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# THE EUROPEAN E-COMPETENCE FRAMEWORK: PAST, PRESENT AND FUTURE

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**ABSTRACT**

This paper is a case study of the creation of a skills framework for ICT practitioners. A short history describes the development of the use of technology in business, and discusses the need for a framework to define the skills required by those who develop and manage systems. The European e-Competence Framework (e-CF) for ICT practitioners was developed by the CEN Workshop for ICT Skills, this workshop being part of the European Standards body. The paper discusses the development of the framework and describes how the need for skills in using technology has progressed, as the business landscape has become more complex with ICT becoming an important part of every organisation. It examines the current situation in ICT skill requirements and how the changing landscape of work will necessitate continuous review of these skills.

**KEYWORDS**

IT competency, frameworks, CEN, CEPIS

## 1. INTRODUCTION

In the early days of computing, the IT infrastructure of an organization was easily defined. Companies usually had one mainframe computer in an air-conditioned computer room; jobs, roles and responsibilities were clear. Today, with the continuous developments in technology, for example - outsourcing, cloud computing and commoditization of technology, it can be unclear what roles are needed for companies to take advantage of technology. However, it can be argued that ICT skills are needed at all levels in an organization. To address these skills, the European Committee for Standardization (CEN) set up a workshop on ICT skills. One output from this workshop is the European e-Competence Framework (e-CF) for ICT practitioners. This paper discusses the development of the framework and its evolution from version 1 to version 3 which was published in January 2014. The methodology is discussed

and the use of the framework is described. The use of the framework as a basis for Job Profiles and the tools provided for self-assessment is also introduced.

## 2. HISTORY

Before the 1960s, computers were used mostly in scientific laboratories or academic environments and the average citizen knew little about these machines. In 1959, IBM launched its 1400 series of business computers using SPS (Symbolic Programming System) and Autocoder. COBOL, a high level programming language, was created by a team led by Grace Mary Hopper for the US navy as a machine independent programming language. This language was a move from the "machine code" level language to one that was more like a natural language. Although there were some computers designed for business use, for example Leo and Univac, these were not in general use at that time. During the sixties, the development of integrated circuits and magnetic core memories made business computing feasible for many organisations. "The faster chips also made development of minicomputers and later, even small micro-computers, possible". (Laudon, K. & Guercio, Traver, C, 1996, p47) The term "multitasking" was used, as more than one person could work on the computer at the same time and it appeared that the computer could serve multiple users at once (McLeod, R. & Schell G, 2001,p93). In 1960, the International Federation for Information Processing (IFIP) was founded as an international forum for research in new technologies (Computer history, 2011).

The use of computers in business grew as companies had begun to realise their value in automating business processes. These computers were big machines, taking up much space and were usually operated and programmed by computer professionals. Many of these machines ran corporate systems with only cards or paper tape as input and hard copy printouts as output. At that time, workers needed to know how to fill in forms that were then sent to a data preparation area. Data were entered on a data sheet and checked, totals were created and other forms of validation were used - for example a checksum of entered data, batch controls and individual document totals. The data were then punched onto paper tape or punched cards and input to the computer (Computer history, 2002).

A computer input validation program performed many checks of the entered data, verifying the batch total against those input and performing range checks and other data validation checks, e.g. date ranges, format checks, etc. Designing the input documents was an important part of system design - forms design courses were obligatory for systems analysts. Management reporting was minimal; reports were defined when a system was being built and the reports were produced at agreed times: weekly, monthly, etc. The reporting needs were defined at the systems analysis stage of a project. The early systems consisted of financial, payroll and accounting systems. The end users of these systems prepared input documents on forms and received output in the form of printed hard copy reports. The business functions running these machines and providing the services were often called Data Processing (DP) departments. Galliers, R. & Currie, W. (2011, p21) define this as the "First Era (1964 - 74)", when computers in business were used to automate business processes and were run by a data processing department.

At that time, to be “computer literate” meant that you were a DP professional. In the sixties and seventies, a computer or DP (data processing) professional was the person who operated the computer, specified the computer systems or wrote the computer programs. Books and educational material at that time which referred to computer literacy, normally referred to programming. Luehrmann (1983), writing about computer literacy, described how to program the Apple computer. With the arrival of systems like the Digital Equipment Corporation’s PDP systems, the computer was small enough to be installed in ordinary offices without air conditioning. Some office managers took over the running of these machines, but the programming and systems development were done by specialist people.

