UPGRADE is the European Journal for the Informatics Professional, published bimonthly at <http://www.upgrade-cepis.org/>

Publisher
UPGRADE is published on behalf of CEPIS (Council of European Professional Informatics Societies, <http://www.cepis.org/>) by Novática <http://www.ati.es/novatica/>, journal of the Spanish CEPIS society ATI (*Asociación de Técnicos de Informática*, <http://www.ati.es/>)

UPGRADE monographs are also published in Spanish (full version printed; summary, abstracts and some articles online) by Novática

UPGRADE was created in October 2000 by CEPIS and was first published by Novática and INFORMATIK/INFORMATIQUE, bimonthly journal of SVI/FSI (Swiss Federation of Professional Informatics Societies, <http://www.svifsi.ch/>)

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UPGRADE Newslist available at
<http://www.upgrade-cepis.org/pages/editinfo.html#newslist>

ISSN 1684-5285

Monograph of next issue (August 2007)
"Ambient Intelligence"

(The full schedule of **UP**GRADE is available at our website)

CEPIS UPGRADE
The European Journal for the Informatics Professional
http://www.upgrade-cepis.org

Vol. VIII, issue No. 3, June 2007

Monograph: ICT Certifications for Informatics Professionals (published jointly with Novática*)

Guest Editors: *Luis Fernández-Sanz, María-José García-García, and Peter Weiß*

UPENET (UPGRADE European NETwork)

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* This monograph will be also published in Spanish (full version printed; summary, abstracts, and some articles online) by **Novática**, journal of the Spanish CEPIS society ATI (*Asociación de Técnicos de Informática*) at <http://www.ati.es/novatica/>.

Survey of ICT Certification Systems for ICT Professionals in Europe

Roman Povalej and Peter Weiß

In the following, investigations concentrate around the following issues. Firstly, what ICT certifications definitely are (and what they are not) is looked at, what they actually offer and what is their obvious "value" offered. Secondly, a top ten list including some examples of the most prominent industry-based ICT certifications are presented. Then, the relationship of ICT certifications and formal education, on the basis of the concept of performance components, is discussed. Some significant and supportive results of an empirical survey are presented. Finally, an outlook on future activities is made.

Keywords: ICT Certification, ICT Professionalism, Professional Learning, Qualification.

1 Introduction

Information and Communication Technology (ICT) certifications meanwhile have become an integral part of the education and training landscape in Europe and beyond. Most prominent ICT certifications for ICT professionals are offered through industry-based or product-oriented credentialing systems of leading ICT vendors, such as Microsoft, Cisco, IBM, etc. However, a variety of alternative products and offerings exist in today's market. Some prestigious ones are offered through vendor-neutral or vendor-independent professional associations, for example [1] [2] [3] [4]. As a result, learners are confronted with a variety of existing offerings and products; but which makes it difficult to oversee and to capture what is actually available on the market.

In the area of ICT, the biggest contingent of candidates to become ICT professionals has been hitherto produced by the traditional, formal higher education system. Formal higher education systems are traditionally governed or accredited by national authorities. Today, the reach of those systems is however limited to their respective national borders that seem actually difficult to overcome, though strong endeavours currently are being made in Europe [5] [6] [7] [8].

National qualification frameworks (NQF) are constituent elements of national systems. They strive for enhanced flexibility and the transferability of qualifications, providing coherent structures for the development, description and systematization of relationships of qualifications ideally through a single set of descriptors and levels [9]. In this way, a NQF classifies and arranges all of a country's hitherto formally recognized qualifications according to defined coherent criteria. In this connection, qualifications are conceived as sets of certified or documented skills independent from their respective learning paths [9]. Basically, all qualifications can be arranged in units or unit standards for which a certain amount of learning time can be assigned to grant corresponding credits [9].

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This already establishes the connection to the actual diverse discussions about appropriate sets or bundles of ICT skills described by learning outcomes as building blocks or basic units of qualifications. Identified (sub-)qualifications and skill sets can then be aligned with qualification levels by means of common descriptors [9]. An overview of systems, as well as an analysis and more profound discussions of the relation of competence and qualification frameworks, can be found in [10].

