What ICT practitioners do

Towards a European e-competence framework

Summary of a joint European effort involving a wide range of stakeholders across the EU

led by

Cedefop
The European Centre for the Development of Vocational Training

CEPIS
The Council of European Professional Informatics Societies

and CEN/ISSS
The European Committee for Standardisation, Information Society Standardisation System

supported by
The European Commission (Directorate-General Enterprise and Industry)

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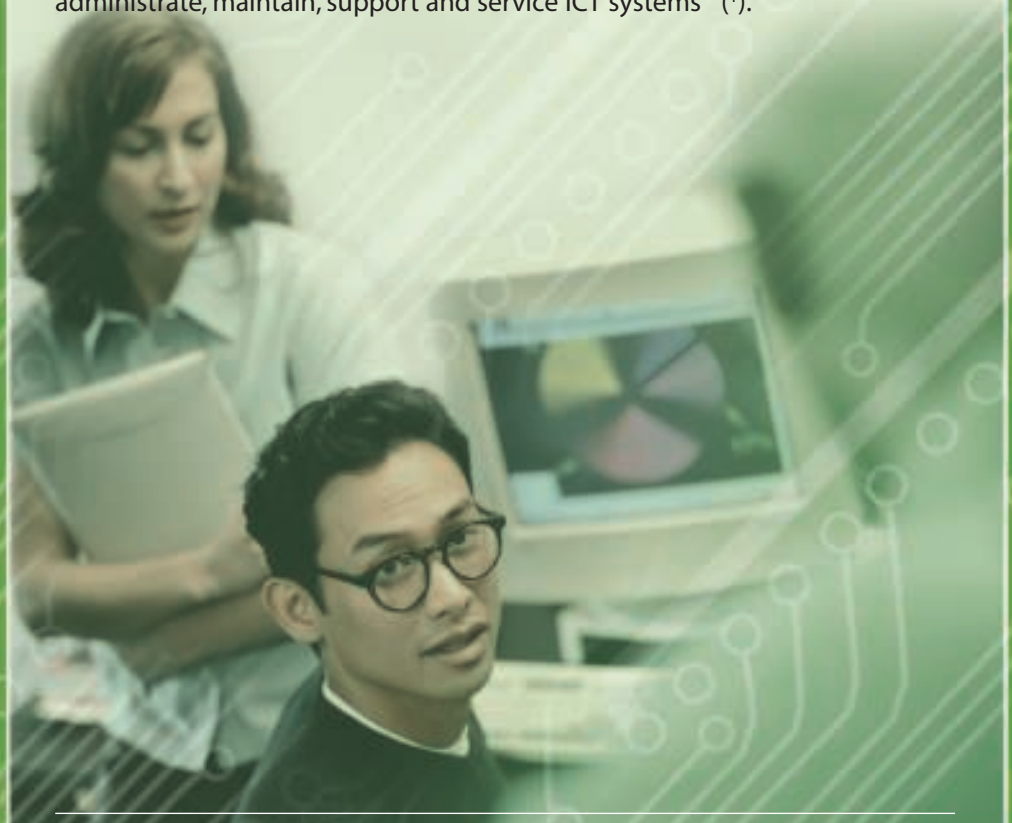
The context

Information and communication technologies (ICT) are everywhere in the European Union today. The European ICT market is estimated to be worth over EUR 500 billion, and the ICT industry employs over four million people. The computer services sector alone employs some 2.5 million people, adds over EUR 150 billion to the EU economy, and Member State computer services industries win exports of some EUR 60 billion a year – so delivering the third most exported European service.

The wealth and jobs created by these technologies all stem from the innovation, creativity and hard work of ICT practitioners who 'research, develop, design, manage, produce, consult, market, sell, integrate, install, administrate, maintain, support and service ICT systems' ([1]).



([1]) As defined by the European e-skills forum, 2004.