At this early stage in designing general business computer systems there was some interest in how people used computers; but usability was secondary to achieving efficiency gains and cost savings. In the eighties, the use of computers spread in business with mid-range computers such as Digital Equipment Corporation (DEC) and Data General (DG) equipment becoming common. DEC launched the PDP-11 in 1981 and the VAX-11 in 1982 (Digital Equipment Corporation, 1992, p184).

Data General had been established in 1968 by Ed deCastro who had worked with DEC. He left DEC and, with some friends, developed the first Data General computer. In 1969, they released the Nova minicomputer and it quickly became a popular machine in scientific and educational markets. This was a very fast business computer, “part of its appeal was its cycle time (300 nanoseconds) which made it the fastest minicomputer on the market for several years” (Data General, 1970). These machines did not normally need a special computer room and were often run by office managers. However, professional computer staff performed the software development, installation and implementation of systems.

End user computing was still a few years away. Ken Olsen, the founder of DEC, said in 1977, “there is no reason anyone would want a computer in their home." In 1981, this changed when IBM launched the Personal Computer (PC). “IBM introduced its PC, igniting a fast growth of the personal computer market. The first PC ran on a 4.77 MHz Intel 8088 microprocessor and used Microsoft’s MS-DOS operating system.” (IBMN, 1981) End user computing arrived in the early eighties. Those who found an aptitude for this technology quickly began creating their own “little systems”. According to research by Rockart, J. & Flannery, L. (1983), “End users exist primarily in staff functions. They develop and use a wide spectrum of computing applications ranging from "operational systems" of the type usually developed by information systems professionals to complex analytical programs. To support a large number of their applications a new computing environment, "the third environment” which “must be developed by Information Systems (I/S) management.” The research also defined “functional support personnel" who had to be identified and trained in each functional area and should be available to support users in their own areas. Rockart, J. & Flannery, L. (*ibid*) noted that these people were “end users in each functional area who spend most of their time programming and aiding other end users”. While end user computing had been acknowledged for some years, this is an early reference to “end user development”, where the user creates, develops and implements the system.

In the mainframe days, the roles of computer operator, programmer, and systems analyst were clearly defined. These technical people created systems, based on stated user requirements, implemented the systems and provided a service to users. It can also be observed that, just as computers had first been implemented as large scale projects in academia and in the military to solve complex mathematical problems, they subsequently became large scale projects in large organizations. This was due to their initial high costs and

physical size and they were designed to solve arithmetical problems, albeit on simple, yet very large, data sets. This was their return on investment. In the intervening years, the landscape has changed in terms of the technology, costs, organizational structures and the roles and responsibilities of the ICT professional. The technology has become ubiquitous. Dramatically lower costs for equipment procurement, maintenance and data storage combined with increasing ease-of-use, ease-of-utility, improved effectiveness and flexibility for an increasingly knowledgeable end user has enabled the roll-out of ICT into every type of workplace, from sole traders, micro-enterprises and SME's. This expansion into non-traditional areas, which are known to be key drivers in job creation, innovation and growth (OECD, 2014) is changing the role of the ICT professional. While there remains a place for single area expertise and high-level skill, there is a growing need for ICT generalists who command solid knowledge and good technical skills (and the capacity to update them) with an understanding of business alignment (whatever form that business may take).

In this changing environment, what constitutes an ICT professional? Can we define what such a professional needs to know?

# 3. A DEFINITION OF ICT PROFESSIONAL SKILLS

## 3.1 The Need

The need for computer skills is not new. Molnar said over 30 years ago - "In an Information Society, a computer literate populace is as important as energy and raw materials are to an industrial society" (Molnar, 1978, p33). In the early implementation of computer systems the same person identified the problem to be solved and wrote the program code to implement it. Subsequently it became apparent that the skills required to define the problem were different from the skills required to write the program code. Thus the systems analyst and programmer were born. The first courses for Systems Analysts in the UK were created in 1969 by the National Computing Centre which had been founded in 1966 (NCC Education, 2014).The Systems Analysis Examining Board was set up in the UK.