It is in this light that a new globally operating system has evolved since the 1990s and has meanwhile supported offering alternative ways to acquire competences for non-formal qualifications for the ICT profession [11]. In contrast to the above described traditional channels, those new

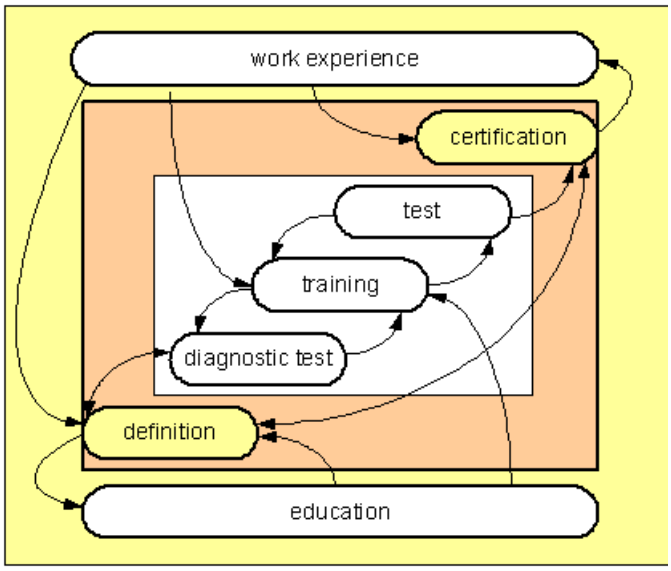

Figure 1: ICT Skills Certification System [14].

industry-based systems have created their own "qualifications world" that is independent from any national authority or influence ("parallel universe") [11]. The systems claim primarily to serve the actual demand for highly-skilled ICT professionals in industry. In this way, a globally acting, well-moneyed ICT training and certification industry [11] has evolved that today is serving a noticeable market. Most significant differences to be pointed out with regard to above described traditional systems are wide-spanning networks of fast reacting, flexible nodes for training delivery and certifications based on global skill standards (as offered e.g. through Tech Career Compass of CompTIA [12]).

The ICT training and certification branch ([11] uses the expression "guild") today provides a well established and organised infrastructure that facilitates learning and the recognition of achievements regardless of their means (whether it has been obtained through formal, non-formal or informal learning settings). Therefore, industry-based certifications show significant potential to be part of a larger transition process towards aspired individualised learning paths and "opportunities-to-learn". These learning paths or opportunities are preferably linked to an overarching common qualifications structure or framework, broadly recognised by employers and ICT professionals in Europe or beyond [11].

Hughes [13] argues that a common framework of IT competences to describe qualifications structure is a prerequisite of a professional environment. He further favours an output-based approach to competence that he defines as "the ability to perform a set of activities in the workplace to the standards required in employment" [13]. The author highlights the need to define a "core body of knowledge" that all ICT professionals must have to ensure that they are able to work effectively with other colleagues. Moreover, he argues that an open structure is required which offers a variety of entry points into the IT profession and intermediate or sub-qualifications to support all the career stages of ICT professionals.

Before diving into the results of the survey, the reader needs to be acquainted with some basics and general background about systems delivering ICT certifications. Hence, the next section introduces the basics of ICT certification.

2 Basics: ICT Certification (System)

Numerous definitions are available explaining what ICT certification is and what it is not [4] [10] [11] [14] [15]. For a better understanding two definitions perceived as appropriate are presented here:

(1): "Certification is the process of formally validating knowledge, know-how and/or skills and competences acquired by an individual, following a standard assessment procedure. Certificates or diplomas are issued by accredited awarding bodies." [16]

(2): "Certification often means the awarding of a certificate, or other testimonial, that formally recognizes and records success in the assessment of knowledge, skills and/or competences, as the final step in the completion of a qualification. However, it is also used, in particular in relation to ICT practitioner occupations, to mean the qualification as a whole. It is important to be aware of these two ("narrow" and "broad") meanings of certification." [10]

Weiß et al. [14] have analysed the system of ICT certification and have broken it down into its constituent elements. The authors underline the interdependencies and links that exist between the distinct components. The authors argue that it is difficult to discuss identified elements separately. Figure 1 depicts the core modules and constituent parts of ICT learning and qualification systems. The arrows symbolise more or less strong interdependencies and influences between the component parts [14], which have to be considered when analysing ICT skills certification programmes. The figure illustrates the complexity arising from depend-

Signals of Performance	Role-specific task proficiency		Non role-specific task proficiency		Written and oral communication		Demonstrating effort		Main training personal discipline		Facilitating peer and team performance		Supervision		Management and administration	
	DK	PK	DK	PK	DK	PK	DK	PK	DK	PK	DK	PK	DK	PK	DK	PK
relevant work experience																
relevant educational degree																
vendor-specific certifications																
vendor-neutral certifications																

Note: DK = Declarative Knowledge; PK = Procedural Knowledge

Figure 2: Performance Components as a Function of Signals of Performance [15, pp. 97].

encies and by the distribution and assignment of duties and responsibilities to various actors in the value chain.

