– CWA –

Interoperability of European e-Career Services

CEN/ISSS Workshop ICT - SKILLS

MAY 2009

The substantive finding of this CWA report is recognition of a significant absence of interoperability for e-Skills and ICT career services across Europe. The CWA builds upon this finding and addresses realistic solutions targeted to

- Policy and decision makers
- Website creators, designers, architects and developers
- Qualification and certification providers

A summary of related recommendations is provided in Chapter 6 of this report.

Consultation Version

CONTENT TABLE

1. THE INTEROPERABILITY VISION

1.1. The benefits of interoperability – the value chain proposition

Today, the interoperability quotient determines economic and social value. A low level of interoperability leads to loss of opportunity. Interconnection between related activities and services has become the new standard for value add and innovative excellence.

> Interoperability primarily refers to the ability of Information and Communication Technology (ICT) systems and of the business processes they support to exchange data and to enable the sharing of information and knowledge.[1]
>
> ICT systems can only reflect the 'real environment' therefore recommendations on how to increase interoperability of European ICT career and e-skills services within this CWA go beyond application in an online environment. The value chain proposition established by interconnecting websites must be underpinned by complementary standards.

Information and communication technologies operate in a global market and ICT business processes, jobs, methods, competence requirements and solutions are converging. However, apart from some examples in the United Kingdom, the current level of European ICT career web services' interoperability is very low. Navigating the web and identifying relevant links is confusing; on-line information about ICT careers and e-Skills developments are structured and presented in many different and isolated ways. This constrains labour mobility in ICT career development and consequently the competitiveness of the European ICT business.

The CEN/ISSS Workshop on ICT Skills agrees that interoperability between e-Skills ICT career services and web portals across European member states should increase. Common reference standards which articulate competences, skills and job roles are the enablers of interconnection and exchange between e-career related products, services and internet portals. Benefiting from enablers such as the European e-Competence Framework, and increasing levels of interoperability will enhance website values and usability across national and company boundaries.

Considerable benefits can be accrued for website users by creating value chains linking data from different web portals. For example, a typical value chain can be found in the travel industry. Booking a flight on-line commonly links to hotel offers, car rental or booking of sight-

[1] IDABC-EIF 2004

seeing tours in the destination city. Transferring these principles to ICT career development, on-line insertion of individual competence profiles could, for example, lead to connections with qualifications, certifications and alignment with job opportunities.

In the past the lack of Europe-wide shared frameworks and tools made connection and integration difficult, however, common reference standards such as the European e-Competence Framework and the EQF are now available. They can support interoperability of e-career related websites and contribute to increasingly efficient connections and data exchanges between ICT Human Resources development needs, offers and products across EU member states.

In the context of multistakeholder efforts to create and maintain a common European ICT sector framework, consistent links between, for example, qualification and certification programs, competence requirements on the job, market research and career information are invaluable. The use of shared languages and structuring principles supports and strengthens long term multistakeholder cooperation to create, manage, plan and develop ICT competences needed in Europe today and for the future.

1.2. ICT Career and e-Skills web services in Europe and their interoperability potential

The volume and diversity of Information and Communication Technologies (ICT) career and e-Skills development websites found and hosted on local, national, European and International levels by organisations, companies and institutions is unsurprisingly huge. Some websites encourage young people to choose an ICT career, others provide advanced ICT career and job guidance. Some sites support qualification and certification promotion others assessment tools, gender issues or job opportunities whilst others focus on statistical data and sector policies or simply provide space for interaction between sector players.

In recent years, a broad range of career support initiatives have been launched at regional, national and international levels. These include Europass, the former Career Space, the e-Skills ILB Industry Leadership Board and the recently launched “e-Skills Europe” pilot portal, the forthcoming European Directory for Woman and ICT, Cedefop portals at a European level, as well as e-Skills UK, Kibnet, Passinformatique and Cigref portals in local and national environments.

However, the current low level of European ICT career website interoperability does not correspond to the needs of a global market: ICT operates globally and differences between jobs, methods, competence requirements and solutions are becoming less. ICT supply and demand companies need staff able to develop and manage ICT devices, to understand, build and integrate technology into business processes to leverage productivity and innovation.

Consequently, a long term strategy to create, manage, plan and develop ICT competences required for the long term perspective across Europe, is a European objective.

In this scenario, services aimed to help the labour market understand jobs, learning and career advancement opportunities in the ICT field are increasingly relevant. From a European, national or regional perspective online ICT Career services are more efficient and benefit providers and users if key services are interconnected. Existing websites and portals need to provide clear, transparent, effective and complete ICT career development information and services to individuals, companies and institutions involved in ICT processes (business, learning, career). Valuable service examples include self-assessment, job search, Job-CV matching, career orientation, competences, qualifications or certifications specifically addressed to ICT. The ability to connect these services in a transnational environment would increase value and efficiency for website users.

In the past lack of Europe-wide shared frameworks and tools made connection and integration very difficult, but recently developed common reference standards such as the European e-Competence Framework and the EQF are now available. Together with a European ICT Qualifications language they can support interoperability of e-career related websites and contribute to supporting data exchange of ICT Human Resource development information and products across EU member states.

The European Directory of Women and ICT, financed by the European Commission's DG Information Society & Media, to be launched in October 2009, will be one of the first platforms, targeting multistakeholder users, to integrate the European e-Competence Framework. The directory using an SOA based solution will address interoperability issues using semantic and syntactic standards and will deploy the recommendations of this CWA.

1.2.1. Towards a shared European online platform: The European e-Skills Portal

The need for a European portal was driven by the significant influence of Information and Communication Technologies on the EU economy, the international competitiveness of the sector and the existence of e-skills gaps in Europe. The provision of a shared European internet platform for e-Skills development is intended to support a wide range of ICT sector players and career seekers.

Following a feasibility study of a European ICT Career Portal carried out in 2007, the European e-Skills and Career Portal project was initiated and supported by the e-Skills Industry Leadership Board (ILB). The ILB and the European Schoolnet service provider launched a pilot version of the portal for the European e-Skills Conference 2008 in Thessaloniki.

The strategic goal of the pilot Portal is to lay foundations for medium to long term development of market-relevant e-Skills capacity. In addition it addresses tactical activities in support of ICT

job seekers and ICT career development. The priority focus group for the pilot phase is students and ICT professionals. The portal functions are dedicated to ICT career guidance, e-Skills information and networking facilities.

In the longer term, the European e-Skills Portal aims to meet the needs of all ICT sector players engaged in European ICT workforce development processes from multiple perspectives. The future target group includes;

- *Individuals*, e-citizen users, students, ICT workers or ICT professionals, the Portal should serve as a 'one-stop-shop' for e-Skills and Career Guidance,
- *Employers*, to support the attraction of people into ICT careers, to serve as a point of communication with potential employees / interns and to offer current information on e-Skills jobs,
- *Educators and trainers*, providing them with a platform for providing appropriate guidance to students / trainees about careers in ICT and further training,
- *Government, non-Government and third party stakeholders*, by offering a source for statistical and survey data, promoting ICT skills awareness raising campaigns and policy, providing an overview of the supply and the demand for skills and monitoring educational provision,
- *Job and Employment Agencies*, providing them a source for potential candidates,
- *ICT skills providers*, raising public awareness of the role of non-formal training and educational channels to provide market-relevant ICT skills through multi-stakeholder partnerships, promoting skills programmes, career options and education programmes and tools, enabling promotion or sponsorship of specific initiatives within the Portal community.[2]

To achieve a sustainable, added value European online platform deploying feasible resources; interoperability of relevant websites on national and European levels is essential. Commonly established concepts and references, such as the European e-Competence Framework, provide the high-quality neutral standards to support this aim.

1.3. Career Services Interoperability

ICT career and e-Skills development websites offer a selected range of services which are relevant for ICT career development; this CWA defines them as the Human Resources domain (see chapter 3). The range of services offered can be grouped into four classes :

- **Learning services** representing learning programs, training and certification programs and diagnostic assessment

[2] See: http://eskills.eun.org/web/guest/objectives

- **CV (curriculum vitae) services** representing curriculum support
- **Job services** representing recruitment and selection
  e.g. internal and external job posting, internal assessment, business processes
- **Market and career information services**
  e.g. career information, market scenarios

Although all these service classes are offered in various online formats individual websites and portals usually provide only partial information covering some elements of the entire Human Resources domain. Therefore users have to shift from one internet site to another in order to seek an integrated pathway for career development. This leads to incomplete evaluation and only partial understanding of ICT career development opportunities. In addition the same information has to be provided in different formats to each site leading to significant inefficiencies. Furthermore, there is a lack of transparency across National websites which limits information provision across Europe and therefore hinders labour mobility.