While there are those few who might say, "IT is like a utility" (Carr, N.G., 2003) which can be switched on and off, many will argue that IT can affect society and it is important to ensure all members of that society have the required competencies to benefit from technology. Technology has changed dramatically over the last 30 years, now it is pervasive and part of the lives of all citizens, making knowledge of the computer and the skills to use it even more important. So what skills are needed? The European Union stresses the requirement for all citizens to have digital skills - "a digital world needs digital skills. And so do we." (EUa, 2014). These skills (e-skills) are defined at three levels:

i. ICT practitioner skills, which are the skills needed by the professional ICT person who will develop software, create web sites and manage and run computer operations. The CEN workshop on ICT skills has examined the skills needs for ICT professionals and has defined a "Framework for ICT Professionals" (eCompetences, 2014).

ii. e-Leadership skills, which are the skills needed to take advantage of technology to improve business processes and to benefit from business opportunities in e-commerce. e-Leadership skills are those skills required to use ICT to identify and exploit business opportunities, to use ICT internally and externally in all business processes, and to improve business performance and competitiveness.
iii. ICT user skills, which are the skills needed by the ordinary citizen in their social, personal and professional lives. ICT end-user skills are at the level of digital literacy and are the skills required by everyone living in the Information Society. Such skills have been defined at different levels, including ECDL, Microsoft Digital Literacy and IC$^3$.

In "ICT for Competitiveness and Innovation" (EUb, 2014), the EU stresses the importance of these e-skills for innovation and to help economic recovery. Innovation, by its very nature, demands rapid and constant change. ICT, although young, perhaps more than any other occupation, can drive innovation, in terms of new products and processes, which in turn, drives innovation in many other sectors.

## 3.2 An ICT Profession

The debate as to whether ICT is a profession at all has been ongoing for decades, from Orlikowski and Baroudi's (1988) 'occupational group', Banville and Landry's (1989) 'fragmented adhocracy' to Weckert and Adeney's (2013) 'not a significant profession'. That this argument continues only highlights the need to define clearly ICT as a profession. The rapid changes in technology, particularly since the advent of the web, have paradoxically not allowed the field to 'take stock' of what it means to be an ICT professional as it strives to keep ahead of continual innovations. As ICT as a field matures, and the ubiquity of its technologies into so many areas of organizational and public life spreads, the time is right to 'take stock'.

ICT has become a broad church and covers many varied jobs, from traditional programmers to data scientists, business analysts to web designers, critical systems engineers to call centre operators (BCS, 2010). Entry into the field can be as diverse as the jobs, and can range from prolonged formal education to short-term vendor qualifications, the self-taught 'hobbyist' and prodigious college drop-out. This has compounded a lack of clarity and consistency in the job titles used by organizations, which poses problems for HR departments when preparing job postings and job seekers in their search. Finally, high profile IT failures eg in banking systems or Denial-of-Service attacks, continue to impact on the public's perception of the profession, leading to questions of responsibility and accountability.

This diversity is both the strength and weakness of the ICT profession. Arising from the issues outlined above, consideration was given to a more formal approach to the definition of an ICT professional or practitioner. A report produced in 2012 "e-Skills and ICT Professionalism, Fostering the ICT Profession in Europe" described four potential building blocks for a potential ICT profession (EU, 2012). Compared with existing professions such as Medicine and Engineering, ICT is in its infancy. However the impact which it is having on society indicates that a more professional approach is essential and required as soon as possible.

The four building blocks in the report mentioned are:

1. A basic Body of Knowledge (BOK) delineating the required knowledge for every ICT professional
2. A competence framework based on learning outcomes to establish competences required for the various roles
3. A mapping of certifications to the competence framework and BOK to ensure that the individuals have the required level of knowledge and competence
4. A code of Ethics which will ensure that all ICT professionals will act in the best interests of their profession and the population at large.

