INTERNATIONAL STANDARD

ISO/IEC 20006-2

Information technology for learning, education and training — Information model for competency —

Part 2:
Proficiency level information model

Technologies de l'information pour l'apprentissage, l'éducation et la formation — Modèle d'information pour les compétences —

Partie 2: Modèle d'information des niveaux de compétence

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.

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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommitee SC 36, *Information technology for learning, education and training*.

ISO/IEC 20006 consists of the following parts, under the general title *Information technology for learning, education and training — Information model for competency*:

— *Part 1: Competency general framework and information model*

— *Part 2: Proficiency level information model*

The following parts are under preparation:

— *Part 3: Guidelines for the aggregation of competency information and data*

Introduction

From the late 1990s, some industrial and academic organizations have developed information technology standards in the skills and competency domain, such as human resources, on a global level to address the interoperability requirements and environment complexities of management and sharing of competency information amongst different organizations. Some examples include work spearheaded by the following organizations: the IMS Global Learning Consortium Inc., HR-XML Consortium, IEEE-LTSC, OMG, CEN TC353, HRMLs, and also ISO/IEC JTC 1/SC36 itself. Some typical problems encountered by stakeholders as well as ITLET systems dedicated to the management and exchange of competency information and where these issues may be encountered are provided in examples below.[1]

Example 1: Technical — Competency and associated information cannot always be selected and shared between different ITLET systems (e.g. learning management, HR, and other related platforms).

Example 2: Organizational — Competency and associated information is not easily used in human development activities, because skills and competency information may be detailed or expressed differently in various ITLET systems (e.g. learning management, HR, national occupational classification, and other related systems).

Example 3: Information exchange — Skills and competency proficiency information, such as individual status or degrees acquired, cannot be shared easily amongst different ITLET systems (e.g. HR, learning management, national occupational classification, and other related systems).

Example 4: Individual learner — Individual developmental learning, education, and training paths cannot easily migrate or be exchanged amongst ITLET systems.

Example 5: Systems perspective (where systems include individuals, organizations, and the technologies that support them) — Individuals and organizations cannot easily design and integrate informal and formal learning, education, and training opportunities to support life goals, career strategies, and career paths using existing common dimensions within ITLET systems.

Example 6: Practical analytics — The ability to access, extract, and analyse competency and associated information can provide evidence as to whether learning, education, and training information needs are being met in order to analyse lifelong learning, thus where competency information must be drawn from different systems and where non-interoperable format and definitions are used.

Example 7: Assessment and evaluation — ITLET systems (e.g. acknowledgement and consideration are needed regarding evaluation biases in human assessment, the use of varying methods and metrics to evaluate human performance, and the need to conduct accurate skill gap analysis), where ITLET systems that use different competency digital schema are involved.

Example 8: Overarching goals and outcomes — Human assessment and support for the development of human potential requires ITLET systems that provide a more flexible, holistic integration, and exchange of competency and associated information beyond individual learning opportunities, everyday operation, and work performance.

Currently, organizations, such as schools, universities, institutes, and companies, use different ITLET systems to support the use of learning content, to enable and enhance various learning activities, and to provide other services. To meet their missions and goals, such organizations can rely on in-house developers, others such as ITLET vendors or suppliers, or a combination of both to provide and operate IT systems to support LET. This means ITLET operations and other organizational systems that deal with skills and competency information, such as interrelated human resources (HR) information systems, need to be interoperable to allow for communication between organizations, their employees, and outsourcing ITLET providers or suppliers.

The purpose of this International Standard is to provide a framework, models, system architecture used for competency and proficiency information, and a way to aggregate competency information. ISO/IEC 20006-1 International Standard will provide a general framework and information model to manage and exchange information about knowledge, skills, ability, attitude, and educational objectives. Especially, this part ISO/IEC 20006 will focus on extending the concepts contained within

ISO/IEC TR 24763 by providing more detailed information regarding competency information and its information aggregation. This International Standard can be used by software developers and implementers, instructional designers and test designers, and others to ensure that learning, education, and training environments satisfy learners' and organizations' competency needs. ISO/IEC 20006-3 will provide definitions of several types of competency information aggregation, which will provide guidance for all stakeholders to better understand and support the development of interoperable systems that will enable competency information exchange.

Information technology for learning, education and training — Information model for competency —

Part 2:
Proficiency level information model

1 Scope

1.1 General

This part of ISO/IEC 20006 provides an information model for competency proficiency and its level. Moreover, it presents several use cases that can be used by software developers, implementers, and architects of human resources systems and learning systems. These use cases will support management and exchange of competency information within information technology systems used for learning, education, and training.

NOTE   This International Standard is based on work completed in ISO/IEC TR 24763.

This International Standard includes the following parts:

— ISO/IEC 20006-1, *Information technology for learning, education and training — Information model for competency — Part 1: Competency general framework and information model*

— ISO/IEC 20006-2, *Information technology for learning, education and training — Information model for competency — Part 2: Proficiency level information model*

— ISO/IEC 20006-3, *Information technology for learning, education and training — Information model for competency — Part 3: Guidelines for aggregations of competency information and data*

This part of ISO/IEC 20006 provides an information model used to express the semantics of competency proficiency and its level and can be used to support the management and exchange of competency information amongst information technology systems for learning, education, and training. This part of ISO/IEC 20006 provides

— information model for expressing semantics of competency proficiency and its levels, and

— use cases used to support the development of the competency proficiency level information model.

ISO/IEC 20006-1 provides a framework, information model and use cases to support the management and exchange of competency information. ISO/IEC 20006-3 provides guidelines regarding the aggregation of competency information and data.

1.2 Exclusions

The scope of this part of ISO/IEC 20006 does not include an in-depth technical review of issues related to:

— adaptability to culture, language, and human functions;

— although intended to support, this part of ISO/IEC 20006 does not replace the requirement for regional, transnational, and international agreements relating to the equivalencies of representations of competency proficiency and its associated levels;

— security;

— authentication;

— privacy;

— accessibility.

1.3   Areas not addressed

This part of ISO/IEC 20006 currently does not address the following items:

— e-Profiles, which are a set of records that pertain to an individual (e.g. personnel records, student information system records);

— evidence information;

— assessment methods and metrics information.

2   Conformance

The objective of this part of ISO/IEC 20006 is to support the management and exchange of competency information in a way that will promote and improve interoperability and integration. The proficiency level information model is based on the Conceptual Reference Model for Competency Information and Related Objects (CRM) (defined by ISO/IEC TR 24763). The CRM provides a toolkit that can be used to abstract and identify concepts used within IT systems to support the management and exchange of competency information across different HR, learning, education, and training contexts. This part of ISO/IEC 20006 builds upon the conceptual and abstract focus of ISO/IEC TR 24763 to provide an information model for proficiency or its associated levels and use cases.

To support competency management and development, competency information needs to be structured and described consistently to promote understanding, mutual communication, and agreement. Competency related information should be detailed in a way that is semantically robust and extensible. For the purposes of this part of ISO/IEC 20006, proficiency and level information are conformant if it uses the corresponding information model and the appropriate item notation as provided in Clause 7.