Given the fact that the ICT certification and training branch operates globally implies its autonomy with regard to national frameworks, authorities and influence [11, pp.29]. ICT certification systems can be perceived as "open" systems that offer various points of entry depending on underlying structure (in form of certification paths or ladders) [17]. Generally speaking, the system puts in particular an emphasis on acknowledging "the ability to perform a set of activities in the workplace to the standards required in employment" according to [13].

In this way, ICT certification attests the individual's mastery of a specific job role in ICT through validating the conformity with "performance standards" in industry. Performance standard is a central concept of certification and is therefore a likely adequate way of clarifying what is actually delivered by ICT certifications and what is definitely not.

From the individuals' perspective it is nearly impossible to oversee the actual market and to choose the "right" product from the numerous offerings, fitting the best one to their needs. Accordingly, Ed Tittel argues that it is difficult to distinguish "[…] good ones from mediocre or bad ones, winners from losers and up-and-comers from programmes in their declining phase" [18]. Assessing data on curriculum, enrolments and other traditional measures turns out to be a difficult task because relevant data and information are kept rather generally and are often rather hidden within some sub-level of the provider's web site. One may have to consult relevant communities on the Internet to share one's knowledge and best practices with other fellow sufferers who try to reach the value and career prospects offered through various certification offerings. Obviously, candidates are in need of clear guidance to find their best way through the "certification jungle".

For this purpose it would be desirable to produce a map for orientation, signalling proven career paths. In turn, this would necessitate a concerted analysis of today's certification landscape. In any case, individuals seem to endure ploughing through the overwhelming amount of data and information delivered through salary surveys and rankings. Ed Tittel recommends looking at job advertisements and vacancies to determine what is actually demanded by employers [18, 19]. Main providers on the current ICT certification market can be grouped into the following six main categories:

1) ICT vendors (industry or product-related certifications).
2) Vendor-neutral organisations.
3) Vendor-independent organisations.
4) Vendor collaborative associations.
5) Professional associations.
6) Governmental agencies.

3 Basics: Performance Standards

As already argued, looking at respective performance components seem a likely way to explore what ICT certifications are, what they are able to deliver and what definitely not.

According to Campbell (1990) eight major performance components can be distinguished [15, pp.97]. The first column in Figure 2 accordingly shows four major performance signals. As shown, the eight components are again subdivided into two categories: declarative and procedural knowledge. Motivation is not shown, though a major deter-

Criterion	Description	e.g. CompTIA	e.g. Cisco	e.g. Microsoft
type of product	operating field of the certificate supplier	enterprise software	network supplier	software
technology	technology, which is taught in the training course; hardware, middleware and software areas	software, hardware	hardware	software
target group	beginners, advanced and Professionals, specialists	certifications are not classified a priori	associates, professionals, experts, specialists	master, expert, specialist; architect, professional, specialist
requirements/ entry level	precondition of the programme e.g. experience, core and elective certificates	not formal, A+ certificate is advised, work experience is advised	depends on level: training is (strongly) advised; sometimes work experiences and/or other certifications are required	depends on level: training is advised; some examinations and/or working experiences are required
structure	structure of certification ladder or path, e.g. modular and/or linear, sequential	tendency linear rather than modular	linear as well as modular	mixture, depends on certification
learning support/ preparation	offered ways to prepare for examinations, e.g. classroom, eLearning systems like virtual classroom or online tests or online courses, special literature and learning materials, etc.	selected learning institutes, self study materials	Cisco certified learning partners, self study materials	MS training family, self study materials
certification process	Organization, activities, responsibilities, processes, etc.	provider of examination: Pearson VUE and Prometric, detailed information about examination	official certification centre, detailed information about certification process	official, external certification center (Prometric, Pearson VUE): multiple choice, drag and drop, filling gaps, simulations, testlets, simlets examinations
job title	title, name of credential, qualification	not applicable	associates, professionals, experts, specialists	[certification title] + [area]
documentation and background information	resources and information: documentation (information packages, homepage, content, etc.), guidance (study guides, study and training material, etc.), transparency (certification ladders and paths, best practices, etc.)	well described	well described	well described, but mixture of naming certifications is not best
market volume	demand for a certification, success, number of enrolments, visibility, appeal, etc.	900,000 certificates since 1993, 500,000 A+ certificates until 2004, etc.	more than 700,000 certifications until October 2005	until now (Dec. 2006) MS certified professionals: 1,800,000

