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Europe 123
GR-57001 Thessaloniki (Pylea)

Postal Address:
PO Box 22427
GR-55102 Thessaloniki

Tel. (30) 23 10 49 01 11
Fax (30) 23 10 49 00 20
E-mail: info@cedefop.eu.int
Homepage: www.cedefop.eu.int
Interactive website: www.trainingvillage.gr

Authors on behalf of CEPIS:
Peter Weiß, Dudley Dolan, Wolffried Stucky, Peter Bumann

Edited by:

Cedefop
Burkart Sellin, Project manager

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Foreword

This study on ICT skills certification in Europe was launched by Cedefop in early 2004 with the intention of helping animate and promote European level discussions and exchanges:

(a) within the e-skills forum set up by the Commission in spring 2003 created to support cooperation between stakeholders and experts on ICT and e-business skills;

(b) with the European and international training industry and social partners engaged in ICT certification issues;

(c) to prepare a next phase of the European committee of normalisation/information society standardisation system (CEN/ISSS) ICT skills workshop to elaborate a European meta-ICT skills or qualifications framework.

This issue has to be seen also in relation to current discussions on European level initiatives on transparency (Europass), credit transfer and overarching European skills and qualification frameworks, aimed at realising wider policies linked to the Lisbon goals and agreed education and training objectives.

The nature of the activities required specialist knowledge, skills and services:

(a) to meet the demands of animating a continuing exchange and generating, reviewing, analysing and reporting on thematically organised information and knowledge for underpinning the policy-making process in line with the European Union's eEurope action plan (in partnership with the industries' own efforts);

(b) to identify and promote training solutions and certification in ICT and e-business skills;

(c) to contribute further to implementing the e-learning action plan of the European Union.

Cedefop's overarching strategic objective is to promote a European area of lifelong learning (LLL) in an enlarged European Union, to support the European Union's aim to increase cooperation in VET (vocational educational and training) and LLL and to contribute to implementing the objectives for education and training in 2010 (European Commission, 2002).

These activities fit perfectly into the context of Cedefop's medium-term priorities 2003-06 and its active support for policy and action at European level. These medium-term priorities set the strategic objectives for Cedefop's activities as follows:

(a) improving access to learning, mobility and social inclusion;

(b) enabling and valuing learning;

(c) supporting networks and partnerships in an enlarged European Union.

The contractor was engaged by Cedefop mainly to support three European level activities launched on ICT and e-business skills:

(a) work of the European Commission's e-skills forum, constituted on 27 March 2003, under the responsibility of the Directorate General Enterprise;

(b) the preparation of inputs to the work of the CEN/ISSS ICT skills workshop (phase 2) sponsored, *inter alia*, by Cedefop;

(c) organising/implementing the e-skills conference in September 2004, which was organised in Thessaloniki with the European Commission (see www.eskills2004.org).

The study covered three main issues:

(a) ICT certification at international and European level and potential solutions and recommendations to current problems, which included:

  (i) analysing existing modes, procedures, methods, institutions and aims relating to e-skills certification as well as their current impact on European debate;

  (ii) highlighting approaches to public or private certification which aim to be valuable at international and European level;

  (iii) elaborating different options for European level actions relating to the eEurope action plan and agreed education/training goals for 2010, linked to matters of recognition, comparability and transparency of certificates, diplomas or other evidence which assist in promoting European skills development and mobility;

(b) propose ways to inform continuously on, and exchanging experience through, existing and future networks by:

  (i) elaborating a coherent approach to European level certification and accreditation, permanent maintenance, quality control and public-private cooperation;

  (ii) verifying a possible approach to standardisation of European certification procedures and outcomes;

  (iii) discussing the linking of ICT certification problems and issues with current EU initiatives at technical and political levels concerning EU education and training objectives and cooperation in the light of the Lisbon goals set for 2010;

(c) verify the future role and contribution of different European level bodies (e.g. Cedefop, CEPIS and CEN/ISSS) in promoting the issues further by:

  - exploring a potential role and task for a permanent body which could be established for more sustainable EU level activities.

We thank the authors for their work performed under tight deadlines in 2004. The extremely useful outcomes delivered by the contractor will be further assessed and discussed by the advisory expert group on e-skills. It is also very useful for continuing work with CEN/ISSS on ICT skills and respective frameworks. The recommendations made need further reflection and may require a more formal consultation of stakeholders and Member States. They will be further explored for possible actions by both the Commission and Cedefop.

Thessaloniki, March 2005

Burkart Sellin, Project coordinator

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Executive summary

A great variety of ICT certification schemes and systems exist throughout Europe. Certification and quality assurance in ICT education and training are extremely important for both employment in the ICT industry and as a basis for a sustainable professional career. CEPIS ([1]) studied and compared, on behalf of Cedefop, existing approaches to e-skills certification in 21 European countries. The survey aims to contribute to the current debate on promoting e-skills, to economic competitiveness, better jobs and social cohesion. It supports the current debate on skills frameworks, quality standards and the increasing attractiveness essential to this labour market segment.

These objectives have been pursued under the auspices of the European Commission and Cedefop since 2002. Within Europe there still exists a lack of labour mobility due to a lack of recognition and transparency of qualifications. Education authorities, training providers and certifying bodies should be enabled to cooperate more closely, exchange experience and build mutual trust to contribute to closing these gaps.

The study focuses on investigating existing modes, procedures, methods and institutions responsible for e-skills certification and on their interests in sharing experience or increasing cooperation. It is intended to support and recommend joint actions to enable European policy and practice for certification, quality assurance and standardisation.

This European study compares and analyses e-skills certification systems. It compares and categorises the identified systems, underlying models and approaches, providers and procedures. The survey investigates the whole range of approaches: public and private, commercial and voluntary standards for e-skills certification. The focus lies on most widely applied systems in the respondents' countries while taking into consideration their potential regarding their possible contribution to convening and implementing standards throughout Europe.

A questionnaire was established and agreed with Cedefop, eliciting a reasonable response from high level stakeholders and experts representing 21 countries. While showing well-balanced European coverage the total number of responses (40) was not as high as expected. However, the origin and character of stakeholders and quality of experts makes the responses convincing despite the lack of breadth.

A total of 106 e-skills certification systems were listed by the respondents; only a few of these, however, are widely applied in their corresponding countries. Certification systems made available by ECDL and ICT vendors from industry, particularly Microsoft certifications were most often quoted. Certifications and formal qualifications provided by public education and vocational training providers also played an eminent role. All these approaches were

([1]) Council of European Professional Informatics Societies.

considered for a future convention or potential actions in voluntary approaches and options for agreeing European quality standards.

The majority of respondents (73 %) feel that fewer, but more relevant, e-skills certification schemes are required. Of the questionnaires returned, 80 % indicate that Europe has too many e-skills certification systems and schemes. The majority of respondents say that the current marketplace is characterised by a focus on vendor-specific (industry) certifications, indicating that vendor-independent approaches need greater focus. These may form the most appropriate basis for a European e-skills quality and standards framework with a vendor-independent voluntary European organisation or body strongly supported by the respondents. Such a body ought to be open to multiple modes and schemes, whether public or private, commercial or industry-specific, on condition that minimum quality standards are met, agreed and continuously maintained.

Answers received support the general perception that transparency, portability and comparability of e-skills certifications should be reached by means of cooperation and joint activities of relevant stakeholders (73 %). A European approach to e-skills certification should be based on learning outcomes which ought to be described in relation to an agreed Europe-wide meta- or reference skills and qualifications framework. This should allow many different certification schemes, whether national or international, regional or local, company or sector specific. New approaches to improved accreditation, validation and certification of non-formal learning ought to be addressed as well.

A possible way forward for the ICT sector is proposed, including establishing a central body. The respondents indicated strong support and agreement which, however, will have to be verified through more formal consultation with the European Commission and Cedefop. Such a central body should aim to establish and maintain common quality standards for ICT training and certification and be based on an agreed European reference framework for both ICT skills and qualifications. It should not only support mobility across Europe but also at international level.

1. Introduction

'When planning for a year, plant corn.
When planning for a decade, plant trees.
When planning for life, train and educate people.'

Chinese proverb: Guanzi (c. 645BC) ([2])

1.1. Motivation

Developments in information and communication technology (ICT) over the last 40 years have had a quite remarkable impact on our lives in general, but more particularly in our work. They have also resulted in the strong growth of a major new industrial sector, and the creation, in a number of countries, of hundreds of thousands, even millions of new jobs (IFIP OECD WITSA, 2002, p. 3). As this technology develops further, additional changes are to be expected. In spite of the recent downturn in the information technology and telecommunications markets, this area continues to be expected to provide, in many economies, a large number of new jobs over the coming years. Today, ICTs are very relevant and important in nearly every business sector. Consequently, the demand on the labour market for ICT practitioners and employees with ICT end-user skills is continuously growing. Increasing pressures on businesses produce a shift of employment realities, resulting in the need for people to recognise that they cannot rely on earning their living in one particular occupation throughout their entire life. Such pressures are produced, amongst other things, by a combination of industrial structural change, the introduction of new technologies and tools in the workplace, and the growing competitive pressure on businesses of most kinds arising from the slow but steady movement towards the globalisation of markets (CEPIS, 2002, p. 23).

Thus, employees must increasingly take responsibility for acquiring updated and often quite different skills, as their career progresses. This implies the need for sound career planning, fostered by adequate information on possible future career paths. The differences in characteristics of national labour markets have to be realistically taken into consideration. However, the mobility of the workforce is increasing. Consequently the comparison, transparency and recognition of outcomes of relevant qualifications and related education and training courses are in the spotlight. Acquiring relevant competences, and thus 'skills', becomes increasingly important for ICT workers' job prospects in the European labour market and for the future economic development of Europe (Stucky and Weiß, 2004). Therefore, policy-makers in many countries are focused on the importance of e-skills and strengthening the opportunities for lifelong learning (CEPIS, 2002, p. 22; OECD 2004, p. 2).

([2]) *Source:* Directorate-General Education and Culture, http://europa.eu.int/comm/education/policies/lll/life/index_en.html [cited 17.6.2004].

The reason for this is that workers with sufficient up-to-date skills are expected to be more productive, have more potential to remain employed, and have better prospects for their individual career development (De Grip et al., 2002). Small and medium-sized enterprises (SMEs) in particular feel increasing pressure on their future business owing to a lack of available ICT workers with the necessary skills to enhance their electronic business, products and services.

1.1.1. Changing demands on ICT workers

Employers are demanding ICT skills across all industries. New job profiles are arising in different business sectors, resulting in changing demand in the labour market. A good example of this development may be taken from the financial sector in Germany.

German banks increasingly make high demands on their ICT practitioners. The transition in career from a bank clerk to an ICT expert is variable, because of the demand for a high level of ICT skills (e.g. business intelligence, data mining, etc.) and, at the same time, comprehensive competences and skills in finance itself. The profession of a bank clerk increasingly shifts towards enhanced use of ICT in daily work. Equally, ICT practitioners need continually to enhance their skills in finance and reporting, to perform their jobs in banks. Driven by the various qualifications available and the individuals' interest in taking responsibility for their own professional development, there is a clear tendency to acquire the necessary skills outside traditional vocational qualification and training systems, e.g. by informal learning and 'virtual' training. Often vocational qualification and training is not able to catch up with rapidly changing requirements and to respond to new job profiles. As a consequence, a new job profile, 'bank engineer', was developed to indicate new job requirements needing adapted qualification and training courses ([3]).

The scenario described above highlights the need for lifelong learning to cope with a changing labour market. However, the example also underlines the importance of this study task. New ways of learning and skills acquisition, increase the need for ICT workers to document learning outcomes in the form of recognised career development credentials, e.g. certificates or diplomas, and to increase the individual's labour market value. Additionally, employers have the problem of identifying which particular skills are missing from their workforce and are needed to supply internal job requirements. The crucial question is, what courses need to be undertaken by the workforce to acquire the relevant qualifications in the form of competences, and thus skills, to perform productively (GIS, 2004) in their occupational role.

([3]) The example is based on the article Banks make high demands on IT professionals. *Computer Zeitung* No 28, 5 July 2004, p. 22.

1.1.2. Skills obsolescence and lifelong learning

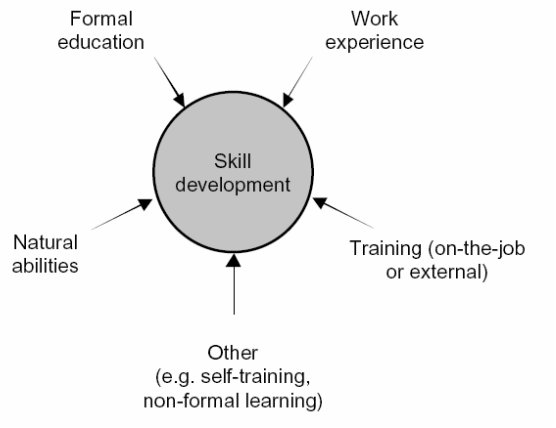
An important force driving the growing demand for continuous learning and related qualification and training courses is the shortening time-cycle of individuals' knowledge and skills. This phenomenon is also called skills obsolescence (De Grip et al., 2002). This can be either induced by changes in the workers themselves (e.g. ageing) and/or skills obsolescence attributable to external developments (e.g. technological change). Both scenarios emphasise the need to support lifelong learning for individuals. ICT related skills, generally summarised under the term 'e-skills', are especially subject to rapid technological change. In this context, two different views can be distinguished: the employee's and the employer's. For an employer, human capital and related investments in education and training represent a continuous depreciation in value. In the ICT sector, technological life-cycles are short and new skill profiles emerging and are demanded by employers. Therefore, a continuous reinvestment in the form of training is required to compensate for skills obsolescence. However, recent demand and supply – both in quality and quantity – of ICT workers did not, and still does not, adequately match. This situation is currently discussed by experts under the terms skills gap (quality) and skills shortage (quantity) (European e-skills forum, 2004; Stucky and Weiß, 2004).

For the employee, it is important to react flexibly to job changes caused by technological and organisational developments (as highlighted in the above example of bank clerks in Germany) and to benefit from adequate individual career-path guidance and development (De Grip et al., 2002, p. 3). Individuals have to maintain those skills that they have previously acquired, but which are not, or are insufficiently, used in their current professions, while actively acquiring relevant job and/or company-specific skills, to stay competitive and to achieve the mobility and flexibility required by the labour market (e.g. shift to other sectors, regions, etc.). Both these demands underline the need to initiate and make available lifelong learning processes within companies, in particular, and in society in general. As a result, employers and employees alike show considerable interest in the availability of recognised qualifications such as e-skills certification systems at national, European and international levels.

1.1.3. Acquiring relevant e-skills

Some of the normal routes towards acquiring e-skills are traditional, e.g. formal education, work experience, training (on-the-job or external), self-training or non-formal learning (see Figure 1). The acquisition of e-skills relies on natural abilities (personal attributes). Traditionally, basic skills and qualifications necessary to compete in the labour market were acquired through the various stages of formal education in schools, vocational training, universities, etc.

Figure 1: Some routes for acquiring e-skills



Source: ICT skills monitoring group, 2002, p. 13.

This sets the background for the career path to be followed during working life. The existing mismatch of supply and demand, caused by the fact that schools and higher education are not providing new job seekers with the right skills set, is something which is currently being explored by several European initiatives such as Career space ([4]). The result of this mismatch is that enterprises will have to take more responsibility for reskilling and retraining those people already in employment and will also have to employ new techniques for learning. In the workforce, training and working must, to some extent, take place in parallel, interacting with each other (ICT skills monitoring group, 2002, p. 12).

1.1.4. Diversity of qualifications

Ensuring that learning is visible and appropriately recognised is an integral element of the quality of education and training and a core element of successful lifelong learning. One of the most significant structural aspects of lifelong learning is the issue of e-skills certification (European Commission, 2002, p. 66), the focus of this report.

Beyond the obvious implications of learner motivation, effective and transparent accreditation and certification systems are of crucial importance for industry itself and any high level political planning. The supply of relevant qualifications and training courses on the market offers individuals a variety and diversity of e-skills certification systems. This implies a growing demand for career guidance and the availability of accessible job requirements. The current demand is served by such a variety of certifications that they are virtually impossible to comprehend. As a result, European employers and employees face a diversified market

([4]) Career space is a major industry-led initiative with the participation of 11 leading ICT companies. It is developing job and skills profiles for main job areas in the ICT sector and curriculum guidelines for the participation of 25 European universities. See: www.career-space.com.

with a multitude of training and learning services. However, the individual's decision for, and selection of, relevant training courses is influenced by several factors, e.g. market recognition, quality, price, etc. This sets the scene and is the motivation for this report which investigates and provides an overview of e-skills certification in Europe.

1.1.5. Comparability of e-skills certification systems

The mere existence of accreditation and e-skills certification systems says nothing about their quality, transparency, or fairness or the comparability of national accreditation and recognition processes within Europe. While it may be possible to cater for non-formal education within a traditional certification framework, recognising skills and competences acquired in an informal learning setting must be processed through an assessment of both the learning process and the learning outcomes. It is difficult to identify applicable indicators to assess the quality of accreditation and certification, though some national initiatives point the way to achieving a more harmonised European approach. Norwegian, Scottish ([5]), Irish, French and Portuguese ([6]) policies are examples to be considered (European Commission, 2002, p. 66).

1.1.6. Harmonise existing approaches

Expert opinions differ, revealing that many initiatives work towards one goal but with different concepts. There is an obvious need to define collective goals and to harmonise existing approaches. Some experts are convinced that job-related qualifications which, thanks to e-skills certification can easily be compared, will lead to a higher transfer level for employees. To investigate how this can be best achieved, a survey was undertaken as described below.

1.1.7. Survey focus and starting point

The survey aims to contribute to discussion of possible ways towards, and solutions for, a harmonisation of the diversified situation of e-skills certification in the European ICT and user industry. The latter suffers most from a lack of e-skills. The survey aims to elaborate on, and suggest methods for, the implementation of a widely acceptable European approach to e-skills certification for ICT workers. ICT workers must be mobile and able to be deployed easily and flexibly in order that they may work across Europe. Concepts which aim to create certifications for qualifications gained on the job and also to enable comparisons between these qualifications should, therefore, be developed as a result of international cooperation ([7]).

([5]) Scottish credit and qualification framework (SCQF).

([6]) National system for recognising, validating and certifying competences (RVCC).

([7]) CEPIS press release: Panel discussion at GI annual conference, concepts for certification, October 2003, http://www.cepis.org [cited 12.11.2004].

The objective is to propose a framework based on the results and to derive concrete recommendations which may be implemented. The survey identifies and investigates the availability of voluntary approaches to setting European quality standards. Consequently, one of the core elements of the survey is to identify existing recognised and widely applied e-skills certification systems in the different countries. Information was gathered from high level experts and bodies widely recognised and active in e-skills certification by means of a questionnaire. Their individual recommendations and preferences were analysed. One important part of the survey task includes investigating the nature, modes and structure of certification systems.

1.2. Objectives

Based on the above, the operational objective for this study is the evaluation of issues of international and European ICT certification by:

(a) analysing attitudes of stakeholders towards current and future European level activities;

(b) highlighting potential solutions and recommendations to perceived problems.

The study's declared aim is to contribute to the European e-skills and the CEN/ISSS working group on ICT skills and to support the activities of Cedefop. The report starts by analysing and structuring the notion 'e-skills certification', explaining the nature, modes and underlying basic concepts. Quality standards are expected to play a central role for transparency and comparability of e-skills certification systems and their availability is covered in the report. The survey aims to identify voluntary approaches offered by widely applied e-skills certifications. The degree of recognition of widely applied systems is investigated and categorised based on the sample. The report develops recommendations and potential ways forward and highlights possible approaches to harmonising e-skills certification throughout Europe.

1.3. Survey

The survey assesses the data on the basis of a standardised questionnaire ([8]), sent to selected stakeholders, covering several important aspects of e-skills certification in Europe. The questionnaire was originated and agreed with Cedefop; it received a reasonable response from 21 countries, offering well-balanced European coverage. However, it should be recognised as being limited to selected high-level expert responses ([9]).

([8]) The questionnaire is attached to this report in Annex 1.

([9]) The survey sample is described in more detail in Annex 3.

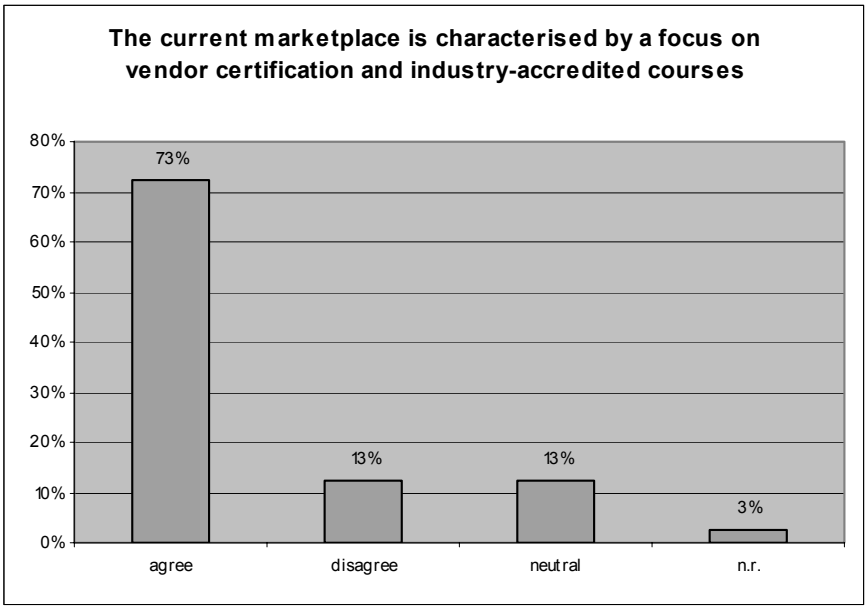
2. E-skills certification

'Human, not financial, capital must be the starting point and ongoing foundation of a successful strategy.'
Barlett and Ghoshal

(Schwarzkopf, 2004, p. 83-88.)

The difficulty individuals may have in demonstrating their knowledge, skills and competences in the labour market complicates the potential for movement into other jobs. This applies particularly for those qualifications acquired at work or in other non-formal/informal settings. This section focuses on e-skills certification. It begins by structuring the notion of e-skills certification and describing the nature of certification by explaining its constituent parts. The gaps in recognising the professional, academic and vocational qualifications of individuals from different countries are a particular obstacle to people working in Europe (COM, 2001, p. 9). The issue of recognition of e-skills certification is too complex, and the perceptions of stakeholders too diversified, to present implementable results within this report. However, this report intends to emphasise important aspects and subsystems influencing the degree of market recognition. The particular aim is to stimulate discussion between stakeholders by querying a sample of high level experts on how harmonisation in Europe might be achieved. In general, the success of systems offering credentials depends on recognition by stakeholders, and in particular by employers, in different industry sectors. The nature, modes and some underlying basic concepts and definitions are described. A reference framework is characterised including the basic elements of e-skills certification, depicting existing interdependencies and inter-relationships. Major roles and related activities within e-skills certification systems are specified. The best way to advance the field of e-skills certification is to understand its roots. Industry ICT certifications play a major role in today's e-skills certification landscape and are amongst the most recognised and most widely applied systems in Europe and beyond. This is backed up by the survey, as shown in Figure 2. The majority (73 %) of respondents feel that the current marketplace is characterised by a focus on vendor certification and industry-accredited courses.

Figure 2: Focus on vendor certification and industry-accredited courses



2.1. Industry ICT certification

eSCC (eSCC, 2004) published a report offering an industry perspective on the role of e-skills certification; this opinion is summarised as follows. Certifications play an important role in today's ICT industry and represent emerging new paradigms concerning the demand for increased flexibility in skills acquisition by ICT workers ([10]). Therefore, certifications give industry an appropriate means of providing an alternative way to 'right-to-title' (eSCC, 2004, p. 17) for individuals, hitherto a privilege and reserved right of formal education. Industry ICT certifications are voluntarily granted by industry stakeholders, providing individuals only a 'right to title'. Through industry ICT certifications companies are capable of integrating *de facto* practice control in their employment process. Examples are certifications offered by Microsoft, Cisco, Compaq, etc. ([11]) 'Within ICT industry, certifications are credentials that result from a voluntary evaluation process whereby an individual's knowledge and/or skill in a particular subject area is verified against a set of predetermined skill standards by means of an objective assessment' (eSCC, 2004, p. 17). The notions certification and certificate are typically confused. Certificates often solely testify the pure physical attendance at a course or class programme. By contrast, 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 (eSCC, 2004, p. 18).

([10]) Flexibility is seen as one of the most important concepts for continuous education and professional development.

([11]) See Annex 2 – List of vendor-specific certificates.

2.1.1. Certification for ICT security professionals

The dynamics of markets (CEPIS, 2002, p. 22) indicate the need for e-skills certification and e-skills as a moving target, as seen in the current debate and increasing demand for ICT security professionals (Bean, 2004). ICT security professional is one of the hottest occupations in the ICT industry. Because industry lacks numbers of qualified security professionals, ICT vendors offer certification based on predetermined requirements which are in turn based on their solutions and technology. The challenge of creating the 'perfect' ICT security professional remains, as does commonly agreeing on what the profile of a real security professional looks like. 'Depending on the responsibilities and functions of a security position and the infrastructure of the organisation, someone in this role at one company can have a drastically different skill set than someone in a similar role at another company' (Bean, 2004). The situation lacks guidance and pathways for lateral entries, allowing individuals to plan their career and step into the labour market as ICT security professionals. Therefore, there is a need to develop a common set of standards by stakeholders defining the role, but little progress has been made in agreeing upon a set of skills or competences to which all of these certifications lead.

Table 1: ICT security professionals

Certification	Description	Content	Certifying body
Cisco certified security professional (CCSP)	Validate advanced knowledge of securing networks	Perimeter security, virtual private networks and intrusion protection, single/integrated network security solution	Cisco
Security+	Geared toward ICT professionals who want a one-exam certification covering a wide range of top-level security knowledge	Topics every network administrator and engineer should know	CompTIA
Certified information systems security professional (**CISSP**)	Focus on 10 bodies of knowledge. Work experience: four years of direct full-time security professional work experience	Law, investigation and ethics to telecommunications, network and Internet security	International information systems security certification consortium
Microsoft certified systems engineer (**MCSE**) Microsoft certified systems administrator (**MCSA**)	Offered security specialisation for popular certifications. Common path for many ICT security professionals, with 3 100 MCSEs obtaining the security specialisation (July 2004)	Exams focused on specific security-related topics. MCSE or MCSA, simply pass few additional exams to add the security specialisation to their credential	Microsoft

Source: Bean, 2004.

Access to the certifications shown in Table 1 has grown in the past year, and these are just a small selection of the security certifications on the market. However, one area of information security that is often neglected is security awareness training for the ICT end user or non-ICT knowledge worker. One reason is the lack of standardised resources available for organisations to train their employees in security awareness. Another reason is likely barriers arising from the fear of the costs of such training programmes (Bean, 2004).

2.1.2. Reasons and motivation for certification

Employers permit their employees pass e-skills certifications in the anticipation of an increase in productivity and a reduction in costs. To achieve these goals, industry vendors offer specific training in their solutions to transfer the required new e-skills (e.g. in security) for advanced technologies (Stiffler, 2004). The five main reasons and motivation for an individual in Europe to pursue e-skills certification are, in order of decreasing importance:

(a) increase credibility (GIS, 2004);

(b) assessment of knowledge;

(c) preparation for a new position;

(d) increase personal productivity;

(e) fulfilment of job requirements.

In North America the reasons are slightly different. The most important reasons given by ICT workers for completing a certification programme are to be up-to-date with new technologies, increased job prospects, and increased credibility (eSCC, 2004, p. 20). Another reason is the request to pursue certification programmes which, implies better job performance and enhanced quality (Tittel, July 2002). In addition, certifications build an advantage for ICT contractors through updating of skills and preparing to compete for new business and retain existing business. Consumers of e-skills certification are categorised in two main groups (eSCC, 2004, p. 20f): functional consumers and performance consumers.

The first category covers individuals that are either new to ICT or to e-skills certification. The second category includes individuals already active as ICT workers in the target certification area (eSCC, 2004, p. 21).

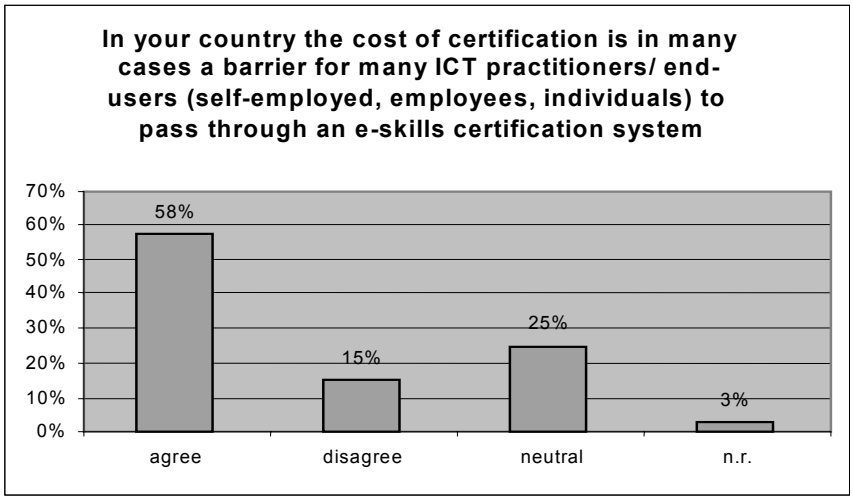
2.1.3. Costs of certification

Tracking costs for certification consists, from an employer's perspective, of accounting for two kinds of outlays (Tittel, July 2002):

(a) out-of-pocket costs, including expenditure on materials, books, practice tests, exams, classes and so on;

(b) time, overhead and opportunity costs, comprising the time costs factor in the hourly value of the time invested in studying, practicing and taking exams, attending classes or seminars, reading, surfing and performing the many activities involved in obtaining or maintaining credentials.

