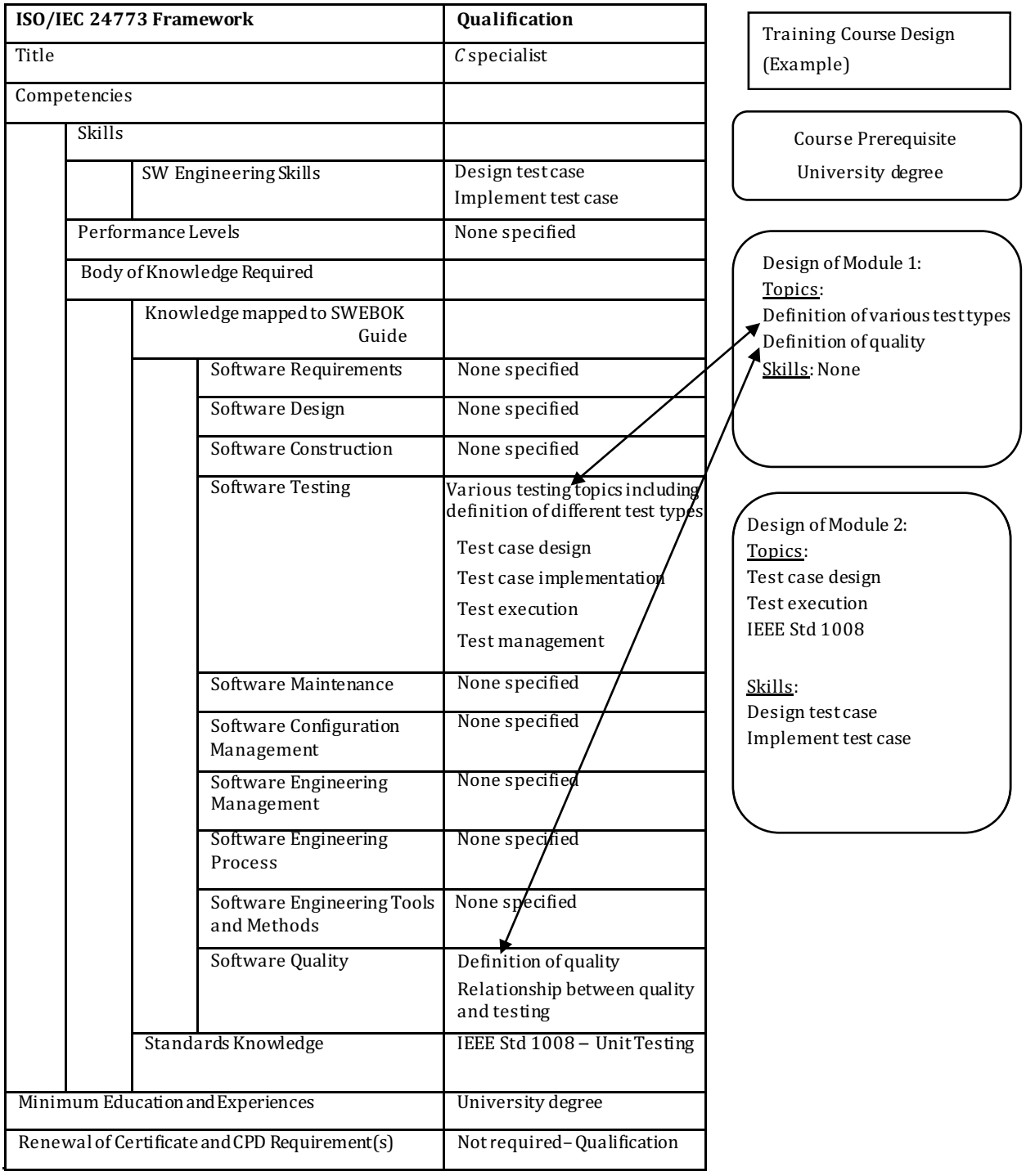

Figure A.1 — Use of ISO/IEC 24773:2008 framework and a sample qualification scheme in training course definition

A.5 Workforce planning and human resources

In this example, workforce planning is facilitated through the screening or categorizing of candidates according to their knowledge and skills. The knowledge and skills of various candidates may be represented in part by their respective certifications and qualifications.

The certificates held by candidates may be analysed and compared through the use of the ISO/IEC 24773:2008 framework. More specifically the framework allows a workforce planner to identify

certain particular skills or knowledge areas, through the use of the ISO/IEC 24773:2008 framework. Then the skills required by the workforce planner can be directly mapped to one or more certification schemes, and thus the use of the framework can produce a screening tool and a planning tool for workforce planning.

Figure A.2 illustrates the use of the ISO/IEC 24773:2008 framework, aligning the skills and knowledge areas covered by certain certificates with the skills and knowledge needed in the workforce.

Job Planning		
Needed (No. of professionals)		
Jr. Tester	Sr. Tester	Test Architect
21	19	12

ISO/IEC 24773 Framework	**Certification**	**Qualification**			
Title	*D* specialist	*E* specialist			
Competencies					
Skills					
SW Engineering Skills	Design test case Implement test case Debug Use test harness	Design test case Implement test case Analyse defect	 √ √ 	√ √ √ √ 	√ √ √
Body of Knowledge Required					
Knowledge mapped to SWEBOK Guide					
Software Requirements					
Software Design					
Software Construction					
Software Testing	Test case design Test case implement Test automation	Test case design Test case implement	 √	√ √	√ √ √
Software Maintenance					
Software Configuration Management					
Software Engineering Management					
Software Engineering Process					
Software Engineering Tools and Methods					
Software Quality	Static analysis	QA planning Defect classification		√ √ 	√ √
Standards Knowledge	IEEE Std 829, 1008	IEEE Std 1008		√	√
Minimum Education and Experiences	University degree	University degree		√	√
Renewal of Certificate and CPD Requirement(s)	30 hours/year				

Figure A.2 — Workforce planning using qualification, certification and ISO/IEC 24773:2008 framework

Bibliography

[1] Bloom B.S.ed. *Taxonomy of educational objectives: The classification of educational goals, Handbook I, cognitive domain*. David Mckay Company, Inc, 1956

[2] ISO/IEC 17024:2003, *Conformity assessment — General requirements for bodies operating certification of persons*[1)]

[3] ISO/IEC TR 19759:2005, *Software Engineering — Guide to the Software Engineering Body of Knowledge (SWEBOK)*

1) ISO/IEC 17024:2003 has been cancelled and replaced by ISO/IEC 17024:2012.

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