Figure 3: Taxonomy to Categorise ICT Certification Systems.

minant of performance [15, pp.97]. Figure 2 points out that neither the formal nor the non-formal education and training systems are able to deliver all required components. Scope and reach of ICT certifications are clearly oriented towards role-specific task proficiency.

Agreed performance standards necessitate an architecture that identifies three types of knowledge, skills and competences: (1) academic knowledge and skills, (2) employability knowledge and skills, and (3) specific occupational and technical knowledge and skills needed for work [15, pp. 103]. Hence, there seem to be an obvious need to develop a common language to exchange information between formal and non-formal systems, e.g. for describing critical work functions, etc. Consequently, strong efforts are currently being made to work towards such a common language and framework, to specify in a coherent way skill requirements relevant for job roles and/or occupations in ICT (see CEN/ISSS WS ICT Skills in its current phase 3) [20].

In the case of task proficiency being mapped as a function of knowledge and skills, it is evident that product-specific (vendor-specific certifications) and foundational technical knowledge and skills (delivered through both vendor-specific and vendor-neutral certifications) play a pivotal role [15, pp.100].

Moreover, using performance signals enables a more

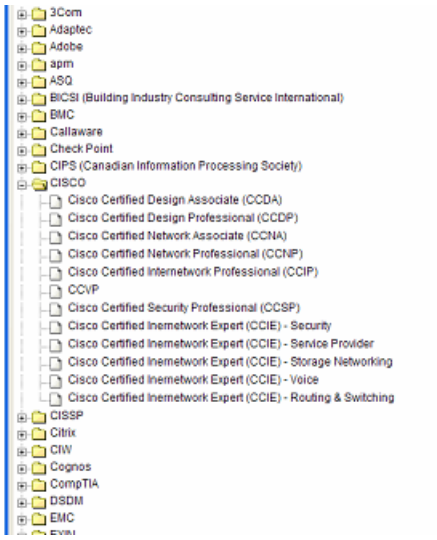

Figure 4: Extract from List of Certifications [22].

realistic understanding of different subsets of declarative and procedural knowledge and skills that likely need to be combined to a learning blend, in order to cover all areas required for role-specific task proficiency in a performance domain [15, pp.100].

Stucky [21] complains that industry-based certification systems do not adequately address all required components that are needed for ICT proficiency, namely declarative knowledge, experience, and tool "know how". Actual offerings often focus on solely application oriented training of "know how" and forget the "know what" and "know why". However, ICT proficiency requires that candidates are also adequately trained with regard to declarative knowledge and understanding of underlying theoretical concepts. Otherwise, knowledge, skills and competence once acquired get quickly obsolete due to the shortening technology life cycles of products. "Short term thinking" should not therefore be predominant in industry. Furthermore, ICT certification systems are able to offer the above mentioned desired multiple entry points [13] and in this way are able to attract new talent to the ICT profession.

From the evidence, industry certifications are comparatively "low on the list of things employers are looking for" when recruiting ICT professionals. The implication is that the challenge, for those seeking to increase the value, is to find ways in which employer behaviour can be changed in this respect [19]. A solution is offered by a performance-based framework that moves away from a focus on job titles [15, pp.102] to performance components and signals, as explained above.

The next section explains applied survey methodology before the certification market is looked at.

4 Survey Methodolog: Towards a Taxonomy

The survey methodology follows two major strands. First, desk research collected the names of certification systems and schemes available in the current market. Second, high-level experts have been asked for widely applied systems in their countries. The list of ICT certifications was the starting point of a general in-depth analysis. Appropriate qualitative criteria have been developed that allow describing and categorising each item. The following taxonomy results from this analysis. It builds on ten criteria as an underlying basis for an in-depth analysis of the aforementioned list of certifications. Respective criteria are explained in Figure 3. CompTIA, Cisco and Microsoft are given as example results from this exercise.

