

Review of e-Skills Certification Schemes for ICT Professional Qualifications in Europe

Abstract: HARMONISE is a project of CEPIS reviewing e-Skills certification schemes for ICT professional qualifications in support of greater harmonisation across Europe and beyond. e-Skills certification plays a crucial role implementing and promoting high standards among ICT professionals/ practitioners and ICT end users. Substantial effort is currently being made by the e-Skills community and involved stakeholders to establish a common European Framework for e-Skills (or more specific ICT Skills) and competences in Europe. ICT skills/competence frameworks are an important prerequisite for ICT competence development and related quality assurance for recognition and transferability of qualifications. In this paper we present our survey approach, applied methodology and yielded results from our ongoing investigations.

1. Introduction

The competitiveness of European industry is dependent on both the effective use of ICT for industrial and business processes and the knowledge, skills and competences (KSC) of existing and new employees [1]. For ICT¹ practitioners it is important that they can seek employment wherever they want within the European Union and beyond. With no formal barriers to mobility between the European Member States and a growing use of English within the ICT workplace, increasing the integration of national labour markets for ICT Professionals for the benefit of the competitiveness of European enterprises must now focus on improving employers' (and customers', where ICT contractors seek work) appreciation of applicants' KSC for the job through better understanding of the ICT practitioner qualifications (or "certifications") of relevance that a potential candidate brings [12]. Today nearly every area of economic activity is affected by ICT and the pace of technological change and short technology life cycles makes these the most dynamic of occupations [14, p.47]. The strategic importance of ICT occupations in the European economy and the highly global character of the ICT sector have resulted in substantial efforts to develop a comprehensive framework of ICT skills/competences [14, p.47]. At present, Europe's citizens who want to improve their "e-Skills" face a wide range of competing qualification and certification schemes, both vendor and non-vendor specific, public and private-commercial ones. In addition, in what has been a rather turbulent labour market, few employers appear to attribute much weight to applicants' qualifications, focusing their requirements more on direct experience in particular software environments [12]. In order to improve the widespread recognition and "transparency" of ICT practitioner qualifications, support is needed to put in place an acceptable framework for clarifying the meaning and value of individual qualifications from Member States, and, ideally, European-wide certification schemes. It is also important that certification arrangements bridge formal, non-formal and informal learning by enabling new ways of certification, accreditation and assessment. In this paper we present the current status of our activity scrutinising of ICT practitioner profiles under consideration of state-of-the-art classification systems. In order to achieve transparency and comparability of ICT worker profiles the smallest building block or unit of qualifications has to be defined [17, 18, and 19].

¹ Information and Communication Technologies

2. Methodology

HARMONISE [12] is reviewing existing qualification and certification schemes in the context of learning provision that leads to certification, as well as clarifying the underlying profiles, terminology and curricula. The project's aims involve clarifying existing arrangements to support greater transparency, and influencing the harmonisation of vocational learning and qualification schemes for ICT professionals at the European Union level. Having assembled a comprehensive knowledge base in this area that can help stakeholders, employers and individuals better understand what is available, HARMONISE will prepare options for achieving greater transparency within the EU and will elaborate ways of clarifying the feasibility of a widely acceptable European approach to qualification and certification for ICT professionals which can draw and build on the successful experience of the ECDL². The results of HARMONISE will be valorised by EUCIP³ a new pan-European qualification scheme for people entering the IT profession and for IT professionals wishing to continue their professional development. The qualification will enable existing IT professionals to document their competencies and skill sets for employers or prospective employers and in addition, increase their market value [3].