Figure 3: Cost of e-skills certification



The respondents in the survey sample mentioned that the cost is, in many cases, a barrier for many ICT practitioners/end-users to undertake an e-skills certification system (as shown in Figure 3). The answers were more diversified on the cost of certification as a barrier for employers to offer vocational training to employees. Some 48 % of the respondents agreed, whereas 40 % disagreed.

2.1.4. Models of e-skills certification

E-skills certification models follow a widespread pyramidal structure distinguishing three expertise levels: entry (base), intermediate (mid), advanced (high). Thereby, the number of certified professionals decreases with increasing expertise level (Tittel, May 2002), (eSCC, 2004, p. 22). E-skills certification models investigated for this study provide individuals with multiple points of entry and are generally based on so-called certification ladders. A certification ladder consists of a sequence of individual certifications starting with relatively simple requirements and lightweight credentials. The model is steadily advancing to more complex requirements and more advanced credentials. Certification ladders offer good career guidance, allowing individuals to plan their professional self-development, though such programmes tend to bind individuals to a specific programme. It appears that the intention is to make it easy for individuals to climb the ladder to reach the first levels but the requirements to climb to higher rungs (levels) of the (job) ladder are more challenging (Tittel, May 2002).

In this way, individuals are able to develop their own career. The combination of credentials offers individual professional development and often holds the key to interesting, lengthy

careers and lucrative consulting opportunities. The pyramidal model is applied by both vendor-specific and vendor-independent programmes. These programmes are not only multi-tiered, but also offer separate tracks, each with its own tiers and separate sets of credentials (e.g. Microsoft). Other companies, e.g. Novell and Cisco, keep the same names of credentials in separate tracks (Tittel, November 2004). Vendor-specific and vendor-independent programmes differ by cost of entry, which is generally higher for the latter.

At base level, vendor-neutral certifications ([12]) are the most common start for an ICT career. These certifications are increasingly offered by organisations like CompTIA, motivated by expected cost savings preventing ICT suppliers from developing their own for base level. Vendor-specific certifications ([13]), are directed towards ICT practitioners at higher levels (eSCC, 2004, p. 23) and demand the knowledge and skills acquired by individuals at base level.

2.1.5. Career paths

In the past, ICT workers were predominantly graduates from higher education and lateral entries from other branches and occupations (Borch and Weißmann, 2002, p. 13). In recent years, a multitude of job profiles and career paths have emerged from new job requirements, mainly driven by technology and application developments within ICT. The increasing number of available e-skills certifications and ICT suppliers boosts the wide recognition of these credentials. The e-skills certification model allows, in principle, two career paths. The typical way is to enter at base (or core) level and then climb up the certification ladder with increasing work experience, expertise, knowledge and skills. ICT workers, in particular ICT practitioners, are generally allowed to enter the pyramid at higher levels depending on their qualification (e.g. university degree in informatics) and general ICT background based on an already acquired level of experience, knowledge and skills. In this context, experience is of growing importance for the advanced level expert (eSCC, 2004, p. 23). ICT workers with a university degree in informatics will enter the pyramidal model at the mid or high level depending on their previous work experience (Borch and Weißmann, 2002, p. 9) and education.

In conclusion, career pathways are not generic and the landscape of e-skills certification offers various ways in which to develop individuals' professional careers. Certifications and related requirements, if based on validated skills standards (eSCC, 2004, p. 18) and frameworks, offer the potential to serve as career guidance. Skills standards recognised by industry are an important factor because of their difference from conventional/formal credentials.

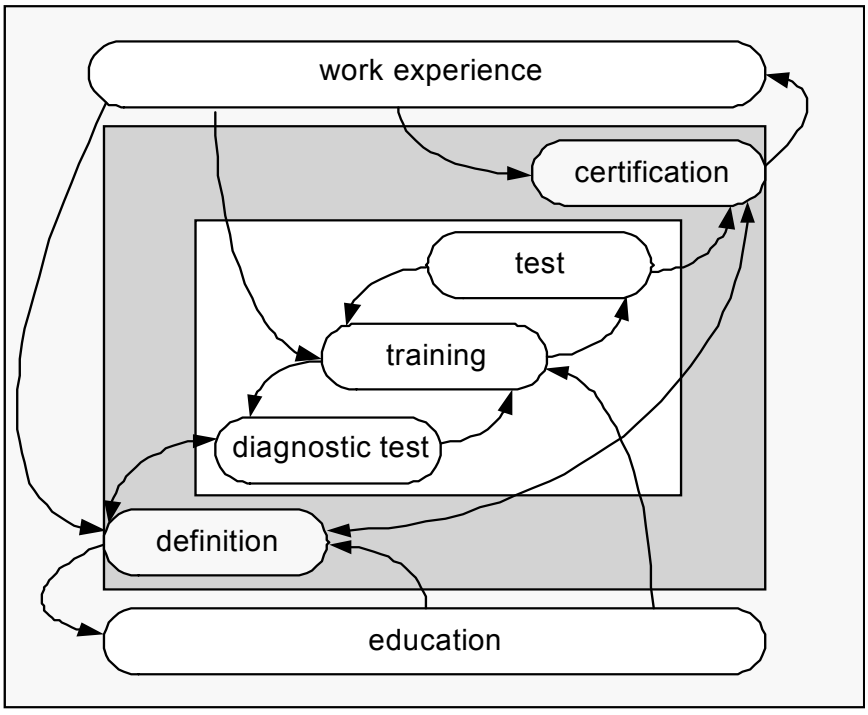
([12]) Vendor-neutral certifications cover foundational ICT knowledge and skill sets that are not specific to a set of ICT products (eSCC, 2004, p. 23).

([13]) Vendor-specific certifications cover knowledge and skill sets closely tied to specific ICT products (e.g. Microsoft, Cisco, IBM, Novell, HP, etc.) (eSCC, 2004, p. 23).

2.2. Structuring e-skills certification

Having explained the perception of e-skills certification by industry, we now describe the basic nature and structure of e-skills certification. Accreditation stands at the end of a (learning) process,, analysed and evaluated in the following. Figure 4 depicts the core modules and constituent parts of qualification and training systems. The arrows symbolise dependencies and influences between modules. This report focuses on module certification, though it is difficult to discuss the notion 'certification' separately. Certification is influenced, to a greater or lesser degree, by the various constituent parts ([14]). Varying levels of dependency exist, which have to be considered when analysing e-skills certification programmes. The figure illustrates the complexity caused by dependencies and distribution and by assignment of duties and responsibilities to various stakeholders. In reality, the elements shown are combined in 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.

Figure 4: Learning and certification: acquiring relevant qualification



Source: AIFB 2004, University of Karlsruhe, Germany.

([14]) As an example, education influences the definition of requirements an individual has to fulfil and which have to be validated by certification, as well as the provision of training and learning. In return existing definitions influence education and qualifications.

Industry stakeholders complain that an insufficient number of graduates is produced; this also applies to qualifications. Education is under increasing pressure as industry complains that the required skills and competences are not being taught within schools and universities (Mattauch and Caumanns, 2003, p 26). Hence, defining job requirements is crucial and should be regularly agreed between industry and educational bodies. Both 'know what' and 'know how' are important learning elements in becoming an ICT professional, (eSCC, 2004, p. 47) and blur the line between education and industry ([15]). E-skills certification provides stakeholders with a means of fulfilling specific job requirements by ICT workers for occupational roles.

Today, a typical career path for an ICT worker starts with formal education. After having achieved credentials in formal education, an individual normally starts his/her professional career with training on the job. However, a direct step into the job is conceivable by acquiring job-specific knowledge and skills primarily by practice, placing emphasis on the importance of non-formal and informal learning. The basis on which to provide specific training for individuals is defining requirements associated with occupational roles to derive and develop relevant training programmes. In this context, diagnostic testing provides an open environment which assumes no supervision and strict regulations. Diagnostic tests aim to offer a voluntary evaluation of a candidate to assess his/her current status of knowledge and skills. Diagnostic and final testing both rely on defining job and qualification requirements as a prerequisite. The basic understanding of training covers the acquisition of relevant knowledge, skills, and competences by an individual needed for a specific job. Final testing is optional and voluntary for individuals to verify formally, and publicly recognise, the fulfilment of required qualification. Certifications are credentials which result from this voluntary evaluation process and can be either lifelong or have to be renewed when expired. The module on top is work experience, continuously gathered by the individual during the working process, informal learning and continuous professional development.

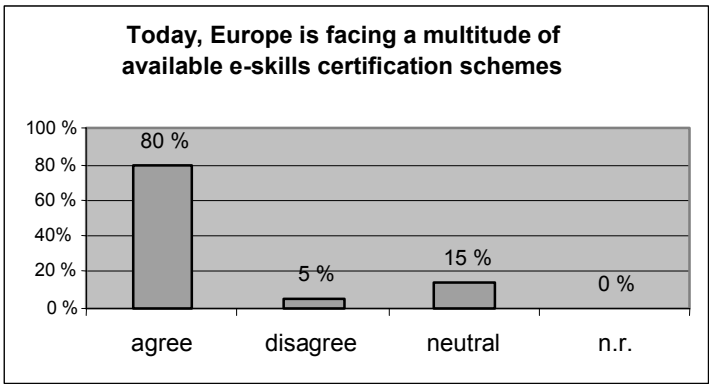
2.3. Certification

Industry stakeholders are particularly anxious to differentiate their certification programmes from so called 'proprietary' organisations, indicating the rather chaotic situation in e-skills certification caused by a multitude of qualification and training programmes (eSCC, 2004, p. 18). This perception is supported by the respondents (see Figure 5) and underlines the current difficulty individuals may encounter when asked to choose between existing qualification and training programmes.

([15]) The e-skills certification consortium (eSCC, 2004) proposes possible ways forward towards recognised e-skills certification and multistakeholder-partnerships.

As shown in Figure 4, certification systems are a constituent part of a larger system (qualification and training). E-skills certification at foundation level will continue to be a door-opener to positions – and the 'must have' set of credentials that validates the individual's mastery of a set of vendor-neutral industry standards and vendor-specific operational details – and a reliable predictor of employee success. Certifications are increasingly seen to become validation milestones along a road of continuous improvement (Venator, 2004).

Figure 5: Multitude of available e-skills certification schemes



Certification is the end point of a training process (Venator, 2004) 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 (IT Sector Committee, 2004). Certification results from a voluntary evaluation process whereby an individual's knowledge and/or skill in a particular area of interest are validated against a set of predetermined skills requirements, e.g. skills standards, by objective assessment (eSCC, 2004, p. 17; GIS, 2004) ([16]). Accordingly, certifications are part of a larger system issuing credentials for achieved learning objectives and outcomes. Today, an ICT worker has to fulfil constantly changing and increasing qualification requirements. Employers prefer to see multiple certifications, but also demand complementary extensive experience; academic credentials; related business, communication and project management skills; outstanding references; and a track record of success (Venator, 2004).

Certifications are typically, though incorrectly, confused with certificates. The latter relates to the documentation of successful completion of a learning programme or class, but lacks reference to skills requirements or standards and wide recognition of industry stakeholders (eSCC, 2004, p. 18). This implies a market value associated with certification programmes as a consequence of existing demand for specific certifications and associated performance expectations by employers.

([16]) Certification is career recognition through the evaluation and approval of individuals engaged in a specific occupation or profession. Professional certification has expanded significantly over the past decades (GIS, 2004).

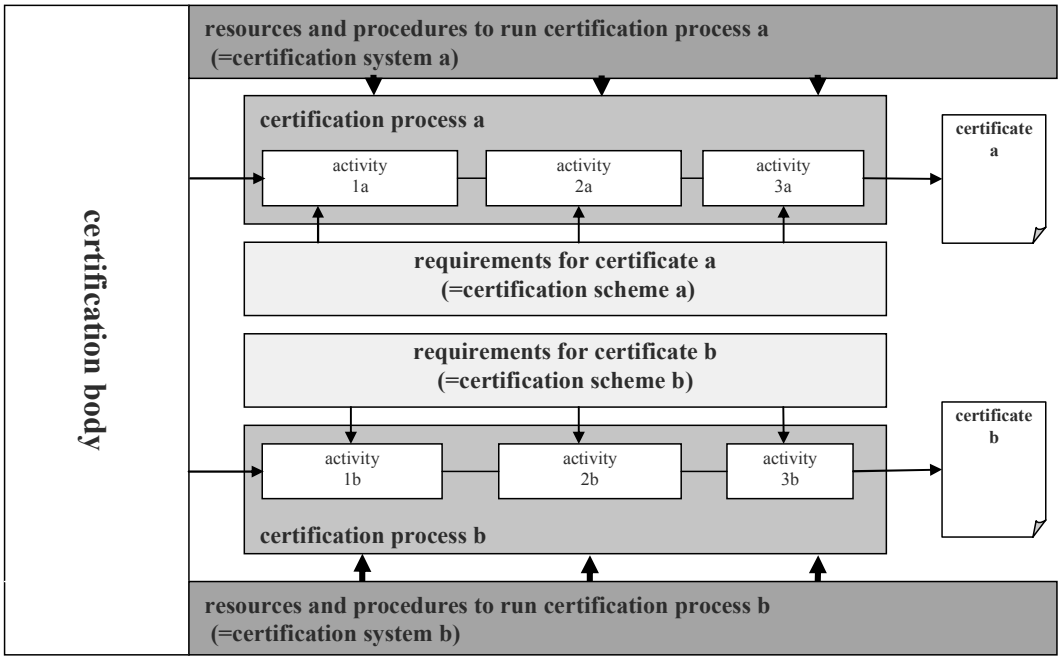
In general, e-skills certifications are granted by professional associations, firms, trade and/or industry associations, or proprietary organisations. At the end of the certification process, individuals obtain formal proof of successful attainment of required knowledge and skills for a specific role or job (eSCC, 2004, p. 17).

A brief history of the ICT certification landscape has been carried out by eSCC (2004, p. 19 et seq.). The ICT certification landscape blossomed in the 1990s owing to the tremendous demand for skilled ICT workers. However, it is necessary to distinguish between situations where certification programmes for individuals are justified and situations where other forms of qualification are more appropriate (Facklam, 2002). From a learner's perspective, the rationale is consequently to select on the basis of cost and market recognition (value) the 'right' certification for his/her professional development. It is important to note that, in general, passing assessment(s) or running through a certification process should not be seen as a necessity for an individuals' career development.

The certification process itself is based on a supporting mechanism provided by certifications and procedures. Hence, they have to be the subject of analysis and are to be closely looked at to validate and determine the degree of market recognition (eSCC, 2004, p. 18). Supporting mechanisms are primarily: defined skill standards; the process for accrediting curricula and learning material; validation of corresponding assessment tools; objectivity of administration protocols; reliability of protocols for ensuring security of data; and mechanisms for tracking compliance, candidate verification and recertification.

Available quality standards such as ISO/IEC 17024 (2004) define general requirements for bodies operating certification of individuals. Figure 6 illustrates the subject covered by the normative document of the standard. Principally, these are the certification system, programme and process.

Figure 6 The system of e-skills certification



Source: Partly based on ISO/IEC 17024, 2004.

2.3.1. Certification system

A certification system summarises the set of procedures and resources for carrying out the certification process, leading to the issue of a certificate of competence by the certifying body and including maintenance as one of the envisaged management activities (ISO/IEC 17024, 2004) (see Figure 6). The certification system normally follows specific policies supporting quality and market recognition, including the operation of specific procedures by means of required resources. In contrast to other types of conformity assessment bodies, such as management system certification/registration bodies, one of the characteristic functions of the personnel certification body is to conduct an examination which uses objective criteria for competence and scoring. It is recognised that such an examination, if well planned and structured by the certification body, can substantially serve to ensure impartiality of operations and reduce the risk of a conflict of interest (ISO/IEC 17024, 2004). In addition, the organisation shall operate a management system which is documented and covers all the requirements of an international standard, e.g. ISO/IEC 17024 (2004), and ensures the effective application of these requirements.

2.3.2. Certification programme

A certification programme specifies certification requirements related to selected categories of persons to which the same particular procedures, standards and rules apply. Many certification programmes are initiated in the form of job profiles which provide a skill set required, for example, for a specific ICT practitioner occupation. It comprises a certificate as a credential, a certification body, requirements of skills defined in profiles, and accompanying policies, e.g. security, confidentiality, impartiality and fairness. The certification process is part of a certification programme and includes such activities as development, maintenance, decision and use of certificates, etc.

Certification of persons is one means of providing evidence that the certified person meets the requirements of the certification scheme. Confidence in the respective certification programmes is achieved through an internationally accepted process of assessment, subsequent surveillance and periodic reassessment of the competence of certified persons. The development of new certification programmes, in response to the ever-increasing velocity of technological innovation and growing specialisation of personnel, may compensate for variations in education and training and thus facilitate the global job market. If commonly accepted and agreed occupational frameworks are used to develop certification programmes, it is a precondition that comparability and transferability are achieved.

The certification body shall appoint a scheme committee (ISO/IEC 17024, 2004), which shall be responsible for developing and maintaining the programme for each type of certification being considered. The programme committee shall fairly and equitably represent the interests of all parties significantly concerned with the certification programme, without any particular interest predominating. Where a certification programme is developed by organisations other than the certification body, the respective developer of the programme shall adhere to the same principles.

2.3.3. Certification process

The certification process comprises all activities by which a certification body establishes that a person fulfils specified competence requirements, including application, examination, evaluation, decision on certification, appeal, complaint, surveillance and recertification, use of certificates and logos/marks. The certification body shall provide, on request, a detailed and up to date description of the certification process, appropriate to each certification programme (including fees), and the documents containing the requirements for certification, the applicants' rights, and the duties of a certified person, including a code of conduct. Core activities to be handled by a certification body are as follows.

Application: the certification body shall require the completion of an application, signed by the applicant seeking certification, which includes the scope of the desired certification and a statement that the person agrees to comply with requirements of a desired certification. The candidate has to agree that he/she is willing to supply any information needed for the

evaluation, details of relevant qualifications, confirmed and supported by evidence. It is foreseen that the application activity will record general information on the applicant, for example name, address and other information required to identify the person.

Evaluation: this is realised in the form of an assessment that a person fulfils the requirements of the certification programme, leading to a decision on certification.

Examination: this is understood as a mechanism that is part of the evaluation, which measures a candidate's competence by one or more means such as written, oral, practical and observational.

Development: the certification body shall define the methods and mechanisms to be used to evaluate the competence of candidates, and shall establish appropriate policies and procedures for the initial development and continued maintenance of these methods and mechanisms.

Use of certificates: a certification body that provides a certification mark or logo shall document the conditions for use and shall appropriately manage the rights for use and representation. This activity foresees that the certified person signs an agreement regulating how to use the issued credential in accordance and conformity to these conditions.

Surveillance and recertification: the certification body shall define a proactive surveillance process to monitor the candidate’s compliance with relevant provisions of the certification programme. Moreover, the certification body shall define recertification requirements according to the competence standard and other relevant documents, to ensure continuity so that the certified person continues to comply with the current certification requirements.

Decision of certification: the decision to certify a candidate shall be made solely by the certification body on the basis of the information gathered during the certification process. Those who make the certification decision shall not have participated in examining or training the candidate. The certification body shall provide a credential (e.g. certificate) to all certified persons. The certification body shall maintain sole ownership of this credential. The credential may take the form of a letter, card or other medium, signed or authorised by a responsible officer of the certification body. If a certificate is issued as a credential it shall, for example, contain, as a minimum, the following information:

(a) name of the certified person and a unique certification number;

(b) name of the certification body;

(c) reference to the competence standard or other relevant documents, including issues, on which the certification is based;

(d) scope of the certification, including validity conditions and limitations;

(e) effective date of certification and date of expiry.

2.4. Definition

As already apparent, certifications are based on definitions of skill requirements, in turn based on skills standards and frameworks (eSCC, 2004, p. 18). These definitions deliver performance specifications that identify the knowledge and skills an individual needs to succeed in the workplace ([17]). In this way, it defines what a person must know and be capable of successfully to perform roles related to a specific job. In this context, the challenge is to assess the relevant qualifications required in a specific work process and to derive from this the qualification required by ICT workers (Mattauch and Caumanns, 2003, p. 36) broken down into knowledge, skills, and competences. This procedure allows job profiles to be transferred into concrete and well-defined learning objectives. The availability and knowledge of learning objectives are prerequisites for informal learning (self-directed learning processes) and thus lifelong learning. Definitions of requirements have to be synchronised with certification programmes at regular intervals. These programmes provide specific certification requirements related to specific categories of persons to which the same particular standards and rules, and the same procedures, apply (Facklam, 2002). Certification programmes should not be confused with, and are not necessarily the same as, definitions, e.g. job profiles. Definitions are provided by organisations independent from certifications. The job profiles defined by the Career space consortium ([18]) serve as an example.

2.4.1. Qualification

Qualification demonstrates personal attributes, education, training and/or work experience (ISO/IEC 17024, 2004). It is shown in the form of credentials (e.g. certificates or diplomas) or other evidence linked to the delivery and assessment of training received ([19]). Qualification is the outcome of specific training, education, work experience and shows a significant interdependency with the personal attributes of an individual. Qualification summarises knowledge, skills, and capabilities which are required by specific activities of a job or daily life. From an employer's point of view, the notion is associated with effectiveness gained by an individual in the production process. From an individual's point of view, qualification is a precondition for successful occupation and job fulfilment, because the status of development influences his/her market opportunities and thus his/her labour market value. The development of key qualifications is directly connected to compliance with specific occupational and academic requirements (Schaub and Zehnke, 2000, p. 448).

([17]) Spill, R. (2002) cited according to eSCC, 2004, p. 18.

([18]) Information about Career space is available at http://www.career-space.com [cited 12.11.2004].

([19]) Cedefop. draft final report: Towards a comprehensive European level e-skills framework, p. 101, restricted report for CEN/ISSS ICT skills workshop, May 2004.

2.4.2. Knowledge, skills, competence

Various definitions of knowledge, skills, and competence can be found in literature. For the purpose of this report, some basic definitions are cited without introducing new definitions or to recapitulate and summarise the variety of available definitions. Interested readers are recommended to refer to referenced material for discussion of the basic terms.

2.4.2.1. Knowledge

Knowledge and information are seen as new economic factors of production in the knowledge society (Mattauch and Caumanns, 2003, p. 23). The notions 'knowledge worker' and 'knowledge company', in this context, reflect the importance of knowledge in today's value creation processes in industry. In particular this applies in knowledge intensive environments such as ICT or those applying ICT intensively. In the future, it is predicted that shortages in these resources will jeopardise continuous economic development and progress. Knowledge is acquired through learning processes and is about facts and social interrelations (Schaub and Zehnke, 2000, p. 316). Knowledge summarises the capabilities and skills applied by individuals to provide solutions for specific problems (Probst et al., 1997, p. 44). A variety of definitions is provided by knowledge management literature ([20]). Two major categories for knowledge are explicit and implicit. Explicit knowledge can be accessed and transferred by other individuals; implicit knowledge is bound to the personal capacities and experience of a certain individual. Additionally, knowledge can be categorised into 'know-what' and 'know-how' (eSCC, 2004, p. 47).

2.4.2.2. Skills

Skills are defined as capabilities, definable by content, to be acquired and activated through related professional training. In this context, capabilities are the physical or psychological attributes of an individual to be applied in activity-related approaches (Schaub and Zehnke, 2000, p. 206).

2.4.2.3. Competence

Competence is a comprehensive expression and it is difficult to build systematic categories (Olbert-Bock, 2002, p. 74f.). Cedefop defines competence as the 'ability to apply knowledge, know-how and skills in an habitual or changing situation' (Tissot, 2004). The term describes the ability to put knowledge and skills into practice. Competence relates to the availability of possible actions or activities of an ICT worker and goes beyond the defined content of knowledge and skills. Competence comprises the ability of an individual to acquire

([20]) Data and information are transformed into knowledge if the individual is able to reason and apply it within a specific professional context. Data is transferred to information by linking to a specific context; information is transferred to knowledge based on experience and individual's intellectual and mental capacity.

autonomously new knowledge and skills on demand. This implies adopting the lifelong learning paradigm and implementing an adequate organisational culture (Behrmann and Schwarz, 2003, p. 20) continuously to acquire knowledge, skills and new capabilities. Important subcategories to be delineated are professional competence ([21]), methods competence ([22]) or expertise, social competence ([23]) and reflection competence ([24]). Competence in a field depends on an individual's capabilities to both name and explore what could be described as tacit knowledge, and to make use of it unthinkingly in appropriate circumstances (Infed, 2004). Competence is the set of capabilities that people in a particular occupation need to have, to perform reliably and consistently that role to an adequate level of performance (the term is therefore close to, and often used in, this context interchangeably with skills) (Stucky et al., 2003). Another definition (ISO/IEC 17024, 2004) uses the term competence as the ability of a person to be certified to apply knowledge and/or skills and, where relevant, demonstrate personal attributes, as defined in the certification scheme. Competence consists of personal attributes, individual knowledge and acquired skills. The notion secures flexibility and provides alternatives and therefore constitutes the capabilities of an individual to act and decide independently in occupation and daily life (Schaub and Zehnke, 2000, p. 448).

2.4.3. E-skills

E-skills are the nucleus, the core concept of our model, and are therefore discussed more broadly. It is difficult to provide a comprehensive and widely accepted definition of e-skills as definitions vary significantly ([25]). However, for this report the following definition is applied mainly based on the European e-skills forum.

'The term 'e-skills' encompasses a wide range of capabilities (knowledge, skills and competences) and issues with an e-skills dimension span over a number of economic and social dimensions' (European e-skills forum, 2004).

Stucky et al. (2003) developed an IT competence maturity model and categorised e-skills according to five degrees: IT awareness (basic knowledge); IT literacy (knowledge to operate

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([21]) Previous knowledge of working content and related tools and methods (Olbert-Bock, 2002, p. 75).

([22]) Formal, logical and informal aspects of methods to be applied in the working context and related handling of knowledge and skills (Olbert-Bock, 2002, p. 75).

([23]) Social interaction with colleagues and human beings in general comprising, e.g. sensibility, abilities to communicate, cooperate, implement, conflict resolution, etc. (Olbert-Bock, 2002, p. 75).

([24]) Capability to link to immediate coherences and derive new knowledge and skills (Olbert-Bock, 2002, p. 75).

([25]) E-skills are distinguished in different ways, e.g. ICT professional skills, applied ICT skills and digital literacy or basic ICT skills (Eurostat, 2003, p. 15f). For other categorisations and definitions see EITO (2001), EITO (2002), European e-skills forum 2004 (definitions); European e-skills forum, 2004 (the e-skills definitions and the four issues papers); European e-skills forum, 2004 (synthesis report); ICT skills monitoring group, 2002; OECD, 2004.

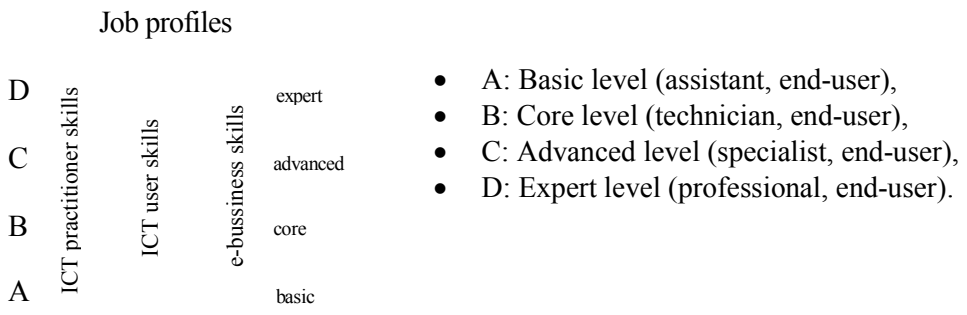
a PC); expert user (special knowledge/expertise with application software, helping other users); professional entry level (professional knowledge); and professional level IT skills (advanced professional knowledge). While the categorisation is satisfactory for the model, it does not provide the required granularity of classification for this study task. Thus, the classification is advanced by distinguishing three main categories as proposed by Stucky et al., (2003), European e-skills forum (2004).

2.4.4. ICT practitioner, end-user and e-business skills

The term e-skills includes ICT practitioner skills, ICT end-user skills and e-leadership or e-business skills (European e-skills forum, 2004). In general, the term skills is used as the set of requirements needed by employers from those who are capable of satisfactorily fulfilling an occupational role (Stucky et al., 2003).

ICT practitioner skills comprise the capabilities required for specifying, designing, developing, installing, operating, supporting, maintaining, managing, evaluating and researching ICT systems, for the benefit of others. ICT end-user skills include the capabilities required for an effective use by the individual user of ICT systems and devices, for whatever purpose. ICT end-users make use of the systems as tools in support of their own work, which is, in many cases, not ICT. End-user skills cover basic digital (or ICT) literacy, the utilisation of common (generic) software tools in an office environment, and the use of specialised tools supporting major business functions within a large number of user sectors. The third category to be distinguished is e-business skills. This category of skills summarises the capabilities needed to exploit the strategic opportunities provided by ICT (in particular, the Internet) for specific industry or societal sectors. E-business skills are strategic and innovation-management skills, but not technology-management skills which are part of ICT practitioner skills. E-business skills contain elements of both ICT practitioner and end-user skills, but in addition they contain a significant element of generic (non-sector specific) non-ICT skills ([26]). Thus the distinction between the categories introduced is not strict. There is an overlap between the categories as illustrated in Figure 7.

Figure 7: E-skills by categories



([26]) A comprehensive overview of the categories of e-skills is provided by European e-skills forum, 2004.