5 ICT Certification Market

Adelman [11] mentions that both corporate vendors and industry/professional associations have created over 300 discrete certifications since the first such credential (Certified Novell Engineer, or CNE) was issued in 1989. Recent figures estimate that there are more than 850 certifications and more than 200 certification programmes to be counted in today's IT certification landscape [18]. Evidently, it is hard to argue the eminent relevance of ICT certifications through concrete numbers showing how many ICT certifications have been issued, due to the absence of a central data repository.

Adelman [11] reports that "[…] the data one can extract from various press releases, examination preparation books and Web sites do not yield unduplicated headcounts. Most (though not all) vendors and industry associations, however, are pleased to provide the information when asked directly."

Figure 5 substantiates the actual difficulty to oversee today's ICT certification market and [18] proposes criteria to produce this top ten list of ICT certifications on the market (some of the criteria match with the dimensions of the taxonomy introduced previously in Figure 3).

The list demonstrates the actual difficulty of individuals to choose the right product from the variety of offerings. The author himself points out that the analysis has been carried out on basis of author's knowledge, experience and observations. Although the shown ranking and labelling could be controversially discussed, it points out the need to choose relevant criteria to judge the right certifications for ones needs. Besides those criteria, job advertisements and number of enrolments are likely additional sources to judge the quality and offered value of a certification. For [11] the value of ICT certifications lies in (a) guaranteed currency of knowledge, (b) intellectual and skills leadership of certified employees, (c) less down-time and greater efficiency, particularly in a rapidly-changing technological environment, and where applicable (d) staff interactions with other parts of the industry through the guild, hence, greater organizational knowledge.

Other factors which may influence decision making are general appeal of a programme, its popularity, employment potential and, last but not least, the return on investment measured through expected increase of an individual's salary. As a matter of fact, the hoped for broader recognition of industry-based ICT certification seems to be hampered pre-

	Criterion						
	Best Hands-On Programs	**Best Supporting Materials**	**Best Specialty Certifications**	**Toughest Re-certification Requirements**	**Best Vendor-Neutral Credentials**	**Most Technically Advanced Programs**	**Best New Programs or Certifications**
1	Certified Professional Information Technology Consultant (CPITC)	(ISC)2 CISSP	Brocade Certified SAN Designer (BCSD)	Cisco Certifications	BICSI	(ISC)2 Certified Information Systems Security Professional (CISSP)	(ISC)2 Associate Program
2	Cisco Career Certifications (Associate, Professional and Specialist)	Adobe	Cisco Specialist Certifications	CISSP	Brainbench	ASIS International	Apple Certified Technician for Pro Products
3	Cisco Certified Internet-work Expert (CCIE)	Apple Computer	CISSP Concentrations	GIAC Security Certifications	The Computing Technology Industry Association (CompTIA)	CCIE, Cisco	Certified Wireless Analysis Professional (CWAP)
4	Novell Certified Linux Engineer (CLE)	Certified Wireless Network Professional (CWNP)	HP Accredited Systems Engineer (ASE) and Master ASE	NARTE Certifications	Help Desk Institute (HDI)	HP Master Accredited Systems Engineer (Master ASE)	CompTIA RFID+
5	Novell Certified Linux Professional (CLP)	Cisco	IBM DB2 Universal Database Certifications	Novell CLE	Information Systems Auditand Control Association (ISACA)	Master Certified Novell Engineer (Master CNE)	Dell Certified Storage Networking Professional (DCSNP) and Dell Certified Systems Expert
6	Oracle Database 10g Administrator Certified Master (OCM)	CompTIA	ISACA's CISA	RedHat Certifications (RHCE, RHCT)	Linux Professional Institute (LPI)	NACSE	EC-Council Certified Hacking Forensic Investigator (CHFI)
7	Oracle Database 10g Administrator Certified Professional (OCP)	Microsoft	Microsoft MCSA/ MCSE Specializations	Adobe/ Macromedia Programs	National Association of Communication Systems Engineers (NACSE)	NARTE	Microsoft Certified Architect, IT Professional (MCITP), Professional Developer (MCPD), Technology Specialist (MCTS)
8	Red Hat Certified Engineer (RHCE)	Novell	Nortel Certified Architect (NCA)	IBM Platform- and Software-Specific Programs	National Association of Radio & Telecommunications Engineers (NARTE)	SANS GIAC Security Expert (GSE)	MySQL Cert Program
9	Red Hat Certified Technician (RHCT)	Oracle	Project Management Professional (PMP)	Microsoft Programs	Project Management Institute (PMI)	Senior Protocol Analysis Certifications	Sun Certified Developer for Java WebServices (SCDJWS)
10	Sniffer Certified Master	Sun Microsystems	SAP Certified Technical Consultant	Oracle Programs	Telecommunications Industry Association (TIA) Certs	Sun Certified Enterprise Architect for the Java2 Platform, Enterprise Edition	Sun Certified Mobile Application Developer (SCMAD)