This CWA provides guidelines to build an interoperable user-friendly environment enabling easy linkage of services to the benefit of e-career service providers and users. Useful links for efficient data exchange leading to integrated career development support for ICT career aspirants and professionals could be established between the classes of service identified earlier in this report.

To achieve connections, learning, CV, job and market & career information services should relate to the European e-Competence Framework (e-CF). As a shared European reference and "e-competence currency" based upon an ICT employer perspective, the e-CF can enable interoperability by reference from job postings, candidate's CV, learning and certification programs, market research and career scenarios.

Detailed recommendations about what services could be connected to what, how and why are addressed in chapters 3. and 5. of this CWA. The use of common frameworks and standards on a European level – e.g. European e-Competence Framework (e-CF), EQF, Europass, international technical standards, will enable e-career service providers and users to fully exploit additional opportunities provided by interoperability. Chapter 2. is therefore dedicated to available European standards which can support interoperability from a strategic, functional, methodological and technical viewpoint.

1.4. Target audiences of this CWA – who can drive interoperability forward

Achieving interoperability of European ICT career and e-Skills services and web portals demands commitment and has various implications at different levels in different working environments. Four target groups were identified as relevant and they are explicitly addressed in this CWA.

1.4.1. The strategic level – policy and decision makers

To implement interoperability in a European ICT career and on-line environment, clear-sighted decisions by policy and strategy makers are required. Importantly, the vision of why (strengthen European mobility and opportunities in ICT career development) and how (by making use of Europe-wide shared frameworks and tools as the European e-Competence Framework and the EQF) to connect ICT career services in a European environment must be understood, driven and promoted by policy and strategy makers.

To ensure a "European view" of the ICT HR domain reflecting both business and educational culture, key stakeholders have contributed to the CWA development. The strategic level of interoperability and target specific guidance is explicitly addressed in chapters 3.1. and 5.1.

1.4.2. The functional level – website creators, designers and architects

To create value chains for e-career services providers and users, website implementers need to determine on a functional level which services they aim to provide and which elements should be connected to what and for what purpose. This CWA supports the identification and structuring process of career services offered by websites and portals ensuring coherence with European objectives.

In addition to representing a systematic approach to potential services and possible connections within the Human resources domain in ICT career development, the report shows how common frameworks and standards within Europe – e.g. European e-Competence Framework (e-CF), EQF, Europass – enable e-career service providers and users to fully exploit additional opportunities provided by interoperability.

This CWA encourages website implementers to identify which interoperable functions should be exploited through website interfaces to benefit the user. Concrete examples show the added value of linking e-Career services to each other, e.g. candidate's CV to job posting or job profiles to certification programs. The functional level of interoperability and target specific guidance is addressed in chapters 3.2., 4.2. and 5.2.

1.4.3. The technical level – website designers, architects and developers

To make interoperability a reality, the technical specification of website development is vital and consequently a significant part of this CWA is dedicated to technical recommendations. The

technical guidelines provide practical support to identify and use existing international standards and good practise on European level for data definitions, data standards and semantic relationships in order to connect internal and external portal functions and services. Practical examples show the added value of international technical standards to achieve functional interoperability. The technical level of interoperability and target specific guidance is explicitly addressed in chapters 2.7., 3.3. and 5.3.

1.4.4. The methodological level – qualification and certification providers

Relating a qualification and certification perspective to the ICT employer viewpoint based on required workplace competences is a basic prerequisite for achieving interoperability within the ICT career Human resources domain. Many e-career services are based on the articulation of competences and/ or learning outcomes. If competences are to be related to qualifications, a consistent methodology is required.

This CWA provides guidance on the development of a methodology.It outlines a common approach to ICT qualifications and competences, deploying context, to provide a key to connecting qualification and certification objects. to ICT workplace competences expressed within the European e-Competence Framework. The need for qualification and certification alignment to competence is also highlighted in the CWA "ICT Certification in Europe". Chapter 5.4. outlines proposals for creating a consistent methodological approach

2. RELEVANCE OF EUROPEAN-WIDE STANDARDS

Interoperability of internet careers services across Europe is reliant upon the availability of European standards. Common reference points provided by frameworks, structures and technical specifications enable consistent exchange of information. The absence of accepted standards has directly led to incompatibility between current internet careers services. The development of the e-competence framework provides a new opportunity to facilitate linkage between web portals in conjunction with the additional standards and methodology described later in this section.

Consistency and transferability are essential ingredients required to connect disparate concepts. For example the telecommunications industry has a long history of establishing international communication standards based upon the requirement to interconnect national networks. National telecommunications providers use different internal technologies to transmit voice and data, but they agree on common international standards to enable seamless transmission across geographic borders. There is a strong parallel here with the aspirations of

this report which promotes the establishment of common standards for stakeholders to use and to establish connections with related career services across national borders.

The growth of Web 2.0 further facilitates the automated exchange of information and is dependent upon semantic compatibility provided by standards.

2.1. The European e-Competence Framework

The European e-Competence Framework is a reference framework comprising of core ICT competencies that are applicable to ICT practitioners across Europe. It provides an international tool for ICT managers to plan competence development. It is equally applicable to education and training institutions, in support of curriculum design, and to ICT practitioners who can use it to support personal continuous professional development.

Based upon the definition “a demonstrated ability to apply knowledge, skills and attitudes for achieving results" the employer defined competences are represented in a simple logical framework structure. The framework consists of 32 competences and comprises of five proficiency levels linked directly to the European Qualifications Framework **(EQF)**. The competences are based upon five main ICT business processes. The European e-competence framework **(e-CF)** facilitates linkage between national structures by providing a set of Europe-wide agreed and defined ICT core competences. It is accompanied by a set of user guidelines to support stakeholder implementation.

The European e-Competence Framework, available since November 2008, is supported by the European Commission and the Council of Ministers.

See http://www.ecompetences.eu/ for further details.

2.2. The EQF

The **EQF** is a European qualification framework which links different national and sectoral qualifications systems to a common European reference model. The **EQF** enables understanding and comparison of qualification levels from different countries and sectors reflecting different education and training systems.

The EQF comprises of eight reference levels and describes in terms of learning outcomes what a learner knows, understands and is able to do on completion of a learning process. The **EQF** applies to a wide range of education, training and qualifications and is not industry sector specific. It covers general, vocational and academic education and training based upon learning outcomes independent of learning institutions and environments, methodologies or study time.

The EQF was adopted by the European Parliament and Council on 23 April 2008.

For further details see http://ec.europa.eu/education/lifelong-learning-policy/doc44_en.htm

2.3. A common European ICT language

With the European Qualifications Framework (EQF) and the European e-Competence Framework (e-CF) two European-wide standards of relevance for the ICT sector are now available. Whilst the EQF covers the qualification perspective, the e-CF articulates competence requirements in the workplace.

There are fundamental differences between qualification frameworks and skills/competence frameworks. *This was highlighted and articulated in the CWA 15515 entitled 'European ICT Skills Meta-Framework" published in November 2005.*[3] The authors noted that skills/competence frameworks represent the demand side of the skills development equation and that qualifications frameworks represent the supply side. Both sides need to be developed; they address different parameters using different language but there is a significant relationship between them that must be taken into account to address both competence demand and qualification supply.

Subsequently, work conducted within the ICT Lane initiative[4] explored a methodology to apply the European Qualifications Framework (EQF) and the European e-Competence Framework (e-CF) to ICT qualifications and certifications. In the course of developing a software tool to facilitate this activity, the relationship between generic learning outcomes, distilled from ICT qualifications, and how they could be associated with workplace competence, expressed by the European e-Competence Framework, was explored. Two major findings of the ICT Lane initiative were 1) standardised learning outcome structures and 2) linkage to e-competences. Knowledge and skills are common objects, shared between the e-Competence Framework and qualification language, as illustrated below.