Official statistics confirm there are more than four million ICT practitioners of different kinds employed (or self-employed) within the EU, and they contribute to all sectors of the economy.

Between 1995 and 2005 over 1.7 million jobs were created in this field throughout the EU, and – while growth rates have slowed since the dot.com bubble burst – these professionals will continue to contribute substantially to the European economy. Through their creativity, they will have a significant impact on technological innovation which is key for the global competitiveness of European enterprises.

Waves of change and undersupply of skills

ICT is a world in constant upheaval! The growth of these technologies over the past 40 years has been phenomenal. This has led to relentless growth in demand for skilled people to work as ICT practitioners.

However, the ICT profession is not yet fully mature: it has continually struggled to establish education and training (initial professional development) paths that are the hallmark of more traditional professions in Europe. By way of comparison, university courses that have, for many years, provided the education base and feeder channels for entrants to professions, such as medicine, law, accountancy and engineering, have long established an adequate capacity for supplying each successive generation. In contrast, tertiary course provision capacity in ICT has, until recently, been much too low to provide the numbers of properly trained graduates needed. The time and funding required to adjust the course design to respond to each new technical innovation, and to recruit good teaching staff to deliver the courses, has meant that university ICT departments have, since the 1970s, generally been fighting to catch up.

Consequently, many entrants to ICT work have come from other occupations and backgrounds, without the deeper technical grounding that is normally required for a profession. This, and several other factors, have led to an ICT market without the necessary maturity or stability.

Given all this complexity and change, ICT employers – in particular those on the system's supply side (the ICT industry) – have focused on effective management of ICT teams, sometimes very large ones. The question then arises: what are the different types of roles or profiles required of ICT practitioners, and for each role, what are the knowledge, skills and competences required to be able to perform effectively? The structuring of this work has been the subject of considerable effort among ICT employers and stakeholders in Member States, and several different approaches have emerged – a diversity that reflects the complexity of the ICT world in general.

In the wake of drastic shortages of ICT practitioner skills in the late 1990s, efforts were made at European level to understand fully these different approaches, and to see if a single, common, European-wide framework for competences and skills of ICT practitioners could be developed: to clarify precisely **what European ICT practitioners do**.

Some ICT practitioner careers

Miguel Jimenez, Spain

Did not know what he wanted to do, following graduation with a degree in history, but joined Telefonica because a close engineer friend was enjoying his work there. After learning a good deal about the global telecoms market, Miguel spent two years in the United States in telecommunication system marketing before joining IBM. After successful roles in four countries, Miguel was poached by a major IBM client in the UK retail sector. Over the past three years, he guided the introduction of a major new network infrastructure, and is now the company's chief information officer. He is married with two children, and has enjoyed his time in the UK. Although he had never expected such a technical career, Miguel has found his work very interesting, and – particularly with more management/leadership opportunities – both enjoyable and well paid. He is now seeking a senior position in ICT back in Spain.

Jutta Andersson, Denmark

Completed a degree in information systems engineering at Manchester university in 1984. After a graduate apprenticeship at SAP in Germany, Jutta got into development work on distributed databases, and joined the research team working at the leading edge of the next generation of enterprise computing systems. Jutta was then head-hunted by Siemens, and led the implementation of their software tools for integrating ERP into a large engineering application within a major corporation in the United States. She has found her ICT career so far interesting and intellectually challenging, and – although generally working in all-male teams, believes that her gender has never held her back – 'quite the reverse', Jutta reports, since she met her husband through her work!