Further, within these categories, e-skills are categorised by four different levels (the related qualification level is indicated for both ICT practitioner and (end-) user level) ([27]). In literature, the definition of skills categories is not consistent and there is a variety of existing definitions. Consequently, this report intends to compromise to find the right granularity on the basis of material and literature available (eSCC, 2004, p. 21 et seq.; European e-skills forum, 2004, p. 4 et seq.; Petersen et al., 2004, p. 51 et seq.; Castelli, 2004, p. 36f; eSCC, 2004, p. 67f). Use of the levels A, B, C, D is not binding, but a straightforward approach, applying four vertical categories, to investigating e-skills certification indicated on questionnaires. In contrast, the SFIA model uses seven different levels of skills ([28]) which were found too explicit for the survey task. The respondents were asked to characterise widely applied e-skills certification systems in their countries according to these categories without differentiating between the horizontal dimensions (see Figure 7).

2.5. Learning process

Learning content has to be continuously adapted to changing requirements by employers and individuals (Mattauch and Caumanns, 2003, p. 33). Individuals are increasingly confronted with a growing demand from industry and society for continuous self-directed learning (Behrmann and Schwarz, 2003) and informal learning. As a result, the number of training programmes is steadily increasing, as is access to and provision of learning content. The concept of certification is seen to be of growing importance as a means of assessing an individual's informal learning outcome and producing evidence of individual's achievements in lifelong learning.

Individuals acquire relevant knowledge and skills by undertaking learning and training activities: testing, in the sense of assessment of achieved individual competences, is an important aspect. Testing and certification are strictly differentiated. Testing is assessing a person who meets defined requirements imposed by a specific qualification. The requirements are predefined by job profiles.

Testing can be part of conformity assessment or evaluations (examination) within a certification system, but does not compulsorily refer to an existing norm or standards. Certification demands impartiality and must consequently be independent of training providers and test centres. Therefore it has to be decoupled from the premise of attending training courses (IT Sector Committee, 2004). Training programmes should build e-skills.

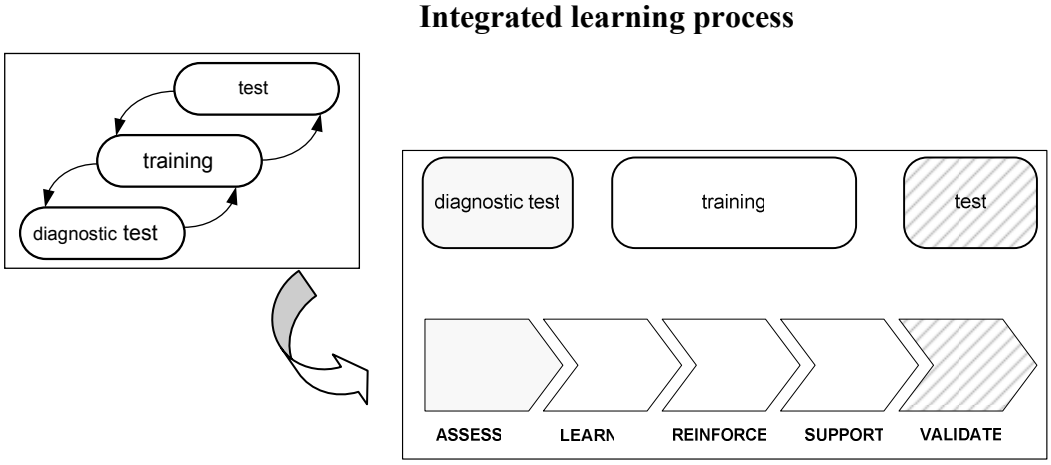
([27]) The term ICT end-user skills emphasises that the term refers to user skills which do not overlap with practitioner skills.

([28]) The SFIA model applies the levels (1) follow, (2) assist, (3) apply, (4) enable, (5) ensure, advise, (6) initiate, influence, (7) set strategy, inspire, mobilise. Those categories imply the third dimension expertise and e-business skills not explicitly. SFIA puts skills into their business context by an additional dimension of five categories: strategy and planning, management and administration, sales and marketing, development and implementation and service delivery (SFIA, 2003).

Certification programmes should guarantee skill levels; in addition, the learning process does not need to be completed by certification. Evaluation, and hence examination, by a certification system is optional and voluntary for individuals. This perception is displayed in Figure 4.

Diagnostic testing assesses the needs for training of an individual. This form of test determines the degree of knowledge and skills of a candidate. In addition, training providers offer counselling interviews for recommend training courses or identify and agree upon learning objectives. Therefore, in the integrated learning process, this activity refers to the process step 'assess' (see Figure 3).

Figure 8: Learning process by modules and process steps



Source: Partly based on New Horizon Computer Learning Centers, 2004.

The process steps 'learn', 'reinforce', 'support' build the module 'training'. Knowledge and skills are acquired by learning methods supported by learning content and media. Individuals secure their knowledge and skills by means of learning material and repetition of learning content to meet the defined learning objectives. The training provider offers support to students in the form of a help desk or moderated communities of practice to answer questions concerning the learning content.

The last activity in the sequence shown is validation of learning objectives met by the student based on the learning outcome ('validate'). The learning outcome and candidate's competence is measured by one or more examination. Examinations are web-based, oral, practical and observational. Testing is offered by test centres which are possibly part of a training centre. The effectiveness of the learning process is influenced by the following dimensions (Infed, 2004): training and motivation, quality and relevance of materials and reinforcement of literacy.

2.5.1. Training

Today, individuals, and in particular ICT workers, require continuous learning and upskilling owing to shortening technological lifecycles and resulting decay of knowledge and e-skills. Lifelong learning requires a flexible qualification and training system: the learner stands in the middle of this system acquiring knowledge, skills, and competences. The traditional ways of acquiring knowledge and skills are still predominant, but new learning concepts, e.g. self-directed learning and informal learning, have become increasingly popular. Personal preferences impact on and influence each individual's learning experience. Therefore, they should be well considered by students and teachers during the planning phase (Tittel, November 2004). Hence, the success and motivation of training depends on the right selection of learning methods and styles, study materials, etc. according to the learner's personal preferences.

2.5.1.1. Learning programmes

A variety of learning models and derived programmes is available for individuals who are willing to pass e-skills certification (Tittel, November 2004). The guiding principle is that different people learn best in different ways. However, learning programmes are often directly aligned with various e-skills certifications. Training material and courseware is created by education and training providers which are often completely independent of certification providers or, in some cases, accredited (e.g. EUCIP) ([29]) or developed by e-skills certifications providers (e.g. Microsoft) and used by accredited and/or authorised training providers (eSCC, 2004, p. 23). Self-directed learning has gained significantly in popularity in the last decade (Infed, 2004; Behrmann and Schwarz, 2003; Mattauch and Caumanns, 2003, p. 37). It can be seen as people teaching themselves through conversation, through constructing some sort of learning plan, or by following programmes of learning constructed by others (e.g. courseware, e-learning, etc.) (Infed, 2004).

2.5.1.2. Training blend

eSCC (2004, p. 25) argues that the type of training is blended according to the type of e-skills certification (defined by level of expertise). The learning content for base and high-level certificates is predominantly delivered through formal learning environments (instructor-led classes). Content required for certification, particularly mid-level, is delivered through informal learning (e-learning, computer- or Internet-based training). Consequently, e-skills certification systems can be distinguished by source, delivery method for available courseware and the individual's access to learning content. Blended training allows choice of the right learning method and media to support different steps in the learning process. Training programmes should, therefore, be a combination of traditional and media-based

([29]) European Certification of Informatics Professionals: http://www.eucip.com.

learning in orientation towards defined learning objectives (Mattauch and Caumanns, 2003, p. 37).

2.5.1.3. Learning methods and styles

Literature offers a multitude of contributions in the form of learning models, styles, etc. This report intends not to repeat the available material. As e-skills certification aims to assess a person's fulfilment of predefined requirements (Facklam, 2002), learning methods and styles have significant influence if these requirements are to be met. A good introduction and overview of fundamental learning methods is provided (Infed, 2004) to which the report in the following mainly refers (see Table 2).

Formal learning stands for 'traditional' learning environments and hierarchically structured chronological learning systems (education, academic studies, a variety of specialised programmes and institutions for full-time technical and professional training) (Infed, 2004). Learning takes place in the form of physical, face-to-face, teacher-centred classroom training (instructor-led training).

Non-formal learning is learner-centred and provides learners with more flexibility. It includes any organised educational activity outside the established formal system. The education provided is in the interests of the learners, and curriculum planning is preferably bottom-up undertaken by the learners themselves. But other examples of non-formal programmes are common. Almost all employer-led and state-provided training falls into this category. Informal learning (or education) is the truly lifelong process whereby every individual acquires attitudes, values, skills and knowledge, from daily experience and influences, by training environment and training resources (public courseware, training material, library, books, mass media, etc.) in the individual's environment. Non-formal and informal learning are more difficult to distinguish.

Table 2: Ideal type models of normal and non-formal education

	formal	**non-formal**	**informal**
purposes	long-term and general credential-based	short-term and specific, non-credential-based	situated learning, specific, activity- and experience-based
timing	long-cycle/preparatory/full-time	individualised/output-centred	individualised
content	standardised/input-centred	individualised/output centred	individualised, contextualised
	academic	practical	practical, tacit knowledge
	entry requirements determine clientele	clientele determine entry requirements	individual interests and needs

delivery system	institution-based, isolated from environment	environment-based, community-related	community-related, work context, collaborative, collegial
	rigidly structured, teacher-centred and resource intensive	flexible, learner-centred and resource saving	flexible, informal ways, non-course based
control	external/hierarchical	self-governing/democratic	self-directed
curriculum formation	top-down	blended: top-down or bottom-up	bottom-up
	set curriculum	negotiated curriculum	non-curriculum, conversation based, interest and needs

Source: Partly based on Infed, 2004.

Formal education is linked with schools and training institutions; non-formal with community groups and other organisations; and informal covers what is left, e.g. interactions with friends, family and work colleagues or communities of practice. Informal learning is defined as 'learning which takes place in the work context, relates to an individual's performance in their job and/or their employability, and which is not formally organised into a programme or curriculum by the employer. It may be recognised by the different parties involved, and may or may not be specifically encouraged' (Infed, 2004). Other definitions emphasise learning that takes place outside a dedicated learning environment, non course-based learning activities, (which might include discussion, talks or presentations, information, advice and guidance) provided or facilitated in response to expressed interests and needs. In addition, there is planned and structured learning, based on identified interests and needs, which is delivered in flexible and informal ways and in informal community settings.

Another view of informal learning is implicit learning (Infed, 2004) aimed at the acquisition of tacit knowledge ('that which we know but cannot tell') as a learning result. Informal learning is linked to situational learning. Learning in this sense is understood as being internal, or 'within the soul' of individuals (Infed, 2004). Educators that are largely working around conversation can be seen as informal; those working through set curricula are formal.

2.5.1.4. Learning and preparation material

Many different materials are available to prepare for e-skills certification. In spite of the past downturn and recent consolidation of the ICT sector, the certification market remains a profitable business. A good overview is provided of the most essential and most frequently chosen elements in a typical collection of certification preparation materials (Tittel, June 2004).

The most convenient approach for learners is to obtain a so-called all-in-one training package. These packages include access to online or computer-based training, audiotapes, question/answer collections and various kinds of books and exam guides ([30]). The prices for these training packages vary. More expensive packages sometimes come with money-back guarantees, e.g. for certification exams or the cost of the materials themselves. Additionally, instructor-led classroom training is offered. Individuals have many options, ranging from costly commercial training, or boot camps, to classes at local community colleges or other education programmes. Further, a variety of collaborative and collegiate learning environments exists, e.g. user groups, study cells, online-communities, etc. These communities are formed by individuals who are studying for the same exams and are strongly recommended by certified ICT workers. Virtual certification communities are strongly recommended for learners to get answers to tough questions and benefit from interaction with colleagues (Tittel, June 2004).

Online training combines the features and benefits of the classroom with self-paced reading assignments, labs and practice tests. In general, online training is cheaper than classroom training, but does not provide as many benefits. Options available for learners range from expensive training outlets or educational conferences to low-cost (or free) video-based training providers.

Practice tests (or diagnostic tests) offer the best form of readiness assessment available. Apart from the purpose of identifying training needs and defining learning objectives, passing practice tests should mean passing the evaluation process of the e-skills certification system.

Publication bundles are popular for multi-exam certifications such as offered by Microsoft, Cisco, etc. Most commonly, these bundles cover core or common topics. Study guide books are a key element in a preparation package. These books are designed to deliver background information and to cover general concepts and technologies. Popular programmes offer a variety of different study guides: individuals choose from these programmes and create their own learning set (Tittel, June 2004).

2.5.2. Test

Certifications provide documentation in a formal way, that an individual has met predefined performance specifications. Having successfully passed the required assessment(s), the individual receives a credential. Assessment or testing is an important part of the e-skills certification process. Testing is a means of providing information about an individual's standing with respect to a specific set of knowledge, skills, and competence as defined by a specific job profile or occupational role (eSCC, 2004, p. 18) For this reason, testing is a critical task that influences strongly the degree of recognition by relevant stakeholders.

([30]) Focused books that stick closely to examination topics and sample questions.

According to eSCC 'assessments must be reliable, valid, objective, unbiased, and criterion-referenced' (eSCC, 2004, p. 18).

One added benefit of a good test is the nature of training and learning the content which the test covers. If the test measures knowledge, then accompanying books and manuals should be helpful in preparing for the test. If the test measures specific job skills, then on-the-job experience, working with simulations and gathering of other types of experience, will be the most effective way to prepare (Foster, 2004). Psychometrics is the science that underlies testing. Question quantity and question quality are two very important aspects of testing that are required for testing to work. If an e-skills certification test is bad, it is most likely because of a problem in one or both of these aspects.

Diagnostic tests are important for individuals prior to the final exam and for preparing for a specific e-skills certification scheme. Recognition of the issued credential depends on the anticipated quality of the final examination tests by the community (Stevens, 2004). E-skills certification providers make great efforts to educate programme participants about the importance of security issues. The aim is to prevent test cheating and exam piracy. Therefore, certification providers create stronger policies for non-disclosure of confidential test information, testing retakes and certification revocation. An example of an offering of diagnostic testing is Microsoft's skill assessment programme ([31]).

Certification providers normally tend to increase the certification programme's value by making sure that the right individuals are certified and that the test content is not compromised (Stevens, 2004). Hence, certification bodies typically conduct data analysis of exam results and develop strategies for minimising programme risks through better test security practices. Nevertheless, communities of learners are an important means for individuals to prepare for certification. Providers monitor the activities of Internet communities, e.g. by combing the Internet to identify test brain-dump sites (Stevens, 2004). Good test content means questions that reasonably measure the appropriate knowledge, skills, or competence.

([31]) http://www.microsoft.com/learning/assessment/default.asp, [cited 24.11.2004].

Table 3: Overview of test methods

test / criterion	web-based	oral	written	document analysis	observation
objective purpose	assess skills, knowledge	interview, interaction, personal attributes	skills and knowledge	project, process-orientation, situative	competence, experience, tacit knowledge, learner centred
content	50-70 questions, multiple-choice, test base	questions learning material, set curriculum, knowledge	open and closed questions, case studies, multiple-choice	outcome project, working process, skills	competence, behaviour, skills
delivery system	Internet, standardised, test centres	audit, educator	paper	paper, review	audit, experiment
control	central	central	central	decentral	decentral, self-directed
response	synchronous	synchronous	asynchronous	asynchronous	asynchronous
system	formal and non-formal	formal, non-formal	formal learning	formal, non-formal	non-formal informal
example	vendor certificates, EUCIP	higher education, university, vocational training, certification, e.g. German AITTS	higher education, university, vocational training	certification, e.g. AITTS	vocational training

Source: Partly based on Behrmann and Schwarz, 2003, p. 244 and Foster, 2004.

However the questions are, whether multiple-choice or some other type, the primary test to capture what the candidate knows or is able to do in conformity with the chosen e-skills certification scheme. Unfortunately, many examinations fail to measure the abilities they claim to test (Foster, 2004).

In e-skills certification, which is heavily dependent on job skills, the tests tend to use questions that measure memorised information, asking for facts and definitions rather than a demonstration of skills. Thus, some tests appear to be irrelevant and overpriced. Even when the test questions are good, there still needs to be a sufficient quantity to get a reliable score. Just asking a person one question, even an excellent question, is inadequate. A test needs, roughly, between 50 and 70 questions to produce a good score (Foster, 2004). With too many questions, money and time are wasted (Foster, 2004). In practice, tests are centrally operated by the certification provider or an accredited test provider. They are based on a test base with a collection of possible questions and topics to be queried. Alternatively, tests consist of a review of documents produced by the candidate and/or oral examination (interview) on the basis of this documentation (Behrmann and Schwarz, 2003, p. 244).

Before a candidate is able to run through the examination, it has to be checked that the candidate meets the requirements for admission to the certification scheme. The test typically combines testing methods shown in Table 3. A good overview of evaluation methods in self-directed learning environments is given by Behrmann and Schwarz (2003, p. 231-257).

2.6. Education and work experience

Education and work experience are the two framing antipoles in the model used to structure e-skills certification (see Figure 4). Becoming an ICT worker requires both learning know-how and know-what, in addition to continuous professional development (eSCC, 2004, p. 47) ([32]). Required education and work experience are defined and documented in specific job profiles or occupational roles: this refers to 'definition' in the aforementioned model. Education and work experience are the basis for developing training courses and content.

2.6.1. Education

Education lays the foundation for the initial transfer of core knowledge and basic understanding (know-how) of ICT workers. Typically, this is the first step of an ICT worker on the career path. Education teaches concepts, theories, and problem-solving capabilities; it also constitutes the prerequisite to training in specific job requirements. Credentials in the form of degrees obtained by students are widely recognised and typically valid for life. Following a traditional linear education and training model, ICT workers obtain their first qualification with relevance for employment solely from education. After entering into the ICT profession, core knowledge and skills are continuously expanded (eSCC, 2004, p. 48). Individuals gain work experience and necessary competences through their occupational roles and preferably gain and expand specialised knowledge and skills.

2.6.2. Work experience

Work experience is continuously gathered by individuals fulfilling their occupational roles, from the daily working process, but also from informal learning and continuous professional development. Without doubt, evidence of relevant working experience is important for current and future employability (eSCC, 2004, p. 48 et seq.). If a candidate has a necessary qualification for a specific job, this does not necessarily imply that he possesses the required competences to fulfil his professional role. Therefore, recent, relevant, extensive experience for an ICT worker is a major hiring criterion of employers, followed by applicable formal education as a means of growing and expanding knowledge and skills.

([32]) See Section 2.4.2.1.

2.7. Quality standards

Quality standards are provided by independent standardisation bodies and sector associations, supplied as normative documents. *De facto* standards are offered by public and/or private industry initiatives and are achieved through broad acceptance of stakeholders in a specific sector/field. Quality standards are distinguished accordinjg to the subjects covered, e.g. process, method and content. Organisations offering certification recognise two international standards:

(a) EAC EN 45013: European standard for bodies operating certification of personnel;

(b) ISO/IEC 17024: ISO norm 'Conformity assessment – general requirements for bodies operating certification for persons'.

What follows is based on ISO/IEC 17024. The standard is international and has been drawn up with the objective of achieving and promoting a globally accepted benchmark for organisations offering certification (ISO/IEC 17024, 2004).

In an ideal case, applied quality standard(s) should be the basis for the certification bodies and their schemes, to promote acceptance at national and international level. One immediate approach to harmonising e-skills certifications is to assess underlying systems for developing and maintaining certification schemes. This is likely to establish the environment for mutual recognition and the global exchange of personnel. Quality management in further education and vocational training focuses, in particular, on organisation, learning infrastructure, training and teaching, and the process of learning itself. Primarily, the certification body has to develop its own quality policy, implemented by means of quality models or concepts. In addition, certification bodies should derive a related mission statement to be followed by all persons involved (Ehses and Zech, 2002).

2.7.1. Organisation of certification bodies

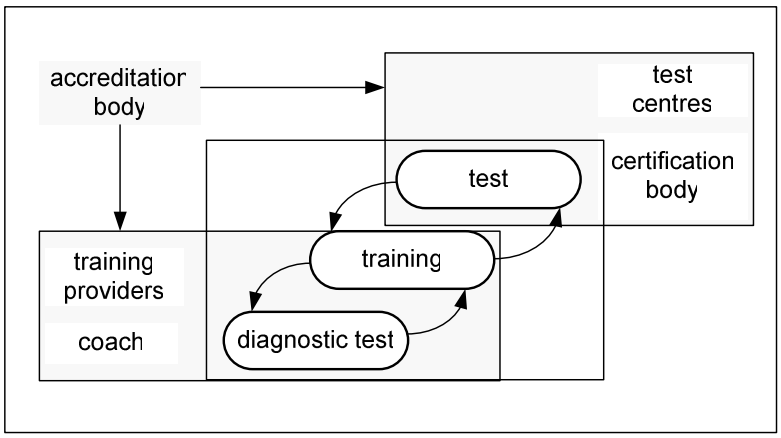
According to the ISO/IEC normative document, the certification body shall have a documented structure which safeguards impartiality, including provisions to assure the impartiality of the operations of the certification body. This structure shall enable the participation of all parties significantly concerned in developing policies and principles on the content and functioning of the certification system, without any particular interest predominating. The imposed requirements are seen as general requirements for bodies operating certification schemes and therefore may have to be supplemented in response to additional market needs by supply or demand side or specific regulations and government requirements (ISO/IEC 17024, 2004). In the case that certification bodies decide to subcontract work related to certification (e.g. examination, testing) to an external body or person, a properly documented agreement is recommended; this should include confidentiality and prevention of a conflict of interest. Decision on certification shall not be subcontracted under any circumstances. In general, the assessment of conformity of an object

of interest with specific obligatory or voluntary standards is subject to further activity called accreditation.

2.7.2. Accreditation

The purpose of accreditation is to assess if a certification system is in conformity with predefined set of requirements or standards, e.g. ISO/IEC 17024. Inspection bodies are in charge of accreditation. Figure 9 maps the aforementioned learning system to existing roles and organisations involved. The delineation is not presumed to be strict, as, for example, the training provider and test centre in practice might belong to the same organisation. However, to put accreditation bodies in place is an important prerequisite for mutual recognition of e-skills certification by stakeholders in the sector or industry branch. The accreditation task can be assigned to certification providers or to independent third parties. Certification bodies are primarily in charge of approving whether specific training courses fulfil requirements imposed by the certification scheme.

Figure 9: Subject of accreditation activities by e-skills certification bodies



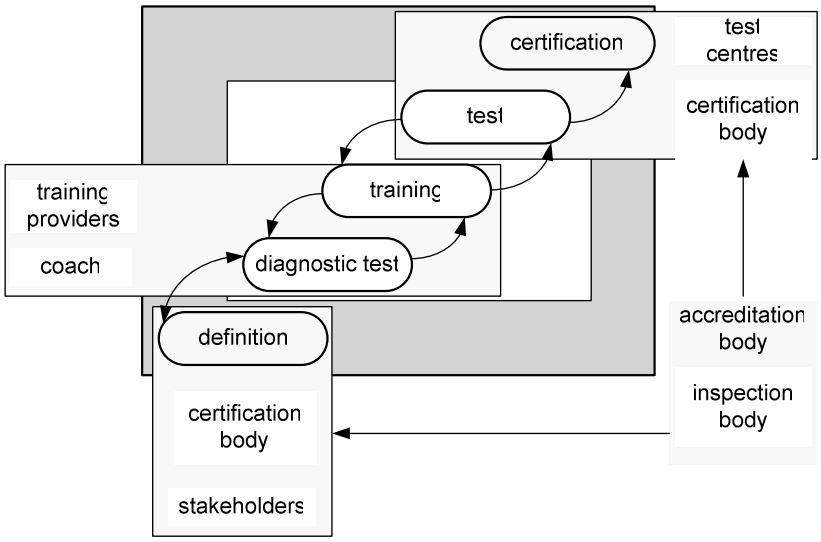
Certification bodies typically require training providers to ensure that candidates who successfully complete their courses to prepare for examination will have met learning objectives relevant to the knowledge and skills prescribed in the certification scheme. In addition, it is in the interest of accreditation bodies to ensure that a systematic process is used to determine the knowledge, skills, and competences of persons throughout a certification programme (IAF, 2004, p. 13). The accreditation process can address training providers, coaches, test centres and certification providers themselves. Accreditation can be enlarged to cover the general recognition of certification systems, the availability of a widely accepted norm or standard being an important prerequisite. In conclusion, within an e-skills certification system, the assessment of conformity with specific standards or quality criteria is the subject of accreditation. Further, the object of inspection is primarily the training and

evaluation system including diagnostic and final testing. Accreditation also covers assessing conformity with policies, e.g. security requirements, code of conduct for candidates, etc.

2.7.3. Conclusion

Accreditation includes inspecting the organisation of the e-skills certification body concerning their fulfilment of predefined requirements and conformity with quality directives or mission statements (Ehses and Zech, 2002). Appropriate quality management procedures within e-skills certifications address three main activity areas (see Figure 10) which go beyond the organisational structures and boundaries of the certification body: examination and testing, training provision, and definition of requirements. 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.

Figure 10: Achieving mutual recognition of e-skills certification systems



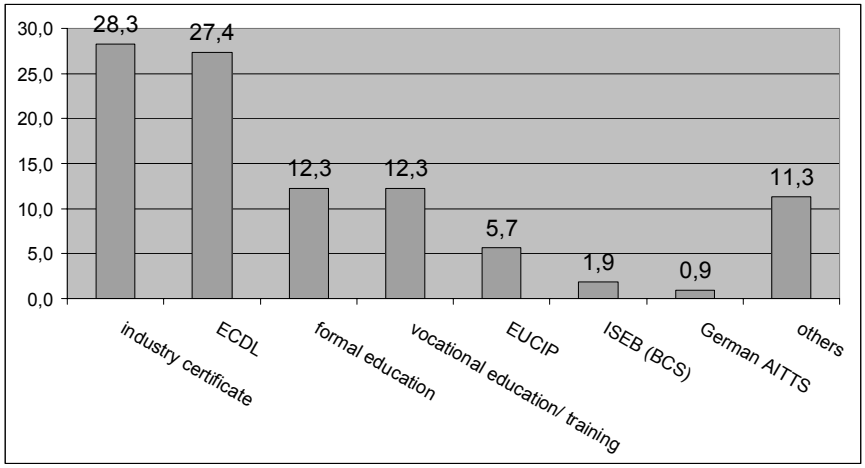
These are the areas primarily to be assessed by accreditation. The quality of learning material, learning and testing infrastructure, etc., subject matter of training and diagnostic testing, are to be considered by adequate quality measures and related policy. This is of growing importance within learner-centred programmes and informal learning environments (Ehses and Zech, 2002).

3. Widely applied e-skills certification systems

'The essence of intelligence is skill in extracting meaning from everyday experience.'
Unknown

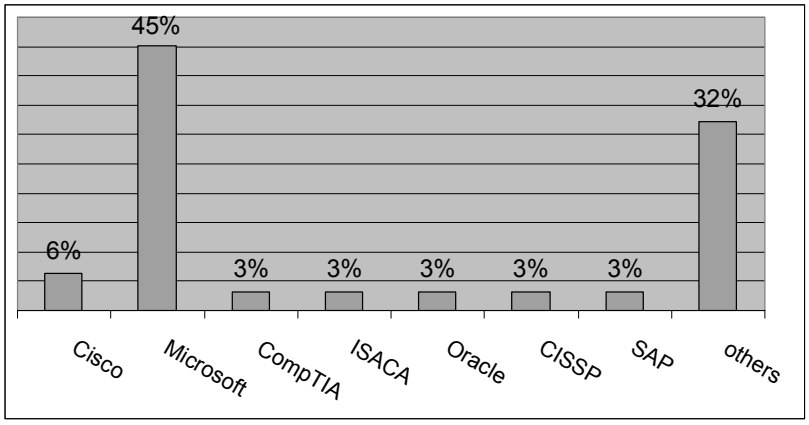
This section presents a categorisation of e-skills certification systems widely applied in Europe. Different categories are used to compare widely applied certification systems. The aim is to review and draw a sufficiently clear picture of what is already in place in the European market. In this way, the report aims to identify, present and propose voluntary approaches for standardisation. The experts involved in the survey were requested to categorise established systems that are already widely applied in their countries.

Figure 11: Widely applied e-skills certification systems (%)



The first task is analysing the current situation by country and characterising systems that are already in place in respondents' countries. The respondents named 106 e-skills certification systems in total, which are widely applied in their countries. The systems were aggregated and Figure 11 shows them ordered by frequency. The results support the perception that industry certifications (28.3 %) play an important role and are widely applied in the respondents' countries. ECDL (27.4 %) is also widely applied, followed by the accredited systems of formal education (12.3 %). EUCIP is a comparatively new initiative aimed at ICT practitioners (5.7 %). Others (11.3 %) summarise named systems not specified or primarily locally known. Figure 12 illustrates the industry certification systems already in place in the respondents' countries. The survey sample underpins the existing diversity of available industry e-skills certification systems on the market.

Figure 12: Widely applied industry certification systems



In the following, e-skills certification systems are categorised by several dimensions and significant statistical results are presented for each dimension. The survey aims to identify and propose voluntary standards for e-skills certification so systems frequently named by the experts are studied in depth more to understand better and extract the nature of available voluntary standards.

3.1. Market recognition

E-skills certification systems can be distinguished by their level of market recognition which strongly influences the ability of an individual to apply for work in a particular area of interest. The level of market recognition also significantly determines the market price for particular skills from the demand side.

The level of market recognition is primarily determined by the recruiting preferences of employers and the resulting market demand and market price for a particular certification. In principle, increasing market prices will lead to an increase in the supply of labour as it becomes more attractive to obtain work in an area of rising labour prices. The level of market recognition of the system is a perceived indicator for individuals/learners of the quality of acquired knowledge, skills, and competences; for employers it is an adequate indicator of the degree of fulfilment of specific predefined requirements determined by an occupational role.