[3] CEN, European Committee for Standardization, 2005
[4] ICT Lane is a Leonardo initiative, it can be accessed at http://ict-lane.eu

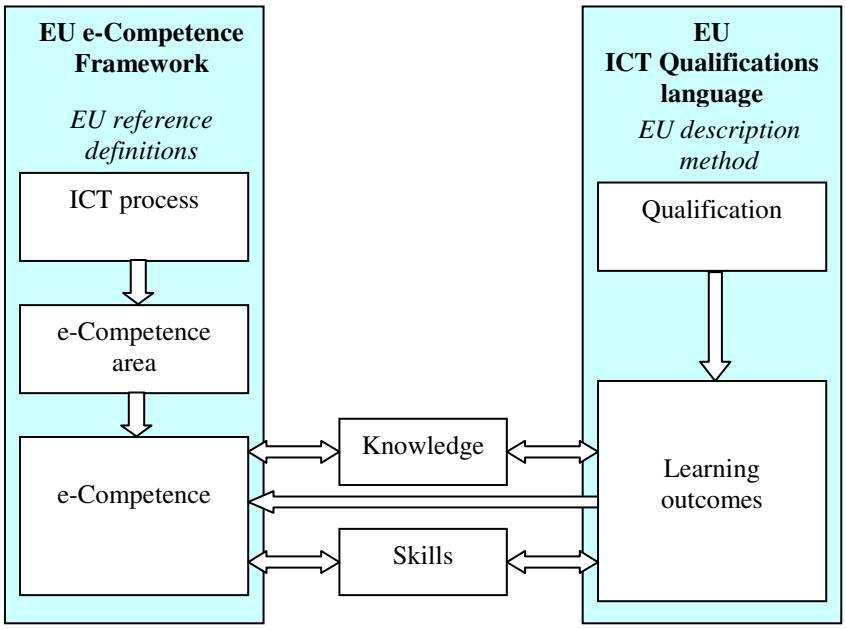


Figure 1: Addressing e-Competence demand and ICT Qualification supply - Connecting learning outcomes to competences

The experience gained from the ICT Lane initiative was carried forward into interoperability discussions and has been further developed and incorporated within the recommendations of this CWA proposal.

Transparency and clarity of interpretation are required to enable international consistency when applying standards. Chapter 5.4 provides a detailed explanation of how this can be achieved by making use of a common European ICT language when linking competences of the e-CF to learning outcomes provided by qualifications and certifications.

2.4. Europass

Europass supports individuals to promote their abilities in an effective way. It consists of five documents that help potential employers, educational establishments and training providers understand subjects studied, what training has been completed or how much work experience has been gained.

There are numerous CV formats used by people across Europe, the Europass CV provides a standard CV format that can be used to detail qualifications and skills in a straightforward and understandable manner. Europass CV can be completed in 26 different languages and additional documents such as language capability can be attached to it.

Europass can help remove barriers to working, studying or training across Europe and is free of charge to use.

Europass CV was developed by the European Parliament and the Council of Europe.

For further details see *http://www.europa-pages.com/jobs/europass.html*

2.5. Credit systems

Translation of qualification parity within and across national borders is supported by the use of credit systems. For example (ECVET) the European Credit System for Vocational Education and Training aims for better comparability and compatibility between different national (VET) Vocational Education and qualification systems. Similarly for Higher Education (ECTS) the European Credit Transfer and Accumulation System is a standard for comparing the study attainment and performance of students of higher education across the European Union.

2.6. Interoperability between European and local/ national frameworks

If e-Career services are referenced to local/ national frameworks (i.e. they have already implemented some mutual levels of interoperability), then connections between the local/national and European Frameworks are easily established. The same is true for information portals. If local e-Career services are related to local/ national e-Career portals, then it is sufficient that the local/ national portals connect to, for instance, the EU e-Skills Portal. In this way interoperability is established across national boundaries to facilitate shared services and mutual information exchange.

2.7. Internationally used technical standards

Technical standards are a key enabling factor to create an interoperable environment, as they enable communications between services.

One significant advantage provided by interoperable services, is the possibility to overcome challenges arising from different platform choices adopted by service providers. For instance content within portals can be managed using different technical solutions provided by a variety of content management systems, such as bitWeaver, Drupal, Joomla, Liferay, Alfresco, Midgard, TYPO3, WebGUI, Xaraya, XOOPS. Also those provided by vendors such as IBM, Microsoft, EMC, SAP, Oracle, Open Text, Interwoven, Xerox, HP, Vignette and more[5] can be applied.

[5] Mentioned providers are the main open source programs and proprietary vendors resulting as market leaders from Gartner's Magic Quadrant classification for Enterprise Content Management

Even though these products use different structures to provide the same features (e.g. web contents, web form, newsletter, media gallery, search engine, RSS, etc.), communication across portals does not have to consider the underlying technology if they are compliant with standards at three levels of architecture. Standards define the communication language. For example, some leading software providers (Microsoft, EMC, IBM, Alfresco, Open Text, Oracle and SAP), aware of the importance of interoperability, jointly created the Web Services Interface Specification for greater interoperability of Enterprise Content Management Systems. Specifications were provided at the application level using Web Services and Web 2.0 interfaces to enable applications to interoperate with multiple Enterprise Content Management (ECM) repositories by different vendors. These Content Management Interoperability Services (CMIS) have been submitted to OASIS (Organization for the Advancement of Structured Information Standards) for advancement through its rigorous standards development process.

2.7.1. A reference model of technical interoperability

Technical interoperability among career services can be defined on three different levels, on presentation, application and data level:

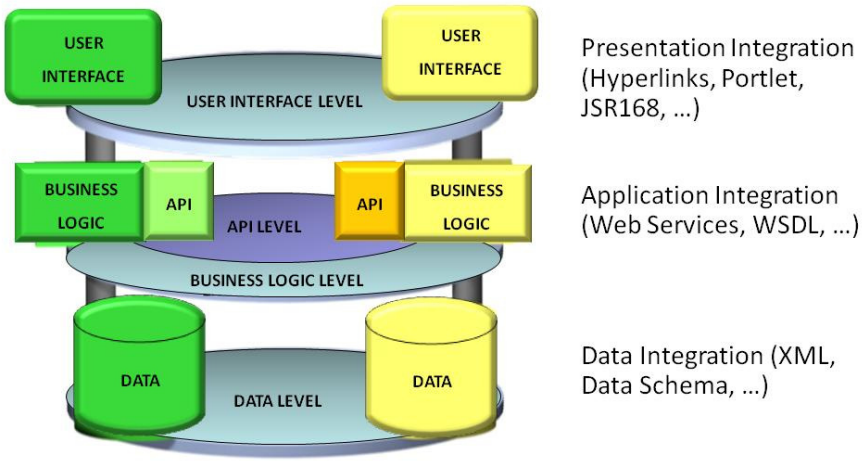


Figure 2: Technical interoperability on presentation, application and data level

Creating interoperability at the **presentation** or **user interface level** requires the use of technical solutions which enable the integration of services inside a common web presentation even if applications are not integrated and data stored inside the original repository.

Integration at this level is enabled by web portal technologies, inside which pluggable user interface software components, called portlets, are managed and displayed. A portal page is generally displayed as a collection of non-overlapping windows, so that a portlet (or collection of portlets) resemble a web-based application implemented natively inside the portal.

Examples of portlet applications are e-mails, weather reports, discussion forums or news. The user has the perception of accessing different contents from a single navigation experience, while information retrieval is made transparent to the end user. Standards at this level are represented by JSR168, JSR268[6], WSRP[7] and similar portlet specifications. JSR defines a programming model for portlet developers. The programming model introduced by Java Specification Request 168 is built in order to provide the portal with features, such as advising the portlet which task to perform and what content should be generated, or to indicate space assigned to the content generated by the portlet. JSR268 is built to improve the model introduced by JSR168 with some inter-portlet communication features, aligned with WSRP. WSRP is a network protocol standard designed for communications with remote portlets; it is complimentary to JSR168 as it may be used to define a portlet's operations to remote containers.

At the **application level**, interoperability is enabled by the use of Web services. A Web service is defined by W3C[8] as "a software system designed to support interoperable machine-to-machine interaction over a network". In other words, a Web service could be described as a standard application developed for delivery to many users.