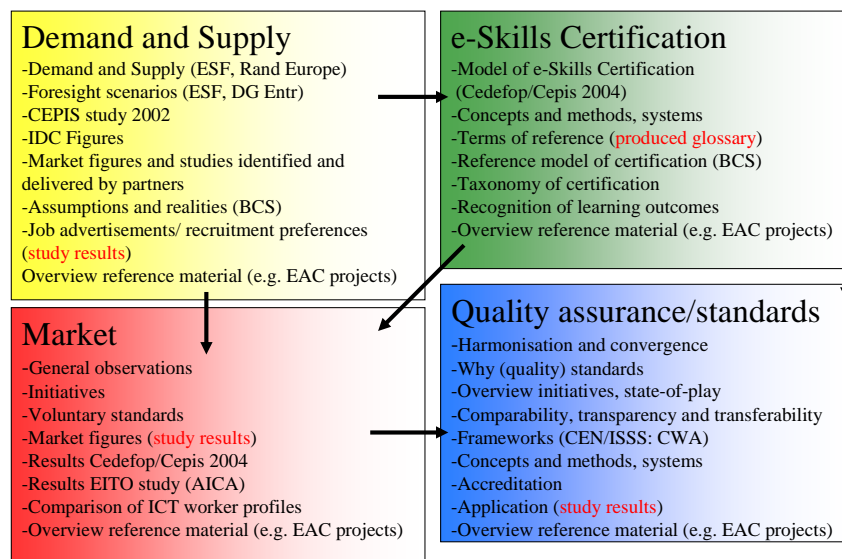


Figure 1: Overview Outputs of HARMONISE Reference Material and Survey Results

Figure 1 shows the four identified focal points addressed by the project: demand and supply, certification market, e-Skills Certification (eSCert) and quality assurance and related standards. The first topic to be looked into is the situation on the market by scrutinising the demand and supply of ICT practitioner on the market. Additionally, the study framework foresees to investigate the market of certification and related offerings. Next issue to be looked into are thus the identifiable elements and underlying concepts of eSCert systems. This covers analysing respective models, concepts, methods and systems available on the market. Furthermore, the study work highlights the respective history and made assumptions of treated systems. In this way the study aims to achieve a comprehensive overview and understanding of the current situation of the eSCert markets in Europe and beyond. Finally, the approach addresses quality assurance and related procedures. Identifiable standards for the certification of persons are referenced. Based on the yielded results concrete recommendations are derived how to achieve better transparency and comparability of eSCert systems in Europe and beyond.

² European Computer Driving Licence: <http://www.ecdl.com>.

³ European Certification of Informatics Professionals: <http://www.eucip.com>.

3. e-Skills Certification

In this section the system and related concepts of eSCert will be explained, as well the market in Europe for eSCert will be considered curtly.

3.1 System

The nature of certification systems is described by explaining its constituent parts. Certification is the end point of a training process and is in turn part of a system providing credentials to individuals. Certification in the strict sense is the acknowledgement of conformity with a norm or standard. The gaps in the recognition of professional, academic and vocational qualifications of individuals from different countries and regions are a particular obstacle to people working in Europe [1]. Certifications play an important role in today's ICT industry and represent emerging new paradigms and requirements concerning the demand for increased flexibility in the acquisition of skills by ICT workers. Industry certifications are perceived as a credential, a result of an objective assessment procedure run by third party, that an individual met the performance specifications delineated in job profiles recognised by industry stakeholders [19]. Figure 2 depicts the core modules and constituent parts of qualification and training systems. The arrows symbolise more or less strong dependencies and influences between these modules [19], which have to be considered when analysing eSCert programmes. The complexity caused by dependencies and distribution and by assignment of duties and responsibilities to various stakeholders is illustrated. In reality, the elements shown are combined to a variety of qualification and training facilities depending on legal and national aspects e.g. regulations, industry requirements, market etc. The model is framed by work experience and education. The dynamics of markets prepare the ground for eSCert and e-Skills as a moving target. An illustrative example provides the actual debate and increasing demand and quest for ICT security, network and advanced technology professionals [19, and 3].

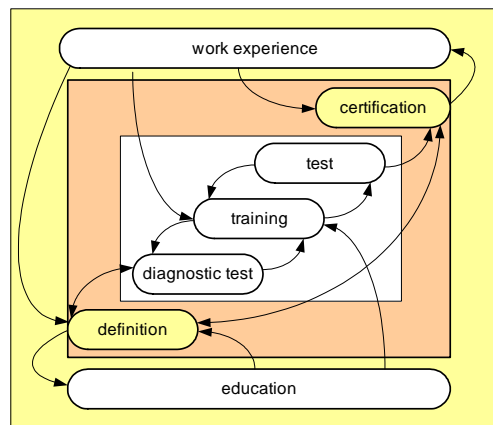


Figure 2: Learning and certification: acquiring of relevant qualification

3.2 Market in Europe

CEPIS studied on behalf of Cedefop in 2004 the situation of eSCert in Europe. The study queried 40 high level experts in the e-Skills community. In addition, the future role of eSCert systems as accreditation systems and formal recognition of individuals' training and learning outcomes (LOC) were investigated. The first issue to be looked into was the perception of the current situation of eSCert in Europe by respondents. Most interesting was that 80% of returned questionnaires agreed that Europe is facing a multitude of available eSCert schemes. The majority of respondents of 73% felt that fewer, but more relevant eSCert schemes would be required, and 80% of returned questionnaires indicated that

Europe is confronted with a too high number of eSCert systems and related schemes. Due to the perception by the respondents of a multitude of existing eSCert systems and the agreement that fewer systems are needed, the question remained which type of eSCert systems play an important role to achieve transparency and comparability of eSCert systems in Europe [19, 3, and 6].