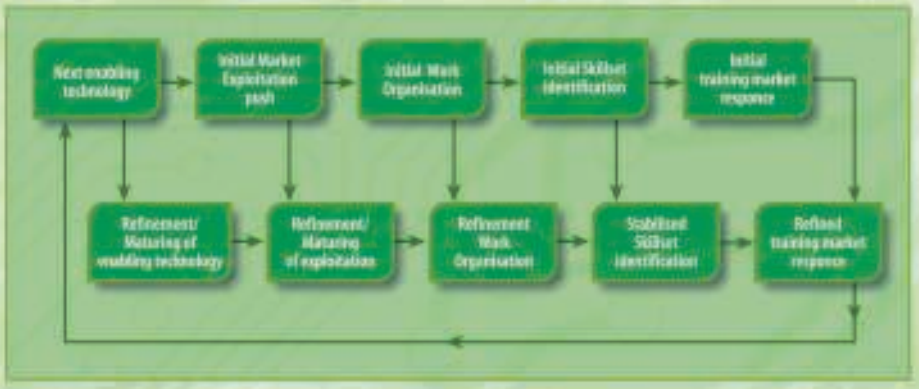
Costas Karcanias, Greece

Costas left school at 16 to work in computers (his father ran a shop selling and repairing PCs). Costas got more and more interested in applications software, and was soon offered a well-paid job in the IT department of Olympic Airways, working in user support at headquarters. After five years, Costas was appointed head of network support for the airline's global systems, and this brought experience in offices around Europe and beyond. He has received a wide range of training, including gaining several industry certifications, and enjoying a short course at a leading French *grande ecole*! Costas worked for four years in France, and two years in Italy before returning to a senior management position in Greece. He enjoys both an interesting job and being back in his home country: the lack of a university degree has proved no barrier to Costas' career prospects and he earns well.

Recognising the dynamic

Given the dynamism of the ICT market, the frameworks produced to structure and codify skills and competence requirements of ICT practitioners need to be reviewed and updated continually, as the environment of the ICT practitioner continues to change, in some cases even faster than before. This can be understood by reference to Figure 1 which shows how the waves of innovation arising from the introduction of new ICT tools and techniques feed new patterns of work organisation, which in turn establish new sets of roles, and underline the need to clarify the skill-sets that go with them. This results in the identification of training needs, and so to new learning provision. As the ICT market moves so fast, these sequences often occur twice – first in initial exploitation (where major ICT players push to establish a strong position and gain commercial rewards), and second when the new approach has begun to be fully understood and mature … just in time for the next wave of innovation …!

Figure 1: **Evolution of work organisation for ICT exploitation** (*)



'This diagram attempts to clarify what ***drives*** the development of specifications of ICT skills/competence needs. It shows how the emergence of each new ICT enabling technology (delivering useful new functionality, whether hardware or software) produces a series of responses in the marketplace, both from ICT supply companies (who believe they can make money by helping deploy the new technology for their customers), and from ICT User Organisations (who believe that the new technology could help improve their business activity and performance, whether public or private). In each case, efforts to pick up the new technology lead to the need for each organization involved to develop or refine the structure through which it deploys its Human Resources in this work, and from this to clarify the (at least, *technical*) skill requirements in the different jobs or roles. In the (general) absence of enough people with such capabilities, these in turn produce specific learning or training needs, to which the suppliers of ICT training provision respond through this "secondary" marketplace. Very often this chain of activity will be driven by assumptions about the new technology that do not (all) turn out to represent the essence of the contribution of the new approach. As a result, there can often be a "second phase" to the process, where each step is refined by being built more soundly on the realities of this technology's characteristics, now these are evident since it has matured. Since there is (as of late 2005) no real sign of the *waves of new technologies* abating, it will remain very important for all thinking about work organization and skill/competence need specification for ICT to recognize the very dynamic nature of the context. As can therefore be inferred, consensus on structures of employer skill-set needs can often follow several years after emergence of each new wave of technical functionality.'

(*) Diagram reproduced from CEN/ISSS (2006) with kind permission of the European Committee for Standardisation © CEN.