At present, Web services are frequently just Web APIs[9] that can be accessed over a network, such as the Internet, and executed on a remote system hosting the requested services. Interoperability among them is achieved through the use of standard profiles. A profile is a set of core specifications (SOAP, WSDL, etc.), expressed in a specific version (SOAP 1.1, UDDI 2.0, etc.). WSDL[10] is an XML-based language that provides a model for describing Web services as collections of network endpoints, or ports. UDDI[11] is a platform-independent, XML-based registry for worldwide businesses to list themselves on the Internet. It is designed to be interrogated by SOAP[12] messages and to provide access to WSDL documents describing the protocol bindings and message formats required to interact with the Web services listed in their directory.

At the **data level**, interoperability is attained by maintaining compliance to standard formats to enable data exchange. This means that website content should be organised in a structure that allows comparison with other content descriptions.

[6] Java Portlet Specification v1.0, v2.0
[7] Web Services for Remote Portlets
[8] World Wide Web Consortium
[9] Application Program Interface
[10] Web Services Description Language
[11] Universal Description, Discovery and Integration
[12] Simple Object Access Protocol

At this level, **syntactic and semantic interoperability** is defined. Semantic interoperability means the use of categories, taxonomies or ontologies to describe content. It is paramount that content is described with a particular formalisation language, such as OWL[13] which is compliant to some other syntactic standards, such as HR-XML[14] definitions or CEN MLO[15] learning opportunities' description, to allow the recognition of common definition patterns.

2.7.2. Syntactic standards

Syntactic and semantic rules can be applied to data.

Syntactic rules have to be followed to ensure accurate communication between different services. This means that they must use standard document formats to be compliant. An influential standard related to human resource management is **HR-XML.** This is a library of XML schemas developed by the HR-XML Consortium, Inc. to support a variety of business processes related to human resources. HR-XML documents represent a vertical specification of XML, providing a series of document structure aiming at codifying specific aspects of the HR environment. For instance, documentation is provided to codify competences (HR-XML Competencies) or to post jobs by defining positions required, needed experiences and education, locations, etc. Using HR-XML Staffing Exchange Protocol, each document must give information for a number of pre-defined fields, so that they are easily interpreted by interacting services.

CEN MLO defines the electronic representation of learning opportunities in order to facilitate their advertising and subsequent discovery by prospective learners. The objective of MLO is to describe learning opportunities by providing information such as credits, proficiency levels, etc. and details of the learning provider. More information about standards and other specifications developed to fill in the gaps left between standard specifications can be found in annex 4.

2.7.3. Semantic standards

While syntactic standards are related to structure, **semantic rules** are concerned with meaning. Many connections exist among the two: for instance, the HR-XML Competency schema is used to communicate both unstructured competency data (such as those which may be captured from a resume or profile) or structured competency data from a taxonomy. The focus in this case is on measuring the competencies in order to provide a numerical evaluation. However, the dependencies between competency elements can only be expressed through a descriptive attribute. Most semantic relationships are not recognized as international standards, even if in common use. References concerning these rules are investigated in chapter 4.4. The only

[13] Web Ontology Language
[14] Human Resources eXtensible Markup Language
[15] Metadata for Learning Opportunities

international standard in this environment is O*NET, coming from the United States. It has been developed as an Occupational Information Network developed under the sponsorship of the US Department of Labour/Employment and Training Administration. The core concept of the program is the O*Net database, continuously updated by ongoing surveys of each occupation's worker population and occupation expertise. A content model defines the information structure for each occupation, combining the required mix of knowledge, skills, abilities and a variety of activities and tasks. The O*NET-SOC taxonomy defines the set of occupations across the world of work, which, together with the content model, contributes to populate the database (http://www.onetcenter.org).

Owing to HR domain complexity, there should be a quest for spreading ontology standard languages, such as OWL, to enhance the level of interoperability facilitated by taxonomies and to enable the automated recognition of elements by creating a semantic network with common meanings. OWL is designed for use by applications that need to process content information data instead of just presenting information. This feature allows OWL to facilitate greater machine interpretation of Web content than that supported by XML or RDF[16] as it provides additional vocabulary to accompany the formal semantic language.

3. THE HUMAN RESOURCES DOMAIN

The human resources domain model was constructed on three levels; strategic, functional and technical, to support detailed analysis and graphical representation of ICT HR related services. Three levels of granularity provide the different target groups of this CWA with guidance, illustrated by the Human Resources domain model:

- The strategic level of interoperability – the HR domain from satellite view
- The functional level of interoperability – the HR domain from helicopter view
- The technical level of interoperability – the HR domain from ground view.

How the three levels of granularity were applied to elaborate guidelines consistent with the three levels of interoperability implementation is explained in the following chapters.

3.1. The strategic level of interoperability – HR domain satellite view

The range of e-career services provided by ICT and e-Skills websites in local, national and international environments addressed to varying target groups can be regrouped according to

[16] Resource Description Framework

four main classes of service. They reflect the main pillars of the (ICT) Human Resources domain:

- **Learning services** representing learning programs, training and certification programs and diagnostic assessment
- **CV (curriculum vitae) services** representing curriculum support
- **Job services** representing business processes, recruitment and selection
  e.g. internal and external job posting, internal assessment, business processes
- **Market and career information services** representing career support
  e.g. career information, market scenarios

This CWA asserts that the level of ICT career websites' interoperability across Europe is very low. The previous absence of accepted standards has directly led to incompatibility between current internet career services.

The completion of the European e-Competence Framework provides a new opportunity to facilitate linkage between web portals in conjunction with the additional standards and methodology described in the previous chapter.

Figure 3 reflects this interoperability vision at a high level of granularity and from an holistic viewpoint. It shows the European e-Competence Framework potential for enabling interoperability of e-Skills and ICT career related websites across the European Union.

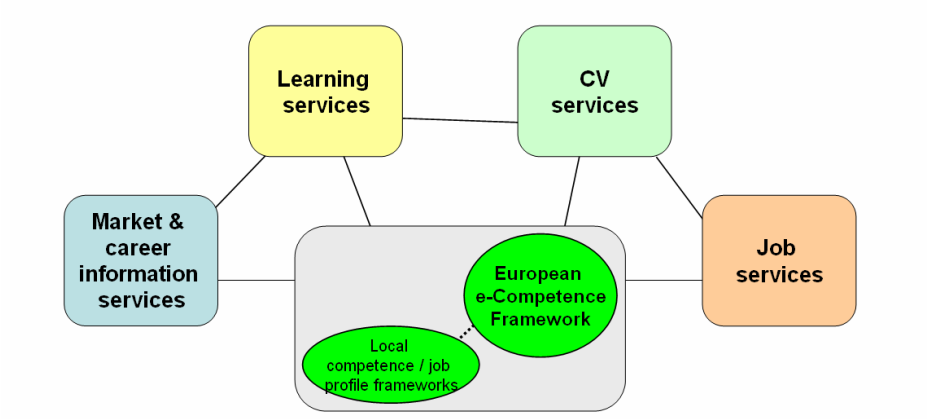


Figure 3: The human Resources domain – satellite view indicating classes of services:

The European e-Competence Framework facilitates interoperability between ICT Career services in Europe.

If e-career services are referenced to local / national frameworks, then connections between the local / national and European frameworks are easily established. If these well-grounded local

and national frameworks are connected to the European e-Competence Framework, interoperability and connection across the European environment can be achieved.

3.2. The functional level of interoperability – HR domain helicopter view

The figure below, discussed, adjusted and elaborated with multistakeholder support in the context of this CWA development, summarizes the most relevant career and skill development services characterising the HR domain and also interoperability potential.