# 4. THE EUROPEAN E-COMPETENCE FRAMEWORK (E-CF)

## 4.1 The Evolution of a Standard

It became clear during the 1990s that Europe needed to develop a policy to take advantage of the development of technology. In 1994 a High Level Group lead by Commissioner Martin Bangemann produced a plan for Europe and the Global Information Society. Many initiatives stemmed from this report which spawned the Bangemann Action Plan. Following this work was undertaken in Europe regarding the e-Skills Agenda since the late 1990s. A project, "Career Space", brought together participants from Academia and Industry and produced Curriculum Guidelines for the ICT Professionals (2001). The Career Space Consortium also produced a set of generic ICT skills profiles (2001). Both of these documents were published by CEDEFOP (European Centre for the Development of Vocational Training) in 2001. The work on competences was further developed at the European e-Learning Summit held in La Hulpe in May 2001.

A European e-Skills Forum was created to bring together stakeholders in the area and the group produced definitions of the skills required in ICT. It was agreed that there was a need for ICT practitioner skills, ICT user skills and e-Leadership Skills now. The latter is now called e-Leadership Skills. Following a number of exploratory meetings of the e-Skills Forum it was agreed that skills frameworks were required and that the best vehicle to achieve this was to set up a Workshop within CEN. Thus, the CEN Workshop on ICT Skills was formed in 2003. The idea of a CEN Workshop is to have an open forum where stakeholders from different backgrounds can meet and reach consensus on matters of mutual interest.

The CEN Workshop on ICT Skills comprises members from Academia, Social Partners, ICT Industry, and Industry. It meets on average four times per annum and works to prepare CEN Workshop Agreements (CWAs) supporting the policy of the European Commission on e-Skills. During the past ten years it has produced 17 CWAs. In the context of this paper the main CWA is the European e-Competence Framework. This was initially produced in 2009 with revisions in 2011 and 2013. This is now a set of 40 competences which describe the needs of the various roles of ICT Practitioners. The CEN Workshop has also produced related Job Profiles based on the e-Competence Framework and in addition documented an approach to Certification based on the e-Competence Framework. In related work an e-Competence framework for ICT Users has been produced and work is underway on Curriculum Guidelines based on the e-CF and also a Framework for e-Leadership Skills.

All the project work undertaken by the CEN Workshop on ICT Skills has directly related to the policies of the European Commission and has been funded by DG Enterprise and Industry.

The CEPIS e-Competence benchmark was created as a free, online interactive tool that is available on the CEPIS web site[1]. It is powered by the e-Competence Framework and enables practitioners to:

1. *Get a personal e-competence assessment*
2. *Match your competence against a Job Profile*
3. *Check your competence against a European Standard*
4. *Communicate your competence with others*
5. *Plan staff development*

The tool is one of the pledges which support the Grand Coalition for Digital Jobs. The Grand Coalition for Digital Jobs is an initiative launched in 2013 by the European Commission to address the skills gap in ICT throughout Europe. It is now the largest collaborative effort between private and public sectors, particularly education, with the objective of attracting young people, the unemployed and women into ICT and importantly, retaining them in the industry. Stakeholders are required to make pledges, which are concrete action plans involving, amongst other initiatives, training, internships, apprenticeships etc (Digital Agenda for Europe, 2015).

## 4.2 The Methodology for the Creation of this Standard

In order to create a standard, a member of the workshop, or a group of members, puts a proposal to a plenary meeting for consideration. If this is deemed to have merit a full proposal is prepared and once approved by the rest of the members and vetted for compliance by the workshop secretariat and the CEN liaison officer, it is sent to the European Commission for consideration. To date all funding in this workshop has been from DG Enterprise and Industry but the workshop is not limited in seeking funding solely from this source. DG Enterprise and Industry assembles an evaluation panel and should the proposal meet appropriate quality standards and be fully relevant to EU policies, it is accepted for funding. The next step is a call for experts to carry out the work specified in the proposal. The CEN workshop selects the project team and work commences.

This procedure has been followed for each version of the European e-Competence Framework (e-CF), which proceeded as follows: The selected panel of experts first agreed on definitions of knowledge, skill, competences and attitudes. Taking into account the definition of knowledge, skills and competences within the European Qualifications Framework (EQF), the experts defined **competence** as "a demonstrated ability to apply knowledge, skills and attitudes for achieving observable results" (Framework, 2014).