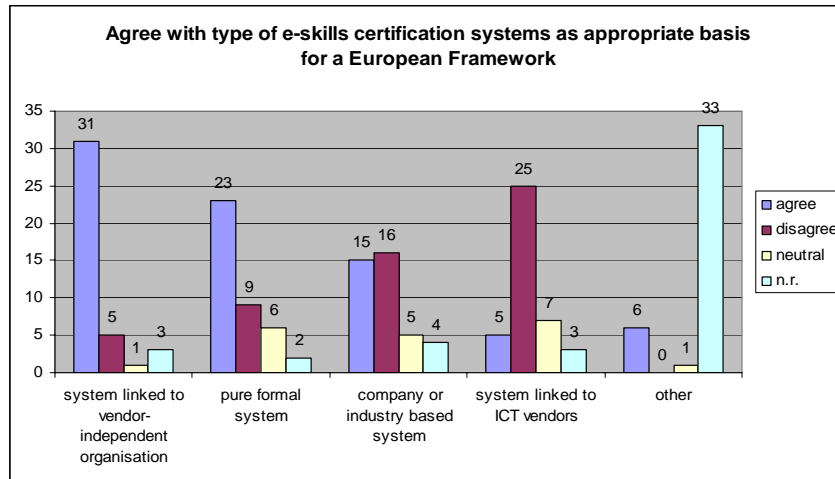


Figure 3: Type of e-Skills Certification systems as basis for a European Framework [19], [6]

The following and other statements can be observed in Figure 3: A system linked to a vendor-independent organisation is strongly supported by the respondents (31). A pure formal system is supported by 23 respondents and 15 respondents showed their agreement with company- or industry-based systems. There is a significant opposition against company- or industry-based systems (16) and systems linked to ICT vendors (25). However, at the same time the majority of the answers received, 73%, support the general perception that transparency, portability and compatibility of eSCerts in Europe and beyond can only be achieved by co-operation of stakeholders on the basis of public-private partnerships. The majority of respondents say that the current market place is characterised by a focus on vendor-specific (industry) certifications. Based on the answers received, it is recommended that vendor-independent approaches should get much higher importance. These may form the most appropriate basis for a *European e-Skills Quality and Standards Framework*. For this purpose a vendor-independent voluntary European level organisation or body is strongly supported by the respondents. Such a body ought to be open to all kinds of modes and schemes, whether public or private, commercial or industry specific under the condition that minimum quality standards are set, agreed and continuously maintained. In general the respondents agreed to the establishment of a central co-ordination organisation of eSCert in Europe. Accreditation includes the inspection of the organisation of the eSCert body concerning their fulfilment of predefined requirements and conformity with quality directives or mission statements. Therefore, appropriate quality management procedures within eSCerts address three main activity areas (see Figure 4) which go beyond the organisational structures and boundaries of the certification body: 1) examination and testing, 2) training provision, and 3) definition of requirements.

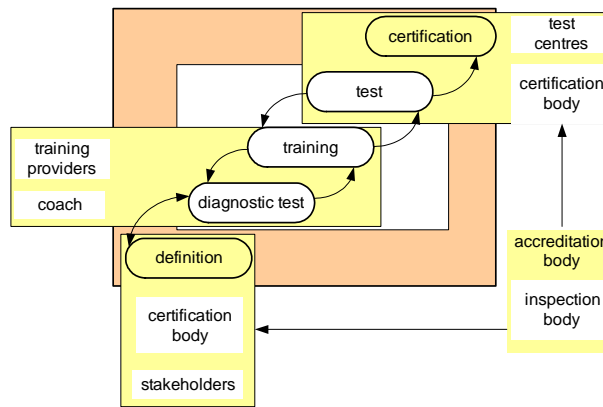


Figure 4: Achieving mutual recognition of e-Skills Certification Systems [6]

Primarily, the certification system is the subject of inspection. Thus, inspection bodies assess the conformity of the modules, certification and test. The certification process relies on the proper definition of specific job or occupational requirements that the candidate has to fulfil [6]. The following most influential and most relevant identified initiatives are aiming to resolve the situation and are the European e-Skills Forum [1], CEN/ISSS Workshop ICT Skills [17], eCCO project in Italy [13] addressing one or more of the above outlined specific problem areas. Of course there are other important initiatives to be mentioned driven by organisations as eSCC⁴, EICTA⁵, CompTIA, Cisco, e-Skills UK, SFIA etc.⁶ Today the market of eSCert is evidently dominated by ICT vendor certifications, foremost by Microsoft⁷ and Cisco⁸ certification programmes and related certification schemes. In the following the paper depends in particular the developments towards a *European reference framework* for ICT job profiles and qualifications. This was mentioned in the survey being of significant importance and high priority for establishing (quality) standards for eSCert in Europe.