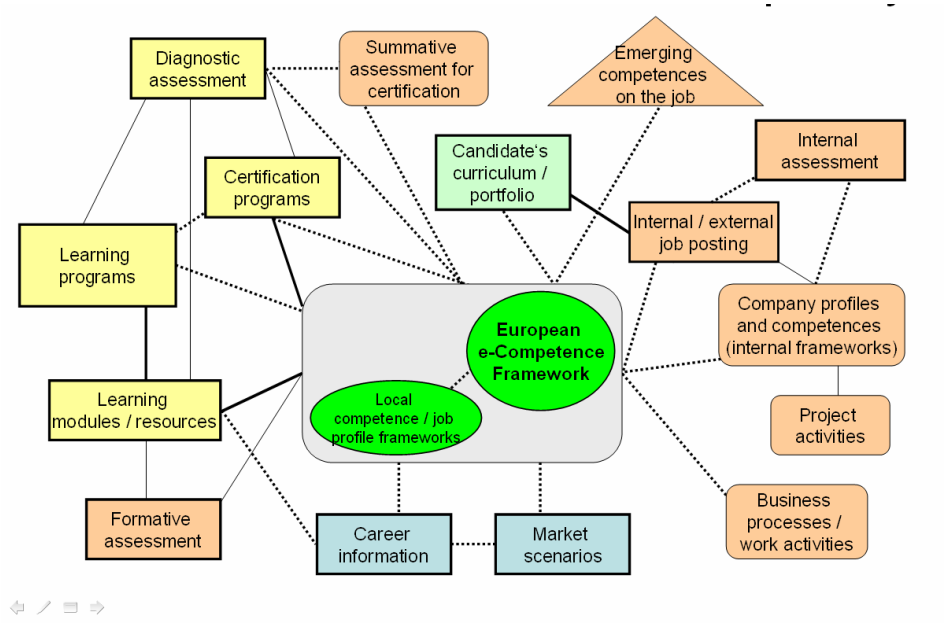


Figure 4: The Human Resources Domain – Helicopter view indicating types of services

The functional level of the Human Resources domain addresses a higher level of granularity than the strategic level described in the previous chapter. Specific types of e-career services within the four main classes of service are identified here. Valuable connections between service types, even if they are rare or non existent today, are considered as they demonstrate the interoperability potential of the human resources domain. Each service can deliver or receive information and enhance the value chain.

Services represented within rectangles are common, those with rounded corners are less common, whilst those within a triangle are new and recommended for future exploitation.

Relationships between services are identified as common, uncommon or innovative: the lines in bold indicate common levels of interoperability between existing services, the simple straight lines indicate unusual relationships, whilst the dotted lines indicate that they do not currently exist but are proposed linkages for higher levels of interoperability.

This representational model underlines many of the main HR process components. It is an initial, basic ontology[17] to be continuously shared among the reference stakeholders. It identifies objects (e-Career services) and possible relationships between them in support of evolving and developing interoperability over time.

For example, diagnostic assessment of competences can be related to job profile frameworks and to qualifications or certification programmes. Competence frameworks are a necessary reference to build competence assessments, while competence assessment results can become an input for qualification or certification programmes.

Furthermore, these relationships can be simply informative, e.g. assessment results provide the necessary information to search certification programmes, or they can be advanced, e.g. assessment results automatically identify and matching with consistent qualification or certification programmes.

The ontology-based model within this CWA shows a view of the HR domain's supply chain; a "value chain" which is conceived as a circular integrated system.

If all services referred to a common language (concept definitions and semantic rules), then building and exploiting mutual interoperable relationships is possible. With respect to this, the European e-Competence framework and the other local frameworks, play a key role. These frameworks can function as shared reference translators / interpreters within the HR domain.

3.3. The technical level of interoperability – HR domain ground view

The Ground level view of the Human Resources domain expresses the highest level of granularity. It looks closely at precise types of e-Career services and technical solutions to establish useful relationships between them. The ground level view provides technical guidelines for people involved in e-Career website development, especially portals. Also training course designers are supported by the Ground level Model.

Figure 5 shows an example of two specific services, possible technical connections are described in the technical interoperability recommendations in chapter 5.3. An element from the

[17] "Ontologies" provide reference structures; describe domains – pieces of worlds – by identifying and defining the core objects inside and relationships between them, in concordance with the domains' agreeing communities.

class of services representing curriculum support (see 3.1.), Candidate's curriculum / portfolio (see 3.2.), can be linked to an element of the class representing recruitment and selection, Internal / external job posting, by making connections to the European e-Competence framework .

Figure 5: The Human Resources Domain – ground view making services interoperable

The Ground level Model transfers added value expressed at the functional level by providing practical examples of technical standards to facilitate interoperability.

For all the links among the elements of the HR domain, syntactic standards already exist as vertical specifications of XML-based documents, related to HR or to learning objects. These standard document formats have common fields which allow linkage with different aspects of the domain. For instance, the use of a XML-based document to describe a learning object makes use of common fields that contain information reusable from another XML-based document with the purpose of describing a job offer. The definition of a job position generally requires an associated education level, for which learning objects provide a useful indicator.

The role of semantic relationships is to provide the possibility to automatically translate and match information coming from different sources. By describing possible relationships among the HR domain elements, the Ground level Model is an enabler which, if recognised and implemented can support, job candidates, for example.

By providing connections between learning outcome information and competence, job candidates could benefit from understanding self improvement requirements and how to address them. Semantic standards could also be used to perform assessments, by matching competence and education attainment to positions using real contexts, so that job seekers can be empowered to improve capabilities to match opportunity requirements.

4. THE CURRENT E-CAREER SERVICES LANDSCAPE

4.1. Current state analysis

In order to define interoperability guidelines for existing and future e-Career service portals in Europe, representative examples of existing ICT career portals on local, national and European levels and their associated services were analysed at functional and technical levels. The technical analysis carried out in the context of this CWA development included data level, presentation level and application level.

This survey needed to be qualitative rather than quantitative. It was neither meaningful nor feasible to analyse the vast number of existing portals across Europe. Representative examples were identified covering different website business models and target groups including national and European websites. Analysing the representative websites provided an insight into the most commonly interconnected. This helped to understand future interoperability needs.[18]

4.2. Current state of interoperability

Current analysis has shown that the level of ICT career websites' interoperability across Europe is very low.

Although there is comprehensive coverage of e-Skills development and ICT career support, individual portals provide only partial information. Users have to shift from one service to another in order to seek an integrated pathway for career development. This leads to incomplete evaluation and only partial understanding of development opportunities. In addition the same information has to be provided in different formats to each site leading to significant inefficiencies. Furthermore, there is a lack of transparency across National websites which limits information provision across Europe and therefore hinders labour mobility.

To illustrate the current state of interoperability in Europe, figure 6 below uses solid lines to show connections between common e-Career services provided by the websites investigated across Europe in the context of this CWA development.

[18] Detailed information on methods, proceedings and findings of the current state analysis can be found in the CWA annex 2: Current state analysis of the European e-Career landscape.