A conforming notation may contain information items that are based on ISO/IEC TR 24763. In other words, it is intended to be extensible and can contain additional information elements of ISO/IEC TR 24763. For information about conformance to ISO/IEC TR 24763, classes associated with a proficiency level in CRM competency are indicated with the following notation [En] where n = a number that refers to a class defined in ISO/IEC TR 24763 to assist with understanding the linkages and relationships between the CRM and this part of ISO/IEC 20001. For example, as noted in ISO/IEC 24763:2011, E1 = Action, E2 = Actor, E3 = Competency, and so on.

3   Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 19796-3, *Information technology — Learning, education and training. Quality management, assurance and metrics. Part 3: Method and metrics*

ISO/IEC 20006-1, *Information technology — Learning, education and training. Information model for competency. Part 1: General framework and information model*

ISO/IEC TR 24763, *Information technology — Learning, education and training. Conceptual reference model for competency information and related objects*

4   Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1
formal
expressed in a restricted syntax language with defined semantics based on well-established mathematical concepts or standardized formats

[SOURCE: ISO/IEC 15408-1:2009, 3.1.35]

4.2
informal
expressed in natural language

[SOURCE: ISO/IEC 15408-1:2009, 3.1.35]

4.3
level
<ITLET competency> position as assessed using criteria and method to determine amount, intensity, extent, or the like

4.4
level sequence
<ITLET competency> ordinal value set of proficiency or levels in a competency

Note 1 to entry: The sequence can be of several types, such as: nominally expressed steps as ordinal degree, numbered steps as ordinal degree (increasing or decreasing), continuance as interval scale or ratio scale by number, structured data type (SDT) (e.g. pass or not). All of these different ways can be used to express concept of competency proficiency or a set of competency levels.

4.5
proficiency
<ITLET competency> competency related concepts that are used to identify amount, level or degree of a competency by judgment or measurement

Note 1 to entry: OED defines proficiency as a skill, a talent; (now freq.) a certain standard of skill acquired after a period of education or training.

Note 2 to entry: Proficiency can be used to ascertain or to identify progress, advancement or improvement in a competency, such as skill, knowledge, and other competency-related concepts.

5   Symbols (and abbreviated terms)

CRM	Conceptual Reference Model
EQF	European Qualifications Framework
HRIS	Human Resources Information System
HRM	Human Resources Management
HR-XML	The HR-XML Consortium
HRMLs	The Society for Human Resources Markup Language
IMS RDCEO	IMS GLC Inc. Reusable Definition of Competency or Educational Objective Specification
info.	Information
ITLET	Information Technology for Learning, Education and Training
ITSS	Skill Standards for IT professionals; The Japanese National Skills Standard
LMS	Learning Management System

3

Mgt	Management
PM	Project Management
RDF	Resource Description Framework
SDT	Structured Data Type
SIS	Student Information System
TOEIC	Test of English for International Communication

6 Relationship between proficiency and competency

ISO/IEC 20006-2 provides proficiency and level information models and use cases to demonstrate how proficiency and its levels may be described in an IT system that is being used to manage and exchange information regarding this aspect of human competency. Through use cases, examples of semantic expressions that are used to describe proficiency and level sequences and structures were extracted. Then commonalities regarding the various structures were identified. The resulting proficiency and level information models provided below in Clause 7 indicate how proficiency and level information regarding individuals' competencies may be expressed within an IT system.

Proficiency level information has several direct relationships with entities in the competency information architecture that is detailed in ISO/IEC 20006-1:2014, 6.2. Proficiency and level information may reside in different types of systems, such as Learning Management Systems (LMS), Human Resources Information Systems (HRIS), Student Information Systems (SIS), etc. Also, it may be expressed in various ways within these different systems, making it challenging to exchange and share these types of information (Figure 1). For this reason, it is crucial to consider separately how competency information and proficiency or level information are expressed in IT systems. For instance, the value set or proficiency and levels sequence of the competencies "statistical skill" and "communication skill" that is at the 4th level or degree within an IT system could be expressed as "needs help", "independent", "automatically demonstrates", and "can teach others", depending on how it has been defined. On the other hand, a definition of "communication skill" could be assessed by an examination and human assessment completed by a boss, and could have only two proficiency values as possible value options for the examination (e.g. "pass" or "fail") and five proficiency values as possible value options for the performance review completed by the assessor for the human assessment. These examples highlight the importance of ensuring that competency information and proficiency and level information should be considered separately.
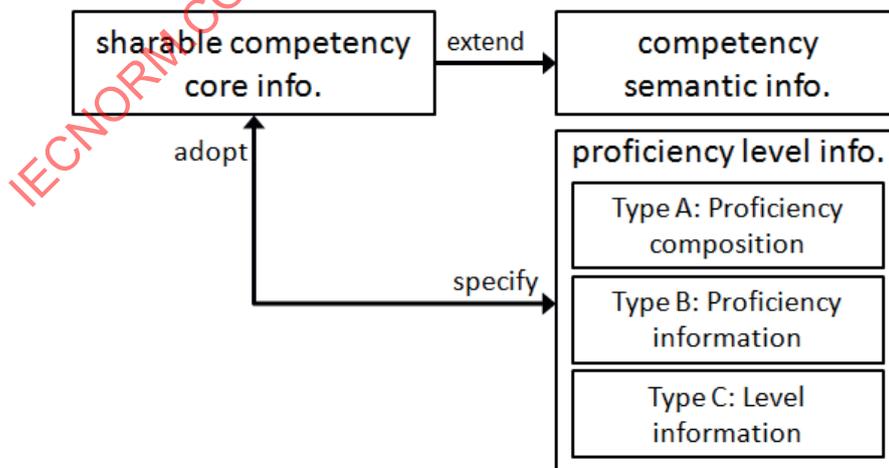

Figure 1 — Relationship between competency and proficiency

Competency information may be structured or organized as a hierarchy. Mapping with the CRM for competency, proficiency level information would be considered as part of the class "[E3] competency" as described in ISO/IEC TR 24763. Competency information may consist of child competencies and each child competency may have its own proficiency level sequence (e.g. be divided into different levels). For example, competency (X) might be defined and comprise of competency (X) 1st, 2nd, and 3rd levels. For example, in the case of a "social skill", the child competency "communication skill" could be a requirement for someone who is at the 1st level and the child competency "negotiation skill" might be required for someone at the 2nd level. The child competencies may each be described using different levels. For example the child competency "communication skill" could be described using 2 levels ("pass" or "fail"). The child competency "negotiation skill" could be described using 5 levels ("exceptional", "exceeds expectations", "meets expectations", "improvement needed", "unsatisfactory"). The competency and child competencies in this example could be labelled differently in various IT systems. Also, the proficiency levels could be structured in a variety of ways across different IT systems. This is one of the reasons why it is helpful to define proficiency level distinctly from competency information.