Table 4 Widely applied systems with significant degree of market recognition

Name of system	#
ECDL	**21**
Microsoft	13
others	10
vocational education/training	10
formal education	10
industry/vendor certificate	7
EUCIP	3
ISEB (BCS)	1
CISSP	1
Oracle	1
ISACA	1
CompTIA	1
Cisco	1
German AITTS	0

The analysis of the survey sample shows that the widely applied systems possess, in general, significant market recognition so there is already something for current activities to build on (see Table 4). This supports our impression that market recognition is central to accessing national markets. The report focuses on systems that occur most frequently.

These systems are ECDL ([33]), Microsoft, vocational education/training system, formal education, industry/vendor certificates ([34]) (other than Microsoft) ([35]) and EUCIP ([36]). In consequence, the subject of analysis is reduced to the systems with the potential to serve as voluntary approaches for standards.

([33]) European computer driving licence: http://www.ecdl.com.

([34]) To simplify the analysis, this category shall represent all vendor certificates excluding Microsoft. A comprehensive list of ICT vendor certificates is provided in the Annex 2.

([35]) Microsoft learning home page: http://www.microsoft.com/learning/.

([36]) European certification of informatics professionals: http://www.eucip.com.

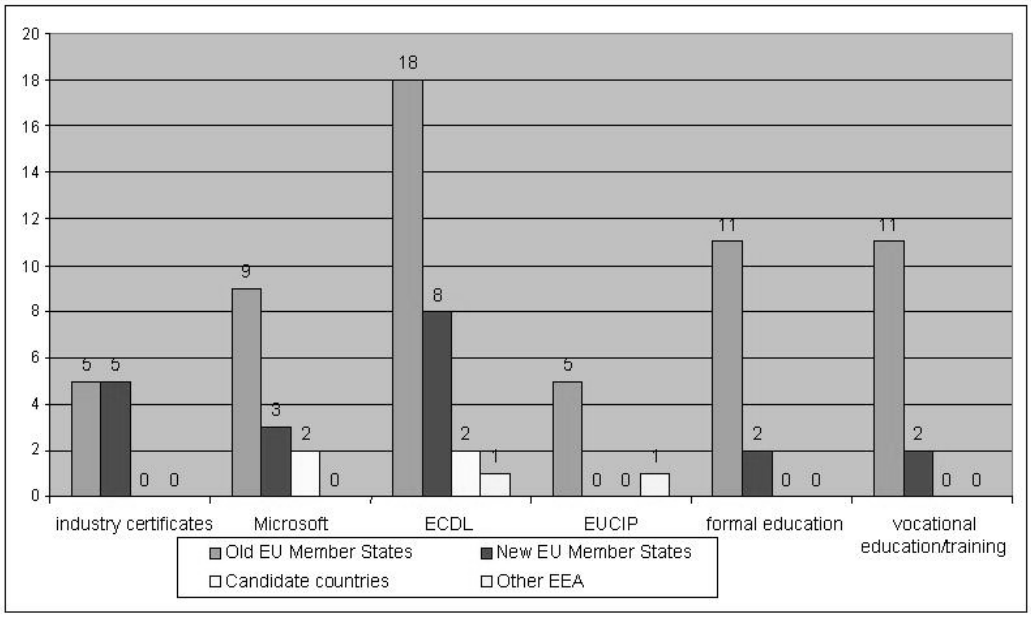
Table 5: Widely applied systems by degree of recognition

No	System	strong	good
1	ECDL	10	11
2	formal education	8	2
3	vocational education/training	4	6
4	Microsoft	2	11
5	industry certificates	0	7
6	EUCIP	0	3

If the degree of recognition is subdivided into strong and good, then formal education and vocational education/training gain ground.

ECDL shows a good balance between strong and good recognition. In contrast, pure industry certificates significantly turn out comparatively weak. Further, the degree of market recognition is strongly influenced by specific characteristics of the national labour market. The frequency of named widely applied and recognised systems is shown in Figure 13 categorised by place of residence of respondents. The survey sample includes respondents from 21 countries. Of these, 13 respondents are located in the 'old' EU Member States, 6 in new Member States as well as 2 respondents belonging to a candidate country (1) and other EEA countries (1) ([37]).

Figure 13: Widely applied systems by place of residence



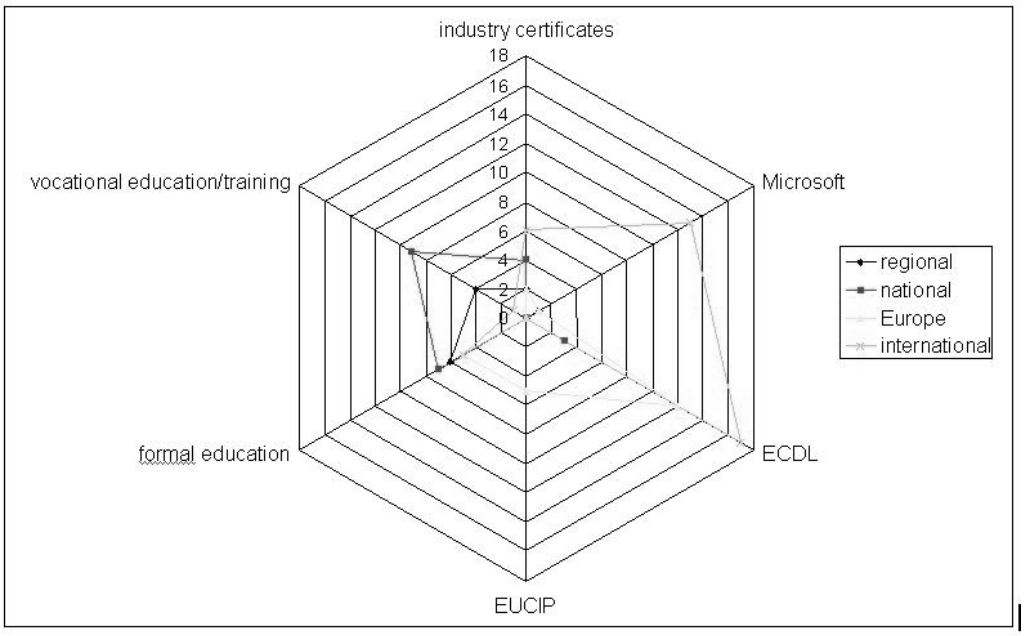
([37]) See Annex 3 for more information concerning analysis of the survey sample.

The respondents were asked to indicate how far the achievement of vocational qualification is a precondition for employment in their countries. The degree of market recognition relies on the attitude of employers and the precondition of certificates or diplomas for ICT workers for employment in a relevant job. The achievement of vocational qualification is, in the majority of the countries, a precondition for employment: 22 respondents agreed, 11 respondents disagreed, and 5 respondents indicated a neutral position. According to the eSCC study (2004, p. 47 et seq.) employers' main hiring criteria are relevant formal education, vendor-specific and vendor-neutral certifications, plus experience, which is considered of the utmost importance.

3.2. Level of recognition

Market recognition of e-skills certification systems relies significantly on the reputation of, and confidence of employers in, the respective certification body.

Figure 14: Level of recognition of widely applied systems



E-skills certification systems are based on defining requirements against which a candidate is validated. Another important aspect influencing general market recognition is the anticipated uptake of existing job or performance requirements and their presence in the respective e-skills certification scheme.

Market recognition is variable across regional, national, European and international levels. The analysis showed that respondent perception is that proprietary or vendor-specific

certification systems often possess a high recognition on all levels as, for example certificates offered by companies such as Microsoft, Sun, Cisco, etc. ([38]).

Table 6: Level of recognition of widely applied systems

system	regional	national	European	international
ECDL	0	3	12	17
EUCIP	0	0	5	0
formal education	6	7	5	5
industry certificates	2	4	2	6
Microsoft	1	0	1	13
vocational education/training	4	9	0	1

The analysis of returned questionnaires is shown in Figure 14 indicating the systems with highest rating for degree of market recognition. Microsoft's certification offerings are clearly perceived to be internationally recognised. The ECDL possesses significant recognition at European and international level. EUCIP and formal education programmes also have significant recognition at European level. The level of recognition of formal education and vocational education/training programmes turns out to be primarily regional and national.

3.3. Level of skills

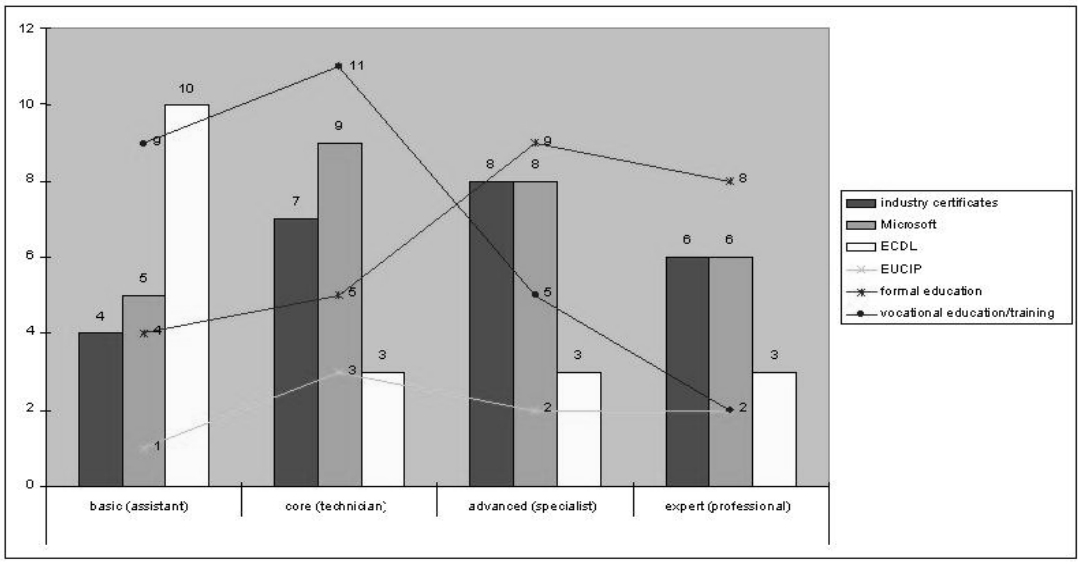
The level of skills (qualification) at which a certification system offers certification is the next means of distinguishing systems. ICT practitioner skills and ICT end-user skills are the two main levels at which a system may offer certification. Because no generally agreed definition of e-skills has been available until now, the categorisation of e-skills applied in this survey relies on the definitions provided in Chapter 2 ([39]).

The analysis of this category is shown in Figure 15. ICT end-user skills are primarily supported by programmes such as ECDL and the vocational education/training system. Microsoft and formal education also offer qualifications at these skill levels. Basic level (assistant) ICT practitioner skills are perceived to be significantly addressed by the ECDL, whereas, Microsoft and other industry certifications primarily address ICT practitioner skills at higher levels (core, advanced and expert).

([38]) See also Annex 2, List of vendor-specific certificates.

([39]) See Section 2.4.3, 'e-Skills'.

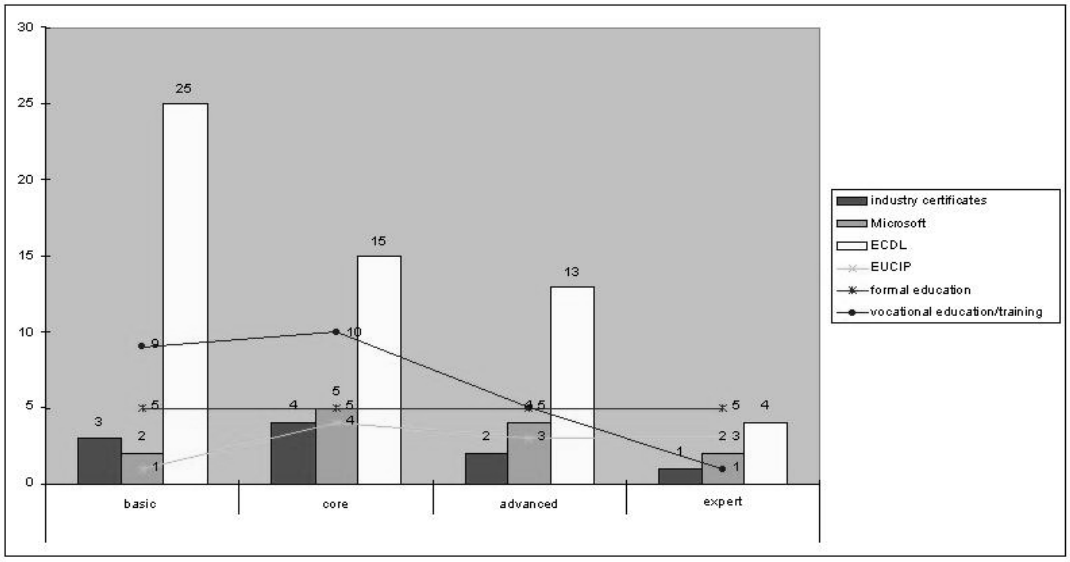
Figure 15: Categorisation of systems by level of e-skills covered (ICT practitioner skills)



When looking into ICT end-user skills, the ECDL is the leading and most widely applied programme, primarily at basic and core, but also at advanced and expert levels. Further programmes to be mentioned are Microsoft and industry certifications for core and advanced levels.

The analysis of the sample for ICT practitioner skills shows that the advanced and expert level is predominantly covered by formal education systems and industry certifications. At the basic and core level, vocational education/training systems and industry certifications play an important role. The ECDL also shows a strong contribution for the basic level (assistant). At the ICT end-user level, the ECDL turns out to be the leading initiative followed by vocational and formal education systems.

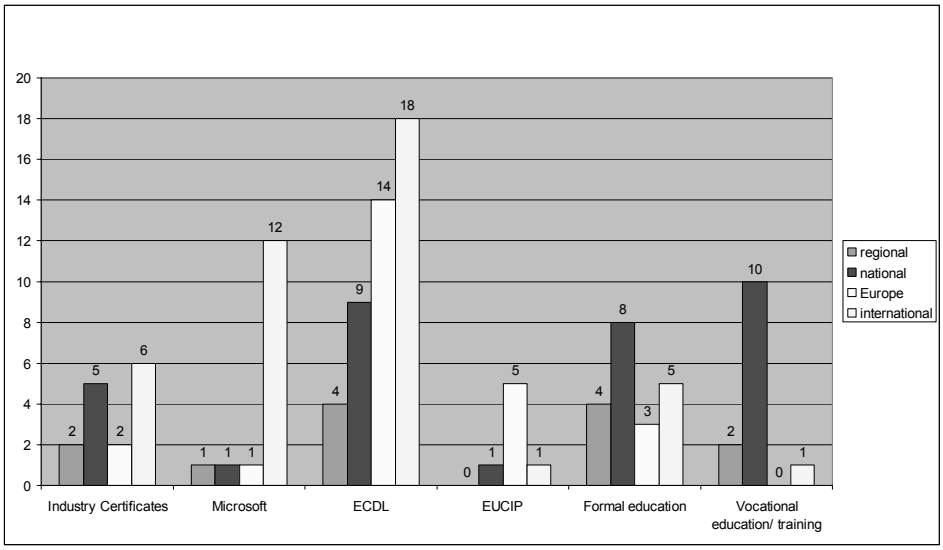
Figure 16: Categorisation of systems by level of e-skills covered (ICT end-user skills)



3.4. Geographic coverage

Certification systems differ in their geographic coverage. International IT vendors, e.g. A strong interdependency exists between geographic coverage and market recognition. Existing barriers, such as differences in culture (e.g. language, attitudes) and labour market structure, may seriously hamper the demand for a specific certification system. The analysis shows that the ECDL, Microsoft and industry certifications are players at European and international level: formal and vocational education systems predominantly cover the national level. The ECDL and industry certificates also turn out to have a significant geographic coverage at national level.

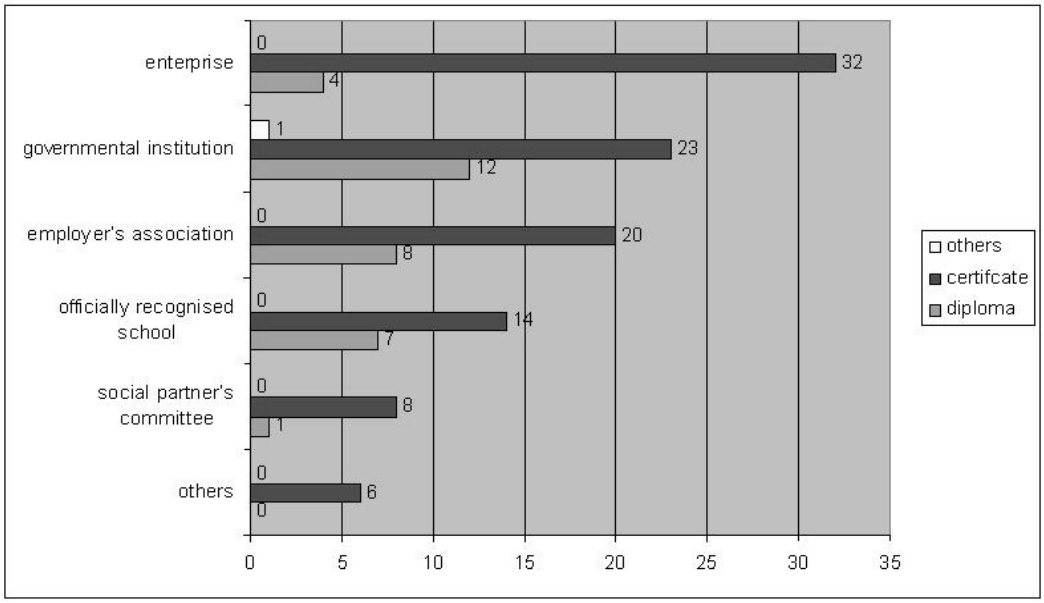
Figure 17: Geographic coverage



3.5. Certification body

Certification systems can be categorised by the type of certification body/institution issuing credentials such as certificates or diplomas. The majority of the accreditation systems of the widely applied e-skills certification programmes named in the sample, issue certificates (see Figure 18). Certification bodies are enterprises (32), government institutions (23), employer's association (20), officially recognised schools (14), social partner committee (8) and others (6). Diplomas are issued by governmental institutions (12) employers' associations (8) and officially recognised schools (7).

Figure 18: Type of certification body/institution by credentials



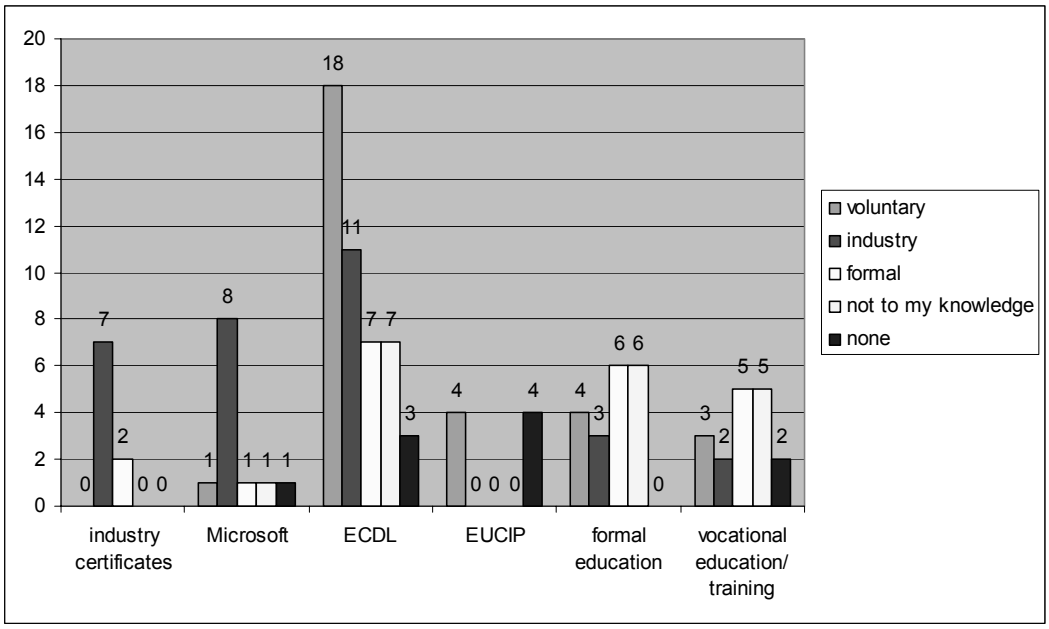
3.6. Degree of standardisation

The degree of standardisation can be a *de facto* standard (either industry or proprietary standard) or a formal standard issued by a government body (ministry) or standardisation body (e.g. ISO/IEC or EAC) ([40]). *De facto* standards or proprietary standards rely on a high degree of market recognition from the demand and/or supply side. Figure 19 displays the available degree of standardisation of the systems named by the respondents.

The ECDL is very well supported by the respondents as a voluntary approach for standardisation (18) and industry standard (11). Industry certifications (7) and Microsoft (8) are characterised as industry standards. Formal standards are rather rare from the perspective of the respondents who associate them primarily with formal and vocational training systems, and with the ECDL. In addition, a significant number of respondents are not sure how to characterise the existing degree of standardisation. This occurred for the ECDL (7), formal (6) and vocational education (5) system.

([40]) See Section 2.7.

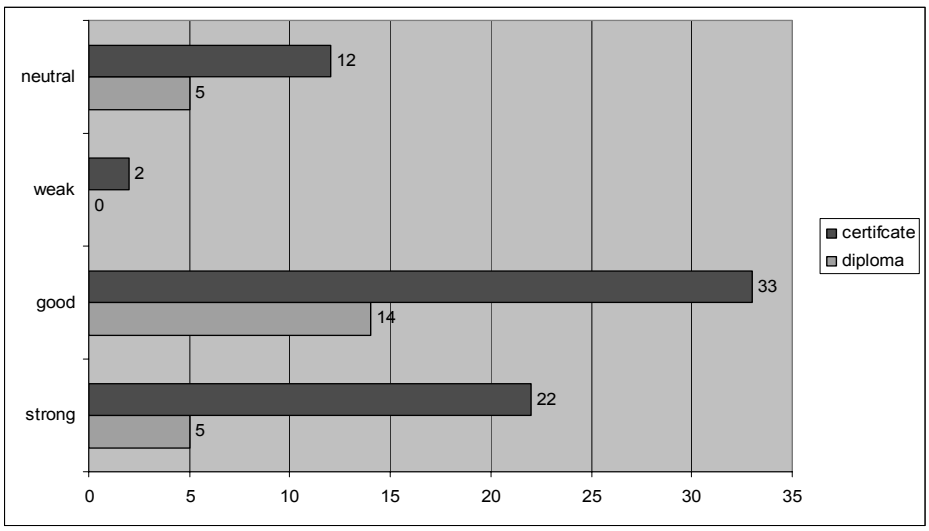
Figure 19: Available degree of standardisation in respondents' countries



3.7. Outcome

The outcome of a certification process can be accreditation in the form of a certificate or a diploma. The decision on certification is made by the certification body at the end of the evaluation process. The certificates or diplomas can be categorised by the organisational status of the certification body, primarily by the dependency of the certification on a specific product or vendor into vendor-neutral, vendor-specific, public or private/industry. In the sample the majority of issued credentials of widely applied e-skills certification systems are named as certificate (73). Diplomas are used as credentials by 24 systems. Certificates are characterised in the sample primarily as vendor-neutral (30). Further categories mentioned are private/industry (20), vendor-specific (15), public (8) and others (6). The category 'other' is used by respondents with comment 'vendor-independent'. Another important aspect is the relationship between market recognition and credential. For the majority of widely applied systems issuing certificates, the respondents feel the degree of market recognition to be good (33) or even to be strong (22). In systems issuing diplomas, the market recognition was rated to be good (14) or even strong (5). For a significant number of certificates (12) and diplomas (5) the market recognition was rated neutral.

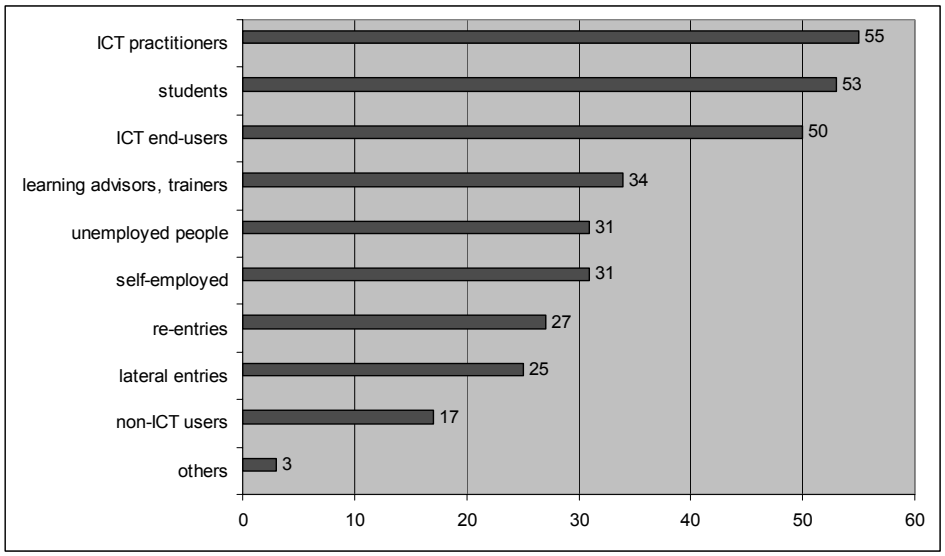
Figure 20: Market recognition of certification



3.8. Target group

E-skills certification systems can be categorised by the target group addressed. The market realities involve significant inflows into ICT worker occupations, both with those from non-IT degrees and from more mature people in other occupations (CEPIS, 2002, p. 22). The different target groups addressed by widely applied e-skills certification systems in the sample are ICT workers (ICT practitioners (55) and ICT end-users (50)) and students (53) as illustrated in Figure 21.

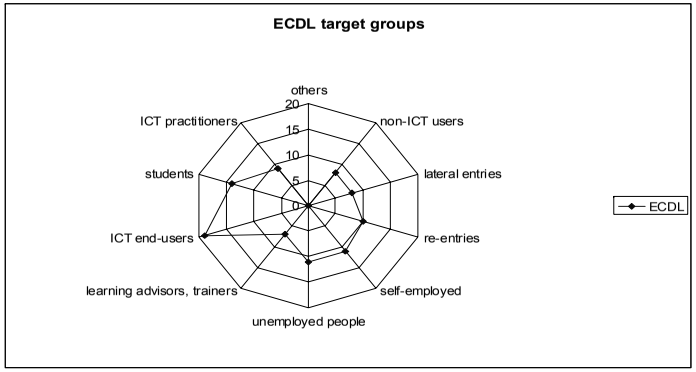
Figure 21: Target groups of widely applied systems

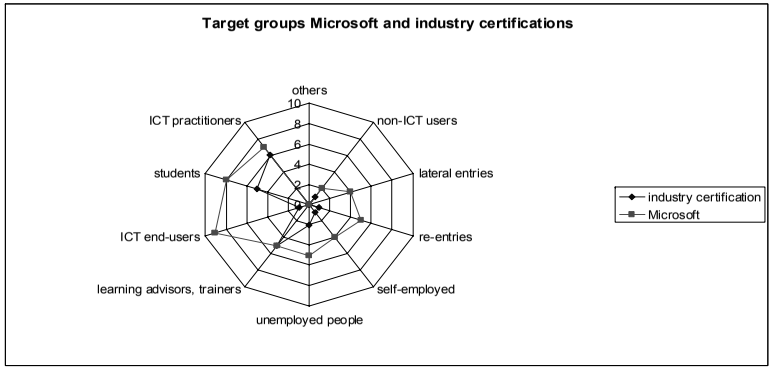


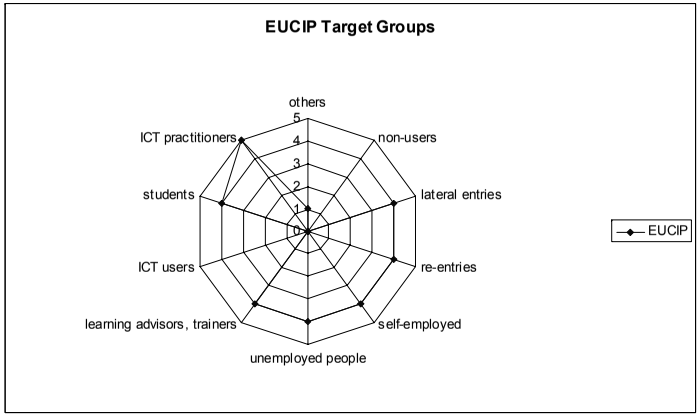
Another reasonable categorisation is to establish the differentiation of the certification system between self-employed (31), unemployed (31) and learning advisors/trainers (34). Lateral entries are addressed by 25 and re-entries by 27 of named widely applied systems in the sample. Lateral entries represent the inflow into specific job areas by other occupations and re-entries emphasise the acquisition of new or retraining or reskilling of workers with obsolescent skills for specific job profiles. For non-ICT users 17 systems are seen to offer relevant qualifications.

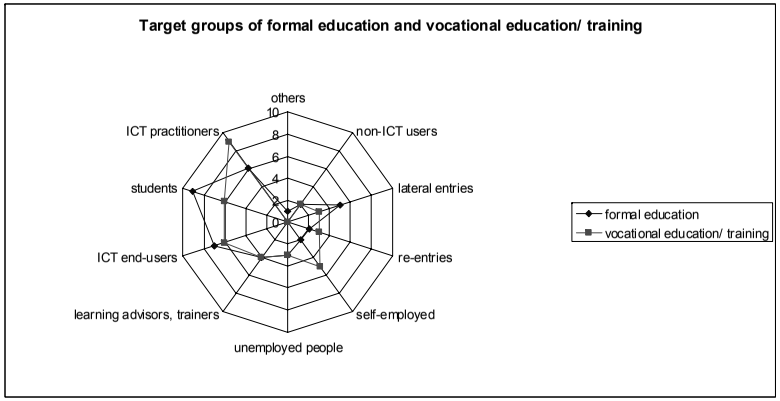
Figure 22 shows the analysis of target groups for the six systems with highest frequencies in the sample, illustrating the ECDL, Microsoft/industry certifications, EUCIP, formal/vocational education.