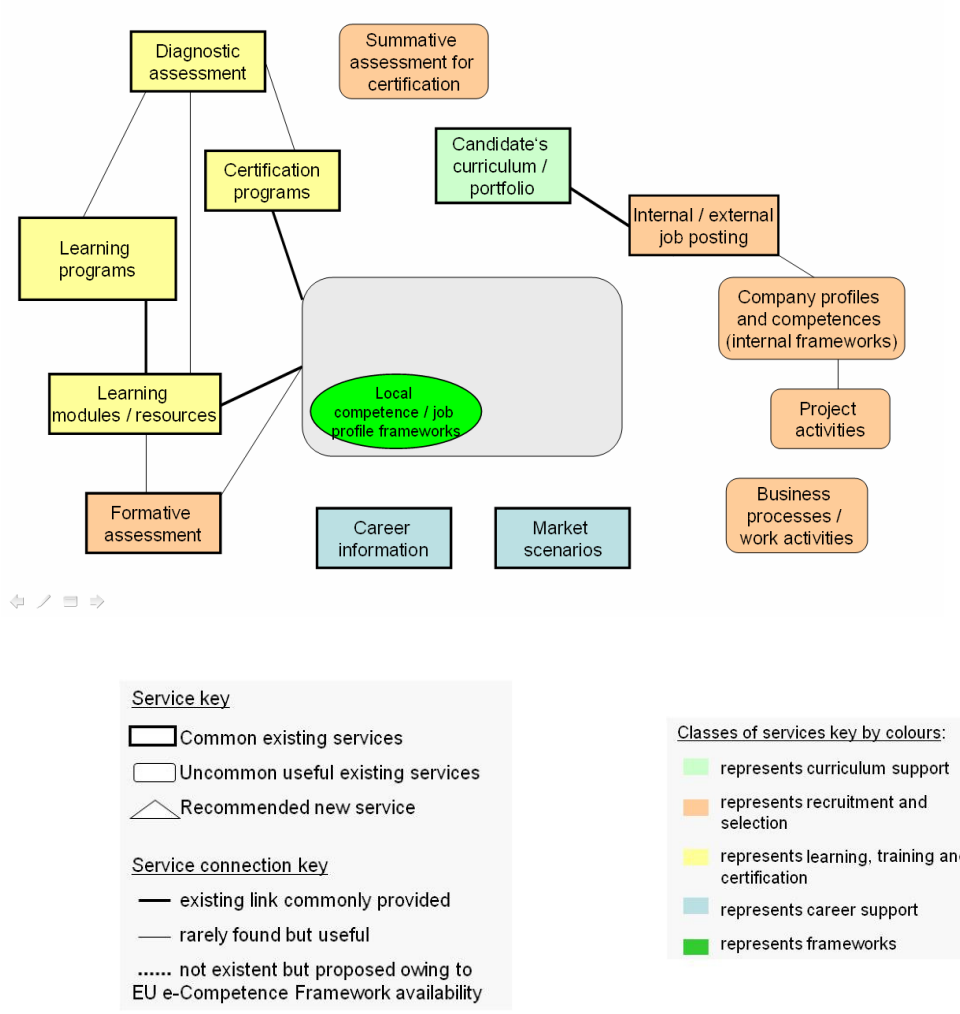


Figure 6: Common e-Career services and rarely found but useful e-Career services in Europe today

Common Services

The only type of assessment commonly available is diagnostic, i.e. self-assessments to evaluate one's own knowledge and skills. Other types of assessments (e.g. summative or formative) are usually not available on line.

If assessments are to be addressed to competences they need to be based on workplace assessment or simulation.

On-line diagnostic assessment services normally address knowledge and skills and are not automatically connected to other services.

For learning and training programmes, basic interoperable links are normally available as learning modules but only for programmes delivered on line. Interoperability is influenced by the provision of fee or free such as pay per use and portal subscriptions. Commercial considerations can influence connectivity.

Interoperable e-Career services related to curriculum elaboration, job posting and matching recruitment opportunities are commonly found.

Some national portals or portals developed by the contributions of large communities of stakeholders from both private and public institutions (see for example the UK, France, and Italy, in the survey) have implemented competence and job profile frameworks as references for training programmes and certifications. In these cases, they have established the basis for creating interoperable services.

Rare Services

The HR domain model in figure 6 above includes rare but very useful e-Career services and connections provided by a few websites investigated in the survey.

Some websites analysed also gave information about tests used to assess progress achieved at the end of each learning modules. These services are connected to local competences and job profile frameworks and also to learning modules. They are interoperable because we can directly move from the competence framework to information on the related learning programmes / modules and formative assessments.

Diagnostic assessment services, currently relate to local / national competence-job profile frameworks with some referring to training and certification programmes.

Whether diagnostic, formative or summative assessments, the websites analysed are able to test knowledge and skills. For competences, on-line assessments are limited but in the future advanced virtual environments may be available.

At a company level some internal services have been developed starting from local/ national competence and job profile frameworks. Some companies merely access them but others also refer to them in order to develop their internal frameworks, organise their internal assessments and learning programmes or define and plan their recruitment requirements. These are commonly large companies with experience in career development programmes, competence enhancement, assessment centres, etc. Nonetheless, interoperability is not well developed either inside or outside with training or certification institutions or with on line recruitment agencies.

Europe is lacking the application of existing common standards to::

a) Understand companies' needs, qualification titles, and competences

b) Identify semantic-based mutual connections,

c) Simplify demand and offer formats

d) Improve e-Career service accuracy and effectiveness

This CWA provides guidelines to build an interoperable user-friendly environment across Europe enabling easy linkage of services providing added value to users.

4.3. Positioning of this CWA with other related activities on interoperability

This paper identifies possible relationships between e-career services such as competence assessments, training paths and certifications, curricula and e-portfolios and job postings, showing interoperability potential. It also provides a ground breaking start point to define a methodology to connect e-competences to learning outcomes providing further opportunities to enhance e-career service interoperability.

To create the foundations for interoperability this CWA defines an initial ontology based on the definitions of competence, skill, knowledge, learning outcome provided by the EQF and the e-CF. It also addresses relationships between proficiency-learning levels and e-competence proficiency levels in an ICT work context. The paper focuses on ICT (from company and training provider viewpoints) to implement a sector based ontology.

There are other European initiatives which address the topic of interoperability in a wider context. These initiatives have been investigated and have been found to be complimentary. Further detail with the positioning and merits of the following projects can be found in the appendix: **TRACE, ICOPER, eCCO, AcKnowledge, SIRE** [19]**.**

Syntactic and semantic references used within the previously mentioned projects were also checked for compatibility with the recommendations in this CWA,. These initiatives can also be referenced in the appendix. They include **ePortfolio**, **O*NET, IMS RDCEO, IMS LD, IEEE RCD, HR-XML, SQI,** and **QTI.**[20]

[19] See CWA Annex chapter 3 – Further European interoperability activities
[20] See CWA Annex chapter 4 – References relevant for activities on interoperability

5. INTEROPERABILITY RECOMMENDATIONS AND RATIONALE

To support the evolutionary process of taking European e-career services to higher levels of interoperability this CWA provides:

a) a taxonomy of e-competences (from the European e-Competence Framework, e-CF)
b) a taxonomy of classes of contexts
c) Relationships between e-competences/ learning outcomes, contexts and levels (in conformance with the e-CF and its relationship with the EQF)

This chapter also provides implementation support for website developments from strategic to operational standpoints.

A summary of recommendations is provided in chapter 6.

5.1. Strategic recommendations for policy/ decision makers and website creators

The strategic, HR domain service schematic figure 7 depicts connections between classes of services. The key to achieving European ICT services interoperability is the ability to consistently interpret services website content through reference to a common model, the European e-competence framework (e-CF).

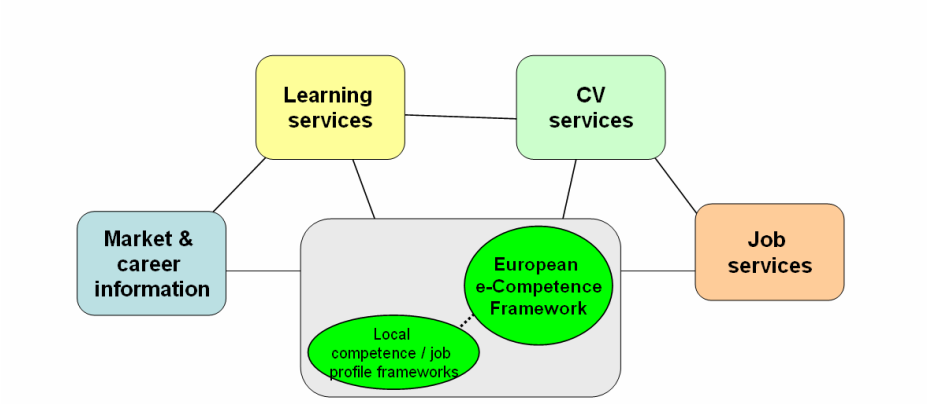


Figure 7: The European e-Competence Framework can facilitate interoperability between ICT Career services in Europe

Linking services either directly to the (e-CF) or from local frameworks to the (e-CF) and back to other local frameworks is at the heart of interoperability recommendations.

Also beyond website interoperability these standard frameworks provide for translation of standard benchmarks, aligning competence metrics across national boundaries.

The helicopter and ground level views (higher granularity and therefore more detailed) of interconnection as shown in the next chapters are enabled by the opportunity created by the construction of the **e-CF** in supplying an overall model of international competence interpretation.

Web service initiators are advised to establish connectivity with either local framework structures or directly use the e-CF standard to ensure the content of their service can be translated throughout Europe.

Recommendation A Communication of the standards and principles articulated in this CWA are an essential ingredient in the propagation and achievement of interoperability and growth of value added services.

Recommendation B EU standards provide a basis for common understanding and when adopted an opportunity for enhanced interoperability. The use of EQF, e-CF and Europass should be promoted collectively with their combined ability to establish interoperability stressed.