The next area for attention was the selection of areas of competence. The experts agreed on business areas of “plan”, “build”, “run”, “enable” and “manage”. They also agreed that knowledge areas should be added to more accurately define the competences required. Proficiency levels were agreed which aligned the e-competence framework to the European Qualifications Framework and a relationship table was created as follows:

[1] www.cepis.org

e-CF level 5 is EQF level 8
e-CF level 4 is EQF level 7
e-CF level 3 is EQF level 6
e-CF level 2 is EQF level 4 and 5
e-CF level 1 is EQF level 3

The European e-Competence Framework was produced by a team of experts selected by the CEN Workshop on ICT Skills. The project team considered aspects of existing national frameworks such as SFIA (Skills Framework for the Information Age), AITTS, CIGREF and EUCIP and acknowledged that these frameworks are important in their own areas but as they exist in parallel they makes it difficult to provide a comparison between them. The e-CF set out to provide a neutral cross national framework to enable competency management and planning across Europe. It is a reference framework of ICT competences that can be used and understood by ICT user and supply companies, the public sector, educational and social partners across Europe. The framework provides a tool for the following:

**ICT practitioners and managers**

The e-CF gives managers a tool to establish the competences required for new projects and to ensure that they have the appropriate staffing levels with the required competences. It allows them to find where there are skills gaps and where recruitment or outsourcing is required.

**HR managers**

The framework can help in understanding the competences required for a company and to assist with job description for personnel planning and recruitment. The e-CF provides a tool for companies to be very specific in their job advertising and puts them in a position to more accurately meet the needs of their clients.

**Education and Training**

The mapping of courses and certifications to e-CF allows for a transparent view of the competence of the graduates which will be coming into the market place. The fact that the e-CF is related to the EQF and that it is based on learning outcomes makes it a powerful tool for academic institutions in demonstrating the effectiveness of their curricula.

**Market researchers and policy makers**

The frameworks can assist in planning with commonly accepted data sets. In this climate of unemployment and a shortfall in the availability of suitably trained ICT practitioners the e-CF provides a means of measuring the output from colleges and the requirements of the market place such that gasps can be quickly identified.

**Procurement managers**

The framework presents a transparent means of describing resources in International bidding situations. As outsourcing continues to be prevalent it is essential that the competences required and provided are matched. The e-CF provides a readymade tool for this aspect of outsourcing.

The content of the e-CF consists of four dimensions. Dimensions one, two and three of the framework are shown in Figure 1. While dimension three indicates the level of competence, dimension four provides examples of the knowledge and skills that relate to the specific e-competences defined in dimension two. These examples are not intended to be exhaustive.

| Dimension 1<br>5 e-CF areas<br>(A – E) | Dimension 2<br>40 e-Competences identified | Dimension 3<br>e-Competence proficiency levels<br>e-1 to e-5, related to EQF levels 3–8 | | | | |
|---|---|---|---|---|---|---|
| | | e-1 | e-2 | e-3 | e-4 | e-5 |
| A. PLAN | A.1. IS and Business Strategy Alignment | | | | ■ | ■ |
| | A.2. Service Level Management | | | ■ | ■ | |
| | A.3. Business Plan Development | | | ■ | ■ | ■ |
| | A.4. Product/Service Planning | | ■ | ■ | ■ | |
| | A.5. Architecture Design | | | ■ | ■ | ■ |
| | A.6. Application Design | ■ | ■ | ■ | | |
| | A.7. Technology Trend Monitoring | | | | ■ | ■ |
| | A.8. Sustainable Development | | | ■ | ■ | |
| | A.9. Innovating | | | | ■ | ■ |
| B. BUILD | B.1. Application Development | ■ | ■ | ■ | | |
| | B.2. Component Integration | | ■ | ■ | ■ | |
| | B.3. Testing | ■ | ■ | ■ | ■ | |
| | B.4. Solution Deployment | ■ | ■ | ■ | | |
| | B.5. Documentation Production | ■ | ■ | ■ | | |
| | B.6. Systems Engineering | | | ■ | ■ | |
| C. RUN | C.1. User Support | ■ | ■ | ■ | | |
| | C.2. Change Support | | ■ | ■ | | |
| | C.3. Service Delivery | ■ | ■ | ■ | | |
| | C.4. Problem Management | | ■ | ■ | ■ | |
| D. ENABLE | D.1. Information Security Strategy Development | | | | ■ | ■ |
| | D.2. ICT Quality Strategy Development | | | | ■ | ■ |
| | D.3. Education and Training Provision | | ■ | ■ | | |
| | D.4. Purchasing | | ■ | ■ | ■ | |
| | D.5. Sales Proposal Development | | ■ | ■ | | |
| | D.6. Channel Management | | | ■ | ■ | |
| | D.7. Sales Management | | | ■ | ■ | ■ |
| | D.8. Contract Management | | ■ | ■ | ■ | |
| | D.9. Personnel Development | | ■ | ■ | ■ | |
| | D.10. Information and Knowledge Management | | | ■ | ■ | ■ |
| | D.11. Needs Identification | | | ■ | ■ | ■ |
| | D.12. Digital Marketing | | ■ | ■ | ■ | |
| E. MANAGE | E.1. Forecast Development | | | ■ | ■ | |
| | E.2. Project and Portfolio Management | | ■ | ■ | ■ | ■ |
| | E.3. Risk Management | | ■ | ■ | ■ | |
| | E.4. Relationship Management | | | ■ | ■ | |
| | E.5. Process Improvement | | | ■ | ■ | |
| | E.6. ICT Quality Management | | ■ | ■ | ■ | |
| | E.7. Business Change Management | | | ■ | ■ | ■ |
| | E.8. Information Security Management | | ■ | ■ | ■ | |
| | E.9. IS Governance | | | | ■ | ■ |