There may be other aspects that impact on how proficiency level is expressed within an IT system. It is possible that other classes of information as defined in the competency CRM (in ISO/IEC TR 24763) could be used to indicate proficiency and level. For example, an individual who has no difficulty communicating with other individuals in an organization might be considered to have a higher proficiency and level with regard to "communication skill" compared to an individual who has difficulty communicating with other individuals in an organization but can communicate with no issue with their good friends. In this case, the proficiency level of "communication skill" may be defined using the classes "[E1] action" or "[E8] outcome". Also, in this example the difference could be specified according to different competency information associated with the class "[E4] criteria and method" and "[E2] actor".

Thus it is helpful to ensure that the variety of ways that proficiency and level information is expressed in IT systems is made explicit to support management and exchange of this aspect of competency information. The next clause provides a competency proficiency and level information model that can assist with communicating about this type of information.

7 Proficiency level information model

The proficiency level information model comprises 3 components as noted below and in Figure 2,

Type A, proficiency composition model (7.1), which is used to define the whole concept for a proficiency or a unit of levels as a highest or abstract conception. It is used, only if a proficiency or a unit of levels is composed of more than two different aspects or stages.

Type B, proficiency information model (7.2), which is used to express and implement one unit of levels.

Type C, level information model (7.3), which is used to express and implement one level in a set of ordinal levels.
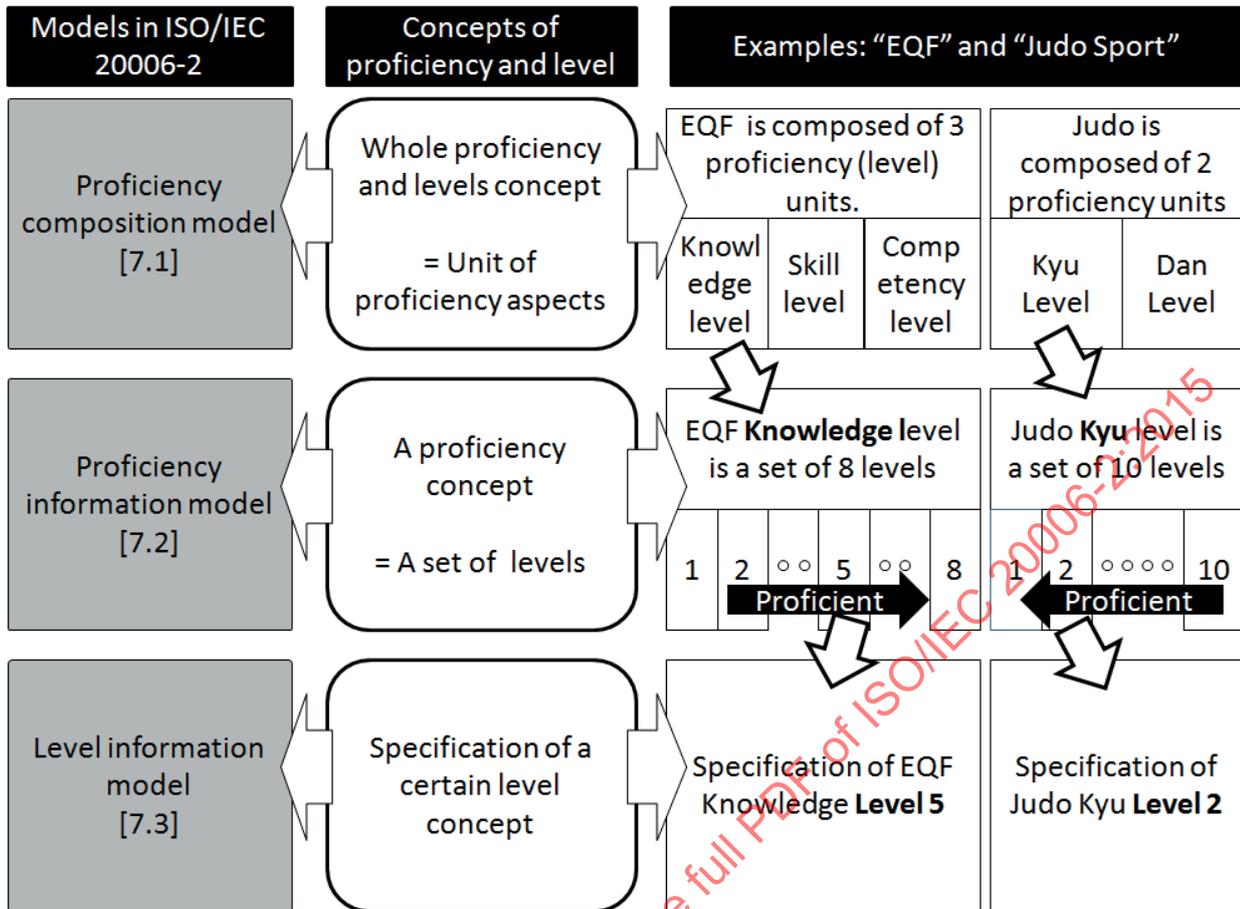
Figure 2 — Relationship among the proficiency composition model, the proficiency information model and the level information model

7.1 Proficiency composition model

The proficiency composition model is used to describe the structure of the proficiency. It includes the attributes that are used as labels within an IT system (e.g. id, name, description). It also includes two items, the proficiencySequence and the proficiencyList. The proficiencySequence is used to describe aspects of the proficiency that is being represented. These aspects are at a high level of abstraction. So, for example, for the European Qualifications Framework (EQF), the proficiencySequence would include three main items (i.e. knowledge levels, skill levels, and competency levels). Additional information regarding the proficiencyList item would be included as attributes (e.g. id, name, description). The structure of the proficiency composition model is provided below in Figure 3.

There are many different types of competency information and rating structures. Some examples are provided below.

a) Single rating scale (e.g. ascending or descending): where an individual would be assigned a specific value on a scale that is either ascending (e.g. 1 – 10) or descending (10 – 1).

b) License or certificate: where a person takes a license or certificate exam and possibly participates in LET activities. In such cases, it is possible that the coursework and/or exam would be either "pass" or "fail". This type of rating structure may be used for professionals, tradespeople, and others.

c) Educational attainment/credential/state: where proficiency and levels are given names, for instance, bachelor, master, and Ph.D., or junior class and senior class.

d) Tiered rating system/scale (e.g. inverse, multi, etc.): some proficiency representations have different tiers of rating scales. For example, taking into account a national education system, there can be several distinctions for students who progress through the system (e.g. kindergarten, primary, junior, senior, university, and post-graduate). There are also other cases that demonstrate tiered rating scales. For example, "Judo" or other Japanese traditional training systems have two different continuances of level sequence, that is "Kyu (class)", and "Dan (stage)". "Kyu" has a continuance from 10th to 1st. "Dan" begins at 1st and goes to 9th. When a person achieves a lower number in the "Kyu" continuance, it means that the person is more skilled. On the other hand, a lower number for the "Dan" continuance means that a person is less skilled. The flows of possible attainment for an individual from "10th Kyu" to "1st Kyu", and from "1st Dan to 9th Dan" are termed continuances, and the continuance is applied to all individuals who attain that level of skill. The continuance is used consistently across all individuals and never changes the order of the skill that is being described. If it were to be expressed within an IT system, this case instance could include a potential of "19" possible grades. However, within an IT system it would be very useful to allow for a combination of 2 different grades to express individuals' skill levels, as the attribution of "composition" allows for the combination of 2 or more continuances, which can be helpful to understand the actual skill level attained.

e) Parallel rating scales: skill certifications used by the Japan ski association are more complex. Individual skiers may be ranked from 5 to 1. The lower numbers indicate that the skiers are more skilled. "1st rank" is the highest level for normal skiers. If a skier passes "1st rank", he/she can take test for higher levels. Above the "1st rank", there are two ways to be recognized as an expert skiers. One is the license for ski instructors. There are two levels for the instructor license, "Associate instructor license" and "Formal instructor license". The other one is the prize certifications for superior ski experts. There are also two levels for practical high level technique, "Technical prize" and "Crown prize". Both the licenses and the prize certifications need high level techniques, the former requires varied ski-control techniques, the later requests practical and competitive techniques. This means that there are two sequences for proficiency and level in parallel.