5.2. Functional recommendations for website creators, designers and architects

The HR domain helicopter view, below, illustrates opportunities for interoperable e-Career services. Individuals seeking ICT HR Domain related information should be supported through a coherent and interconnected virtual environment.

In the ideal scenario individuals interested in ICT competence information should be connected to further related information such as certifications/qualifications, assessment services, related documentation and possibly companies seeking this competence.

Website analysis has confirmed the existence of a large number of e-career services, it has also highlighted the low level of mutual connectivity between them. Only the UK demonstrates a good level of interoperability facilitated by National Occupational Standards linked to the National Qualifications Framework.

In general, the lack of interoperability between services results in fragmentation of information to users, repetition of actions by users, and loss of information by providers and users; in other words, a recipe for inefficiency, higher costs and lost opportunities.

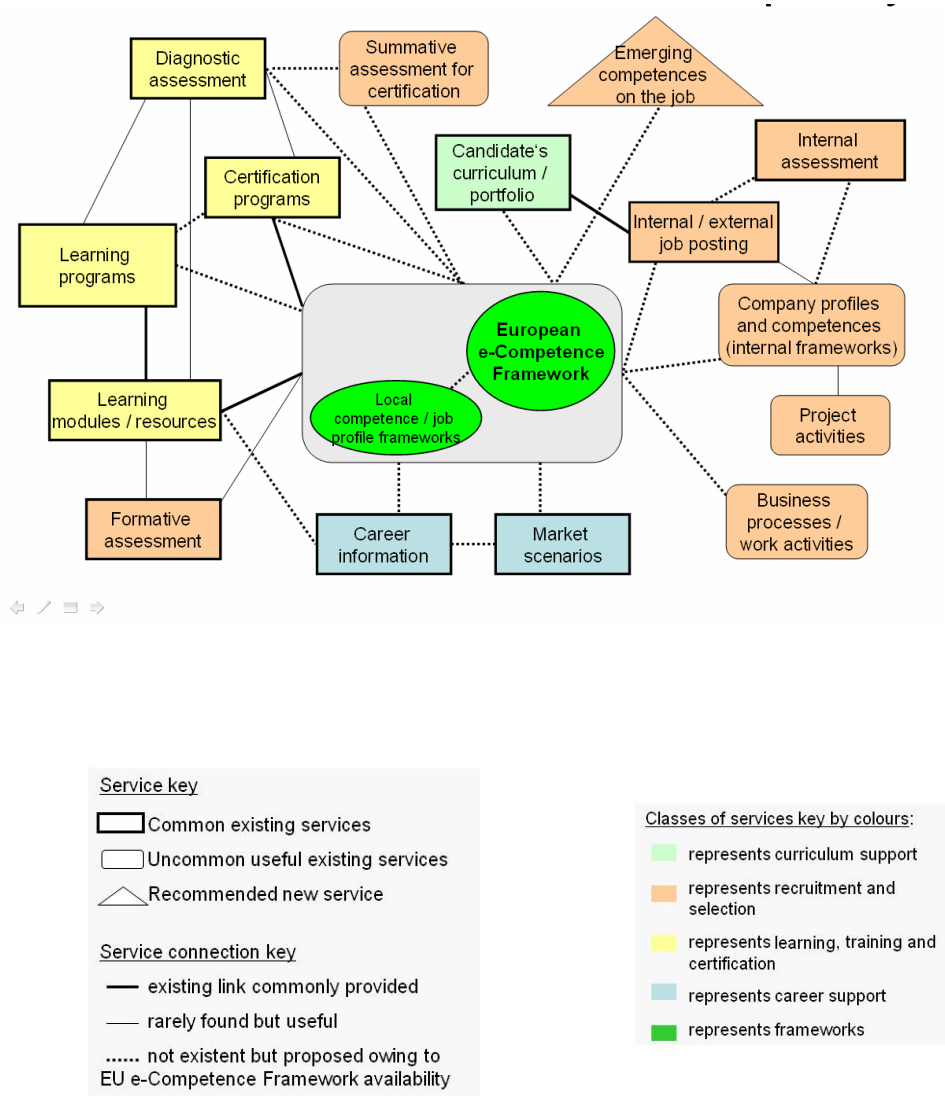


Figure 8: HR domain model Helicopter view – Current and future opportunities of interoperable e-Career services

The above model illustrates the current online services environment and opportunities for future improvement in the value chain.

The European e-Competence Framework (e-CF) and local frameworks provide the key references for interoperability between e-career services. These frameworks offer a language comprised of competence, knowledge and skill taxonomies. They provide a consistent reference base for mutually connected e-career services. Current e-career services do not need to change their structures; they just need to establish relationships to reference frameworks that operate as “adapters” or “translators”.

e-Career services can be directly connected to the e-CF or alternatively they can refer to national or local frameworks that in turn are related to the e-CF.

Recommendation C It is recommended that website creators, designers and architects consider and verify these relationships.

Accordingly, figure 8 shows the central role of these Frameworks as the reference ontology for building interoperability for e-Career services across nations. The e-CF together with the EQF and the Europass, defines competence at different proficiency and learning levels and provides a standard way to fill in CVs, in a common language. The e-CF has been developed to link to local/national competences and job profile frameworks, The EQF and the Europass have been subject to public consultations and therefore all three have been exposed to communities of stakeholders.

Recommendation D These frameworks therefore satisfy ontology conditions and it is recommended that they are considered and deployed by website creators, designers and architects..

Suggested New Links

For e-Career services, some additional interoperable connections have been defined. The purpose is to identify new interoperable links and to create new opportunities and to enhance value and demand for e-Career services.

Recommendation E For example, it is recommended, that website creators, designers and architects link diagnostic assessments and summative assessments. Learning programmes could be linked to certification programmes as the latter can become an input for designing and developing qualifications and learning measures.

Companies

Companies can elaborate internal competence and job profile frameworks based on internal processes and then refer them to the European frameworks. Internal processes such as assessment, recruiting, training, etc, can also become interoperable with external e-Career services (e.g. recruitment agencies, certification bodies, training institutions, etc.).

Future Opportunities

A prospective e-Career service has also been inserted concerned with “emerging competences on the job”.

Recommendation F Through virtual communities and social networks, ICT professionals can populate this space with emerging competences and job profiles as yet not formalised or implemented in the European model. This service can monitor emerging competences and profiles being open to innovation from bottom up input and contributing to European framework

maintenance. Connections could also be made to certification programmes to validate competences acquired on the job (learned within non formal or informal environments).

Improvements in the effectiveness and interoperability of related services will be based on communities of stakeholders or multistakeholder partnerships sharing common views, tools and frameworks (i.e. competence and job profile frameworks), thus also including the organisational and semantic scopes.

Based on new European Frameworks such as EQF, e-CF and Europass, some e-Career services could be developed at a European level and incorporated into portals such as the EU e-Skills Portal. This would set a leadership example and guarantee mutually interoperable connections and interoperability with local/national e-Career services.

Developing and implementing interoperability on a European e-Skills portal level

Some e-Career services can be developed at a European level as references for interested stakeholders (including training or certification institutions, companies or professionals). As they offer neutral indications on European e-competences' trends and needs; they can be included into the EU e-Skills Portal without provoking commercial conflicts of interest.

Recommendation G In order to guarantee mutual interoperability with local/ national e-Career services to share information, services such as the European e-Skills Portal should be developed on the basis of the new European Frameworks, i.e. the European e-Competence Framework (e-CF). This would set a leadership example and drive interoperability with local/national e-Career services.

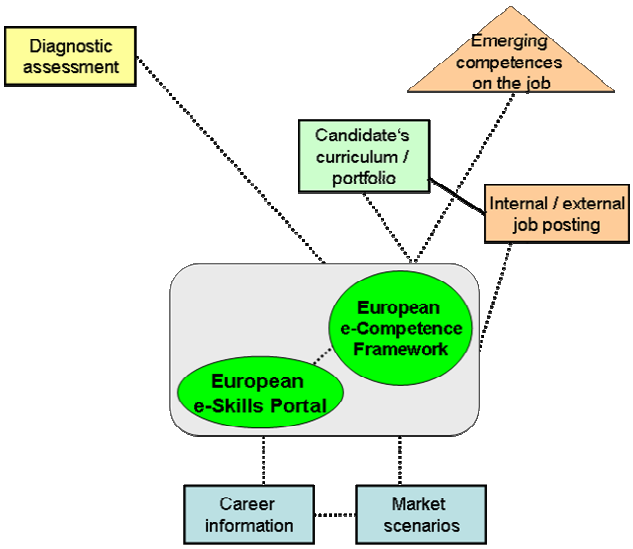


Figure 9: Developing interoperability – Possible key services for the European e-Skills portal, feasible in the near future

This would encourage the connection of further local/ national e-Career services to the EU e-Skills Portal. To connect, they would need to relate to the European Frameworks enhancing breadth of service provision.