Building on existing achievements to bring greater coherence

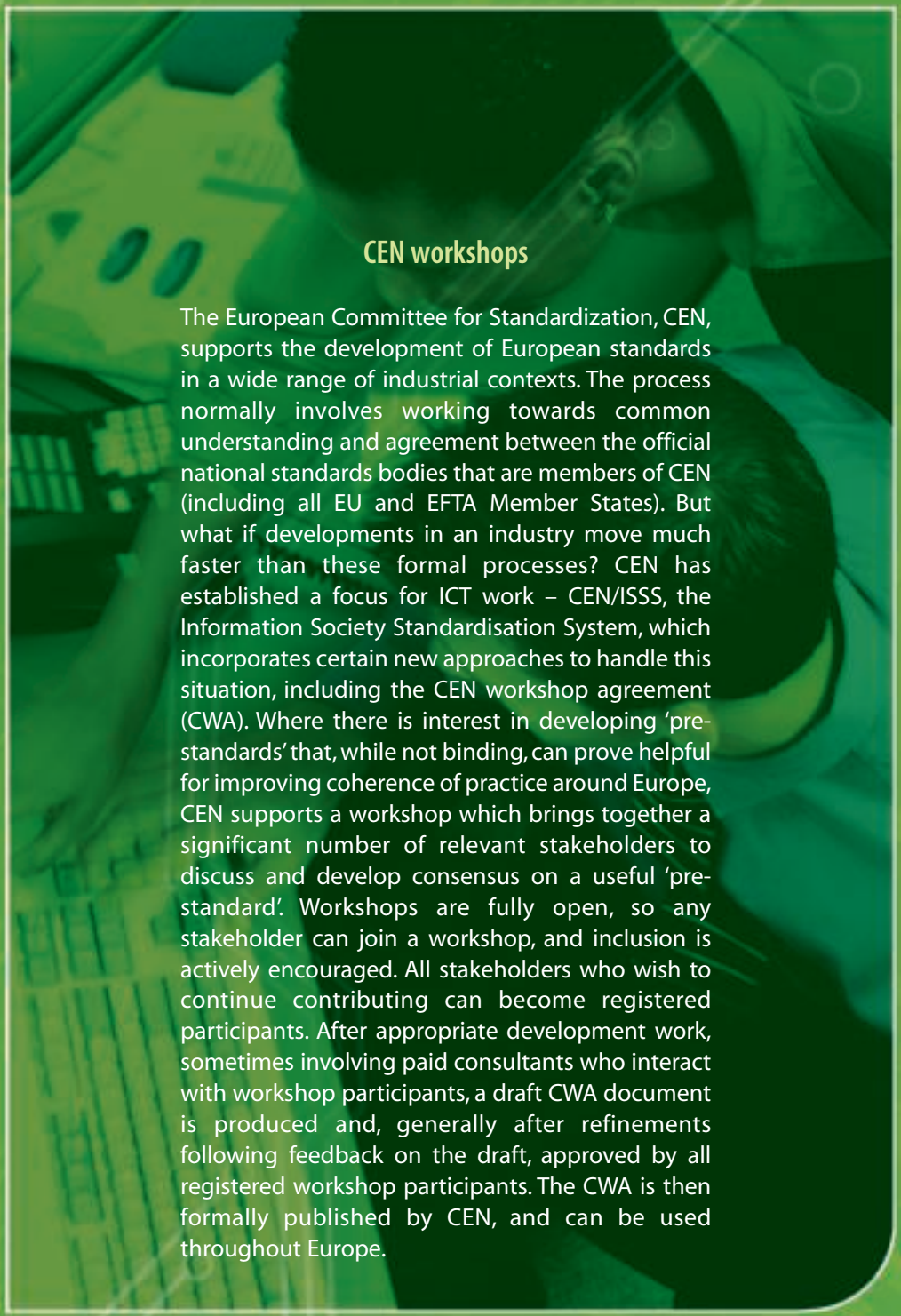
Much analysis of the different roles, occupational profiles and skill requirements for the whole range of ICT practitioner work has been undertaken around Europe. As a result, several Member States have developed ICT practitioner skill frameworks.