Figure 22: Target groups of most frequently named systems





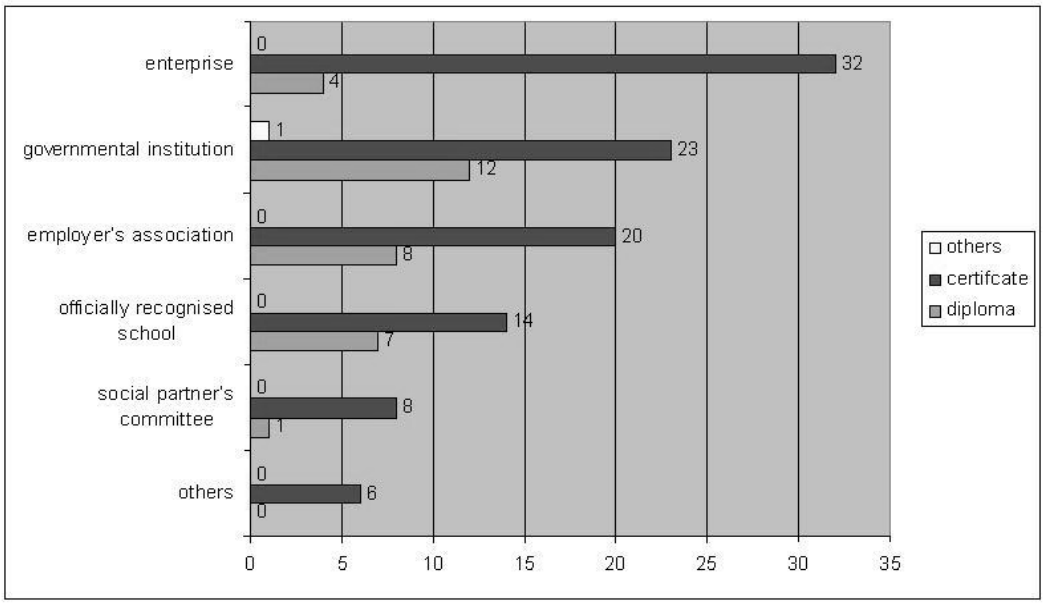




3.9. Success factors

The success of ICT industry certification systems depends mainly on the wide recognition by industry stakeholders (eSCC, 2004, p. 18) ([41]). From this point of view, the success of e-skills certification systems constitutes the general recognition by employers and stakeholders in a specific branch or industry sector. This perception is strongly supported and was agreed by 95 % of the respondents in the sample (see Figure 23).

Figure 23: Success factors for e-skills certification systems ([42])



However, there is another perspective to be considered, as an individual's certifications and related training and qualifications are more likely to present an opportunity for his/her personal or professional development. From this perspective, e-skills certification systems play an important role for accreditation and recognition of self-directed learning outcomes. Relevance is perceived to be an important success factor and is supported by 92.5 % of respondents (see Figure 23). Lifelong learning demands new ways of learning and acquisition of knowledge, skills and competences. Thus, proprietary certification systems give an individual the opportunity to show evidence of, and benefit from, continuous expansion of his/her knowledge and skills. This is seen as an important prerequisite for personal or professional development. This is backed up by the survey results showing 90 % of the respondents agreeing with the individual's benefit as reason for success (see Figure 23). However, it is worth mentioning that 5 % of the respondents disagreed. The reason is probably that not all respondents perceive both perspectives of e-skills certification to be

([41]) See Section 2.1.

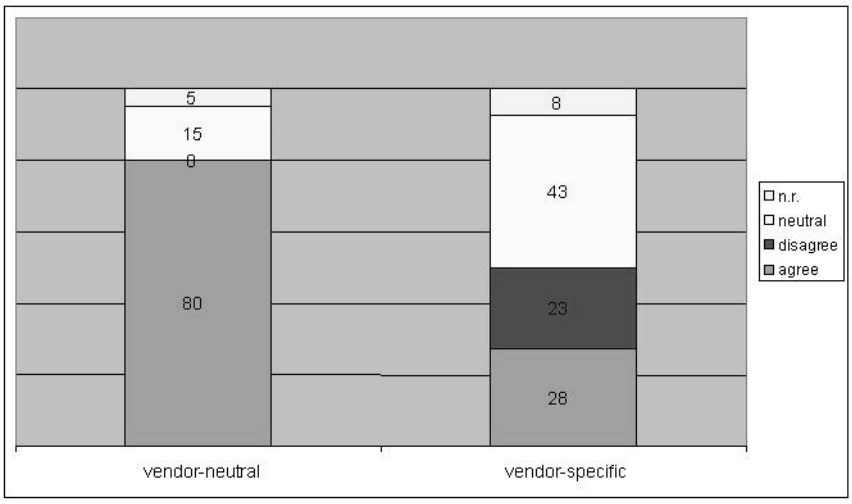
([42]) The respondents were asked how far they agree with the following success factors.

important, and primarily feel increase in employability as motivation for individuals to undertake a programme.

Other reasons for success of e-skills certification systems are consistency ([43]) (82.5 %), flexibility (80 %), cost and price (77.5 %) of participation, degree of global coverage and acceptance ([44]) (72.5 %), robustness ([45]) (60 %), and security (55 %). The rating by respondents for security as being less important is astonishing because leading e-skills certification systems are trying to ensure a high degree of security for their programmes (e.g. Microsoft) ([46]). Security expresses the degree of reliability and validity of a certification (e.g. integrity of the programme and the assurance that a person certified by a specific certification system did not copy or pass the test or exam by unfair means, e.g. by legislating against piracy of exam items).

Additionally, respondents were asked if they agreed with independence from specific products or ICT vendors as a reason for the success of e-skills certification systems. The results of the analysis are displayed in Figure 24.

Figure 24: Independency as success factor



([43]) Consistency expresses to what degree the transferred knowledge, skills and training contents match the underlying job requirements implied with a certification.

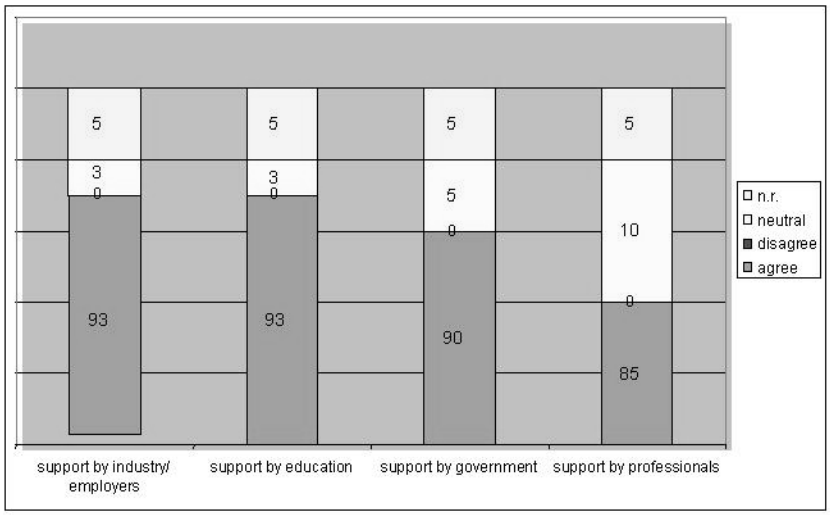
([44]) The degree of global coverage and acceptance is an indicator for the durability and sustainability of the investment made.

([45]) Robustness expresses the time horizon and the degree of validity of the issued credentials of certifications with regard to skill obsolescence.

([46]) For example, Microsoft reports about content privacy of exams and tests. http://www.microsoft.com/learning/mcpexams/faq/security.asp, [cited 13.8.2004].

The majority of respondents answered that vendor-neutral systems are more successful (80 %), 15 % disagreed and 5 % were neutral. The opinion regarding vendor-specific systems is rather diversified. 43 % of respondents take a neutral position and neither agreed nor disagreed. Less than one third (28 %) of respondents agreed and 23 % disagreed with vendor-specific orientation for reasons of success.

Figure 25: Support by relevant stakeholder



The degree of market recognition is presumably influenced by the active and official support of stakeholders. Figure 25 shows how the respondents agreed with support by relevant stakeholders as being a reason for success. Support by industry/employers (93 %), education (93 %) and government (90 %) are perceived to enhance the impact and success of e-skills certification systems. Support by professionals was seen by 85 % of respondents to be relevant.

4. Future of e-skills certification

'The world does not pay for what a person knows.
But it pays for what a person does with what he knows.'
Laurence Lee

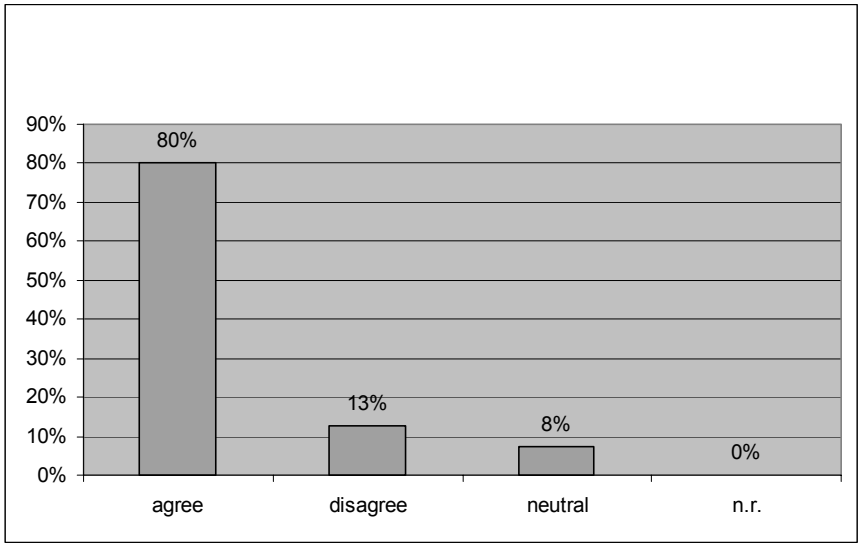
This section describes the future role of e-skills certification systems as accreditation systems and formal recognition of individual training and learning outcomes; the results of the statistical analysis regarding the future of e-skills certification are presented. Most importantly, significant results are described which are likely to contribute to the current discussion of stakeholders on how transparency and comparability is likely to be achieved for qualifications of ICT workers throughout Europe and beyond.

4.1. Current situation

The first issue is the perception of the current situation of e-skills certification in Europe by respondents. There is a clear statement from 80 % of respondents that, in the short term, compatible and recognised e-skills certificates are needed at European level. In addition, 80 % agreed that Europe is facing a multitude of available e-skills certification schemes ([47]). The situation differs in the respondents' countries where the importance (level of acceptance and use) of e-skills certification differs significantly amongst Member States and other countries. This statement is supported by 70 % of the respondents, 3 % disagreed, 23 % had a neutral position, 5 % selected 'not relevant'. National regulations and legislation are also considered. More than half the respondents (53 %) agreed that, in their country, vocational qualification and related training is generally specified and regulated through legislation involving licensing and certification. Disagreement is at 25 % and 18 % of respondents take a neutral position. Further, analysis of the sample shows that 48 % of respondents disagree that the comparability and transparency of e-skills certification schemes at European and international level is given too much priority in the current debate.

([47]) See Figure 5.

Figure 26: Compatible and recognised e-skills certifications are much needed



Less than one third of respondents (28 %) agree. The majority of respondents (73 %) state that Europe needs fewer, but more relevant, e-skills certification schemes. Only 5 % of respondents disagree with this statement, while 23 % have a neutral position.

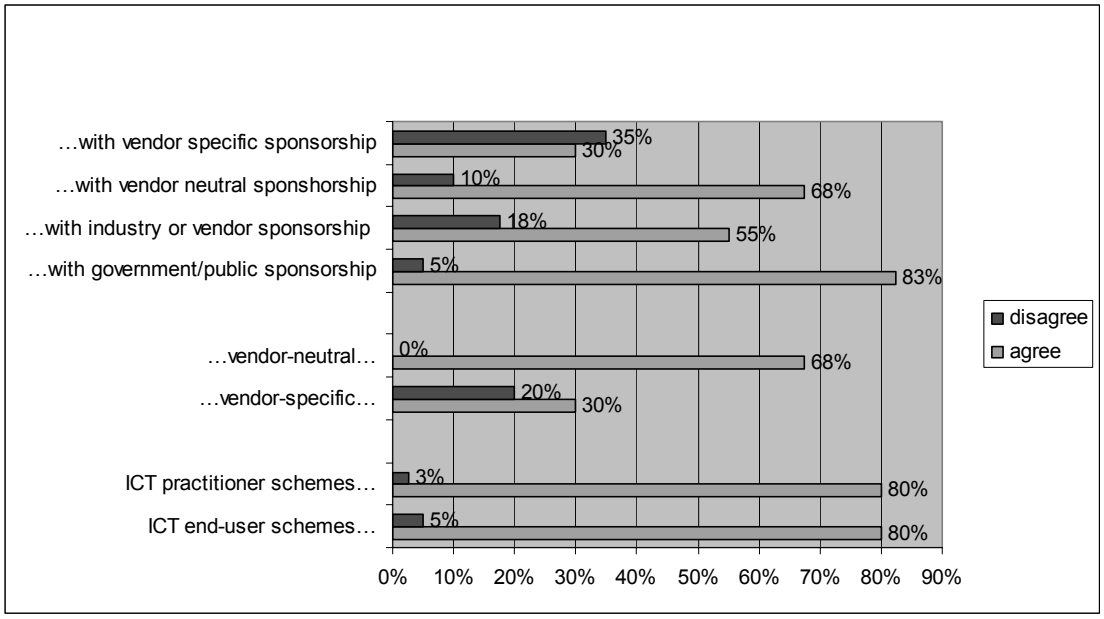
Although good progress is made by current initiatives (European e-skills forum, 2004), from the perspective of 65 % of the respondents the current initiatives and current debate are still far away from a European reference framework of promoting e-skills training, recognition and transparency. Only 5 % disagreed with this statement but 28 % were neutral. This indicates the need for a broader and more intensive dissemination of achievements and progress made by the current initiatives and debate. The respondents also had a diversified perception of the cost of certification in their countries, in many cases as seeing it as a barrier for ICT employers to offer certified vocational training for employed ICT practitioners/users. In the sample, 48 % agreed, 40 % disagreed and 13 % indicated a neutral position.

4.2. Type of e-skills certification systems

Due to the perception by the respondents of a multitude of existing e-skills certification systems and the agreement that fewer systems are needed, the question is which systems play an important role in achieving transparency and comparability of e-skills certification across Europe. Based on the answers received, vendor-independent sponsorship turns out to be of high importance (see Figure 27). However, as already mentioned, the survey sample supports the perception that the current marketplace is characterised by a focus on vendor-specific certification and industry-accredited courses ([48]).

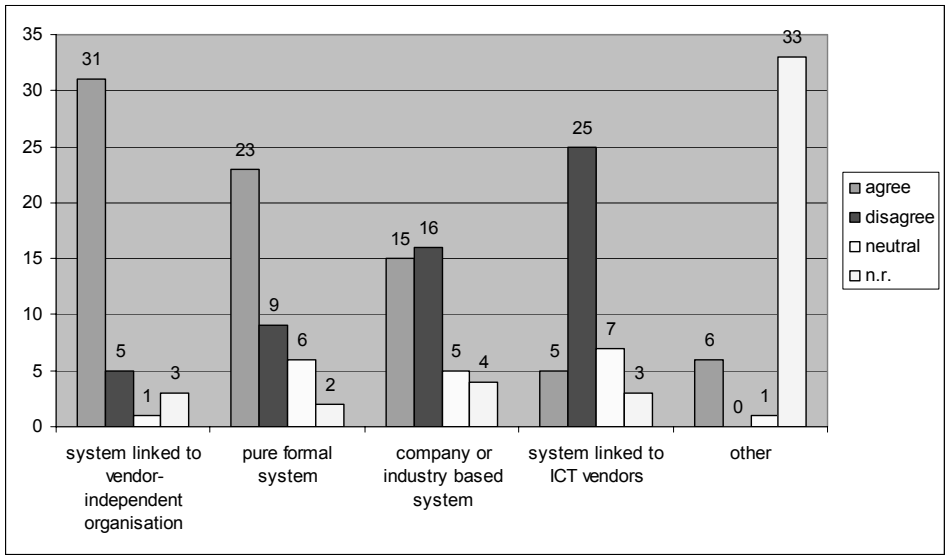
([48]) See Figure 2.

Figure 27: E-skills certification systems that play an important role regarding transparency and comparability



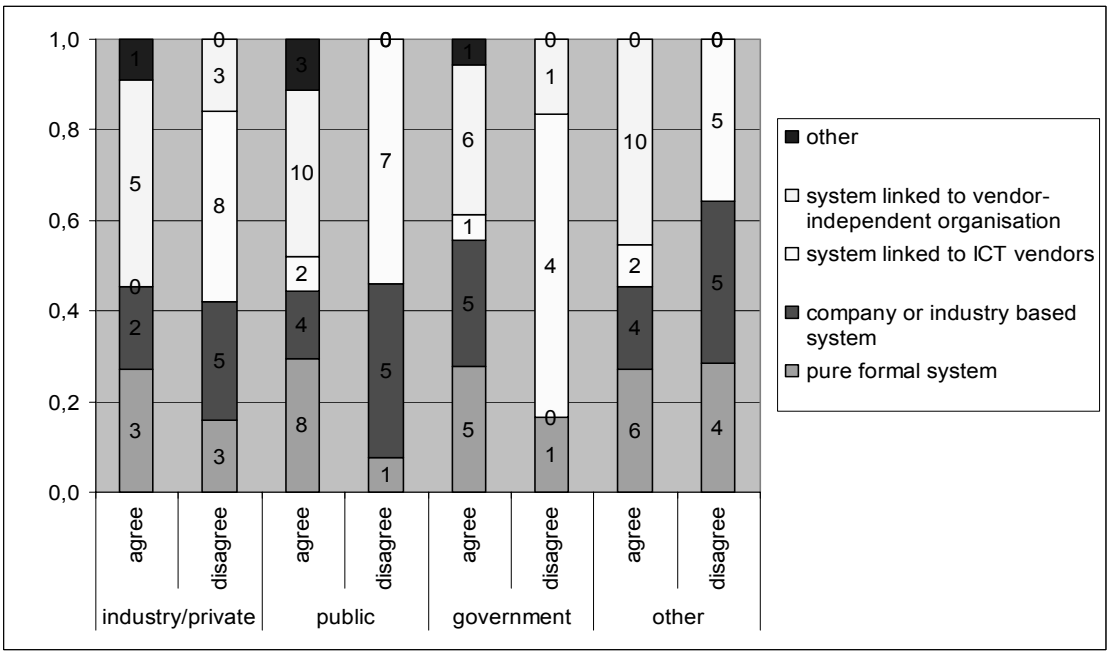
Both ICT practitioner and ICT end-user schemes play an important role. Analysis showed that 83 % of respondents support government/public sponsorship. Although industry or vendor sponsorship is not generally neglected (supported by 55 % of respondents, but at the same time with significant opposition, 18 %), vendor-neutral sponsorship is supported by 68 %. However, the analysis showed that 35 % of the respondents disagree with vendor-specific sponsorship, while only 30 % agreed; vendor-neutral e-skills certifications are supported by 68 %. Only 30 % of respondents support vendor-specific systems. In the sample a significant disagreement with vendor-specific systems can be observed, at 20 % of respondents. There is also analysis of the type of e-skills certification systems that are an appropriate basis for a European framework (see Figure 28).

Figure 28: Type of e-skills certification systems as basis for a European framework



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. A significant opposition against company- or industry-based systems (16) and systems linked to ICT vendors (25) can be observed.

Figure 29: Type of e-skills certification systems as basis for a European framework by status of organisation



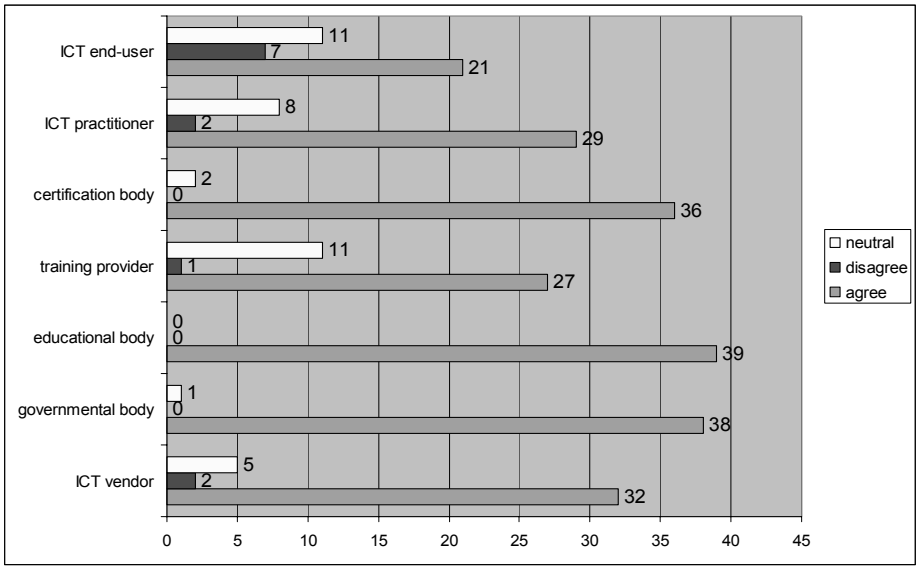
It is interesting to analyse the sample according to the preferred type of e-skills certification system by status of organisation (see Figure 29). Independent organisations show significant support for systems linked to a vendor-independent organisation. Even respondents from industry/private organisations showed significant support (5). There is an observed tendency by respondents to disagree with systems linked to ICT vendors.

4.3. Cooperation and joint activities

These results underline the existing diversity and complexity in discussing e-skills certification systems. Hence, the required harmonisation and comparability is mainly achieved by cooperation and joint activities among relevant stakeholders. Multi-stakeholder partnerships are discussed in this context (Tittel, 2004; eSCC, 2004).

The majority of the answers received (73 %) support the general perception that transparency, portability and compatibility of e-skills certifications in Europe and beyond can only be achieved by cooperation between stakeholders on the basis of public-private partnerships. Only 10 % of the respondents disagreed, 15 % having a neutral position.

Figure 30: Importance of cooperation and joint activities by relevant stakeholders

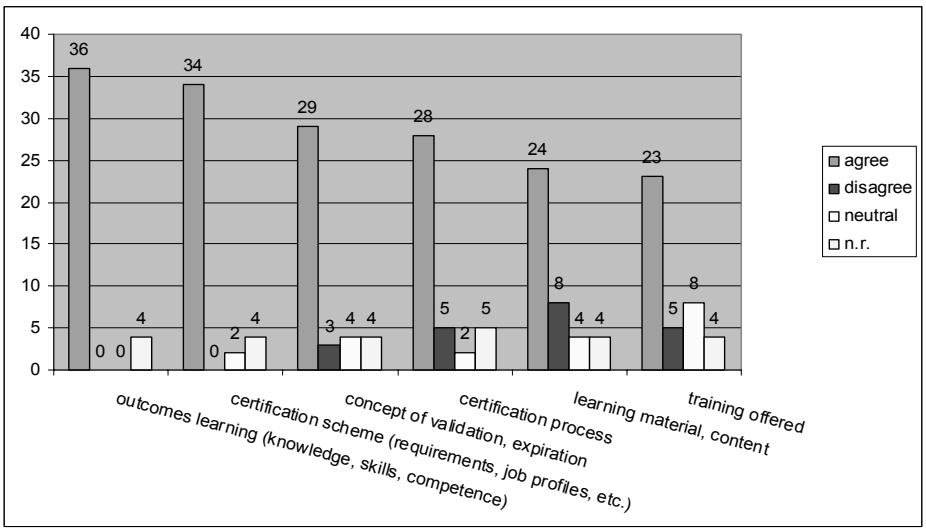


The experts were asked to rate the importance of cooperation of and joint activities between relevant stakeholders on transparency and comparability of e-skills certification systems in Europe. Figure 30 displays the results of the analysis. The respondents significantly support the cooperation and joint activities of educational (39) and governmental bodies (38), certification bodies (36), ICT vendors (29). Training providers (27) and ICT practitioners (29) are also seen as important for partnerships and joint activities.

The analysis of who should take the lead in the initiatives on comparable European e-skills certification systems shows that governmental/public bodies are generally preferred by the respondents (57.5 %).

The issues to be addressed by a relevant framework for e-skills certification are depicted in Figure 31. From the respondents' perspective, learning outcomes (36) and certification scheme (34) are the main issues for a European framework. Concept of validation (29) and certification process (28) are also seen as important.

Figure 31 Issues to be addressed by a relevant framework for e-skills certification

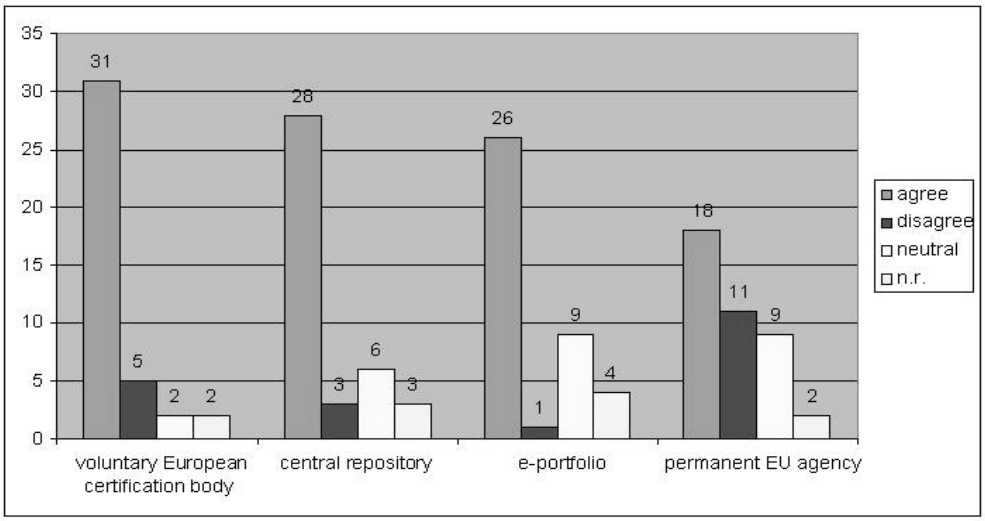


4.4. Quality standards

Recognised formal quality standards and related common criteria are likely to be a solution to achieving harmonisation of existing e-skills certification systems. Europe needs recognised formal quality standards and related common criteria and requirements for e-skills certification. This statement is supported by 53 % of the respondents in the sample; 25 % disagreed, 18 % indicated a neutral position. E-skills certification stands at the end of the learning process. In the sample, 68 % of the respondents support that Europe needs recognised formal quality standards and related common criteria and requirements for training providers. Only 15 % of the respondents disagreed with this statement, 18 % having a neutral position.

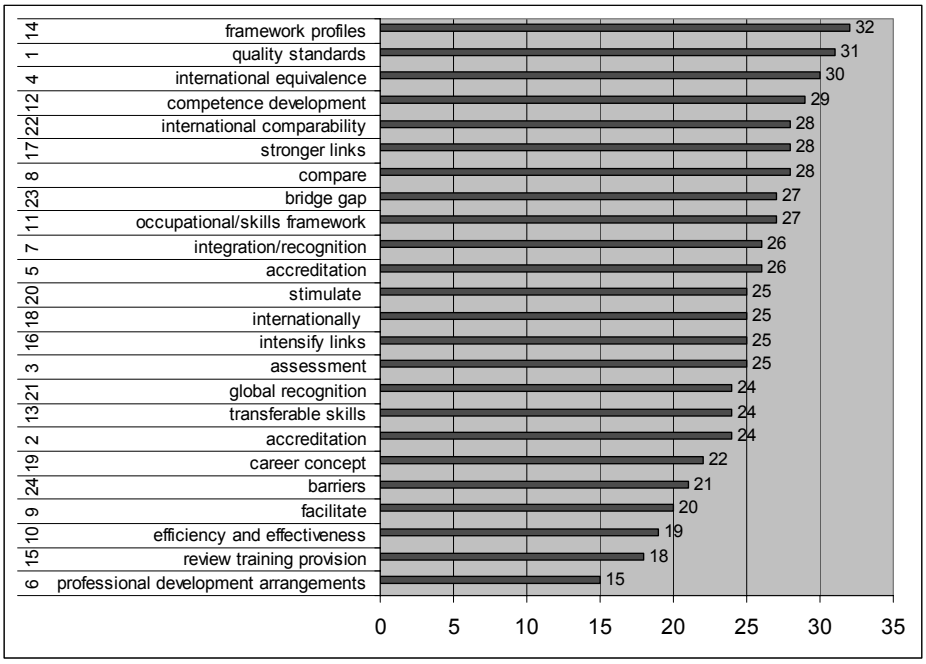
In general the respondents agreed to the establishment of a central coordination organisation of e-skills certification in Europe (see Figure 32). The setting up of a voluntary European certification body is agreed by 31 of the respondents; 28 prefer a central repository and 26 an e-portfolio. The establishment of a permanent EU agency receives little support (18 agree, 11 disagree) from the respondents.

Figure 32: General support for a central coordination and organisation



The survey suggested the setting up of an international or European testing and certification board. The respondents indicate strong support and agreement (31) with only five respondents answering that they disagree.

Figure 33: Activities of international or European testing board and certification boards



Asking what should be the task and activities of the board, there is significant support (31 respondents) for offering a European reference framework for ICT job profiles and qualifications which is widely recognised by public bodies and private industry. The establishment and maintenance of common quality standards for ICT training and certification (31) and the enablement of international equivalence of ICT qualifications to support international mobility (30) are strongly supported by the respondents in the sample.