Figure 5: Top 10 Lists of ICT Certifications [18].

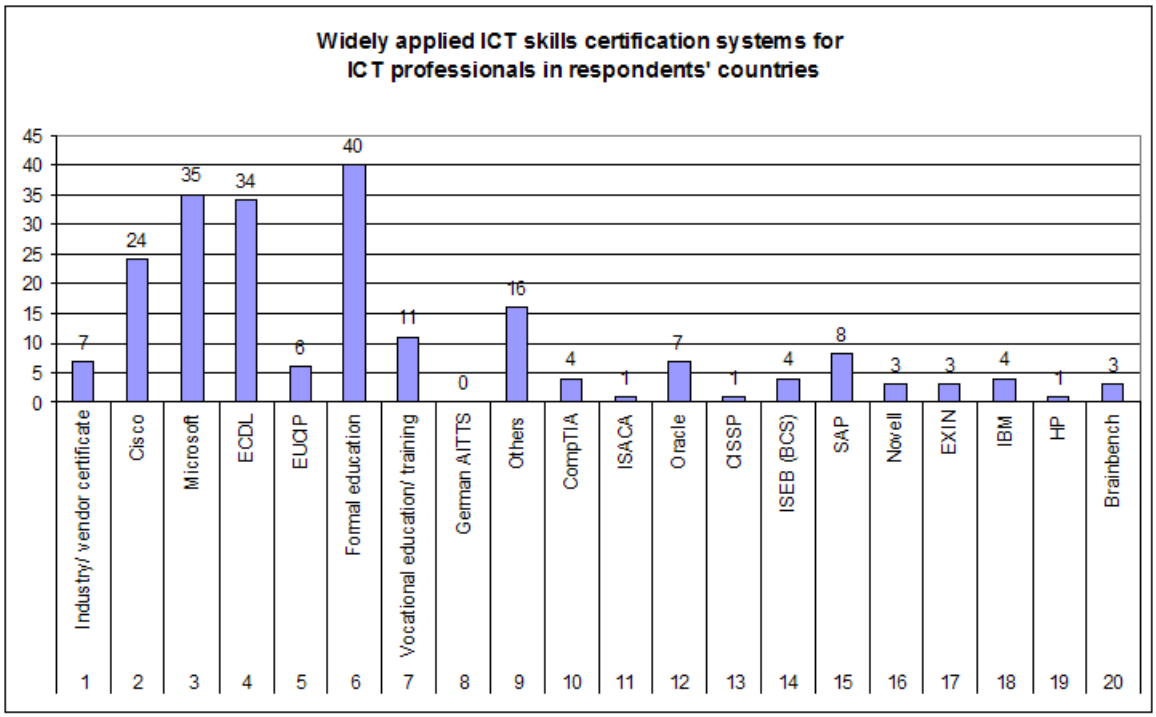

Figure 6: Widely Applied ICT Skills Certification Systems for ICT Professionals in Respondents' Countries [22]

dominantly by the diversity of offerings itself. Additional lists of certifications are provided by [12] and [22] (see Figure 4).

Actually, it is of interest in connection with this debate to have a look at the situation in the European countries. Thus, the results of a respective survey that was conducted in 2006 by CEPIS and a consortium of eight project partners in Europe was looked at next. The survey examines the perception of selected high-level experts about what qualification and certification systems in ICT are widely applied in their countries.

6 Survey Results

In the following, the assessed empirical data of widely applied systems in Europe was looked at – the second strand of analysis mentioned above.