Comparing current frameworks from France ([2]), Germany ([3]) and the United Kingdom ([4]) shows, while similar in broad terms, there remain certain differences. Why? Is this because of variations in work organisation in the different countries, differences in employment and training culture, or simply because it is possible to cut the cake in several different ways?

Are ICT practitioner profiles different in large organisations from small ones? Although, most ICT functions carried out in both small and medium-sized enterprises (SMEs) and large organisations are the same, the work must be done with smaller, sometimes much smaller, teams. How do ICT contractors, who provide an important temporary contribution to ICT resources, fit into the picture?

These are some of the important questions addressed in the CEN/ISSS workshop on ICT skills.

([2]) CIGREF (see http://www.cigref.fr/cigref/livelink.exe?func=ll&objId=529028&objAction=ViewNews
([3]) AITTS (see http://www.kibnet.org/english/en.aitts/index.html
([4]) SFIA (see http://www.sfia.org.uk/)



CEN workshops

The European Committee for Standardization, CEN, supports the development of European standards in a wide range of industrial contexts. The process normally involves working towards common understanding and agreement between the official national standards bodies that are members of CEN (including all EU and EFTA Member States). But what if developments in an industry move much faster than these formal processes? CEN has established a focus for ICT work – CEN/ISSS, the Information Society Standardisation System, which incorporates certain new approaches to handle this situation, including the CEN workshop agreement (CWA). Where there is interest in developing 'pre-standards' that, while not binding, can prove helpful for improving coherence of practice around Europe, CEN supports a workshop which brings together a significant number of relevant stakeholders to discuss and develop consensus on a useful 'pre-standard'. Workshops are fully open, so any stakeholder can join a workshop, and inclusion is actively encouraged. All stakeholders who wish to continue contributing can become registered participants. After appropriate development work, sometimes involving paid consultants who interact with workshop participants, a draft CWA document is produced and, generally after refinements following feedback on the draft, approved by all registered workshop participants. The CWA is then formally published by CEN, and can be used throughout Europe.

Example profiles

Développeur
(Developer)

Mission
À la demande de la maîtrise d'oeuvre, et sur la base des spécifications fonctionnelles émises par celle-ci, le développeur analyse, paramètre et code les composants logiciels applicatifs dans le respect des normes et procédures, ainsi que les évolutions souhaitées.

Activités et tâches

ANALYSE
- Définition de spécifications
- Analyse organique
- Adaptation et paramétrage de progiciels applicatifs
- Prototypage

QUALIFICATION
- Élaboration de jeux d'essais (tests unitaires d'intégration)
- Tests
- Identification et traitement des dysfonctionnements

DÉVELOPPEMENT
- Réalisation de modules (objets et composants logiciels)
- Assemblage de ces éléments
- Rédaction de documentations
- Industrialisation de composants et d'applications

MAINTENANCE
- Maintenance corrective
- Maintenance évolutive
- Administration des composants logiciels réutilisables et gestion de la nomenclature de ces composants

from the CIGREF Nomenclature

Software-Entwickler/in
(Software developer)

Kurzbeschreibung
Software Developer konzipieren und implementieren einzelne Software-Bausteine (Komponenten und Module).

Arbeitsgebiete und Aufgaben
IT Software Developer konzipieren und implementieren einzelne Software-Bausteine bedarfsgerecht und wirtschaftlich auf der Basis vorliegender System-, Datenbank- und GUI-Designs. Sie spezifizieren Software-technische Details von Software-Bausteinen und definieren Schnittstellen zu anderen Komponenten des Systems.

Software Developer entwerfen Algorithmen, definieren Datenstrukturen und setzen Programme in einer höheren (3GL- bzw. 4GL-) Programmiersprache um.