Considering the above examples, if a whole proficiency schema is constructed by only numbered order, or SDT (Structured Data Type), the schema can be defined clearly. However, if the data types are qualitative or complex (such as nominal type, combination type, parallel), additional information may be needed because one proficiency schema may be based on multiple underlying schemas. To develop competency expressions of this type that can be more easily shared across IT systems, a composition model for proficiency is used (see Figure 3). If proficiency information consists of or is expressed by only one level sequence or SDT (in other words it is structured in a simple and straightforward manner), then the additional attributes and elements for proficiency composition may not be required.

As noted above, the proficiency composition model consists of attributes and elements and can be used to express multiple different proficiency level sequences and structures. Attributes consist of indispensible information for identification (e.g. id, name, and description), which can be used for the simplest implementations. Other attributes and elements can be added according to other specifications, such as RDF, IMS RDCEO, HR-XML competencies and so on.
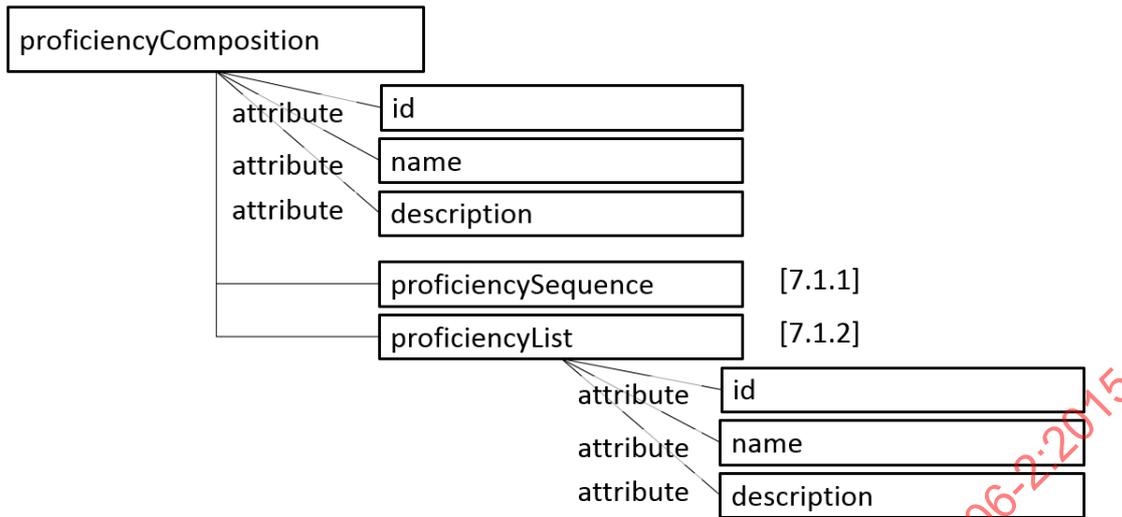
Figure 3 — Proficiency composition model

7.1.1 proficiencySequence

This information item indicates the combination of multiple proficiency or sets of levels as sequence using id or name of proficiency information. The order of level sequence in proficiency is expressed by numbers, smaller number is less advanced stage, and same numbers means parallel (see Example).

EXAMPLE

Table 1 — Information modelling examples of proficiencySequence

	Information modelling	Supplement
TOEIC	— {1:listening, 1:reading}	These are tagged by —"1:" in the front. This means these are two components of the competency.
EQF	— {1:eqf_knowledge, 1:eqf_skill, 1:eqf_compe-tency} (see Annex A)	Same as above, in this case there are potentially three components of the competency.
ITSS	— {1:careerLevel, 1:skillLevel}	
Judo	— {1:kyu, 2:dan}	"2:" means upper level to "1:"
Ski	— {1:skiSkillTest, 2:skiPrizeTest, 2:skiInstruc-torLicense}	Same as above in the Judo example.

Note 1   TOEIC; Test of English for International Communication

Note 2   EQF; European Qualifications Framework — In the case of EQF (see Annex A), EQF_01 means a set of knowledge levels, EQF_02 means a set of skill levels and EQF_03 means a set of competency levels. Whole concept of EQF consists of these three sets of levels. And all these 3 are tagged by "1:" in the front. This means these three ones are same stage.

Note 3   ITSS; Skill Standards for IT Professionals

Note 4   Judo; Kodokan Judo Institute

Note 5   Ski; Ski Association of Japan

7.1.2 proficiencyList

This informational element indicates list of different sequential patterns of proficiency or sets of levels. If terms of proficiency concepts or concepts of sets of levels are indicated value in item of "proficiencyList", this information should be listed as items in order to refer to the item of "proficiencyList" (see Example).

EXAMPLE

Table 2 — Information modelling examples of proficiencyList

	Information modelling	**Supplement**
TOEIC	— {listening} — {reading}	All bullet points should be set as parts, and each item can have id, name, and description.
EQF	— {eqf_knowledge} — {eqf_skill} — {eqf_competency}	
ITSS	— {itssCareerLevel} — {itssSkillLevel}	
Judo	— {kyu} — {Dan}	
Ski	— {skiSkillTest} — {skilPriseTest} — {skiInstructorLicense}	

7.2 Proficiency information model

Proficiency information model can be adapted to illustrate a concept of proficiency in/for a competency. This information model is represented below as a class diagram. This model is adapted to an actual whole concept of proficiency as an object diagram.

This proficiency information model consists of attributes and items (Figure 4). Attributes consist of several items of indispensable information for identification. This document indicates only id, name, and description for the simplest implementation. But some other attributes can be added according to other standards and specifications. Additional attributes can be added according to other specifications, as the proficiency information model (as well as other aspects of this approach) are extensible.