4. Developments

Skills/competence frameworks specify the demand side of the ICT practitioner labour market, while qualification specifications relate to the supply side of the market [17]. The term competence framework in preference to skills framework should be used being a more comprehensive and holistic concept. The relationship between skills/competence frameworks for ICT practitioners and qualifications frameworks is examined in some detail in [17]. Existing frameworks are linked to concrete application contexts from which they can hardly be separated. In this context reference and meta level are two fundamental views differentiated by syntactic and semantic abstraction level, respectively. Meta and reference models offer a common language to be used for the formal description, analysis and comparison of ICT worker profiles. In the following basic concepts and elements of respective models are introduced. LOC are perceived as building blocks of skills or qualification frameworks [10, 9, and 14]. LOC should be described in a common language in form of profiles. The proposed EQF⁹ consists of a set of 8 level descriptors, specifying LOC in terms of KSC and thus enables direct comparison of qualifications thus described with occupational competence profiles. Generic ICT worker profiles¹⁰ of KSC ought to be

⁴ eSkills Certification Consortium: <http://www.e-scc.org/>.

⁵ European Information & Communications Technology Industry Association: <http://www.eicta.org/>.

⁶ For further information please visit: <http://eskills.cedefop.eu.int>.

⁷ <http://www.microsoft.com/learning/>.

⁸ <http://www.cisco.com/web/learning/>.

⁹ European Qualifications Framework [10].

¹⁰ See <http://www.career-space.com> and look up skills profiles to see a range of examples.

related clearly to reference levels since they are often used to define training, structure qualifications and allocate individual job profiles applicable in the respective industry or labour market segment [8, p.51] (see as well [14, p.48]). The profiling process encompasses the selection of values in form of a matrix P. But the term LOC already refers to a specific application context, namely training and education. As this abstraction might be not sufficient for reference modelling, the term qualification component (QC) is more adequate and is introduced as smallest unit to describe general descriptions of ICT worker sector profiles (P). The development of a common *European e-Skills Framework* (EF) has to consider three constituent parts (according the Meta-Model Framework approach by ISO standardisation activity [16]): 1) ontology, 2) syntax and 3) constructs.¹¹ In our approach, a profile constitutes on three sub-systems to be defined and specified by a respective modeller/developer: 1) the general description of QC (e.g. constructs described as LOC by KSC), 2) the specific description of the working area (WA), job role, function, business process etc., 3) the performance level required. These three elements combined define the qualification unit (QU) as smallest describable and measurable unit within a qualification or profile P. These results are summarised in the definition of ICT worker sector profile P. An ICT worker profile is defined as the selection of the tuple (WA, QC, L) and can be described as matrix P with the job role q as follows (notation is shown in Table 1):

$$P_q = L_q = \left(l_{qij} \right)_{j=1 \dots n}^{i=1 \dots m} = \left(wa_i, qc_j \right)_{j=1 \dots n}^{i=1 \dots m} \quad (1)$$

According to the definition above, P is now to be interpreted as follows. In the sector profile P the following performance is required: for the working area WA and the qualification component QC, at performance level L. The constructs of an EF are now defined (see Figure 5). As already mentioned, based on the respective purpose of the profile a higher granularity of applied concepts as foremost of WA may be required. Our approach corresponds to the central concepts or terms suggested by [15, p.11].

Table 1: Overview of Applied Notation

element/ concept	Notation
P	set of profiles; $P = \{q_1, \dots, q_m\}$
L	set of levels (vertical)
QC	qualification component as general description of the smallest unit of a qualification to be described. QC may be expressed as set of learning outcomes (LOC) on basis of KSC in relation to the intended application context (QC = LOC). (e.g. general EQF descriptions)
WA	set of working areas (horizontal level e.g. ‘sales and marketing’, ‘management and administration’. This is applied synonymously with the terms ‘field of work’, ‘function’, ‘business process’ etc.). $WA = \{wa_1, \dots, wa_m\}$. If higher granularity is required, WA may be subdivided in further sub-categories.
Q	job role e.g. software developer, IS analyst etc.
i, j	Indices to define KSC category based on typology (WA, QC)
m, n	Indices for existing numbers of categories for WA, QC

QU are the smallest unit to be measured and assessed in a certification process. It is thus subject of quality assurance (e.g. certification and accreditation) and related quality measures. Awarded qualifications may refer to different systems but can now be compared and analysed on basis of QU. As well will the comparison and discussion of QU lead to convergence of existing approaches, but foremost maintain mutual trust.