Sie erstellen Testspezifikationen, Testdaten und Testumgebungen und führen Unit-Tests auf der Ebene der Software-Bausteine durch. Sie lösen Probleme im Entwickler-Team und in Kooperation mit Fachleuten aus dem Anwendungsumfeld.

Teilprozesse
01. Unterstützen von Systemanalyse und -design; Entwicklung von Prototypen
02. Überprüfen der Anforderungsmodelle und Systemdesign-Dokumente
03. Mitwirken bei der Festlegung des Entwicklungsrahmens
04. Verfeinern der Systementwürfe
05. Abstimmen der internen Schnittstellen und Datenformate
06. Ableiten von Testszenarien und Testdaten
07. Implementieren von Testprogrammen
08. Implementieren der Nutzerschnittstelle

from the AITTS/APO-IT

Programming / software development

Level 1: The design, creation, testing and documenting of new and amended programs from supplied specifications in accordance with agreed standards.

Level 2: Designs, codes, tests, corrects and documents simple programs and assists in the implementation of software which forms part of a properly engineered information or communications system.

Level 3: Designs, codes, tests, corrects and documents moderately complex programs and program modifications from supplied specifications, using agreed standards and tools. Conducts reviews of supplied specifications, with others as appropriate.

Level 4: Designs, codes, tests, corrects and documents large and/or complex programs and program modifications from supplied specifications using agreed standards and tools, to achieve a well-engineered result. Takes part in reviews of own work and leads reviews of colleagues' work.

Level 5: Sets standards for programming tools and techniques, advises on their application and ensures compliance. Takes technical responsibility for all stages in the software development process. Prepares project and quality plans and advises systems development teams. Assigns work to programming staff and monitors performance, providing advice, guidance and assistance to less experienced colleagues as required.

from SFIA

Potential benefits: the ultimate goal

In an ideal scenario, for clarifying the structure of ICT practitioner skills for Europe as a whole, an agreed skills/competence framework would be used by the ICT industry in the EU, and also by ICT user industries or organisations employing significant numbers of ICT practitioners. As a single common platform, this would be valid, effective and – as a result – used in all Member States for a range of different purposes.

Such a situation would bring several valuable benefits.

- Data (in particular on skill shortages) gathered from all surveys (whether official - government - or in commercial market research) using the framework would be directly comparable both within and between EU Member States, thus providing a stronger basis for policy review and development, as well as for better labour market understanding by both employers and jobseekers.
- The labour market would possess clear evidence to help employers understand more clearly what a certificate or documented experience presented, by a job applicant (for a qualification the employer has not heard of) really means. For example, analysts/programmers with seven years experience with a particular software environment would – in essence – all be at the same level, whether they came from supply or user sides of the ICT world, whether their competences were acquired in Estonia, Spain or Austria, or whether acquired through formal education or non-formal experience or learning.
- Education and training providers would have a clear set of target knowledge, skills and competences at which course design and provision could be aimed, and easily positioned, in relation to the forthcoming European qualifications framework (EQF), and there would be a clear, agreed set of benchmarks against which all ICT practitioner qualifications could be measured.
- Individuals contemplating entering the ICT profession, or ICT practitioners planning their career development could better understand the opportunities and choices for fulfilling a career anywhere in the European Union.

While achieving such an ideal scenario would involve change of several current institutional positions and approaches and will not happen quickly, it is essential as a longer-term objective, for greater coherence of the ICT practitioner labour market in Europe, for improved mobility and more enlightened development of both supply and demand of skills and competences.

Phase 2 findings

The CEN workshop agreement approved by the ICT skills workshop at the end of 2005 was published in February 2006 as CWA 15515 *European ICT skills meta-framework – state-of-the-art review, clarification of the realities, and recommendations for next steps*.

It provides a wide range of useful background information, and concludes with several important recommendations.