The items of proficiency information are the main targets of this standard. The item of "metrics" indicates characteristics of a proficiency or a set of level schema. Four items for proficiency or a set of levels are set in metrics item, "level number", "level sequence", "dimension number", and "dimension". "Dimension" is listed together with "dimension number". If the value of the number or level is 5, then 5 items of dimension are required and should be made explicit.
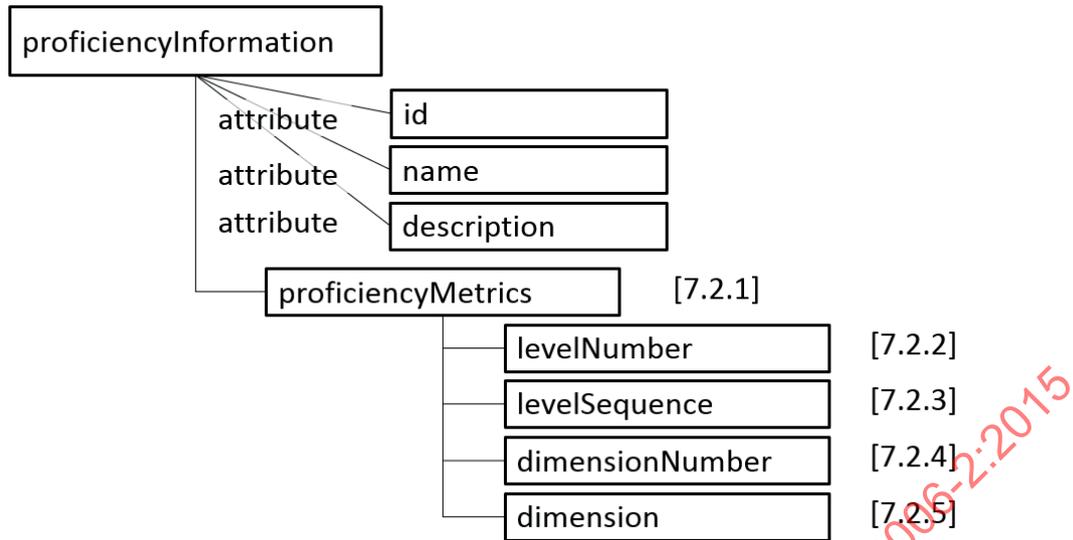
Figure 4 — Proficiency information model

7.2.1 proficiencyMetrics

The proficiencyMetrics in the proficiency information model are used to specify differentiation in the competency proficiency and level of learners, trainees, students, etc. The metrics information is used to help specify and assess what or how competency proficiency and its level are measured (e.g. for grade, degree, level, etc.). A proficiencyMetrics item provides information of level number pattern, including the number of levels and the relationship(s) amongst the level numbers (see Example).

The proficiencyMetrics also provide information from a viewpoint of differences of proficiency and set(s) of levels. Proficiency is divided into some levels, so a dimension is needed for segmentation, and is also useful to identify the meaning of each level, and to evaluate and assess human performance. This dimension may be named in different ways in various contexts, such as factors, assessment elements or criteria. It also has two items, "dimension number" and "dimension". It may not be easy to elicit and to define the metrics being used, because more detailed information related to the metrics that are being used may be hidden or implicit, and complex.

EXAMPLE

Table 3 — Information modelling examples of proficiencyMetrics

	Information modelling example	Supplement
TOEIC listening	— {listeningMetric}	It is under {(TOEIC)listening} as proficiencyInformation
EQF knowledge	— {eqf_knowledgeMetric}	It is under {eqf_knowledge} as proficiencyInformation
ITSS career	— {careerLevelMetric}	It is under {itssCareerLevel} as proficiencyInformation
Judo kyu	— {kyuMetric}	It is under {kyu} as proficiencyInformation
Ski prize	— {skilPrizeMetric}	It is under {skilPrizeTest} as proficiencyInformation

7.2.2 levelNumber

The levelNumber expresses the total number of levels or segmentations. An integer could be used to indicate nominal segmentation if required. This information usually permits one value. If a proficiency level schema has several sequences, each sequence should be defined for each information model. If its proficiency levels consist in stages from "level 1" to "level 5", the number of levels is "5". In the case of nominal segmentations, such as "junior" and "senior", the number of levels is "2". SDT data, such as "pass" or "not pass" (or "fail") could be expressed as "1" or "0".

In the case of the previous example of TOEIC, this could be expressed as "continuous" and a range of numbers could be provided (e.g. 5-495; see Example).

Some types of information, such as the TOEIC listening score, the proficiency can be expressed in different ways, such as nominal proficiency levels, such as level E to level A, instead of "continuance". The label "level E" includes the range of scores from 5 –109, "level D" includes the range from 110 – 234, "level C" includes the range from 235 – 314, and so on. Then multiplicity is needed.

EXAMPLE

Table 4 — Information modelling examples of levelNumber

	Information modelling example	Supplement
TOEIC listening	— {continuance} or {5-495}	{5}
EQF knowledge	— {8}	
ITSS career	— {7}	ITSS defines many jobs, and each job is modelled and involves set data. In this and below tables, ITSS career means a specific job, PM; IT project manager.
Judo kyu	— {10}	
Ski prize	— {2}	

7.2.3 levelSequence

This information is created according to the level number. If the level number is "5", five data might be produced in this item. This identifies the titles of each level and sequence. The lowest, weakest, or minimum level as inexpertness or needs improvement (in other words the lowest skill level) should be listed first, and the highest, strongest, or maximum level as expert or highly proficient (in other words the highest skill level) should be listed last. The sequence information is important to share and understand level concept and data. The listed terms in this item can be a set described and directly connected to a level information model (7.3) as children of proficiency information model. For a continuous data range, this level might be expressed by a number within the range. Some examples are provided below (see Examples 1 and 2).

EXAMPLE 1

For nominal sequenced category

Case 1: stage 1st, stage 2nd, stage 3rd

Case 2: beginner, intermediate, expert

Case 3: level 0, level 1, level 2,...level 7

For nominal SDT

Case 4: no rank, certification

For continuous numbering

Case 5: Total TOEIC score (listening and reading); [10 – 990]

EXAMPLE 2

Table 5 — Information modelling examples of levelSequence

	Information modelling example	Supplement
TOEIC listening	— {5-495}	continuous numbering
EQF knowledge	— {level 1, level 2, level 3, level 4, level 5, level 6, level 7, level 8}	nominal sequenced category
ITSS career	— {level 1, level 2, level 3, level 4, level 5, level 6, level 7}	nominal sequenced category
Judo kyu	— {10tht kyu, 9th kyu, 8th kyu, 7th kyu, 6th kyu, 5th kyu, 4th kyu, 3rd kyu, 2nd kyu, 1st kyu}	nominal sequenced category
Ski prize	— {technical prize, crown prize}	nominal sequenced category

7.2.4 dimensionNumber

The dimensionNumber item is used to specify the differences among a set of proficiency levels. In other words, it can be stated as viewpoints, factors or criteria. This information is the number of condition statements used for measuring and assessing competency proficiency. Sometimes this dimension is unclear or hidden. When it is transparent and clear, dimension information might be expressed. For assessing human competency or specifying difference of levels, several dimensions are used. This is a statement with a variable number of dimensions (see Example).

For example, a driving license test may include several different evaluation components such as reviewing training archival record, paper test, and practical driving skill examination. These evaluation methods are reflecting different viewpoints. So a driving license in Japan is assessed by a combination of "3" dimensions at least, "general knowledge", "knowledge for driving", and "driving skill".