The population of the empirical analysis numbers 55

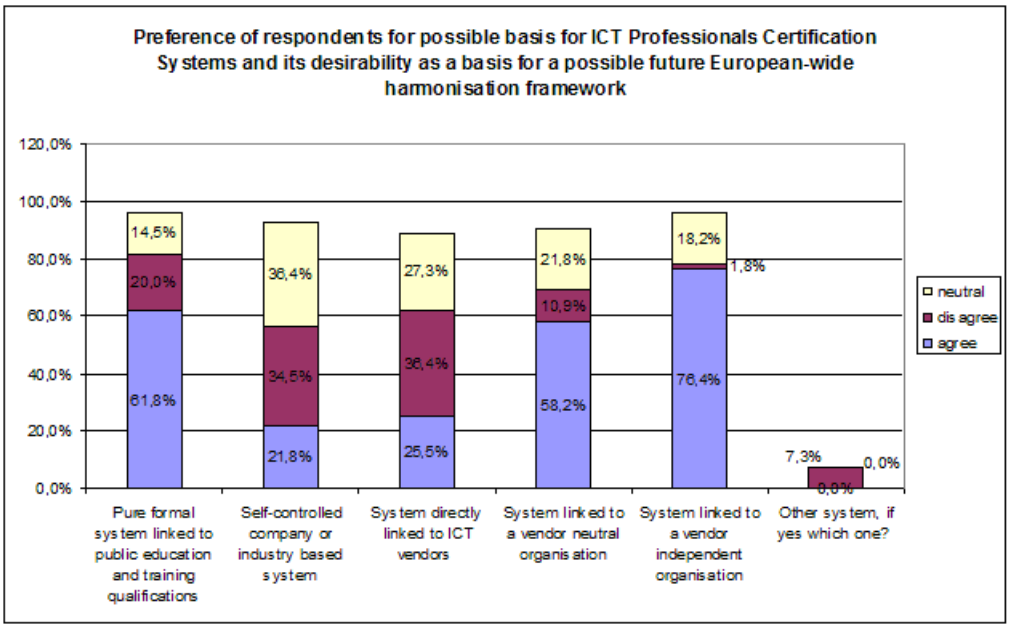

Figure 7: Possible Future European-Wide Framework of ICT Certifications (multiple answers possible) [22].

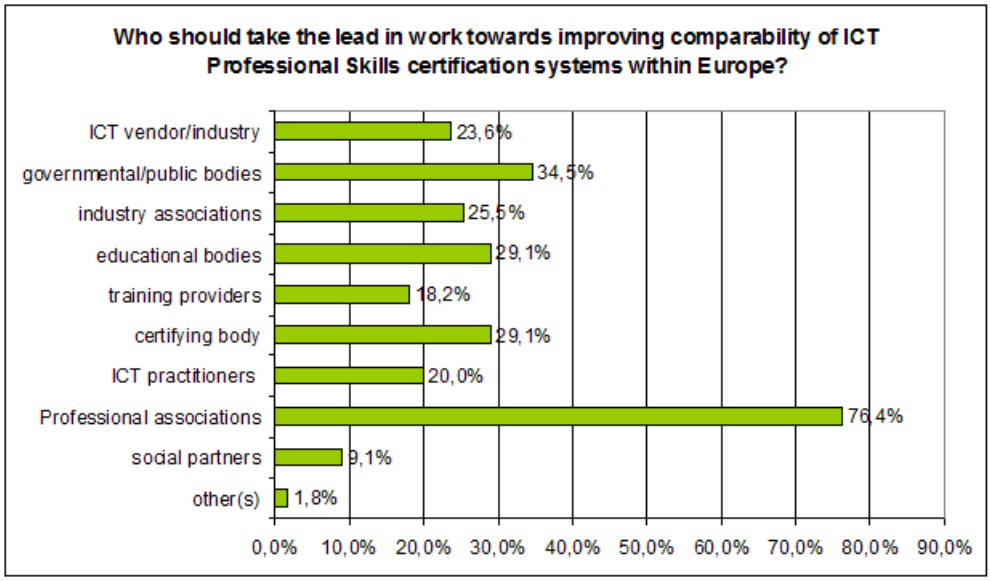

Figure 8: Improving Comparability of ICT Professional Skills [22].

high-level experts in total; the experts responded by filling in a standardised questionnaire. The survey covers 21 European countries, in total, comprising seven (7) old member states, nine (9) new member states and three (3) respondents categorised as "other EEA[1] countries". The position of respondents in their organisations is high-level, 61,8 per cent of respondents occupy a central position as e.g. director (22), general manager (3), professor (8), unit management (4), etc.