- To encourage and strengthen the process of convergence of ICT practitioner skills/competence frameworks within the EU by a three step process:
  (a) provide – via the CWA – basic information about frameworks, highlighting criteria that help to compare and contrast various approaches and help companies and ICT professionals to select or adapt a framework that best fits their purpose and needs;
  (b) promote the guidance given in this document. New framework initiatives may be able, and should be encouraged, to base their implementation on it. Existing frameworks may progress towards convergence during stages of review and updating;
  (c) work towards an e-competence (reference) framework and provide information on how each framework/profile or proficiency model is related to it, recognising this will take time.
- Lifelong learning is of the utmost importance, especially in the ICT sector and ICT practitioner occupations, where understanding, skills and competence need regular updating. Consequently, recognising professional qualifications and transferability of all learning outcomes (regardless of how they were acquired, and including those from informal learning) must be supported at all ages.
- Owners of the major ICT practitioner skills frameworks in Europe should be asked to cooperate in developing a two-dimensional framework, with horizontal skills/competence descriptors specifying profiles, clustered into relevant groups, whose (vertical) level specifications would be based on the generic level descriptors in the CWA. This framework would be neutral, not subject to any national/cultural or constituency interests, and would be especially helpful in Member States where no skills/competence framework for ICT practitioners exists.

- A study should be undertaken to clarify options for the top-level structure of a European ICT qualifications framework, fully congruent with the proposed European qualifications framework (EQF), drawing on the reactions of stakeholders to discussions on the possible structuring shown in Annex F of the CWA, and where possible, on horizontal descriptors from the proposed two dimensional framework.
- Considering the emergence in recent years of the concept of competence in many Member States, the term competence framework, in preference to skills/competence framework, should be used as a more comprehensive and holistic concept.
- The Commission should support gathering concrete evidence of the benefits of using ICT practitioner skills/competence frameworks and potential use of a European e-competence framework for ICT practitioners.
- Since language, terminology and semantics have posed problems during Phase 2, it is recommended that a project should tackle this.
- (Approaches to) methods and tools that could prove helpful in developing a European ICT qualifications framework (such as eCCO) should be supported.

For more widespread employer buy-in, the CWA and its recommendations should be presented, on a one-on-one basis, to several key European employers. The results should be written up and act as the starting point for the next stage of development towards a European e-competence framework.

Although this CWA focused on ICT practitioner skills, this should not detract from the importance of ICT user skills. A study on options for a European e-competence framework would be a natural follow-up to this CWA.

Achievements of the CEN/ISSS ICT skills workshop

Phase 1 (2002-03): establishing an initial profile set for ICT practitioners (based on the Career-Space ICT industry consortium 'generic job profiles'), and some broad principles for tertiary education curriculum development (resulting in publication of CWAs 14925 (*) and 15005 (*)).

Phase 2 (2004-05): a deeper, broader analysis of the current position, an initial interpretation of the proposed European qualifications framework (EQF) for ICT practitioner work, and elaboration of the nature of a European meta-framework – a framework for assessing existing ICT practitioner skills frameworks (reported in CWA 15515 (*)).

Phase 3 (2006-07): towards a European e-competence framework: building on the Phase 2 analysis and recommendations to tackle three important dimensions of development towards greater coherence at European level (see 'Next steps').

(*) For more information, visit:
http://www.cenorm.be/cenorm/businessdomains/businessdomains/ isss/cwa/ict-skills.asp

Stakeholder benefits

Social partners on both sides of industry see the potential benefits, in particular those active at European level: leaders from the two sides of the labour market recognise the importance of this work.

Patrick Mathieu

Head of Resource Management
Airbus Information Systems

'The cost-effectiveness of its future information systems will have a strong influence on the overall success of Airbus's operation and global business. We have large teams of very able ICT practitioners in several EU Member States, but the education and training traditions vary between cultures. We believe the development work going on through the CEN/ISSS ICT skills workshop could make an important strategic continuation to our needs.'