EXAMPLE

Table 6 — Information modelling examples of dimensionNumber

	Information modelling example	Supplement
TOEIC listening	— {2}	
EQF knowledge	— {5}	Based on research (see Table A.1 in Annex A)
ITSS PM career	— {4}	{6} can be set by a more detailed segmentation (see Table B.4 in Annex B)
Judo kyu	— {4}	
Ski prize	— {7}	

7.2.5 dimension

The dimension item in proficiency information model is used to specify how the content of discrimination outlined in the criterion will be measured and judged to arrive at a level, degree, grade, etc. of competency proficiency. Dimension is used to provide a specific view for scales and assessment. Dimension specifies the differences among levels. It can be stated as viewpoints, factors or criteria. This information expresses the content of dimensions used for measuring and assessing competency proficiency. Sometimes dimension is unclear or hidden. If it is open and clear, dimension information might be expressed. For assessing human competency or specifying differences in proficiency levels, several dimensions can be used (see Example).

EXAMPLE

Table 7 — Information modelling examples of dimension

	Information modelling example	Supplement
TOEIC listening	— {listening} — {speaking}	Each item has more detailed sub-items.
EQF knowledge	— {specialty} — {advancement} — {range of content type} — {breadth of knowledge} — {understanding}	See Figure A.2 in Annex A
ITSS PM career	— {responsibility} — {complexity} — {size} — {professional contribution}	See Table B.2 in Annex B
Judo kyu	— {age} — {competition results} — {attitude for training} — {mastering the spirit of Judo}	
Ski prize	— {turn construction: positioning} — {turn construction: edging} — {situational response for high speed} — {situational response for arcing} :	

7.3 Level information model

This level information model consists of attributes and items. Level is directly related to "levelSequence" (7.2.3) in the proficiency information model. Attributes consists of several items of indispensable information for identification. This document indicates only id, name, and description for the simplest implementation. But some other attributes can be added according to other specifications.

The items of level information are the main targets of this standard (Figure 5). The item of metrics indicates characteristics of level information schema. Four items for level information are set in metrics items, "proficiencyInformation", "levelPosition", "levelDimensionNumber", and "levelDimension". The number of dimension items must be listed according to value in the item of "dimensionNumber". If the value of dimensionNumber is "5", then five items of dimension are required.

The dimension item itself and value or content must be reflected in the dimension item (7.2.5) in the proficiency information model.
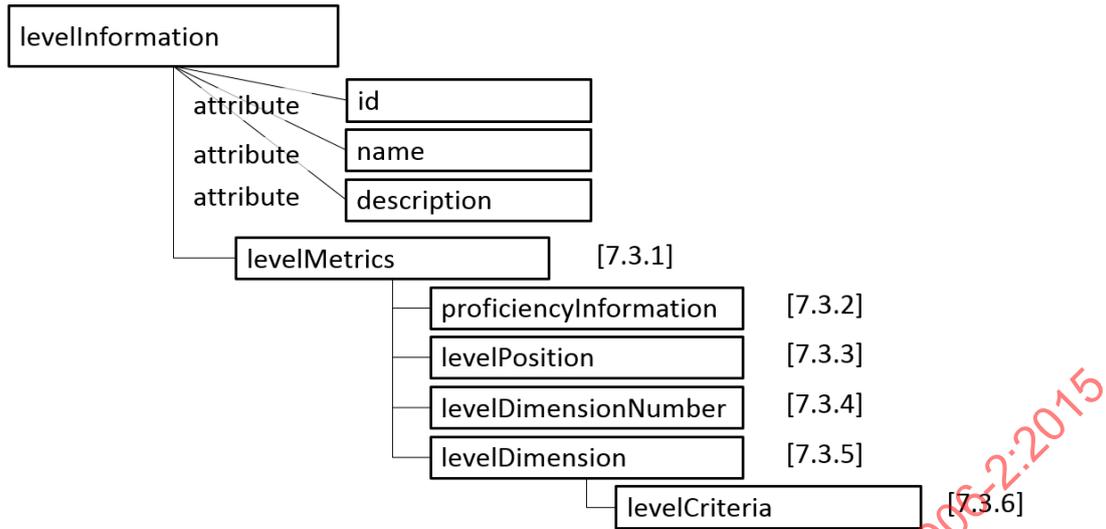
Figure 5 — Level information model

7.3.1   levelMetrics

The levelMetrics item in level information model is used to specify differentiation in the competency proficiency and its level of learners, trainees, students, learning objectives and others. A levelMetrics item is used to help specify and assess what or how competency proficiency and its level are measured (e.g. for grade, degree, level, etc.). Two items, "proficiencyInformation" and "levelPosition", provide information about relationship and position or placement in a set of levels.

The levelMetrics item also provides information from a viewpoint of the differences of a proficiency level with dimension and its criteria in order to indicate the meaning of a level. It has the other two items, "levelDimensionNumber" and "levelDimension". It may not be easy to elicit and to define the levelMetrics and levelCriteria being used for a certain level, because more detailed information related to the levelMetrics that is being used may be hidden or implicit, and complex. (see Example)

EXAMPLE

Table 8 — Information modelling examples of levelMetrics

	Information modelling example	Supplement
TOEIC listening (Intermediate stage)	not applicable A realistic use case is below* — {listeningIntermediatelMetric}	*If TOEIC score will be merged some stage categories, such as "beginner", junior", "intermediate", "senior", "advanced", and "native", each title can be adopted.
EQF knowledge Level 5	— {eqf_knowledgeLevel5_Metric}	It is under {eqf_knowledgeLevel5} as levelInformation
ITSS career level 3 (PM)	— {PMcareer3LevelMetric}	It is under {itssPMCareerLevel3} as levelInformation
Judo 2nd kyu	— {2nd kyuMetric}	It is under {kyu} as levelInformation
Ski technical prize	— {skilPrizeMetric}	It is under {skilPrize} as levelInformation

7.3.2 proficiencyInformation

This item information identifies super-ordinate concept of proficiency information as parents or connections. The "id" and/or specific "title name" of/in a proficiency information model is used in the item (see Example).

EXAMPLE

Table 9 — Information modelling examples of proficiencyInformation

	Information modelling example	Supplement
TOEIC listening (Intermediate level)	Not applicable Realistic use case is below* — {listening}	All items can be substituted with an id or url for its name.
EQF knowledge level 5	— {eqf_knowledge}	
ITSS PM career level 3	— {itssCareerLevel}	
Judo 2nd kyu	— {kyu}	
Ski technical prize	— {skiPrizeTest}	

7.3.3 levelPosition

The levelPosition item identifies a position within/amongst the defined levels. For this expression, decimal should be used. A numerator is this level number counted from the smallest number, and a denominator is total level number. Several examples are provided below (see Examples 1 and 2).

EXAMPLE 1

For nominal sequenced category

Case 1: stage 1st, stage 2nd, stage 3rd -> total level number is 3.

"Stage 1st" should be expressed as "1/3"

Case 2: beginner, intermediate, expert -> total level number is 3.