¹¹ The term “construct” is defined as a more generic terminology for “modeling element”. Some time modeling construct includes metadata, code, object patterns rather than notations of a particular modeling facility such as UML [16].

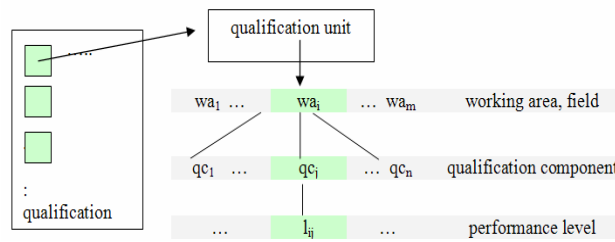


Figure 5: Qualification Unit of EM-F

The second constituent part of an EF is a *Conceptual Model* in form of ontology. Ontologies are conceptual models which allow reasoning based on the precise underlying mathematical structure. Therefore, we use an ontology structure as a tuple (C, R, H^C, A) to describe the relationships R between concepts C and create a concept hierarchy H^C (taxonomy) as well as to provide additional background information by means of axioms A . Figure 6 illustrates the interrelation of introduced constructs and existing relationships. For a more comprehensive introduction regarding ontologies see AIFB (Studer et al., Erdmann, Decker, Maedche, Volz).¹² Based on the given definition of constructs, P has specific and generic descriptions which refer to WA . P exists of QC and L , the latter being an integral part. As mentioned before, WA refers to a specific context and may be further sub-divided into sub- WA if greater granularity is required by the addressed application context. KAON represents ontologies in RDF(S)¹³ but allows export of the data in OWL¹⁴ syntax.¹⁵

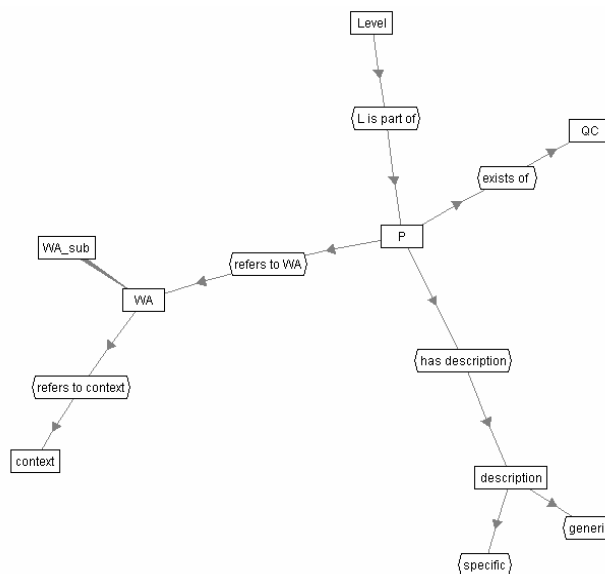


Figure 6: Identified Concepts and Properties of ICT Worker Sector Profile in OI-Modeller¹⁶

5. Conclusions and Outlook

In this paper we presented the HARMONISE survey framework and provided insights in the applied methodologies. eSCert systems and existing interdependencies and

¹² See <http://kaon.semanticweb.org/> and AIFB, <http://www.aifb.uni-karlsruhe.de/>; research group Prof. Studer.

¹³ See W3C RDF Specification; <http://www.w3.org/RDF>

¹⁴ See W3C OWL Specification; <http://www.w3.org/TR/owl-features/>

¹⁵ See KAON developer's page; <http://kaon.semanticweb.org/>

¹⁶ KAON was developed by AIFB (University of Karlsruhe) and FZI (Research Center of Information Technology) in Karlsruhe, Germany, and provides an open source infrastructure for the development and management ontologies.

interrelations of basic elements were described. We overviewed the eSCert market in Europe and presented results from a recent CEPIS study undertaken for Cedefop¹⁷. The paper accentuated the formal description of the smallest unit as building block of qualifications and for analysing ICT worker profiles. Qualification units are the smallest element to be scrutinised in respective competence assessments and in the certification process. In the next phase of the CEN/ISSS Workshop ICT Skills the work will start on the development of a *European e-Skills Reference Framework*. The paper developed and discussed already important aspects to be considered in the development process. For the future we envisage to further elaborate the presented work and related analysis approach. Priority will be given to the application and validation of the methodology by analysing certification schemes and respective ICT worker profiles in order to analyse and compare their underlying structure with the aim to identify similarities. Another objective will be to liaise with leading initiatives in Europe and beyond.

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