The goal has been to clarify the realities of the qualification and certification market in the respondents' countries. A list of existing widely applied qualification and certification systems for ICT professionals has been produced. Most interestingly, 58 per cent of respondents indicated that the achievement of vocational qualification (e.g. certificate, diploma) is a precondition in their countries for ICT professionals for employment in a relevant job. Moreover, the high-level experts had been asked to name widely applied ICT skills certification systems for ICT professionals in their countries.

6.1 Widely Applied ICT Skills Certification Systems

Figure 6 shows the widely applied systems in the countries named by the respondents. Evidently, formal education (40) and vocational education/training (11) are most widely applied systems in respondents' countries. Unsurprisingly, they play a pivotal role in the national context. Microsoft was named by 35 respondents, followed by the ECDL (European Computer Driving Licence) (34) and Cisco (24).

[1] European Economic Area

Figure 6 illustrates the already argued diversity of systems in Europe. Although given only a small "sample size", which rigorously may not be seen as statistically reliable, the excellent European coverage and the high quality of responses obtained makes the achieved results, from a qualitative research point of view, valuable. At the forefront, the results underline the argued actual proliferation of ICT certifications have resulted rather in their continuous devaluation by employers and the professional community.

6.2 Possible Future European-wide Harmonisation Framework

The respondents have been asked to indicate their preferences with regard to a possible basis for ICT professional certification systems and its desirability as a basis for a possible future European-wide harmonisation framework (see Figure 7). Evidently, there is consensus among the questioned experts that systems linked to a vendor independent organisation are a desirable basis for such a framework (agreed: 76,4 per cent). Pure formal systems linked to public education and training qualifications and systems linked to a vendor neutral organisation are equally to be considered as an appropriate basis. A significant disagreement is apparent concerning "systems directly linked to ICT vendors" and "self-controlled company or industry-based systems" [22].

6.3 Improving Comparability of ICT Professional Skills

In connection with a possible future European-wide harmonisation framework, the respondents had been asked additionally to indicate their preferences concerning who should take the lead in the work towards improving comparability of ICT professional skills certification systems within Europe. Figure 8 shows the results of this analysis.

Professional associations seem to be asked for by the majority of respondents to take the lead.

With a significant gap governmental/ public bodies, educational bodies and certifying bodies together with industry associations and ICT vendor/industry are encouraged to build respective partnerships to improve the required transparency and comparability and, as a consequence, better portability of issued credentials by non-formal systems [21]. This seems likely to be the key to a fruitful co-operation and broader recognition of non-formal credentialing systems and, in consequence, better career guidance and information provision for employees [21].

Obviously, none of the partners seem to be able to go for the aspired leveraging of ICT certifications all alone. A more detailed analysis and further results can be found in [22].

7. Conclusions and Outlook

The article has highlighted the role of ICT certification in relation to employability, ICT professionalism and the actual need for skill and/or performance standards in industry. It has been pointed out that a common language and a shared common framework are needed. The latter should strive for enhanced flexibility and transferability of issued credentials, through the ICT certification systems.

Although these systems operate globally, they do not rely on a common framework to arrange certifications according to a common structure for the development, description and systematization of relationships between certification programmes.

This seems to be a precondition for the aspired broader recognition and valuing of ICT certifications by ICT professionals and employers in Europe. This would likely mean an important step forward towards the further convergence of existing approaches and harmonisation of existing systems.

Professional associations together with industry and academia should take the lead starting a dialogue how performance standards in industry might be likely better integrated into current curricula and courses at universities. Industry-based training systems should look into how performance components offered by the formal-system are possible to be integrated into their training programmes and certification offerings.

In this way, the best of the "two worlds", formal and non-formal ICT education and training, learner-centred/ competence-oriented and long-term oriented, could be combined to a flexible and innovative credentialing systems to foster ICT proficiency.

Central aims are thus to create the "right" conditions to attract talented people by relevant career guidance, information services and by highlighting flexible entry points into the IT profession. Industry-based ICT skills certifications can likely play an important role but need to become more transparent and more comparable. The latter might be achieved by better referencing (national) qualification levels.

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