Figure 1. European e-Competence Framework

An extrapolation of Dimensions 1, 2 and 3 to show some exemplar knowledge and skills of Dimension 4 is given below. These are not intended to be exhaustive and will react to emerging trends.

<table>
<tr><td>Dimension 1<br>eComp area</td><td colspan="5">A: Plan</td></tr>
<tr><td>Dimension 2<br>e-Competence: Title + generic description</td><td colspan="5">A.1. IS and Business Strategy Alignment<br>Anticipates long term business requirements, influences improvement of organisational process efficiency and effectivenes. Determines the IS model and the enterprise architecture in line with the<br>organisation’s policy and ensures a secure environment. Makes strategic IS policy decisions for the<br>enterprise, including sourcing strategies.</td></tr>
<tr><td rowspan="2">Dimension 3<br>e-Competence proficiency levels<br>e-1 to e-5, related<br>to EQF levels 3 to 8</td><td>Level 1</td><td>Level 2</td><td>Level 3</td><td>Level 4</td><td>Level 5</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>Provides leadership for the construction and implementation of long term innovative IS solutions.</td><td>Provides IS strategic leadership to reach consensus and commitment from the management team of the enterprise.</td></tr>
<tr><td>Dimension 4<br>Knowledge examples<br>Knows / aware of /<br>familiar with</td><td colspan="5">K1 business strategy concepts<br>K2 trends and implications of ICT internal or external developments for typical organisations<br>K3 the potential and opportunities of relevant business models<br>K4 the business aims and organisational objectives<br>K5 the issues and implications of sourcing models<br>K6 the new emerging technologies (e.g. distributed systems, virtualisation, mobility, data sets)<br>K7 architectural frameworks<br>K8 security<br>…</td></tr>
<tr><td>Skills examples<br>Is able to</td><td colspan="5">S1 analyse future developments in business process and technology application<br>S2 determine requirements for processes related to ICT services<br>S3 identify and analyse long term user / customer needs<br>S4 contribute to the development of ICT strategy and policy, including ICT security and quality<br>S5 contribute to the development of the business strategy<br>S6 analyse feasibility in terms of costs and benefits<br>S7 review and analyse effects of implementations<br>S8 understand the impact of new technologies on business (e.g. open / big data, dematerialisation opportunities and strategies)<br>S9 understand the business benefits of new technologies and how this can add value and provide competitive advantage (e.g. open / big data, dematerialisation opportunities and strategies)<br>S10 understand the enterprise architecture<br>…</td></tr>
</table>

## 4.3 The Current Situation of the e-CF

The e-CF has gone through three iterations since it was launched and it is anticipated that it will continue to be updated and maintained in keeping with the dynamic area of the marketplace which it serves. The updates will probably have a three year cycle. This may alter when e-CF becomes a European Standard.