Gerhard Rohde

Union Network International (UNI) - Europa
Industry, business and IT services

'Our members work hard to support effective professional development and career progression of their ICT practitioners. This work provides a very important opportunity for us to work with employers to clarify the nature of the skill needs of the future, and so ensure that individual ICT practitioners can plan their training and career development.'

Next steps

Commitment to exploring the benefits and possibility of a European e-competence framework for ICT practitioners continues among the major stakeholders. After extensive discussions following the publication of CWA 15515, proposals have been submitted to the European Commission for support for work in three main areas:

- developing a comprehensive European e-competence framework encompassing ICT competences at all practitioner levels and major job profiles;
- promoting the results of CEN/ISSS ICT skills workshop Phase 2 (CWA 15515);
- e-competences: towards harmonisation of certifications for ICT practitioners in Europe.

Initial approval has been agreed, and the funded programme is expected to start at the beginning of 2007.

Key stakeholders

A number of important bodies are already active in the CEN/ISSS ICT skills workshop:

- Associazione Italiana per l'Informatica ed il Calcolo Automatico (AICA) (Italian Association for Informatics and Automatic Computation), Italy
- Airbus
- Associación de Técnicos de Informática (Association of Informatics Technicians), Spain
- BIAT, University of Flensburg, Germany
- BITKOM e.V., Germany
- British Computer Society
- CDI GmbH, Germany
- Cedefop
- CEPIS
- CIGREF, France
- DEKRA Akademie GmbH, Germany
- Dutch Computer Society (NGI)
- EC DG ENTR
- EC DG INFSO
- ECDL Foundation, Ireland
- e-Skills UK
- e-Skills Certification Consortium (e-SCC) Secretariat
- Escola d'Administració Pública de Catalunya (EAPC), Spain
- EUCIP (ECDLF)
- EXIN, Netherlands
- Federal Ministry for Education, Science and Culture, Austria
- Federation of Belgian Informatics Associations (FBVI-FAIB)
- Federcomin, Italy
- Fondazione Politecnico di Milano (Milan Polytechnic Foundation), Italy
- Fraunhofer IAO and Fraunhofer ISST, Germany
- HBO-I Foundation, Netherlands
- Instituto para a Qualidade na Formação (Institute for Quality in Training), Portugal
- Irish Computer Society
- KIBNET, Germany
- IG Metall, Germany
- Koordinierungsstelle fuer Weiterbildung und Beschaeftigung (KWB) (Coordination Centre for Further Learning and Employment) e.V., Germany
- Michelin, France
- Microsoft
- Powertech Europe, UK
- Renault, France
- SFIA Foundation, UK
- SkillsNET Enterprises, US
- Société AKELA S.A., Belgium
- Trinity College Dublin, Ireland
- UNI/SWEDBANK, Sweden
- UNI-Europa
- UNINFO
- University of Karlsruhe (AIFB), Germany
- Zentralverband Elektrotechnik- und Elektronikindustrie e.V. (German Electrical and Electronic Manufacturers' Association) (ZVEI)

Get involved!

The CEN/ISSS ICT skills workshop exists to channel the interest and contribution of those committed to promoting and strengthening the development of ICT skills for Europe. The workshop is open: if you would like to contribute to the next steps, and perhaps have a significant opportunity to influence the emerging framework, please contact Luc Van den Berghe at CEN/ISSS (0032 2 550 09 57).

Read more: **www.cenorm.be/cenorm/businessdomains/businessdomains/isss/activity/wsict-skills.asp**

CEDEFOP

The European Centre for the Development of Vocational Training is active in a wide range of research and development activities relating to European Union vocational education and training policy, and supports lifelong learning in the current and future European workforce. It advises the European Commission and Member States on issues linked to skill and competence development and their consequences for education and training systems and provision. It has played a leading role in European level work on e-skills since 2002, and continues to make this contribution, commissioning major studies, and cosponsoring and cochairing the CEN/ISSS workshop on ICT skills.

Cedefop October, 2006

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