5. Recommendations

'Genius without education is like silver in the mine.'
Benjamin Franklin

Based on the results of the study, we propose and illustrate a possible path towards internationally agreed certifications and recognised qualifications throughout Europe.

At the European Council in Lisbon in March 2000, Heads of State and Government of the European Union launched a strategy to prepare the EU for the challenges of the new century. This has become known as the 'Lisbon strategy'. The objectives set at Lisbon – higher growth, more and better jobs and greater social inclusion – were ambitious. Information and communication technologies (ICT) were identified as playing a key role in achieving them. The target of the 'information society for all' was confirmed at the Spring Council 2004 and by the recent Wim Kok report (Kok, 2004).

There are several initiatives which attempt to ensure harmonisation and comparability of qualifications across Europe, the Bologna process being one at university level. This initiative attempts to establish common structures for degree programmes and also uses the European credit transfer system (ECTS) to allow students move between Member States and retain credit for their studies. The Copenhagen process attempts to do the same for the vocational sector and comparability is achieved through the use of ECVET. The European credit transfer system (ECTS) was introduced as a tool within the framework of the Erasmus/Socrates programme between 1988 and 1995. It was hoped that this would facilitate the recognition of courses for exchange students when returning home to their own institution. However, under the framework of the Bologna process it became a tool that could be used for all students, and not only for the purposes of recognition. It should, however, be noted that the implementation of ECTS has been fairly problematic in most countries.

'ECTS implementation differs from country to country, mainly depending on the existence or non-existence of a national credit system and on the lack of information about the consequences. When governments are trying to introduce ECTS without first having a national credit system, the whole process feels forced and rather untransparent.

One of the main ECTS aims set by the European Commission - ECTS guarantees academic recognition of studies abroad - is still not fully achieved. Sometimes, institutions still think that courses from certain universities are better than those from others - with no objective criteria to underpin these claims. This all leads to a need for more solidarity and trust between institutions' (ESIB survey, February 2003).

There is anecdotal evidence together with the surveys which indicate that the ECTS system is not working as successfully as was hoped. The operation of ECTS depends on a degree of trust between cooperating universities and works well on a bilateral basis but is not a general solution which can have wide implementation. It is even more likely that the ECVET

approach will also run into difficulties because of the larger number and wider diversity of vocational training institutions across the Member States. It is against this background and with the support of the results of this survey that a different approach to recognition of certification across Europe is suggested.

5.1. Towards internationally agreed certification

Several sectors are examining the possibility of pan-European certifications and indeed there is already agreement that there should be one such certification for the ICT area. The Presidency conclusions following the Lisbon European Council, 23 and 24 March 2000, included the following:

'A European framework should define the new basic skills to be provided through lifelong learning: IT skills, foreign languages, technological culture, entrepreneurship and social skills; a European diploma for basic IT skills, with decentralised certification procedures, should be established to promote digital literacy throughout the Union.'

In Feira, June 2000, the European Council endorsed the eEurope action plan 2002 with a specific action line which provided the mechanisms and deadlines for achieving some of the Lisbon goals such as, 'Establish a European diploma for basic information technology skills, with decentralised certification procedures. With: actors – European Commission, Member States and deadline: end 2001'.

Several initiatives are in progress at the moment which could lead to the implementation of European Certification in a number of sectors.

At the Council meeting education, youth and culture (only education and youth items) in Brussels, 15 November 2004, it was agreed that priority at European level be given to developing an open and flexible European qualifications framework, founded on transparency and mutual trust, which will stand as a common reference covering both VET and higher education, based mainly on competences and learning outcomes.

There was also a symposium in Strasbourg on 30 September and 1 October 2004 to discuss the construction of qualifications at European level, various approaches to the links between prevailing national systems and developing European qualifications.

Against this background, and with the results of the survey in mind, it is proposed that there is a better way forward for some sectors than using ECVET. The way forward for the ICT sector could include the following:

(a) the construction of an e-skills meta framework for Europe (already planned through CEN/ISSS);

(b) the creation of a European qualifications framework for e-skills;

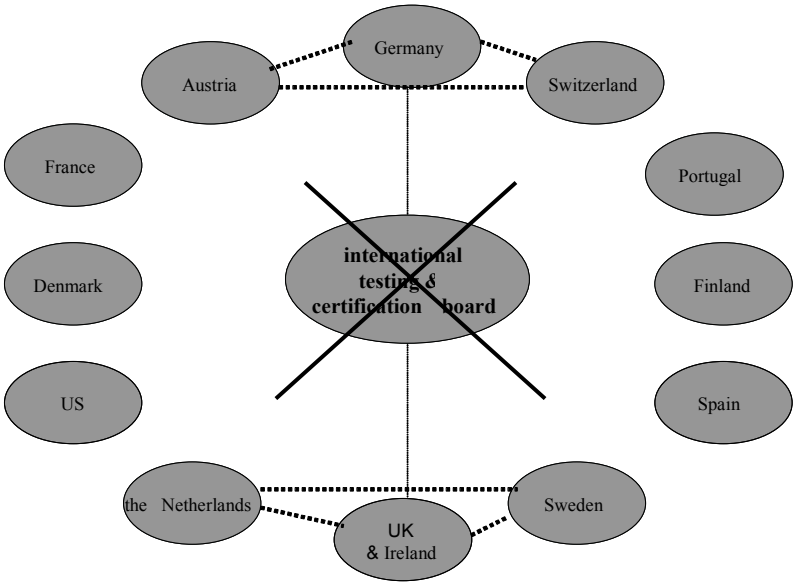
(c) the creation of a European syllabus and curriculum for e-skills courses so that teaching could be harmonised (Career space have already created a proposed curriculum for certain ICT courses at university level);

(d) the creation of a European mechanism to oversee European certification for several e-skills areas.

5.2. International testing board

The European mechanism (central body) could be an international testing board, could be responsible for standards and definitions and could also monitor testing so that the process would be unbiased and transparent. Certifications recognised by the central body would be similarly recognised in all Member States and thus lead to enhanced mobility and a means of avoiding skills mismatches. It would mean that certification for Europeans would be under the direction and control of a European body and could deal with European social issues as well as the particular needs of European industry. The central body could provide a repository for definitions and curriculum guidelines for VET.

Figure 34: Lack of international connections in e-skills certification



Core subjects could be agreed and defined and there could be an open curriculum for additional modules. The central body could monitor an agreed skills framework and could develop an agreed qualifications framework. Within the agreed skills and qualification frameworks there could be room for national qualifications and vendor certifications. The task of setting up such a body would be considerable. It would require political lobbying in the Member States and in the European Parliament. It would require the approval of industry and

commerce. The central body could not only monitor certifications but could also promote the image of ICT as a suitable career for young Europeans.

It would also

(a) update definitions,

(b) update curriculum guidelines,

(c) update skills framework,

(d) update register of approved qualifications,

(e) monitor testing procedures,

(f) quality assure and audit the process,

(g) promote the value of European certification.

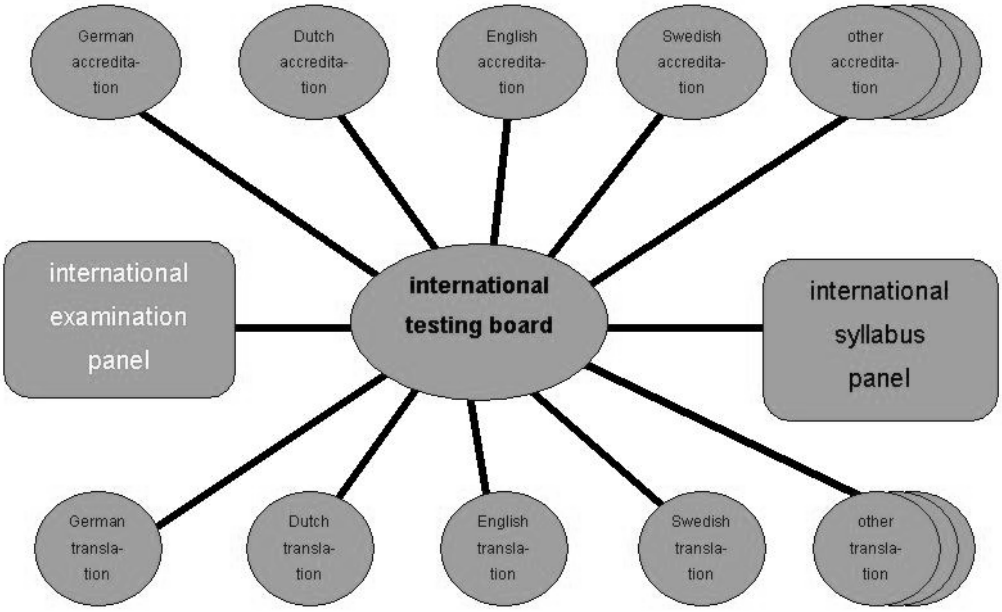
There are regional frameworks being developed based on geographical and language factors and these will lead to small regional areas of competence and mobility. It is the contention of this report that the alternative of a European central body would be a considerably better solution and lead to true mobility and transparency.

5.3. Available approaches for general framework

CEPIS has worked on developing a framework leading to the EUCIP (European certificate for informatics professionals) certification. This framework could be developed to embrace modules from a variety of sources and also cope with existing industry certifications. The development of the EUCIP framework into a European framework for ICT qualifications is proposed and it is believed that this can be achieved in a relatively short timescale.

The adoption of English as the common language at the ICT practitioner level will make the establishment of a central body very much easier. It is, of course, essential that the majority of qualifications should be available in as many languages as possible. At the end-user level, qualifications would certainly need to be available in the native language of the participants.

Figure 35: Possible way forward to internationally recognised e-skills certification



5.4. General framework to setting European level quality standards

The ECDL foundation has created a widely respected set of quality guidelines for creating syllabi and conducting tests. It is considered that a European framework for quality standards can be based on existing materials and could be in place in a relatively short timescale. Such a set of quality standards would require a central body to ensure adherence and to conduct audits.

It is clear that much progress has been made with ECTS and, to a lesser extent, with ECVET. It is, therefore, appropriate that any proposed framework should include these elements. This would allow the existing arrangements to continue.

In addition, it is proposed to set up an international structure together with the proposed European central body to coordinate qualifications and certifications in Europe.

Figure 36: Proposed structure of a general framework

The framework proposed will ensure that there can be widely recognised qualifications and, with the introduction of a suitable testing environment with strong guidelines and a strong emphasis on quality, the possibility of internationally recognised certifications.

The introduction of automated test procedures, using existing, tried and tested, ICT testing engines, would go a long way to ensuring the transparency of the testing processes. There is a wealth of experience in Europe at the moment regarding automated testing and this approach would be an essential element within a European certification process. Automated testing is particularly suited to testing for ICT practitioners and ICT end-users. It should be appreciated that it does not consist only of multiple choice questions; there can be a variety of question types including multiple choice, hotspots, drag and drop and simulation. In addition great strides have been made by European testers in the area of automatically assessing free text (essay type) answers.

It is clear that, for the future of Europe, there is a need for transparency and mobility in all areas of the workforce. This proposal can lead to the setting up of such transparent qualifications and certifications that it will contribute to the mobility of the European workforce in the ICT area.

For these recommendations to succeed, the establishment of the proposed European meta e-skills framework should be followed by the creation of a European e-skills qualifications framework; this can then lead to creation of European e-skills certification.

6. Glossary

Accreditation
Assessment of conformity of an object of interest with specific obligatory or voluntary standards. Process of accrediting an institution of vocational education or training, a programme of study, or a service, showing it has been approved by the relevant legislative and professional authorities by having met predetermined standards.

Assessment
The sum of methods and processes used to evaluate the attainments (knowledge, know-how, skills and competences) of an individual, and typically leading to certification.

Certification (of skills and competences)
Certification results from a voluntary evaluation process whereby an individual's knowledge and/or skill in a particular area of interest are validated against a set of predetermined skills requirements, e.g. skills standards by means of an objective assessment.

Certification process
The certification process comprises all activities by which a certification body establishes that a person fulfils specified competence requirements.

Certification system
Set of procedures and resources for carrying out the certification process as per a certification scheme, leading to the issue of a certificate of competence including maintenance.

Certification scheme
Specific certification requirements related to specified categories of persons to which the same particular standards and rules, and the same procedures apply.

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

Certificate/diploma
An official document, issued by an awarding body, which records the achievements of an individual following a standard assessment procedure.

Competence
Demonstrated ability to apply knowledge and/or skills and, where relevant, demonstrated personal attributes in an habitual or changing situation, and/or as defined in the certification scheme.

Comparability
The extent to which it is possible to establish equivalence between the level and content of formal qualifications (certificates or diplomas) at sectoral, regional, national or international levels.

E-skills
E-skills encompasses a wide range of capabilities (knowledge, skills and competences) and issues with an e-skills dimension covering a number of economic and social dimensions. The term e-skills includes ICT practitioner skills, ICT user skills and e-leadership skills.

Education
Education is responsible and lays the foundation for the initial transfer of core knowledge and basic understanding (know-how) of ICT workers. Education teaches concepts, theories, problem solving capabilities and constitutes the prerequisite to be trained on specific job requirements.

Formal learning
Learning that takes place in the form of physical, face-to-face, teacher-centred classroom training (instructor-led training).

Informal learning
Learning which takes place in the work context, relates to an individual's performance in their job and/or their employability, and which is not formally organised into a programme or curriculum by the employer. Learning resulting from daily activities related to work, family or leisure. It is not organised or structured (in terms of objectives, time or learning support). Informal learning is, in most cases, unintentional from the learner's perspective. It typically does not lead to certification.

ICT skills
The skills needed for efficient use of ICT. Professional ICT skills: ability to use advanced ICT tools, and/or to develop, repair and create such tools. Applied ICT skills: ability to use simple ICT tools in general workplace settings (in non-IT jobs). Basic ICT skills or 'ICT literacy': skills needed to use efficiently the basic functions of information and communication technologies (ICT). Ability to use ICT for basic tasks and as a tool for learning.

ICT
Information and communication technology (ICT) is technology which provides for the electronic input, storage, retrieval, processing, transmission and dissemination of information.

ICT practitioners
ICT practitioners possess the capabilities required for specifying, designing, developing, installing, operating, supporting, maintaining, managing, evaluating and researching ICT systems, for the benefit of others. ICT practitioners include both professional ICT ('informatics') and non-professional ICT workers.

ICT users
ICT users need the capabilities required for effective use by the individual of ICT systems and devices. ICT users make use of the systems as tools in support of their own work, which is, in most cases, not ICT. User skills cover the use of common generic software tools, such as word processing, spreadsheets, presentations, e-mail and Internet, and use of specialised tools supporting business functions within user sectors.

Knowledge
Knowledge summarises the capabilities and skills applied by individuals to provide solutions for specific problems. Two major categories for knowledge are explicit and implicit. Explicit knowledge can be accessed and transferred by other individuals; implicit knowledge is bound to the personal capacities and experience of a certain individual.

Know-how
Practical knowledge or expertise.

Learning
Learning is a cumulative process whereby individuals gradually assimilate increasingly complex and abstract entities (concepts, categories, and patterns of behaviour or models) and/or acquire skills and competences.

Learning outcome(s)/learning attainments
The set of knowledge, skills and/or competences an individual acquired and/or is able to demonstrate after completion of a learning process.

Lifelong learning
All learning activity undertaken throughout life, with the aim of improving knowledge, skills and/or qualifications for personal, social and/or professional reasons.

Non-formal learning
Non-formal learning includes any organised, learner-centred, more flexible educational activity outside the established formal system.

Qualification
Demonstration of personal attributes, education, training and/or work experience. Qualification as certificates or diplomas or other evidence linked to the delivery and assessment of training received. The requirements for an individual to enter or progress within an occupation.

Quality standards
Quality standards are provided in formal way by independent standardisation bodies and sector associations documented in form of normative documents. *De facto* standards are offered by public and/or private initiatives and are achieved through a broad acceptance by the actors in a specific sector/field. Quality standards can be distinguished concerning their focus, e.g. on process, method, content.

Recognition
The process of granting official status to skills and competences either through the award of certificates or through granting equivalence, credit units, validation of gained skills and/or competences (formal recognition). The acknowledgement of the value of skills and/or competences by economic and social stakeholders (social recognition).

Skills
The knowledge and experience needed to perform a specific task or job. Capabilities of an individual, definable by content, to be acquired and activated through related professional training. In this context, capabilities are the physical or psychological attributes of an individual to be applied in activity-related approaches.

Test
Provision of information about an individual's standing with respect to a specific set of knowledge, skills, and competence as defined by a specific job profile or occupational role.

Validation of informal/non-formal learning
The process of assessing and recognising a wide range of knowledge, know-how, skills and competences, which people develop throughout their lives within different environments, for example through education, work and leisure activities.

Vocational and education and training (VET)
Education and training which aims to equip people with skills and competences that can be used in the labour market.

Work experience
Continuously gathered by individuals fulfilling their occupational role, and gained in the daily working process, but also by informal learning and continuous professional development.

Bibliography

Adelman, C. A parallel universe, expanded: certification in the information technology guild. *Change***,** Vol. 32, No 3, p. 20-29. Available from Internet: http://www.aahe.org/change/paralleluniverse.htm [cited 17.8.2004].

Bean, M. The quest for the IT security professional. *Certification Magazine*, November 2004. Available from Internet: http://www.certmag.com/articles/templates/cmag_contributor_ft.asp?articleid=951&zoneid=20 [cited 12.11.2004].

Behringer, F.; Coles, M. *The role of national qualifications systems in promoting lifelong learning: towards an understanding of the mechanisms that link qualifications and lifelong learning*. Paris: OECD, 2003. (OECD education working paper, 3). Available from Internet: http://www.oecd.org/dataoecd/15/11/15520534.pdf [cited 20.1.2005].

Behrmann, D.; Schwarz, B. (eds). *Selbstgesteuertes lebenslanges Lernen: Herausforderungen an die Weiterbildungsorganisationen.* Bielefeld: Bertelmanns Verlag, 2003. (Forum Weiterbildung, 1).

Borch, H.; Weißmann, H. (eds). *IT-Berufe machen Karriere*. Bielefeld: Bertelsmann Verlag, 2002.

Bruniaux, C. et al. International trends in the quantity and quality of entrants to computer science courses in higher education. *Quarterly Journal of Economic Research*, 2000, No 4, p. 527-543. Available from Internet: http://www.diw.de/english/produkte/publikationen/vierteljahrshefte/docs/papers/v_00_4_4.pdf [cited 26.10.2005].

Castelli, A. *ICT practitioner skills and training: banking and financial services.* Luxembourg: Office for Official Publications of the European Communities, 2004 (Cedefop Panorama series, 95). Available from Internet: http://www2.trainingvillage.gr/etv/publication/download/panorama/5151_en.pdf [cited 26.10.2005].

Dixon, M. *Information technology practitioner skills in Europe: study of the labour market position, in particular for Germany, Ireland, Sweden and the United Kingdom*. Frankfurt: CEPIS, 2002. Available from Internet: http://www.cepis.org/download/cepis_report.pdf [cited 26.10.2004].

Ehses, C.; Zech, R. *Lernorientierte Qualitätstestierung in Weiterbildungsnetzwerken*. Final project report. BLK Modellversuchsprogramm 'Lebenslanges Lernen'. October 2002. Available from Internet: http://www.artset.de [cited 12.11.2004].

EITO. *EITO 2001: European information technology observatory*. Frankfurt: EITO, 2001. Available from Internet: http://www.eito.com [cited 25.10.2005].

EITO. *EITO 2002: European information technology observatory*. Frankfurt: EITO, 2002. Available from Internet: http://www.eito.com [cited 25.10.2005].

Empirica. *E-skills and e-security statistics: revised final draft prepared by Empiricia for Eurostat*. Bonn, Empirica, 2002. Available from Internet: http://www.empirica.biz/empirica/projekte/laufende-details_en.htm [cited 20.1.2005].

E-skills certification consortium. *The situation and the role of e-skills industry certification in Europe: prepared for the European e-skills conference in Thessaloniki.* CompTIA, 2004. Available from Internet: http://www.eskills2004.org/files/ESCC%20report%20for%20e-Skills%202004.zip [cited 25.10.2005].

European Commission. *European report on quality indicators of lifelong learning: fifteen quality indicators: report based on the work of the Working group on quality indicators.* Brussels: European Commission, 2002. Available from Internet: http://europa.eu.int/comm/education/policies/lll/life/report/quality/report_en.pdf [cited 25.10.2005].

European Commission. *High-level task force on skills and mobility: final report.*. Brussels: European Commission, 2002. Available from Internet: http://europa.eu.int/comm/employment_social/news/2001/dec/taskforce2001_en.pdf [cited 25.10.2005].

European Commission. *New European labour markets, open to all, with access for all*. Brussels: European Commission, 2001. (COM (2001) 116 final). Available from Internet: http://europa.eu.int/comm/employment_social/empl_esf/news/labour.pdf [cited 26.10.2004].

European e-skills forum 2004. *Definitions*. Available from Internet: http://communities.trainingvillage.gr/esf [cited 20.1.2005].

European e-skills forum 2004. *Synthesis report*. [Draft version]. Available from Internet: http://communities.trainingvillage.gr/esf [cited 20. 1.2005].

European e-skills forum 2004. *The e-skills definition and the four issue papers*. May 2004. Available from Internet: http://communities.trainingvillage.gr/esf [cited 20.1.2005].

European e-skills forum. *E-skills for Europe: towards 2010 and beyond: synthesis report.* Brussels: European Commission, 2004. Available from Internet: http://europa.eu.int/comm/enterprise/ict/policy/doc/e-skills-forum-2004-09-fsr.pdf [cited 25.10.2005].

Facklam, T. Certification of persons: ISO/IEC DIS 17024, general requirements for bodies operating certification of persons. *ISO bulletin*, October 2002, p. 31-34. Available from Internet: http://www.iso.org/iso/en/commcentre/isobulletin/articles/2002/pdf/certification02-10.pdf [cited 12.11.2004].

Foster, D. Psychometrics 101: test quality. *Certification Magazine,* November 2004. Available from Internet: http://www.certmag.com/articles/templates/cmag_contributor_ex.asp?articleid=950&zoneid=18 [cited 12.11.2004].

Grip, A. de; Loo, J. van; Mayhew, J. (eds). *The economics of skills obsolescence: theoretical innovations and empirical applications*. Amsterdam: Elsevier, 2002. (Research in labor economics, 21).

IAF. *IAF guidance on the application of 17024: 2003: conformity assessment: general requirements for bodies operating oertification of persons*. International Accreditation Forum, 2004. (IAF guidance document, 1). Available from Internet: http://www.compad.com.au/cms/iaf/workstation/upFiles/228543.IAF-GD24-2004_Guidance_on_ISO_17024_Pub.pdf [cited 26.10.2005].

ICT skills monitoring group. *E-business and ICT skills in Europe: synthesis report.* Brussels: European Commission, 2002. Available from Internet: http://europa.eu.int/comm/enterprise/ict/policy/ict-skills/wshop/synthesis-report-v1.pdf [cited 26.10.2005].

IFIP; OECD; WITSA. *Meeting global IT skills needs: the role of professionalism: joint working conference. 25–27 October 2002*. Gorse Hill Executive Centre. Woking: IFIP 2002. Available from Internet: http://www.globalitskills.org/proceedings.pdf [cited 26.10.2005].

Infed. *The encyclopaedia of informal education: Formal, non-formal and informal education.* London: Infed, 2004. Available from Internet: http://www.infed.org/encyclopaedia.htm [cited 26.10.2005].

ISO/IEC 17024. *Conformity assessment: general requirements for bodies operating certification of persons*. Geneva: ISO, 2004.

IT Sector Committee. *Der Zertifzierzungsprozeß*. Hanau: IT Sector Committee, 2005. Available from Internet: http://www.it-sektorkomitee.de/unterseiten/zertifizierung/zertifizierung_frame.htm [cited 26.10.2005].

Kok, W. *Facing the challenge: the Lisbon strategy for growth and employment: report from the high level group chaired by Wim Kok.* Brussels: European Commission, 2004. Available from Internet: http://europa.eu.int/growthandjobs/pdf/kok_report_en.pdf [cited 26.10.2005].

Lukaschewski, M. *Umsetzbarkeit des Systems der Personenzertifizierung von IT-Spezialisten bei KMU's und Konzernen: Projektarbeit.* Bergisch-Gladbach: Fachhochschule der Wirtschaft, 2004.

Mattauch, W.; Caumanns, J. (eds). *Innovationen der IT-Weiterbildung*. Bielefeld: Bertelsmann Verlag, 2003.

New Horizon Computer Learning Centers. *Integrated learning concept*. Available from Internet: http://www.newhorizons.de [cited 26.10.2005].

OECD. ICT skills and employment. In OECD *Information technology outlook 2004*: Chapter 6. Available from Internet: http://www.oecd.org/dataoecd/31/53/34238722.pdf [cited 26.10.2005].

OECD. Lifelong learning. *OECD observer*, February 2004. Available from Internet: http://www.oecdobserver.org/news/fullstory.php/aid/1192/Down_to_work_and_better_jobs.html [cited 26.10.2005].

Olbert-Bock, S. *Lernprozesse bei Veränderungen in Unternehmen.* Dissertation Universität Karlsruhe. Frankfurt: Lang, 2002.

Petersen, A.W. et al. *ICT and e-business skills and training in Europe: Towards a comprehensive European e-skills reference framework: final synthesis report*. Luxembourg: Office for Official Publications of the European Communities, 2005 (Cedefop Panorama series, 93). Available from Internet: *http://www2.trainingvillage.gr/etv/publication/download/panorama/5149_en.pdf* [cited 26.10.2005].

Plant, P. *Quality in careers guidance*. Paris: OECD, 2001. Available from Internet: http://www.oecd.org/dataoecd/35/47/2698228.pdf [cited 26.10.2005].

Probst, G.; Raub, S.; Romhardt, K. *Wissen managen: wie Unternehmen ihre wertvollste Ressource optimal nutzen*. Wiesbaden: Gabler Verlag, 1997.

Schaub, H.; Zehnke, K.G. *Wörterbuch der Pädagogik*. Munich: Deutscher Taschenbuch-Verlag, 2000.

Schwarzkopf, A.B. et al. Effective practices for IT skills staffing: how to identify, hire and keep prized IT professionals with the skills companies need most to compete in uncertain technological and business times. *Communication of the ACM*, 2004, Vol. 47, No 1, p. 83-88.

SFIA. *Skills framework for the information age*. Available from Internet: http://www.sfia.org.uk [cited 25.10.2005].

Spöttl, G.; Becker, M. *ICT practitioner skills and training: automotive industry.* Luxembourg: Office for Official Publications of the European Communities, 2004 (Cedefop Panorama series, 91). Available from Internet: http://www2.trainingvillage.gr/etv/publication/download/panorama/5147_en.pdf [cited 26.10.2005].

Steedman, H.; Wagner, K.; Foreman, J. *ICT skills in the UK and Germany: how companies adapt and react: an Anglo-German foundation report.* London: AGF, 2003. Available from Internet: http://www.agf.org.uk/pubs/pdfs/ES1358.pdf [cited 26.10.2005].

Stevens, M.; Sandro, B. Securing value: the HP certified professional program. *Certification Magazine,* November 2004. Available from Internet: http://www.certmag.com/articles/templates/cmag_department.asp?articleid=955&zoneid=63 [cited 26.10.2005].

Stiffler, Rick. Specialised Cisco certifications prepare business for change. *Certification Magazine,* November 2004. Available from Internet: http://www.certmag.com/articles/templates/cmag_department.asp?articleid=959&zoneid=63 [cited 26.10.2005].

Stucky, W. et al. Information technology practitioners skills in Europe: current status and challenges for the future. In Klein, R.; Six, H.-W.; Wegner, L. (eds). *Computer science in perspective.* Heidelberg: Springer Verlag, 2003, p. 304-317.

Stucky, W.; Bumann, P.; Weiß, P. Filling e-skills gap and shortage. In Stucky, W.; Weiß, P. *eEurope – IT skills: challenging Europe's economic future.* Frankfurt: CEPIS, 2004, p. 9-19.

Stucky, W.; Weiß, P. *eEurope – IT skills: challenging Europe's economic future*; workshop proceedings eChallenges e2003. Frankfurt: CEPIS, 2004. Available from Internet: http://www.cepis.org/download/proceedings_e2003_cepis.pdf cited 26.10.2005].

Tissot, P. *Terminology of vocational training policy: a multilingual glossary for an enlarged Europe*. Luxembourg: Office for Official Publications of the European Communities, 2004. (Cedefop Reference series). Available from Internet: http://www2.trainingvillage.gr/etv/publication/download/panorama/4030_6k.pdf [cited 26.10.2005].

Tittel, E. Factoring the costs of certification. *Certification Magazine,* July 2002. Available from Internet: http://www.certmag.com/itcissues/jul02/exp_tittel.cfm [cited 26.10.2005].

Tittel, E. Find the best certification prep materials. *Certification Magazine,* June 2004. Available from Internet: http://www.certmag.com/articles/templates/cmag_department.asp?articleid=746&zoneid=63 [cited 26.10.2005].

Tittel, E. Learning with style: what's your learning personality? *Certification Magazine,* November 2004. Available from Internet: http://www.certmag.com/articles/templates/cmag_feature.asp?articleid=954&zoneid=9 [cited 26.10.2005].

Tittel, E. Top IT certifications for 2002. *Certification Magazine,* January 2002. Available from Internet: http://www.certmag.com/itcissues/jan02/exp_tittel.cfm [cited 26.10.2005].

Tittel, E. Understanding certification ladders. *Certification Magazine,* May 2002. Available from Internet: http://www.certmag.com/itcissues/may02/exp_tittel.cfm [cited 26.10.2005].