The competences described by the e-CF can provide the building blocks for a particular job profile. This is very useful for HR managers and recruitment professionals who wish to be

able to describe the competences required for a particular job accurately and without ambiguity. Competences from different areas and with different levels of proficiency can be put together to create a particular set of competences required for a job. "Job Profiles" consist of 23 profiles within 6 "families". A proposal has been submitted to the CEN Workshop on ICT Skills for the updating of the CWA on Job Profiles to reflect the changes in the e-CF and the changing careers in ICT.

A number of Industry Based Training providers have mapped their courses and certifications to the e-CF. Microsoft did this some years ago to e-CF version 2 and more recently HP completed a similar mapping exercise. The European e-Competence Framework Brief prepared by HP and Certiport is entitled "Closing the Skills Gap with Real-world IT and Business Skills" (Certiport, 2014). It describes the approach taken by HP and Certiport to map the HP certification and profiles to the e-CF. Other companies such as Cisco have started a similar mapping exercise. EXIN has created the e-CF Assessment tool makes the labour market transparent for ICT practitioners. The e-Competence Assessment gives an insight into the competences required by an ICT professional[2]. This web site provides a range of services including a self-assessment evaluation against the e-CF and related to Job Profiles[3].

The Italian Standards Body, UNI, has adopted the e-CF as a National Standard. UNI made a proposal to CEN that e-CF should be adopted as a European Standard. Following approval by the members of CEN PC 428 was established with a view to taking the e-CF version 3 and creating it into a European Standard. An inaugural meeting was held in Milan on 28th January 2014 and a programme of work was adopted to create the standard. Some nine member bodies of CEN were present at the meeting. It is anticipated that the process of transforming the CEN CWA into an EN number (standard) will take at least eighteen months.

## 4.4 The Future of e-CF

Figures of a shortfall in ICT jobs vary from 700,000 to 900,000 in 2015 (Irish Times, 2013, Digital Agenda for Jobs, 2015). Added to this, jobs exist now that were unheard of just 5 years ago such is the change that ICT has brought to the labour landscape. A survey conducted by LinkedIn in 2014 of 259m members examined job titles that barely existed in 2008 eg IOS developers (growth factor 142x), Android developers (199x), Big Data architects (3440x) (LinkedIn, 2014). It is likely that jobs that do not exist today will emerge 5 years from now. The e-CF may provide the structure to allow people to anticipate emerging trends and exploit them more fully. As mentioned earlier in this paper, it is micro enterprises and SME's that are key drivers in job creation and growth. More than a decade ago, it was noted that developed countries had been undergoing a transition from traditional economic models to a more entrepreneurial one (Audretsch and Thurik, 2001), and it continues (de Kok *et al*, 2011). In the past five years, they have created around 85% of new jobs and provided two-thirds of the total private sector employment in the EU (Growth, 2015). This is acknowledged in the third version of the e-CF which has incorporated such competences as Needs Idenitfication, Applied research and Innovation

[2] www.ecfassessment.org
[3] http://www.eskillslandscape.eu/self-assessment-2/

## 5. CONCLUSION

This paper has set out to show the changing landscape of ICT systems over the past 70 years. It discusses the concept of an ICT profession as the use of technology in business and industry has moved to today's complex IT environments and infrastructures. The skill set required to take advantage of technology has changed - from computer operating, programming, systems analysis and management to the complex environment of today. It is a far cry from the situation in the 1950s when according to pioneer Murray Laver, FBCS, in a lecture to the Irish Computer Society in 1968 "it took the combined efforts of the entire staff to keep the computer on the verge of working". Today, the Information Systems practitioner must understand the needs of business, the value or otherwise of emerging technologies to meet the business needs, the sourcing options for the organization – at the same time operating under strict budget demands.

The e-CF provides the first and perhaps the key building block for the ICT profession. It provides a transparent means for describing the competences required to build computer based systems. It provides a means for creating curricula to meet the requirements of the ICT users. It also provides the basis for showing the job profiles associated with ICT and the career paths which can be followed. The certification building block is already under way with Industry Based Training Certifications being mapped to e-CF. A new EU funded project has just started to build a Foundation BOK, this will relate to e-CF. And finally work is underway on establishing a code of ethics for ICT practitioners. The start of a real ICT profession cannot be too far away.

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