"Expert" should be expressed as "3/3".

Case 3: level 0, level 1, level 2,...level 7 -> total level number is 8.

"Level 0" should be expressed as "1/8".

For nominal SDT

Case 4: "not ranked" [or "no rank"] / certified total level number is 2

"not ranked" [or "no rank"] should be expressed as "0/1"

For continuance number

Case 5: [10 – 990] -> Full point is a denominator. In the case of 650 score, "650/990".

EXAMPLE 2

Table 10 — Information modelling examples of levelPosition

	Information modelling example	Supplement
TOEIC listening (Intermediate level)	Not applicable A realistic use case is below* — {3/6}	continuance number *this example shows, if TOEIC score will be merged some categories, such as "beginner", "junior", "intermediate", "senior", "advanced", and "native", the intermediate level can be expressed as noted in the cell to the left.
EQF knowledge (level 5)	— {5/8}	nominal sequenced category
ITSS career level 3 (PM)	— {1/5}	nominal sequenced category
Judo 2nd kyu	— {8/10}	nominal sequenced category
Ski technical prize	— {1/2}	nominal sequenced category

7.3.4 levelDimensionNumber

The levelDimensionNumber specifies the features of a proficiency level. In other words, it can be stated as viewpoints, factors or criteria. This information is a number of condition statements used for measuring and assessing a competency proficiency level. Sometimes levelDimensionNumber is unclear or hidden. If it is clear and known (or clear and transparent), then levelDimensionNumber information might be expressed. For defining and specifying a proficiency or skilled level, several dimensions are used.

For example, the knowledge level schema of EQF may include several different evaluation components such as "specialty", "breadth of knowledge" and so on. The total number of dimensions is "5" for all of levels of segmentation in case of EQF knowledge. On the other hand, for defining or assessing a certain level, all dimensions for segmentation may not be used. Several additional examples are provided below (see Examples 1 and 2).

EXAMPLE 1

Case 1; EQF knowledge level (see Table A.1 in A.3 of Annex A)

EQF knowledge level 1st → 2

EQF knowledge level 2nd → 2

EQF knowledge level 6th → 4

Case 2; ITSS performance indicator level (see Table B.4 in B.3 of Annex B)

ITSS PM career level 3rd → 1

ITSS PM career level 4th → 3

ITSS PM career level 5th → 4

EXAMPLE 2

Table 11 — Information modelling examples of levelDimensionNumber

	Information modelling example	Supplement
TOEIC listening (Intermediate level)	— {2}	
EQF knowledge level 5	— {5}	see Table A.1 in Annex A
ITSS career level 3	— {1}	See above example 1 {3} can be set by a more detailed segmentation (see Table B.1 in Annex B)
Judo 2nd kyu	— {4}	
Ski technical prize	— {7}	

7.3.5 levelDimension

The levelDimension item in level information model is used to specify how the content of discrimination outlined in the criterion will be measured and judged to arrive at a level, degree, grade, etc. as a certain competency proficiency level. Dimension can be used to provide a specific view for scale and assessment. This dimension is used to identify a certain level amongst a set of levels. In other words, it can be stated as viewpoints, factors or criteria. This information expresses the content of dimensions used for measuring and assessing whether person has or executes a specific grade or a level of competency. Sometimes dimension is unclear or hidden. If it is clear and known (or clear and transparent), then levelDimension information might be expressed. For assessing human competency or specifying the differences in proficiency levels, several dimensions are used.

For example, the knowledge level schema of EQF may include several different evaluation components such as "specialty", "breadth of knowledge" and so on. These meta or super-ordinate concepts for a specific level are picked up and indicated in the items. According to "levelDimensionNumber", the same number of items should be listed. Several examples are provided below.

EXAMPLE 1

Case 1; EQF knowledge level (see A.4 in Annex A)

levelDimensionNumber of EQF knowledge level 1 is 2 → "specialty", "breadth of knowledge"

levelDimensionNumber of EQF knowledge level 2 is 2 → "specialty", "range of content type"

levelDimensionNumber of EQF knowledge level 6 is 4 → "specialty", "advancement", "range of

content type", "understanding"

Case 2; ITSS career level (performance indicator) (see B.4 Annex B)

levelDimensionNumber of ITSS PM career 3 is 1 → "complexity"

levelDimensionNumber of ITSS PM career 4 is 3 → "responsibility", "complexity", "professional

contribution"

levelDimensionNumber of ITSS PM career 5 is 4 → "responsibility", "complexity", "professional

contribution", "size"

EXAMPLE 2

Table 12 — Information modelling examples of levelDimension

	Information modelling example	Supplement
TOEIC listening (Intermediate level)	Quantitative modelling — {listening test score} Qualitative modelling — {complexity of listening contents} — {difficulty of situation} — {listening from different type speakers} — {effectiveness}	
EQF knowledge level 5	— {specialty} — {advancement} — {breadth of knowledge}	
ITSS career level 3	— {responsibility}	
Judo 2nd kyu	— {age} — {training experience} — {competition results} — {attitude for training}	
Ski technical prize	— {turn construction: positioning} — {turn construction: edging} — {situational response for high speed} — {situational response for arcing}	

7.3.6 levelCriteria

The levelCriteria item provides more specific and detailed information for defining and evaluating a certain proficiency level. Only dimensions can define and assess a level. Some dimensions are variables, which means those also have degree, weight, parameter and so on. ISO/IEC 19796-3 is useful to assist with choosing and defining level criteria (see Examples 1 and 2).

EXAMPLE 1

Case; EQF knowledge level

levelCriteria of "Specialty" in Level 5th → "specialized in a field".

levelCriteria of "Specialty" in Level 7th → "highly specialized in a field".

EXAMPLE 2

Table 13 — Information modelling examples of levelCriteria

	Information modelling example	Supplement
TOEIC listening (Intermediate level)	Quantitative modelling — {listening test score} Qualitative modelling — {complexity of listening contents} — {difficulty of situation} — {listening from different type speakers} — {effectiveness}	Each item has more detailed sub-items.
EQF knowledge/ level 5/ metric/ specialty	— {required knowledge specialty in "a field" at least} — {required specialized level knowledge}	
ITSS career level 3/ metric/ responsibility	— {all three sub items are required: familiarity with project, project complete, and optimized solution}	Other modelling — {familiarity with project: required} — {project complete: required} — {optimized solution: required}
2nd kyu/metrics/age	— {over 15 years old}	
technical prize/ metrics/ turn construction: positioning		

Annex A
(informative)

Application to the European Qualifications Framework (EQF)

A.1 General

The European Qualifications Framework (EQF)[2] acts as a translation device to make national qualifications more readable across Europe, promoting workers' and learners' mobility between countries and facilitating their lifelong learning. The EQF is a common European reference framework that links countries' qualifications systems together, acting as a translation device to make qualifications more readable and understandable across different countries and systems in Europe. It has two principal aims: to promote citizens' mobility between countries and to facilitate their lifelong learning. The EQF aims to relate different countries' national qualifications systems to a common European reference framework. Individuals and employers will be able to use the EQF to better understand and compare the qualifications levels of different countries and different education and training systems.