URISA. *GIS certification: what is certification*. Urban and regional information systems association, 2005. Available from Internet: http://www.urisa.org/certification/2certific.htm#What%20is%20Certification? [cited 26.10.2005].

URISA. *The GIS certification institute's (GISCI) certification program for GIS professionals*. Urban and regional information systems association, 2004. Available from Internet: http://www.urisa.org [cited 26.10.2005].

Venator, John A. An important time for IT professionals. *Certification Magazine*, October 2004. Available from Internet: http://www.certmag.com/articles/templates/cmag_contributor_persp.asp?articleid=920&zoneid=67 [cited 26.10.2005].

Annex 1 - Questionnaire

Survey

E-skills certification in Europe

Conducted by

CEPIS
Council of European Professional Informatics Societies

On behalf of

Cedefop
European Centre for the Development of
Vocational Training

July 2004

Dear Colleague,

Multiple certification programmes and systems are known throughout the ICT practitioner/user community as highly important for getting into the information technology field and building a solid professional career. CEPIS ([49]) studies and compares, on behalf of Cedefop ([50]), existing approaches to e-skills certification at European and international level. The survey intends to contribute to the current debate by investigating existing modes, procedures, methods and institutions responsible for e-skills certification.

The results of the survey will be addressed in current European working groups and are intended to inform Cedefop and the European Commission on further steps to be taken in the framework of promoting ICT skills training, recognition and transparency ([51]) as well as social cohesion and mobility of labour and last but not least the competitiveness of European enterprises. This activity is closely linked to the outcomes of the e-skills forum, which was set up by the European Commission in 2003 and to the current work of the European standardisation committee linked to the information society standardisation system ([52]).

The questionnaire is primarily aimed at members of CEPIS, the e-skills forum and the CEN-ICT skills workshop. However, we would appreciate if you send us names and addresses of other stakeholders (bodies of public services, non-governmental bodies, training providers, private industry-led certifying or training bodies), which are knowledgeable and competent in the field.

We would like you as an expert to answer the following questions purely on the basis of your knowledge and experience. The data gathered will be kept and processed strictly confidentially and anonymously throughout the entire survey and analysis task.

The questionnaire is composed of elements for qualitative information in five sections:

Details on respondent:

1. European e-skills certification: problems, issues, solutions,
2. existing recognised e-skills certification systems in your country,
3. future of e-skills certification,
4. recommendations.

The completion of the questionnaire will require about **20 minutes** of your precious time.

Thank you for your support in advance.

Sincerely yours,

The CEPIS project team

Signed by

Peter Bumann,
CEO, CEPIS

([49]) http://www.cepis.org.

([50]) The European Union's Thessaloniki based agency: European Centre for the Development of Vocational Training: http://www.cedefop.eu.int/.

([51]) In this interrelation is comprehended as precondition to achieve comparability and transferability of e-skills.

([52]) See also http://cedefop.communityzero.com/esf and http://cedefop.communityzero.com/cen-ict.

For Cedefop, this text was seen by Burkart Sellin, principal administrator and project manager, contact: bs@cedefop.eu.int

Deadline: 31 July 2004

Please return the questionnaire

by e-mail to weiss@aifb.uni-karlsruhe.de.

Contacts concerning this questionnaire are:

Peter Weiß (weiss@aifb.uni-karlsruhe.de) or **Ralf Trunko** (trunko@aifb.uni-karlsruhe.de).

Definition of concepts ([53])

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

Certification scheme
Specific certification requirements related to specified categories of persons to which the same particular standards and rules, and the same procedures apply.

Certification system
Set of procedures and resources for carrying out the certification process as per a certification scheme, leading to the issue of a certificate of competence including maintenance.

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

E-skills
The term e-skills includes ICT practitioner skills, ICT user skills and e-leadership skills. E-skills can be categorised by four different levels of complexity, in brackets the related qualification level is indicated for both ICT practitioner and end-user level: A: basic level (assistant, end-user), B: core level (technician, end-user), C: advanced level (specialist, end-user), D: expert level (professional, end-user). ICT end-users are people who are using e-skills only to support their primary profession whereby ICT is not the main focus of their jobs. E-skills are acquired and assessed in a number of ways, including courses in tertiary (and other) education, commercial training provision (mainly in relation to the use of specific software) and industry certification ([54]).

ICT practitioners
ICT practitioners possess the capabilities required for specifying, designing, developing, installing, operating, supporting, maintaining, managing, evaluating and researching ICT systems, for the benefit of others ([55]). ICT practitioners include both professional ICT ('informatics') and non-professional ICT workers.

ICT users
ICT users need the capabilities required for effective use by the individual of ICT systems and devices. ICT users make use of the systems as tools in support of their own work, which is, in most cases, not ICT. User skills cover the utilisation of common generic software tools, such as word processing, spreadsheets, presentations, e-mail and Internet, and use of specialied tools supporting business functions within user sectors.

Qualification
Demonstration of personal attributes, education, training and/or work experience. Qualification as certificates or diplomas or other evidence linked to the delivery and assessment of training received ([56]).

Quality standards
Quality standards are provided in a formal way by independent standardisation bodies and sector associations documented in the form of normative doucments. *De facto* standards are offered by public and/or private initiatives and are achieved through a broad acceptance by the actors in a specific sector/field. Quality standards can be distinguished concerning their focus, e.g. on process, method, content.

([53]) Mainly based on ISO/IEC 17024 'Standard for the certification of persons' and the CEPIS survey 'I.T. practitioner skills in Europe'. The term e-skills is defined according to a definition by the European e-skills forum.

([54]) Meeting global IT skill needs – the role of professionalism. IFIP, OECD, WITSA, joint working conference. Summary of proceedings.

([55]) CEPIS report 'IT practitioner skills in Europe', p. 95f. Definition according to the e-skills forum, May 2004.

([56]) Cedefop: draft final report: towards a comprehensive European level e-skills framework, page 101, restricted report for CEN/ISSS ICT skills working group, May 2004.

1 Details on respondent and organisation

The information given on this page will be kept strictly confidential and is processed anonymously throughout the survey and analysis task. We kindly ask you to provide us with the required information in the table below. The fields indicated by a **(*)** are obligatory fields for the statistical analysis.

Respondent and organisation

(*) Position within organisation	
Email ([57])	
Name of affiliated organisation	

Details of your organisation

(*) Type of organisation	( ) certifying body ( ) test centre ( ) training provider ( ) ICT vendor ( ) education ( ) government ( ) ICT (supplier) company ( ) ICT (end-)user organisation ( ) other _____
(*) Status of organisation	( ) industry/private ( ) public ( ) government Other _____
(*) Business sector (if applicable, e.g. IT, Manufacturing, etc.)	
(*) What is your place of residence?	
( ) Old EU Member States ( ) New EU Member States ( ) Associated countries ( ) Other	

(*) Please indicate your **membership in** relevant **working group(s)/association(s)** at international/European or national level related to e-skills certification?
( ) E-skills forum ( ) CEN ISSS ICT ( ) CompTIA ( ) Career space ( ) EICTA ( ) Uni Europa ( ) other(s): [ ]

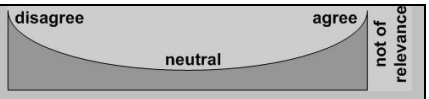
([57]) If you wish to receive information about the results of the survey and the project in the near future.

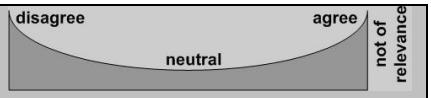
2 European e-skills certification: problems, issues, solutions

The following questions investigate the importance and future role of e-skills certification on a European level. **The questions should be answered concerning e-skills certification at all levels and over all categories of e-skills: ICT practitioner skills, ICT user skills and e-leadership skills**. Please answer the questions purely on the basis of your experience, best practice and knowledge.

2.1 General statements

Q2.1 How do you agree with the **following statements** in relation to the current debate towards comparable e-skills certification for **ICT practitioners/end-users** at European and international level?

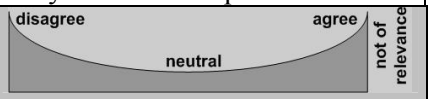
							
		-2	**-1**	**0**	**+1**	**+2**	**n.r.**
1	Today, Europe is facing a **multitude** of available e-skills certification schemes.						
2	Europe needs **fewer**, but more relevant e-skills certification schemes.						
3	The **importance (level of acceptance and usage)** of e-skills certification differs significantly amongst member states and other countries.						
4	The **comparability and transparency** of e-skills certification schemes at European and international level is given too much priority in the current debate.						
5	On a European level, in short-term compatible and recognised e-skills certificates are **strongly** needed.						
6	The following **types of e-skills certification schemes** play an important role to achieve transparency and comparability of e-skills certification in Europe (a+b+c):						
a	ICT end-user schemes…						
	ICT practitioner schemes…						
b	…vendor-specific…						
	…vendor-neutral…						
c	…with government/public sponsorship						
	…with industry or vendor sponsorship						
	…with vendor neutral sponsorship						
	…with vendor specific sponsorship						
7	**Transparency, portability and compatibility** of e-skills certificates can only be achieved by cooperation of stakeholders on basis of **public-private partnerships**.						
8	The **current initiatives and current debate** are still far away from a European reference framework of promoting e-skills training, recognition and transparency.						

						
	-2	**-1**	**0**	**+1**	**+2**	**n.r.**
9	Europe needs **recognised formal quality standards** and related common criteria and requirements for e-skills certification.						
10	Europe needs **recognised formal quality standards** and related common criteria and requirements for **training providers**.						
11	The current marketplace is characterised by a **focus on vendor certification and industry-accredited courses**.						
12	There is a obvious void in terms of **accepted e-skills certification schemes** and the current market need.						
13	In your country **vocational qualification** and related training is generally specified and regulated through legislation involving licensing and certification.						
14	In your country the **cost of certification** is **in many cases** a **barrier** for many **ICT practitioners/end-users** (self-employed, employees, individuals) to pass through an e-skills certification system.						
15	In your country the **cost of certification** is **in many cases** a **barrier** for many **ICT employers** to offer certified vocational training for employed ICT practitioners/users.						

Q2.2 Wherein do you see important differences in **e-skills certification schemes** for **ICT practitioners** and **ICT end-users** to be addressed to achieve improved comparability and transferability?

[your comments]

Q2.3 From your perspective, how important are cooperations of and **joint activities** by relevant stakeholders on transparency and comparability of e-skills certification systems in Europe?

						
	-2	**-1**	**0**	**+1**	**+2**	**n.r.**
1	ICT vendor/industry						
2	governmental/public bodies						
3	educational bodies						
4	training provider						
5	certifying body						
6	ICT practitioner						
7	ICT end-user						

2.2 Problems

Q2.4 Which **problems mainly hamper** the transparency and comparability of certificates/diploma for ICT practitioners/end-users on a European level?

[your comments]

Q2.5 Which **problems** have **to be solved by the stakeholders** in view of the transparency and comparability of e-skills certificates at European and international level?

[your comments]

Q2.6 Which other **problems have you identified** towards a European framework of promoting ICT skills training, recognition and transparency?

[your comments]

2.3 Issues

Q2.7 Which are the **key issues to be addressed by the stakeholder**s towards the comparability and transparency of e-skills certificates at European and international level?

…in the short term…?

[your comments]

….and in the long term?

[your comments]

2.4 Solutions

Q2.8 Which are **possible solutions** towards the comparability and transparency of e-skills certificates at European and international level?

e.g. European e-skills meta-framework, design of innovative e-skills training solutions, promotion of European e-skills multi-stakeholders partnerships, improve planning and data availability for the ICT sector market, develop long-term strategic approaches to ICT sector.

…in short term…?

[your comments]

…and in long term?

[your comments]

3 Existing recognised e-skills certification systems in your country

Q3.1 Which e-skills certification systems **for ICT practitioners/end-users** you know are being **widely applied in your country**? (Please mention max. five (5) of the most important or recognised systems).

A. Please fill in the name of the **mostly recognised** e-skills certification system for ICT practitioners/end-users in your country and name the certifying body if to you are aware of it.
B. Please note the **degree of market recognition** per certification system in your country by employers and by employees.
C. Please categorise the **level of recognition**: regional, national, European, international.

A		B					C			
1) Name of certification system 2) Name of certifying body		**Degree of market recognition in your country?**					**Level of recognition**			
		low		**neutral**		**high**	**regional**	**national**	**Europe**	**International**
		-2	**-1**	**0**	**1**	**2**				
1	1) 2)									
2	1) 2)									
3	1) 2)									
4	1) 2)									
5	1) 2)									

Q3.2 Wherein do you see important differences in e-skills certification systems for **ICT practitioners/end-users in your country**?

☐ **None** ☐ **Do not know** ☐ **Yes.**

If answered 'yes' which major differences do you see?

[your comments]

Q3.3 Please describe the mentioned e-skills certification system(s) by the following additional **categories**. Multiple answers are possible. If you do not know the answer please leave the table blank and/or provide a comment (optional)

Name of category	No. of mentioned e-skills certification system in Q3.1				
	1	2	3	4	5
At which **level of e-skills** (qualification) does the system offer certification? (In brackets the related qualification level is indicated for both **ICT practitioner and end-user level**.)					
ICT practitioner skills ☐					
a basic level (assistant)					
b core level (technician)					
c advanced level (specialist)					
d expert level (professional)					
ICT end-user skills ☐					
a basic level					
b core level					
c advanced level					
d expert level					
Other, please specify:					
Comments (optional)	[e.g. not to my knowledge]				

Name of category	No. of mentioned e-skills certification system in Q3.1				
	1	2	3	4	5
What is the **geographic coverage** of the system?					
regional					
national					
European					
international					
Other, please specify: _____					
Comments (optional)	[e.g. not to my knowledge]				

Select the type of **certifying body**/institution issuing certificates or diplomas					
enterprise					
social partners' committee					
officially recognised school					
professional or employer's association					
governmental institution					
Other, please specify: _____					
Comments (optional)	[e.g. not to my knowledge]				

How do you describe the available degree of **standardisation**?					
industry standard (e.g. de facto standard)					
formal standard (e.g. iso, eac)					
not to my knowledge					
none					
Other, please specify: _____					
Comments (optional)					

Name of category	**No. of mentioned e-skills certification system**				
	1	**2**	**3**	**4**	**5**

How do you describe the **outcome** of the certification system?					
certificate					
diploma					
Other, please specify: _____					
Comments (optional)	[e.g. not to my knowledge]				

vendor-neutral					
vendor-specific					
public					
private/industry					
Other, please specify: _____					
Comments (optional)	[e.g. not to my knowledge]				

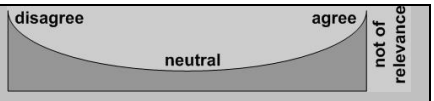
Which is (are) the **target group(s)** of the mentioned e-skills certification system?					
students					
non-users					
ICT users					
ICT practitioners					
lateral entries					
re-entries					
self-employed					
unemployed people					
learning advisors/trainers					
Other, please specify: _____					
Comments (optional)	[e.g. not to my knowledge]				

Q3.4 Which of the mentioned e-skills certification systems would you put forward and should be considered in the current discussion of **voluntary approaches setting standards** for European e-skills certification?

☐ None

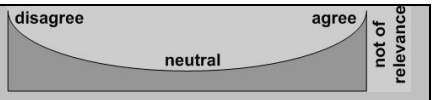
☐ [Please fill in the name of the system]

Additional comments (optional)



	-2	-1	0	+1	+2	n.r.
Q3.5 In your country, is the achievement of **vocational qualification** (e.g. certificate, diploma) a precondition for ICT practitioners/end-users for employment in a relevant job?						
[your comments]						

Q3.6 How do you agree with the following **success factors** for e-skills certification systems?



	-2	-1	0	+1	+2	n.r.
Relevance						
Global coverage and acceptance						
Consistency						
Security						
Robustness						
Flexibility						
Price/costs						
Benefit for						
employers						
individuals						
Independency						
vendor-neutral						
vendor-specific						
Support by ….						
industry/employers						
government						
professionals						
education						
[your comments]						

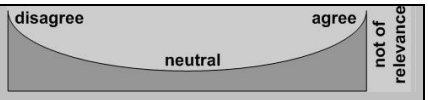
4 Future of e-skills certification

4.1 Quality standards

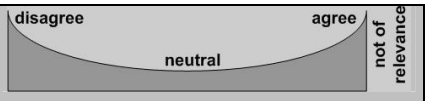
Q4.1 From your point of view, which e-skills certification system(s) would be an **appropriate basis for a framework** of promoting e-skills training, recognition and comparability on a European level?

[your comments]

Q4.2 How do you agree with the below shown types of e-skills certification systems as an **appropriate basis for such a framework**?

							
		-2	**-1**	**0**	**+1**	**+2**	**n.r.**
1	A **pure formal** system linked to public education and training qualifications						
[Examples, comments]:							
2	A self-controlled **company or industry based** system						
[Examples, comments]:							
3	System linked to **ICT vendors**						
[Examples, comments]:							
4	An e-skills certification system linked to a **vendor independent** organisation						
[Examples, comments]:							
5	Other system, if yes which one?						
[Examples, comments]:							

Q4.3 How do you agree with the following issues to be addressed by a relevant **framework** for e-skills certification?

							
		-2	**-1**	**0**	**+1**	**+2**	**n.r.**
1	certification process						
2	certification scheme (requirements, job profiles, etc.)						
3	learning material, content						
4	outcomes of learning (knowledge and skills)						
5	training offered						
6	concept of validation, expiration						
7	other, please comment:						

[your comments]

Q4.4 How far do you agree with the following **statements**?

		disagree / neutral / agree / not of relevance					
		-2	**-1**	**0**	**+1**	**+2**	**n.r.**
1	There should be a permanent EU Agency to be entrusted with e-skills certifications' comparability and recognition/standards issues.						
2	Transparency and comparability should be achieved by establishing a **voluntary European Certification Body** (e.g. European ICT Qualifications and Certifications Network, International/European Testing & Certification Board?).						
[your comments]							
3	All individual learners should get access to an **e-portfolio** to be handed out by a European e-skills certification body/network						
4	A central **repository** listing and categorising offered and available e-skills certification in Europe is needed.						
[your comments]							

The following questions refer to your agreement with the **goals and related tasks of an assumed central European body/board** responsible for achieving recognition, transparency and comparability of e-skills certification for ICT practitioners/end-users.

Q4.5 Do you support the setting up of an **International or European Testing & Certification Board**?

☐	**No, because….**
[your comments]	
☐	**Yes. Please rate the following statements.**

		disagree / neutral / agree / not of relevance					
		-2	**-1**	**0**	**+1**	**+2**	**n.r.**
1	To **establish** and to **maintain** common **quality standards for ICT training and certification.**						
2	To **accredit** other organisations who train the individual learners in accordance with the standards.						
3	To **assess** and certify the practitioners who meet agreed quality standards.						
4	To enable international equivalence of ICT qualifications to support international mobility.						
5	To **accredit** or register current competence assessment approaches.						
6	To achieve **'professional development' arrangements** enabled by computer societies and stakeholders and measurement against national and 'regional' standards.						
7	To improve the mutual **integration/recognition** of public and private, professional and industry certification.						
8	**To provide** mechanisms, methods and tools as a basis **to compare** different occupational or job profiles.						
9	**To facilitate** an e-portfolio and career management for ICT practitioners and ICT users.						
10	To examine **efficiency and effectiveness** in reconciling systems for training of individuals with existing industry e-skills requirements in the different sectors.						
11	To contribute to a **universally-acceptable occupational or ICT skills framework.**						
12	To observe competence development issues for ICT practitioners and ICT users and to achieve **higher professional mobility** of the ICT workforce.						
13	To enable the acquisition of **transferable e-skills** that are recognised globally.						
14	To offer a European reference framework for **ICT job profiles and qualifications which is widely** recognised by public bodies and private industry.						
15	To review regularly the **education/training provision** in the light of changing requirements of the marketplace						
16	To establish and **intensify links** between certification vendors, employers, recruitment agencies and training providers at European and international level.						
17	To develop **stronger links** between qualification and ICT skills frameworks.						
18	To offer **internationally** accepted certification.						
19	To create a sustainable lifelong learning and career concept, to promote and implement **business awareness factors** of e-skills.						
20	To cooperate with and **stimulate** existing certification schemes, to achieve public and governmental support.						
21	To achieve **global recognition** of e-skills certification systems and related vocational qualifications.						
22	To acquire greater international comparability (in particular on the e-skills classification systems – e.g. occupations and educational achievement), and better migration data.						
23	To **bridge the gap** between bodies of knowledge and occupational frameworks by elaborating pathways to greater relevance of tertiary education curricula.						
24	To identify and overcome existing (e.g. governmental, marketplace) **barriers to professional mobility**.						

[your comments]

Q4.6 Which **organisations/initiatives should be represented** in the central European body/board?

[your comments]

E-portfolio

Training suppliers are looking increasingly at providing broader career management and qualification development services. An e-portfolio is defined as an inventory of ICT practitioners/end-users skills and qualifications. Such a portfolio may support international mobility and cooperation.

Q4.8 Do you agree with the idea of setting up a **European e-portfolio**?

☐ **No** ☐ **Do not know** ☐ **Yes**

Initiatives

Q4.9 Who should be, from your point of view, the **leading and entrusted certifying bodies/organisations** offering e-skills certification in Europe?

Q4.10 Who are the leading **industry-led initiatives** addressing e-skills certification at European and international level ?

Q4.11 What are the leading **public-led initiatives** addressing e-skills certification at European and international level ?

5 Recommendations

5.1 Government

Q5.1 What **recommendations for activities and/or initiatives** do you propose **for governmental bodies** to achieve the **transparency and comparability** of e-skills certifications?

…in the short term….?

[your comments]

….and in the long term?

[your comments]

5.2 Industry

Q5.2 What **recommendations for activities** and/or initiatives do you propose **for industry** to achieve the transparency and comparability of e-skills certifications?

…in the short term….?

[your comments]

….and in the long term?

[your comments]

5.3 Education

Q5.3 What **recommendations and activities** do you propose **for educators/training providers** to achieve the transparency and comparability of e-skills certifications?

…in the short term….?

[your comments]

….and in the long term?

[your comments]

Q5.4 Who should take the **lead in the initiative towards** comparable European e-skills certification systems?

ICT vendor/industry			certifying body	
governmental/public bodies			ICT practitioner	
educational bodies			ICT end-user	
training provider			other(s): [Please specify]	

[your comments]

5.4 Feedback

Please give if convenient feedback and your opinion concerning this questionnaire:

[your comments]

If you are interested, we will send you (by request) the results of our survey via e-mail. In this case please indicate your e-mail address in the corresponding field on page 4.

Thank you for your patience and for answering our questionnaire!

The CEPIS project team

Please return the questionnaire
by e-mail to weiss@aifb.uni-karlsruhe.de.

Deadline: 31 July 2004

Annex 2 – List of vendor-specific certifications

In this appendix a list of vendor-specific certifications is given. The list is the result of desktop research of available vendor-specific certifications and does not claim to be comprehensive. Some vendor-specific certifications might be missing; however, the list documents the existing diversity of certificates offered on the training and learning market.

3Com	Master of Network Science (MNS): http://www.3com.com/support/mns
Ascend	Ascend Certified Technical Expert (ACTE): http://www.ascend.com/acte/
Adobe	Adobe Certified Expert (ACE), Adobe Certified Training Provider (ACTP): http://partners.adobe.com/asn/training/acehowto.html
Adaptec	Adaptec Certified Engineer: http://www.adaptec.com/
American Society for Quality	Software Quality Engineer: http://www.asq.org/standcert/cert.html
Association for Project Management	Certificated Project Manager (CPM): http://www.apm.org.uk/ac/cert.htm
Association of Web Professionals (AWP)	Certified Web Designer (CWD), Certified Web Manager (CWM), Certified Web Technician (CWT): http://www.a-w-p.org/cert.htm
Baan Company	Baan ERP Certification, Baan IV Certification, Baan Supply Chains Solutions (SCS) Certification: http://www.baan.com
Banyan	Certified Banyan Specialist (CBS), Certified Banyan Expert (CBE), Certified Banyan Instructor (CBI): http://www.banyan.com/
BIGHelpDesk.com	BIGHelpDesk.com Certified Developer: http://www.bighelpdesk.com/cert.htm
BICSI	Registered Communications Distribution Designer, (RCDD): http://www.bicsi.org/rcdd.htm
Building Industry Consulting Service International	Registered Communications Distribution Designer, (RCDD): http://www.bicsi.org/rcdd.htm
Cabletron Systems	Cabletron Specialist (CS), Cabletron Systems Engineer (CSE), Spectrum Engineer (SE), Spectrum Solutions Engineer (SSE): http://www.cabletron.com/training/certification/Internetwork/cs_prog.html
Callware Technologies	Certified Network Telephony Engineer (CNTE): http://www.callware.com/support/education.asp
Canadian Information Processing Society (CIPS)	Information Systems Professional of Canada (ISP): http://www.callware.com/support/education.asp
Centura Software/Gupta	Centura DBA Certification, Centura Developer Certification: http://www.centurasoft.com/services/certification/

Chauncey Group	Associate Technology Specialist: http://www.chauncey.com Certified Technical Trainer (CTT): http://www.chauncey.com/ctt.html
Check Point Software	Check Point Certified Network Traffic Engineer (CCAE), Check Point Certified Security Administrator (CCSA), Check Point Certified Security Engineer (CCSE), Check Point Certified Quality of Service Engineer (CCQE): http://www.checkpoint.com/services/education/certification/certs.html
Cisco Systems	Cisco Certified Network Associate (CCNA), Cisco Certified Network Professional (CCNP), Cisco Certified Internetwork Expert (CCIE) - ISP Dial, Cisco Certified Internetwork Expert (CCIE) - Routing and Switching: http://www.cisco.com/warp/public/10/wwtraining/certprog/ Cisco Certified Design Associate (CCDA): http://www.cisco.com/warp/public/10/wwtraining/certprog/lan/programs/ccda.html Cisco Certified Design Professional (CCDP): http://www.cisco.com/warp/public/10/wwtraining/certprog/lan/programs/ccdp.html Certified Cisco Systems Instructor (CCSI): http://www.cisco.com/warp/public/10/wwtraining/tpprgde2.html Cisco Learning Partner Connection: http://www.cisco.com/pcgi-bin/front.x/wwtraining/training_partners.pl
Citrix	Citrix Certified Administrator (CCA), Citrix Certified Enterprise Administrator (CCEA), Citrix Certified Instructor (CCI): http://www.citrix.com/training/
CIW	Certified Internet Webmaster: http://www.ciwcertified.com/
CNX Consortium	Certified Network Expert (CNX): http://www.mycnx2000.com/
Cognos, Inc.	Cognos Certified Professional Program (CCPP): http://www.cognos.com/busintell/ccpp.html
Compaq	Compaq Associate Accredited Systems Engineer (Associate ASE), Compaq Master Accredited Systems Engineer (Master ASE): http://www.compaq.com/ase/index.html Compaq Accredited Systems Engineer (ASE): http://www.compaq.com/training/home.html Accredited Compaq Technician Program (ACT): http://www.compaq.com/training/2083.html

CompTIA - Computing Technology Industry Association	A+ Service Technician Certification: http://www.comptia.org/index.asp?ContentPage=/certification/aplus/aplus.asp Certified Document Imaging Architect (CDIA): http://www.comptia.org/index.asp?ContentPage=/certification/cdia/cdia.asp Network+: http://www.comptia.org/index.asp?ContentPage=/certification/networkplus/networkplus.asp i-Net+: http://www.comptia.org/index.asp?ContentPage=/certification/inetplus/inetplus.asp Find Training Resources for CompTIA: http://www.comptia.org/index.asp?ContentPage=/certification/training/training1.asp
Computer Associates International	Certified Unicenter Engineer (CUE): http://www.cai.com/education/certified/cue_program.htm Certified Opal Developer (COD): http://www.cai.com/education/certified Certified Unicenter Administrator (CUA): http://www.cai.com/education/paths/path_desktop_specialist.htm Certified Professional Desktop Specialist (CACP-Desktop Specialist): http://www.cai.com/education/paths/path_helpdesk_specialist.htm Certified Professional Help Desk Specialist (CACP-Help Desk Specialist): http://www.cai.com/education/paths/path_network_specialist.htm Certified Professional Network Specialist (CACP-Network Specialist), Certified Professional Storage Specialist (CACP Storage Specialist): http://www.cai.com/education/paths/path_storage_specialist.htm Certified Professional Security Specialist (CACP Security Specialist): http://www.cai.com/education/paths/path_security_specialist.htm
Computer Telephony Institute, Inc.	Computer Telephony Engineer (CTE): http://www.ctinstitute.com/
Corel Corporation	Corel Certified Proficient User: http://www.corel.com/learning/cert_program/proficient_user.htm Corel Certified Expert User: http://www.corel.com/learning/cert_program/expert_user.htm Corel Certified Instructor (CCI): http://www.corel.com/learning/cert_program/cert_instructor.htm
CyberTech Institute, Inc.	CyberTech Certified (various applications): http://www.getcertified.com/coi/cc.htm CyberTech Linux Certification: http://www.getcertified.com/coi/describ1.asp?Subject=LNX131
Dialogic	CT Professional/Solutions Developer:

	http://www.dialogic.com/support/cti-edu/certify.htm
Digital Equipment Corporation (DEC)	DIGITAL-Certified: http://www.networks.digital.com/dr/training/acp-mn.html
Digital Metrics	Digital Metrics Certified Linux Administrator: http://www.digitalmetrics.com/
Disaster Recovery Institute International (DRI)	Associate Business Continuity Planner (ABCP): http://www.dr.org/ADRP.html Certified Business Continuity Planner (CBCP): http://www.dr.org/cdrp.html Certified Business Continuity Planner (CBCP): http://www.dr.org/mbcp.html
DSDM Secretariat	Dynamic Systems Development Method (DSDM): http://www.dsdm.org/certhp.htm
Enterprise Certified Corp.	Enterprise Certified Administrator, Enterprise Certified Architect, Enterprise Certified Professional: http://enterprisecertified.com/
EXIN	Foundation Certificate in IT Service Management (ITIL Foundation), Practitioner's Certificate in IT Service Management (ITIL Practitioner), Manager's Certificate in IT Service Management (ITIL Service Management): http://www.exin-exams.com/default.asp?menuID=%7bB1D15F54-7154-4B36-A011-FE6BC38AB461%7d
FileNET	FileNET Certified Professional (FCP): http://education.filenet.com/edu/fcp/
FORE Systems	FORE Systems LAN Certified Engineer, FORE Systems WAN Certified Engineer: http://www.fore.com/atm-edu/train/cert.html
Gartner Institute	Gartner Certified Associate in Project Management: http://www.gartnerinstitute.com/products/pr_ce.htm
Global Knowledge	TCP/IP Network Analyst Certification: http://db.globalknowledge.com/catalog/certlisting.asp?code=TCPI
HelpDesk 2000	Certified Field Support Technician (CFST): http://www.helpdesk2000.org/education/classes_technician.html Certified Help Desk Director (CHDD): http://www.helpdesk2000.org/education/classes_director.html Certified Help Desk Manager (CHDM): http://www.helpdesk2000.org/education/classes_manager.html Certified Help Desk Professional (CHDP): http://www.helpdesk2000.org/education/classes_professional.html Help Desk 2000 Certified Instructor: http://www.helpdesk2000.org/education/classes_instructor.html
Hewlett Packard	HP Certified IT Professional - HP-UX System Administration: http://education.hp.com/hpcert-track1.htm HP Certified IT Professional - HP-UX System Administration: http://education.hp.com/hpcert-track6.htm HP Certified IT Professional - OpenView Network Management: http://education.hp.com/hpcert-track3.htm HP Certified IT Professional - OpenView Unix Server &

	Applications Management: http://education.hp.com/hpcert-track4.htm HP Certified IT Professional - OpenView Unix/NT Integration: http://education.hp.com/hpcert-track5.htm HP Certified IT Professional - OpenView Windows NT Server & Applications Management: http://education.hp.com/hpcert-track2.htm HP OpenView Certified Consultant: http://www.openview.hp.com/partners/general/general.asp?docID=27 HP STAR - Certified Cluster Installer (CLU), HP STAR - NetServer Technology Professional (NTP), HP STAR - Digital Workplace Professional (DWP), HP STAR - Information Storage Professional (ISP), HP STAR - Network Connectivity Professional (NCP): http://www.interactive.hp.com/CPO_TRAINING/CP/HPS/genInfo.html
HyCurve Inc.	HyCurve Administration Specialist, HyCurve Applications Specialist, HyCurve Security Specialist, HyCurve Web Design Specialist: http://www.hycurve.com/certification/default.asp
IBM Corporation	AIX Professional Certification: http://www.rs6000.ibm.com/support/aixcert Object Technology Certifications: http://www.software.ibm.com/spslibrary Professional Certification Program: ttp://www.ibm.com/Education/certify/
iGeneration Certified Professional Program	All Internet Certifications: http://you.igeneration.com/certification/default.asp
Information Systems Audit and Control Association	Certified Information Systems Auditor (CISA): http://www.isaca.org/cert1.htm
Informix Software, Inc.	Informix Certified Professional: http://www.informix.com/certification
Inprise Corporation	Certified Inprise Consultant (CIC): http://www.borland.com/services/training/certification/consultants.html Certified Inprise Instructor: http://www.borland.com/services/training/certification/instructors.html
Institute for Certification of Computing Professionals	Associate Computing Professional (ACP), Certified Computing Professional (CCP): http://www.iccp.org/
Institute for Configuration Management (ICM)	Configuration Management II Certification (CMII): http://www.icmhq.com/
Institute for Interconnecting & Packaging Electronic Circuits (IPC)	IPC PWB Designer: http://www.ipc.org/
Intel Corporation	Intel Certified Integration Specialist: http://channel.intel.com/training/certification/integration/index.htm Intel Certified Solutions Consultant:

	ttp://channel.intel.com/training/certification/solutions/index.htm Intel Training Center Locator: http://www.intel.com/training/certification/training_locator.htm
International Function Point Users Group (IFPUG)	Certified Function Point Specialist (CFPS): http://www.ifpug.org/home/docs/cert.html
International Information Systems Security Certification Consortium	Certified Information Systems Security Professional (CISSP): http://www.utoronto.ca/security/isc.htm" \l "isc
International Programmers Guild (IPG)	Certified Programmer: http://www.ipgnet.com/certify.htm
International Society of Certified Electronics Technicians (ISCET)	Certified Electronics Technician (CET): http://www.iscet.org/info.htm
International Webmasters Association	IWA Certified Web (CWP), IWA Certified Corporate Webmaster (CCW), IWA Certified Web Developer (CWD): http://www.iwanet.org/profdevel/
Learning Tree International	Learning Tree Int. Certifications (various): http://www.learningtree.com/us/cert/index.htm
Legato Systems (acquired Vinca)	Legato Certified Administrator (LCA), Legato Certified Operator (LCO), Legato Certified Specialist (LCS): http://www.legato.com/training/index.html
Linux Professional Institute	Linux Professional Institute Certified Level 1 (LPIC1), Linux Professional Institute Certified Level 2 (LPIC2), Linux Professional Institute Certified Level 3 (LPIC3): http://www.lpi.org/program.html
Lotus	Certified Lotus Professional (CLP), Certified Lotus Specialist (CLS), Certified Lotus End-User Instructor (CLEI) http://www.lotus.com/home.nsf/welcome/certification Certified Lotus Instructor (CLI): http://www.lotus.com/home.nsf/welcome/instructor
Lucent InterNetworking Systems (was Ascend Communications Inc)	Lucent Certified Solutions Expert (LCSE), Lucent Certified Technical Expert (LCTE) – ATM, Lucent Certified Technical Expert (LCTE) - Frame Relay, Lucent Certified Technical Expert (LCTE) - Remote Access, Lucent Certified Technical Expert (LCTE) – VPRN: http://www.lucent.com/serviceprovider/certification/certifications_4d.html
Marimba	Certified Castanet Developer: ttp://www.marimba.com/services/training.htm
MERANT	Merant Certified Professional in PVCS: http://www.merant.com/training/programs/cp.asp
Mercury Interactive	Certified Product Specialist (CPS), Certified Product Instructor (CPI): http://www.merc-int.com/edu_services/certprog/
Microsoft	Microsoft Training & Services: http://www.microsoft.com/trainingandservices/default.asp Microsoft Certified Professional (MCP): http://www.microsoft.com/trainingandservices/default.asp?PageID=mcp&PageCall=mcp&SubSite=cert/mcp&AnnMenu=mcp Microsoft Certified Professional + Internet (MCP+I):

	http://www.microsoft.com/trainingandservices/default.asp?PageID=mcp&PageCall=mcpi&SubSite=cert/mcpi&AnnMenu=mcpi Microsoft Certified Professional + Site Builder (MCP+SB): http://www.microsoft.com/trainingandservices/default.asp?PageID=mcp&PageCall=mcpsb&SubSite=cert/mcpsb&AnnMenu=mcpsb Microsoft Certified Solutions Developer (MCSD): http://www.microsoft.com/trainingandservices/default.asp?PageID=mcp&PageCall=mcsd&SubSite=cert/mcsd&AnnMenu=mcsd Microsoft Certified Systems Engineer (MCSE): http://www.microsoft.com/trainingandservices/default.asp?PageID=mcp&PageCall=mcse&SubSite=cert/mcse&AnnMenu=mcse Microsoft Certified Systems Engineer + Internet (MCSE+I): http://www.microsoft.com/trainingandservices/default.asp?PageID=mcp&PageCall=mcsei&SubSite=cert/mcsei&AnnMenu=mcsei Microsoft Certified Database Administrator (MCDBA): http://www.microsoft.com/trainingandservices/default.asp?PageID=mcp&SubSite=cert/mcdba&AnnMenu=mcdba Microsoft Certified Trainer (MCT): http://www.microsoft.com/trainingandservices/default.asp?PageID=mcp&PageCall=mct&SubSite=cert/mct Microsoft Office User Specialist (MOUS) Certification: http://www.microsoft.com/trainingandservices/default.asp?PageID=mcp&PageCall=mous&PageLoc=training&PageMenu=mix Find Microsoft Training and Testing Centers: http://209.245.178.185/training.asp
Motorola	ISG Certifications: http://www.mot.com/MIMS/ISG/Training/cert/index.html
National Association of Communications Systems Engineers (NACSE)	Network Certifications: httpp://www.nacse.com/
Network Associates, Inc.	Certified Network Expert (CNX): http://www.mycnx2000.com
Newbridge Networks	Newbridge Remote Access Specialist, Newbridge Wise for Broadband Network Administrator, Newbridge Wise for Broadband WAN, Newbridge Wise for Narrowband Network Administrator, Newbridge Wise for Narrowband WAN, Newbridge Wise for Switched Routing: http://www.newbridge.com/training/wise/index.html
Nortel Networks	Nortel Networks Certified Design Expert (NNCDE): http://support.baynetworks.com/training2/certification/nncde.html Nortel Networks Certified Design Specialist (NNCDS): http://support.baynetworks.com/training2/certification/nncds.html Nortel Networks Certified Network Architect (NNCNA): http://support.baynetworks.com/training2/certification/nncna.html Nortel Networks Certified Support Expert (NNCSE): http://support.baynetworks.com/training2/certification/nncse.html Nortel Networks Certified Support Specialist (NNCSS): http://support.baynetworks.com/training2/certification/nncss.html
Novell	Certified Internet Professional (CIP):

	http://www.netboss.com/ Certified Novell Administrator (CNA): http://education.novell.com/cna Certified Novell Engineer (CNE): http://education.novell.com/cne Certified Novell Instructor (CNI): http://education.novell.com/cni Certified Novell Salesperson (CNS) http://www.novell.com/channel/academy/resources.html Master CNE (MCNE): http://education.novell.com/mcne Master CNI (MCNI): http://education.novell.com/mcni Novell Education Authorised Training Locator: http://novell.netpub.com/cgi-bin/locator/naecloc
Oracle	Oracle Certified Enterprise Developer - Oracle Internet Platform: http://education.oracle.com/certification/javatrack.html Oracle Certified Professional (OCP) - Application Developer: http://education.oracle.com/certification/appdev2_track.html Oracle Certified Professional (OCP) - Database Operator (DBO): http://education.oracle.com/certification/dbo_track.html Oracle Certified Professional (OCP) - Application Developer: http://education.oracle.com/certification/dba8_track.html Oracle Certified Professional (OCP) - Financial Apps Consultant: http://education.oracle.com/certification/finapps_track.html Oracle Certified Solution Developer – Jdeveloper: http://education.oracle.com/certification/javatrack.html
Paradyne	WAN Applications Certified Expert (WAN A.C.E.), FrameSaver Certification, Hotwire Certification: http://www.paradyne.com/training_seminars/cert_programs.html
ParcPlace-Digitalk	Certified Smalltalk Developer (CSD), Certified Senior Smalltalk Developer (CSSD): http://www.parcplace.com/about/press/certify1.htm
PC DOCS, Inc.	Certified DOCS Professional: http://www.pcdocs.com/
PeopleSoft	PeopleSoft Business Analyst Pro, PeopleSoft Database Administrator Pro, PeopleSoft Programmer/Analyst Pro, PeopleSoft Project Lead Pro, PeopleSoft Quality Assurance Pro, PeopleSoft System Administrator Pro, PeopleSoft System Architect Pro, PeopleSoft Technical Pro: http://www.peoplesoft.com/en/customer_services/training/
Pine Mountain Group, Inc.	Certified NetAnalyst – Architect, Certified NetAnalyst - Cross Technology, Certified NetAnalyst – Internet: http://www.pmg.com/cna_home.htm
Project Management Institute	Project Management Professional:

(PMI)	http://www.pmi.org/certification/
Quality Assurance Institute (QAI)	Certified Quality Analyst (CQA): http://www.qaiusa.com/certification/index.html Certified SPICE Assessor: http://www.qaiusa.com/certification/csa-prog.html Certified Software Test Engineer (CSTE): http://www.qaiusa.com/certification/index.html
Red Hat Software	Red Hat Certified Engineer (RHCE), Red Hat Certified Engineer II (RHCEII): http://www.redhat.com/products/training_overview.html Red Hat Certified Examiner (RHCX): http://www.redhat.com/services/training/training_rh310.html
Rockwell Software	Training Certification: http://www.software.rockwell.com/training/certprgm.htm
SAIR	Linux Certified Professional (LCP): http://www.linuxcertification.org Linux/GNU Certified Administrator (LCA): http://www.linuxcertification.org/ Linux/GNU Certified Engineer (LCE): http://www.linuxcertification.org/ Linux/GNU Certified Trainer: http://www.linuxcertification.org/ Master Linux/GNU Certified Engineer (MLCE): http://www.linuxcertification.org/
Santa Cruz Operation (SCO)	SCO Advanced System Engineer (ACE): http://www.sco.com/education/ace/acemain.html SCO Certified UNIX System Administrator (CUSA): http://www.sco.com/education/ace/acemain.html
SAP Partner Academy	SAP Certified Application Consultant: http://www.sap.com/ SAP Certified Technical Consultant: http://www.sap.com/
SAS Institute Inc.	SAS Certified Professional - Application Development, SAS Certified Professional - Business Intelligence, SAS Certified Professional - Data Management V6, SAS Certified Professional V6 : http://www.sas.com/service/edu/certify/intro.html
Shiva	Shiva Certified Professional: http://www.shiva.com
Siebel Systems	Siebel Certified Consultant, Siebel Certified Instructor: http://hera.siebel.com/edPortal/index.htm
Silicon Graphics	Certified IRIX System Administrator: http://www.sgi.com/support/custeducation/us/certified.html
Software Publishers Association (SPA)	Certified Software Manager (CSM): http://www.spa.org
Solomon Software	Solomon Certified Trainer, Solomon IV Certified Application Developer (SCAD), Solomon IV Certified Systems Engineer (SCSE): http://www.solomon.com/
Sun Microsystems, Inc.	Sun Certified Programmer for the Java Platform,

	Sun Certified Developer for the Java Platform, Sun Certified Enterprise Architect for Java 2 Platform: http://suned.sun.com/USA/certification/javamain.html Sun Certified System Administrator for Solaris, Part 1 & 2, Sun Certified Network Administrator for Solaris: http://suned.sun.com/USA/certification/solarismain.html Sun Educational Services Training Centers: http://suned.sun.com/USA/locations/
Sybase	Sybase Certified Professional Program: http://www.sybase.com/education/profcert/ Sybase Certification Exams: http://www.sybase.com/detail/1,3151,203422,00.html Sybase Certification Exam Information: http://www.sybase.com/detail/1,3151,1009635,00.html Sybase Certified Adaptive Server Administrator: http://www.sybase.com/detail/1,3151,1003446,00.html Sybase Certified SQL Anywhere: http://my.sybase.com/detail?id=1008992 Certified PowerBuilder Developer 7.0: http://www.sybase.com/detail/1,3151,1008962,00.html Certified PowerBuilder Developer 6.0: http://www.sybase.com/detail/1,3151,1008995,00.html Sybase Certified Professional Program Study Guidelines: http://www.sybase.com/detail/1,3151,1002813,00.html
Symantec Corp	ACT! Certified Consultant (ACC): http://www.symantec.com/specprog/acc/index.html
Sysoft	Sysoft Certified Advanced Webmaster & EBusiness Architect: http://www.sysoft.com/caw/ Sysoft Certified Internet Developer: http://www.sysoft.com/cid/ Sysoft Certified Webmaster & E-Commerce Architect: http://www.sysoft.com/cw/
Texas Instruments	Certified Composer Professional (CCP): http://www.ti.com/software/educ/ccp.htm
Tivoli Systems, Inc.	Tivoli Certified Consultant, Tivoli Certified Enterprise Consultant, Tivoli Certified Instructor, Tivoli Certified Solutions Expert: http://www.tivoli.com/services/certification/
Vinca	Vinca Certified Engineer (VCE): http://www.vinca.com/
Xplor	Electronic Document & Printing Professional (EDPP) http://www.xplor.org
Xylan	Alcatel Certified Switch Expert (ACSE), Alcatel Certified Switch Specialist (ACSS): http://www.ind.alcatel.com/support/training/certification.html

Annex 3 – Description of survey sample

Survey methodology

The survey assessed the data from a standardised questionnaire which was sent to stakeholders. The survey addressed primarily high level experts in Europe and was therefore sent to the members of the European e-skills forum, CEN/ISSS ICT skills, CEPIS member societies and other groups and working groups in Europe involved in qualification and certification of ICT workers.

The questionnaire (attached to this report in Annex 1) covered several important aspects of e-skills certification in Europe. It was established and agreed with Cedefop and received a reasonable response from 21 countries. While showing a well balanced European coverage the total number of responses (40) was not as high as expected. However, the origin and character of stakeholders and quality of experts has to be taken into account. The quality of these responses seems to be convincing despite the lack of a broader representativeness.

Structure of the sample

The structure of the survey sample is analysed below. The respondents are categorised regarding place of residence, position in organisation, type of organisation, membership in working group(s)/association(s) and status of organisation.

Position in organisation

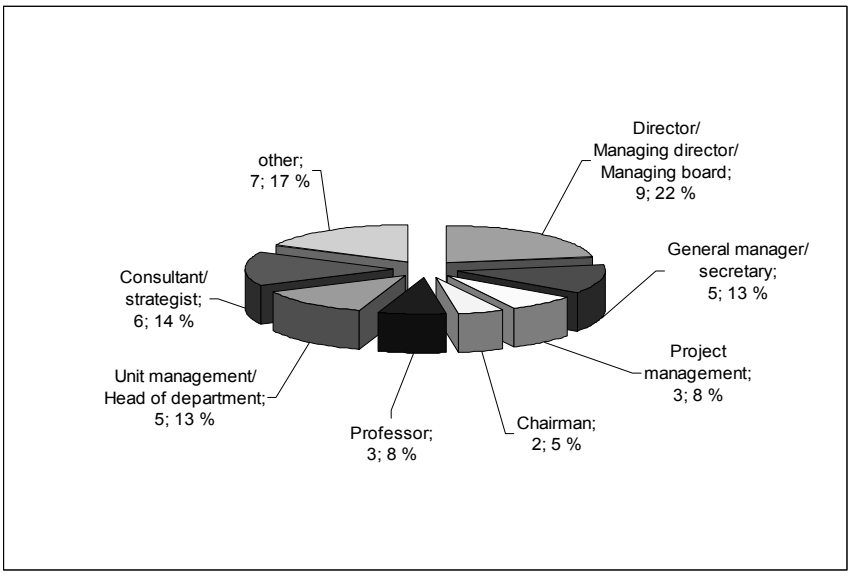
Table 7 shows the results of the analysis of respondents by position in organisation.

Table 7: Position in organisation

Position in organisation	**#**
Director/Managing director/Managing board	9
General manager/secretary	5
Project management	3
Chairman	2
Professor	3
Unit management/Head of department	5
Consultant/strategist	6
Other	7
Total	**40**

The frequencies are better illustrated in form of a pie chart as shown below in Figure 37. The analysis shows that primarily high level experts responded.

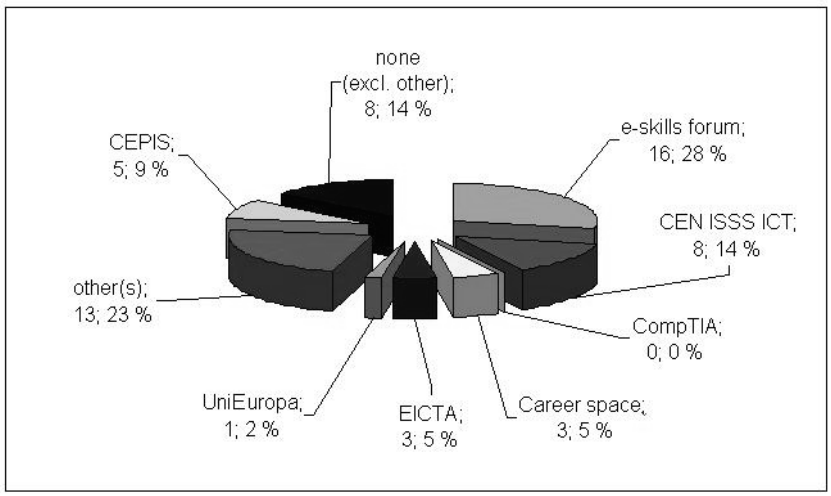
Figure 37: Respondent by position in organisation



Membership in working groups

Another important aspect is the categorisation of respondents according to membership of working groups. The questionnaire offered eight identified working groups at European level and offered the opportunity for respondents to indicate additional working groups using the category 'other'. The chart below displays the result of this analysis:

Figure 38: Membership in working group(s)/association(s)



The European e-skills forum is well represented by 16 respondents, as is the CEN/ISSS workshop ICT skills (8). Other groupings included in the survey sample are CEPIS (5),

Career space (3), EICTA (3) and UniEuropa (1). It is important to mention that respondents may belong to two or more groupings at the same time.

The questionnaire allowed multiple answers. Eight respondents indicated not being a member of a European working group or possibly did not indicate their membership. No contributions were received from CompTIA members. Table 8 below summarises the result of the analysis.

Table 8: Membership in working group(s)/associations

	Membership mutliple answers possible		
A	E-skills forum	16	28.1%
B	CEN ISSS ICT	8	14.0%
C	CompTIA	0	0.0%
D	Career space	3	5.3%
E	EICTA	3	5.3%
F	UniEuropa	1	1.8%
G	Other(s)	13	22.8%
I	CEPIS	5	8.8%
H	None (excl. other)	8	14.0%
	total	**57**	100.0%

Place of residence

The respondents were asked to indicate their place of residence selecting from the four categories: old EU Member State, new EU Member State, associated country, other. The responses given were sorted according to the country codes listed in the Annex 4.

As shown in Figure 39, 64 % of the responses were received from old EU Member States (26), 28 % from new EMember States (11), 5 % from candidate countries (2). One questionnaire was received from other EEA (European Economic Area).

Figure 39: Respondents by place of residence

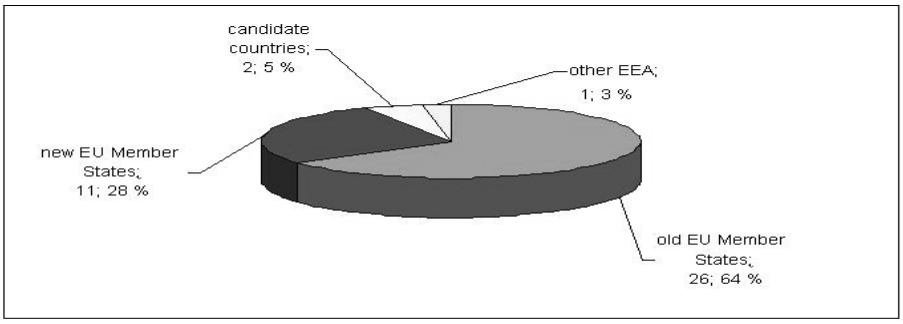


Table 9 displays in more detail the distribution of received questionnaires by country. In total responses were received from 21 European countries.

Table 9: Respondents by countries

Member States		New Member States		Candidate countries		Other EEA countries	
code	**#**	**code**	**#**	**code**	**#**	**code**	**#**
BE	3	CZ	4	BG	0	IS	0
DK	1	EE	1	RO	2	LI	0
DE	4	CY	1	TR	0	NO	1
GR	1	LV	0	HR	0		
ES	2	LT	1				
FR	0	HU	2				
IE	1	MT	0				
IT	3	PL	0			**OT**	**0**
LU	1	SI	2				
NL	2	SK	0				
AT	1						
PT	0						
FI	3						
SE	1						
UK	3						
	26		**11**		**2**		**1**
						total	**40**

N.B. See Annex 4 for country codes

Type of organisation

The results of the analysis of the respondents by type of organisation are presented below, again, with allowance for multiple answers. Table 10 below displays the frequencies for the following types of organisation:

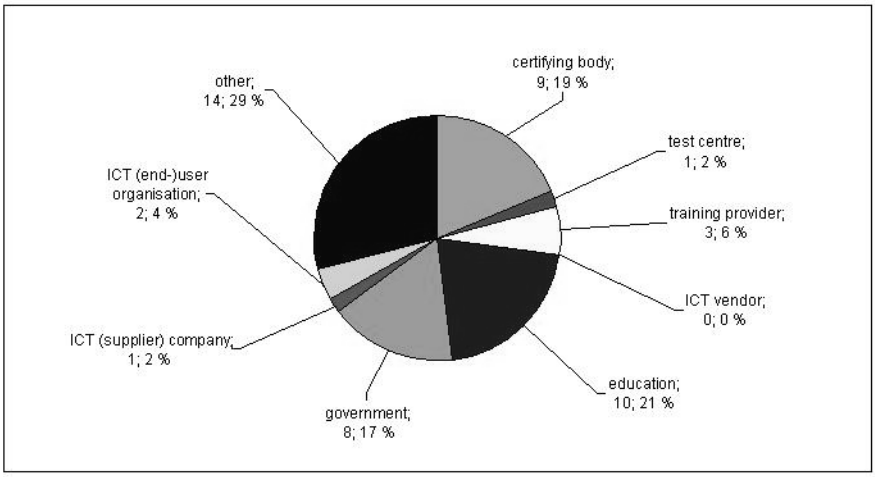
Table 10: Type of organisation

Type of organisation	mutliple answers possible		
no.	**type**	**#**	**%**
A	certifying body	9	18.8
B	test centre	1	2.1
C	training provider	3	6.3
D	ICT vendor	0	0.0
E	education	10	20.8
F	government	8	16.7

G	ICT (supplier) company	1	2.1
H	ICT (end-)user organisation	2	4.2
I	other	14	29.2
total		**48**	**100.0**

The analysis of respondents shows no direct involvement of the ICT vendor industry. All other categories are reasonably represented. The category 'other' primarily covered associations and bodies such as Federation of European professionals. If required, this category could be further analysed for demonstrated added value, though for this study no further separation of cases appears necessary. Figure 40 summarises the results of the analysis in the form of a pie chart.

Figure 40: Type of organisation



Status of organisation

The pie chart in Figure 41 shows the respondents subdivided into four categories: industry/private, public, government and others. The analysis indicated 9 organisations with status industry/private (23 %), 11 organisations with status public (27 %), 7 with status government (18 %) and 13 organisations with status other (32 %).

Figure 41: Respondents by status of organisation

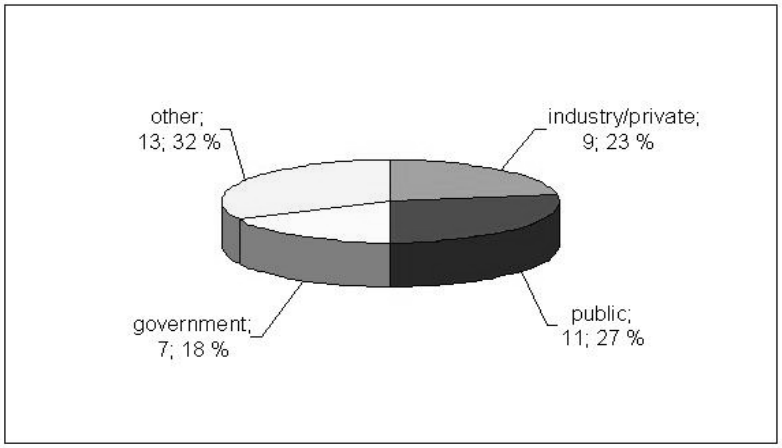


Table 11 below shows again the status of organisation but in more detail, displaying for each category frequency and percentage.

Table 1: Respondents by status of organisation

Status of organisation			
no.	**status**	**#**	**%**
A	industry/private	9	22.5
B	public	11	27.5
C	government	7	17.5
D	other	13	32.5
total		**40**	**100.0**

The preparatory anaylsis of the respondents by their status of organisation is important to the main statistical analysis. The categorisation allows available tendencies to be noted and possible trends extracted, supporting the opinions of the respondents. This is important for the proposed development of recommendations from the survey results and the more sophisticated investigations concerning attitudes and preferences of various groupings.

Annex 4 – Country codes

Table 2: Country codes

European Union (Member States)			**Candidate countries**		
1	AT	Austria	1	BG	Bulgaria
2	BE	Belgium	2	RO	Romania
3	DK	Denmark	3	TR	Turkey
4	DE	Germany	4	HR	Croatia
5	ES	Spain	**Other EEA countries**		
6	FI	Finland	1	IS	Iceland
7	FR	France	2	LI	Liechtenstein
8	GR	Greece	3	NO	Norway
9	IE	Ireland	**Other**		
10	IT	Italy	1	OT	Other
11	LU	Luxembourg			
12	NL	Netherlands			
13	PT	Portugal			
14	SE	Sweden			
15	UK	United Kingdom			
European Union (new Member States)					
1	CY	Cyprus			
2	CZ	Czech Republic			
3	EE	Estonia			
4	HU	Hungary			
5	LV	Latvia			
6	LT	Lithuania			
7	MT	Malta			
8	PL	Poland			
9	SK	Slovakia			
10	SI	Slovenia			

Cedefop (European Centre for the Development of Vocational Training)

ICT skills certification in Europe

Luxembourg: Office for Official Publications of the European Communities, 2006

2006 – VI, 118 pp. – 21 x 29.7 cm

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EN

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CEDEFOP
European Centre for the
Development of Vocational Training

Europe 123, GR-570 01 Thessaloniki (Pylea)
Postal address: PO Box 22427, GR-551 02 Thessaloniki
Tel. (30) 23 10 49 01 11, Fax (30) 23 10 49 00 20
E-mail: info@cedefop.eu.int
Homepage: www.cedefop.eu.int
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