A.2 Application of proficiency composition to EQF

The EQF shows 8 levels for each of the three domains (Figure A.1). The three domains are knowledge, skill, and competence. Both the levels and the domains are closely related, but are defined separately. This means EQF is best described using both levels and domains, despite each being constructed similarly using 8 levels.
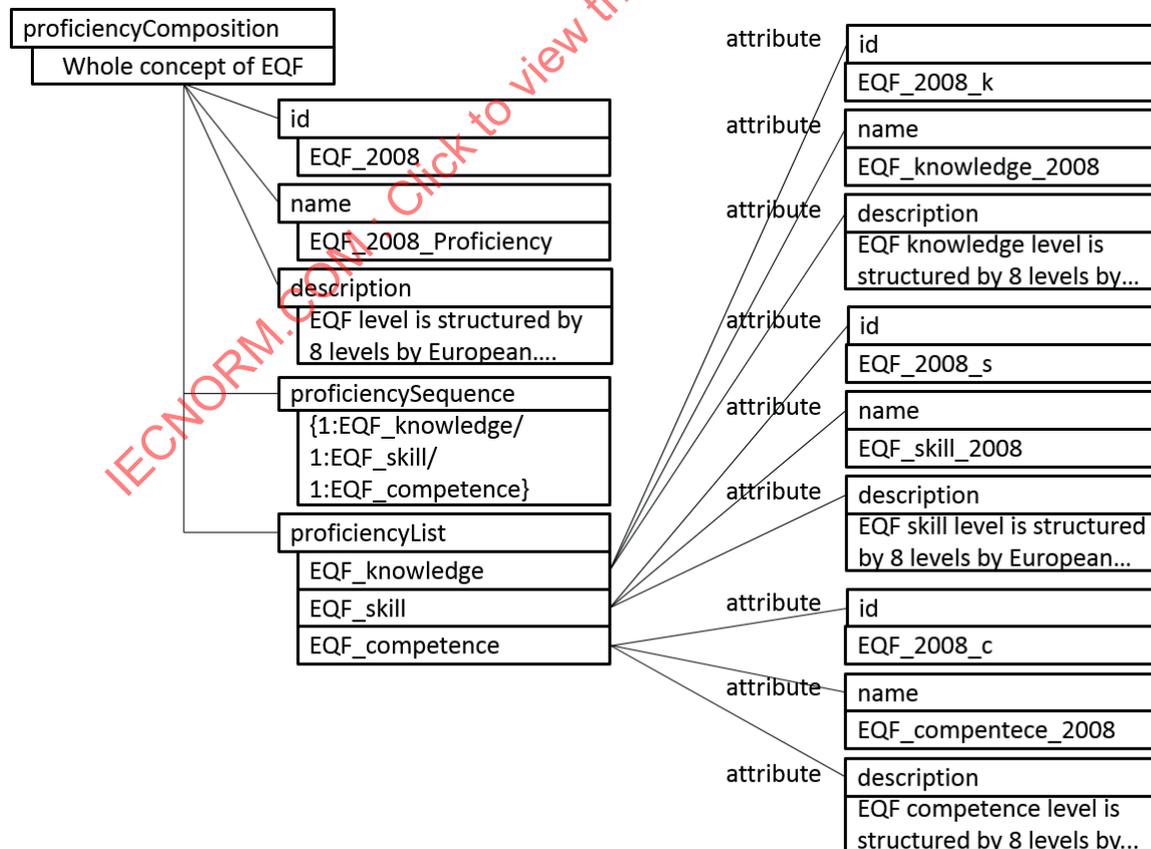

Figure A.1 — Application of proficiency composition model for EQF

A.3 Application of proficiency information model to EQF

Prior to applying the Proficiency Information model in ISO/IEC 20006-2 to the EQF, a content analysis of the EQF structure and levels was completed. Based on a document content analysis of the EQF level and descriptions was conducted for each level and the results are provided in Tables A.1, A.2, and A.3 below. Then the application of the proficiency information model provided in ISO/IEC 20006-2 is shown in Figure A.2. In this annex, an example of EQF knowledge proficiency level schema is shown below in Table A.1.

Table A.1 — Content analysis of EQF knowledge proficiency level schema

Factor	Specialty level	Advancement	Range of content type	Breadth of knowledge	Understanding
Level 1	General	Basic			
Level 2	A field		Basic factual		
Level 3	A field		Fact/Principle/Process/ General concept		
Level 4	A field		Factual/ Theoretical	Broad contexts	
Level 5	A field/ Specialized		Factual/ Theoretical/ Comprehensive	Boundaries	
Level 6	A field	Advanced	Theories/ Principle		Critical understanding
Level 7	A field/ Highly Specialized	Forefront		Interface between different fields	Original thinking and research
Level 8		Most advanced		Interface between different fields	

Table A.2 — Content analysis of EQF skill proficiency level schema

Factor	Problem type	How to solve	Skill width	Advancement	Skill type	Responsibility in task
Level 1				Basic		Carry out simple task
Level 2	Routine problems	Simple rules and tools		Basic	Cognitive/ Practical	Carry out tasks with info.
Level 3	Problems	Selecting and applying basic method/Tools/ Materials/ Information	A range		Cognitive/ Practical	Accomplish tasks
Level 4	Specific problems	General solutions	A range		Cognitive/ Practical	
Level 5	Creative solution	Develop	A comprehensive range			
Level 6	Complex/ Unpredictable problems in a specialized field			Advanced	Demonstrate mastery and innovation	

Table A.2 *(continued)*

Factor	Problem type	How to solve	Skill width	Advancement	Skill type	Responsibility in task
Level 7	Research/ Innovation	Develop new knowledge and procedure/ Integrated knowledge			Specialized problem solving	
Level 8	Critical problems in research and innovation	Extend and redefine existing knowledge or professional practice		Most advanced	Specialized/ Technique/ Synthesis and evaluation	

Table A.3 — Content analysis of EQF competence proficiency level schema

Factor	Action type	Independence/ responsibility	Management objects	Context	Flexibility
Level 1	Work	Under direct supervision		Structured	
Level 2	Work	Under supervision/ some autonomy			
Level 3	1) Work 2) Problem solving	1) For task completion			2) Adapt own behaviour to circumstance
Level 4	1) Work 2) Supervise	1) Exercise self mgt. with guidelines 2) Some of evaluation and improvement of activity	2) Routine work	Usually predictable	
Level 5	1) Manage and supervise 2) Review and develop		1) Work 2) Self and other performance	Unpredict-able	
Level 6	1) Manage and supervise 2) Develop professional		1) Professional activities or projects 2) Individuals and groups	Unpredict-able	
Level 7	1) Manage and transform 2) Contribute and review		Professional knowledge and practice/ Strategic team performance	Complex/ Unpredict-able	1) New strategic approaches
Level 8	1) Demonstrate 2) Communicate		1) Substantial authority, innovation, autonomy, and professional integrity 2) Develop new ideas or process	Forefront	