However, if local e-Career services are well connected to local/national frameworks (i.e. they have already implemented some mutual levels of interoperability), then connections between the local/national and European Frameworks are sufficient to enable connections with the EU e-Skills Portal. This is illustrated in the figure below.

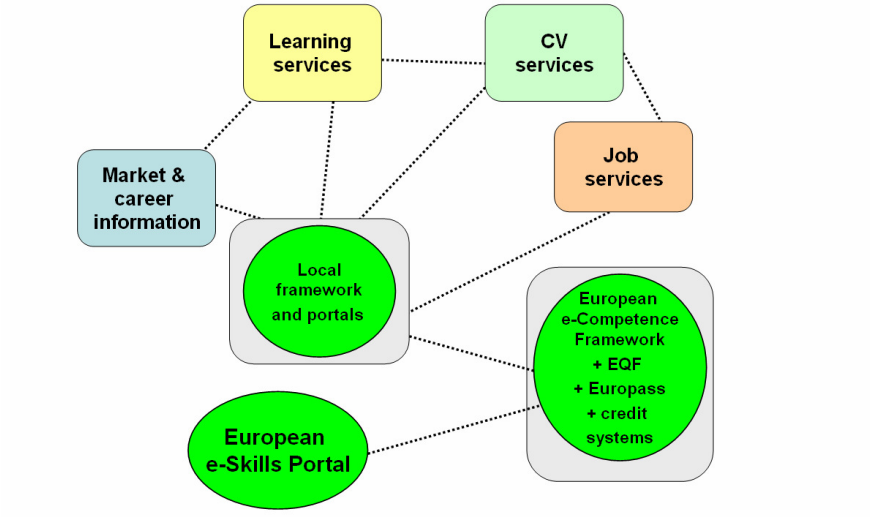


Figure 10: Developing interoperability – connecting local / national portals to the EU portal by making use of e-CF, EQF, Europass and credit systems

5.3. Technical recommendations for website architects and developers

Technical recommendations addressed to website developers, architect and designers and to learning modules' designers are supported by two types of guidelines: basic integration choices and syntactic and semantic selections. The first class is related to choices to be taken at the three architectural levels providing the basics for interoperability. The second goes into deeper detail about the links between HR domain elements, identifying the use of single syntactic standards and semantic rules to provide data integration.

Architectural Levels

Presentation level

Recommendation H Hyperlinks currently used by most e-Career Services to provide interoperability should be integrated and replaced by portlet standards, such as JSR168 and

JSR 286 or WSRP, with the aim of integrating sections of portals inside others, to provide users with a career development path from on a one stop shop. This means that a portal could import different information on career scenarios provided by other websites. Also documentation related to national or European frameworks could be downloaded directly from another section of the portal rather than through hyperlinks. The possibility to use tools to customise portals would significantly improve access to relevant information by users, avoiding the need to navigate several hyperlinks.

Application level

At the application level, integration could be achieved by widening the diffusion of web services among the different fields of the HR domain model. The use of web services enables different portals to call remote services which allow linkage to various scenarios such as interacting with learning management systems, measuring on the job performance or assessing competences. The reference integration model for this layer is SOA[21] and WSDL, and in the HR domain there are vertical WSDL standards as in HR-XML (e.g. Manage development plans in HR-XML model).

Data level

Recommendation I Content exchange is realised at data level, by using standard languages which allow the management of documents in different environments. General data exchange standard, such as RSS[22], should be used to exchange news and non structured information. More structured information can be modelled by using vertical standards, such as HR XML for the "classic" HR domain or XCRI for course-related information. Vertical syntactic and semantic standards related to the HR domain will be broadly discussed in the following section.

Syntactic and semantic standards

Technical recommendations on syntactic and semantic choices addressed to website developers, architect and designers and to learning modules' designers are listed in two tables below. In Table 1 a tick corresponds with the presence of syntactic and semantic standards. Table 2 gives a full description of the standards which exist to establish connections among the different elements of the HR domain. The tables focus on non-proprietary standards since the aim is to provide a method for platform-independent interoperability.

[21] Service Oriented Architecture
[22] Really Simple Syndication

Syntactic Standards

Both tables identify with different colours the elements according to the classes of services to which they belong. Syntactic standards identified are all XML-based documents and have been divided into three catergories; e-Learning (i), e-Competences (ii) and Assessment (iii).

(I) Syntactic standards related to e-Learning, such as CEN MLO and its specifications (e.g. XCRI), are listed in Annex 4, and have been taken into consideration. Also SCORM, a reference methodology for the development of e-Learning materials, combining XML documents with graphical, audio and video files, is referenced. These are key reference models for learning materials and compliance to them is an enabling requirement for linking elements belonging to different categories.

(II) For competences, references have been made to some modules of HR XML:

- Staffing Exchange Protocol (HR XML SEP): includes the posting of job or position opportunities to job boards and the exchange of a candidate resume and/or profile data independent of (or related to) those postings to other recruiting and sourcing venues
- Competencies (in tables shown as HR XML Comp): this specification provides a flexible means for trading partners to referencing a known competency by its identifier. Moreover it provides a structure which could be filled in with competences taxonomies and proficiency levels based upon a pre-defined vocabulary
- Education history (in tables HR XML Edu): this specification allow to describe education histories in order to support recruiting and staffing as well as employee screening
- Employment history (in tables HR XML Empl): this specification provides a method to exchange historical employment information between trading partners

(III) For assessment, HR XML Assessment (shown in tables as HR XML Assess) is the reference standard to support order requests to providers of assessment and testing services. The specification is designed also to support the return of assessment status and results. The aim is the same of QTI (Question and Test Interoperability) specifications, which has the objective of defining a standard format to provide questions and answers, in order to allow employers to perform assessments over employees' competences.

Europass CV has been considered since it provides a reference data standard for structuring European CVs. Also IEEE RCD, described in Annex 4, has to be considered as a standard at European level in terms of competency definition.

Symantic Standards

Semantic relationships have been classified under possible connections they are able to support:

- ICT qualifications and ICT competences: semantic rules in this sense aim at defining an ontology which provides linkage between competences and learning programs. The link is enabled by matching the learning outcomes coming from the training measures to those recognised as a support in acquiring competences. To enhance interoperability, competences are defined inside the ontology according to the European e-Competence framework
- ICT competences and CV evaluation: ontologies here are based on the eCCO model. The e-Competence framework is a taxonomy necessary to fill in competence-based documents with a standard vocabulary. The framework has been built upon the outcomes of eCCO, whose ontology is referenced in Annex 3. This project defines the process of competence creation as the composition of knowledge objects and action verbs, linked with a specific application context. The project aims at enabling a diagnostic assessment, through which a candidate could perform the matching between his competences and job profiles built as a set of competences. Other ontologies which have been considered are the already mentioned AcKnowledge and SIRE (s. Annex 3). They both aim at creating a link between the two concepts, the former by linking contexts to competences, the latter by linking professional positions to learning objects.
- Learning Objects and ICT competences with context: this kind of semantic relationship is the main result of this CWA, described in paragraph 5.4. The aim of the ontology is filling the gap in connecting competences from the e-Competence framework to the ICT qualification framework. This aim is reached by defining real ICT contexts in which competences are acquired and by linking these competences to learning outcomes, so as to reach qualifications defined with the standard vocabularies by a common European ICT language.

To illustrate the structure of tables 1 and 2, figure 10 shows an example, introduced in chapter 3.3, of how the technical connections described in the Ground level Model can be applied. The example shows how syntactic and semantic selections can be applied to establish connections between different elements of the HR domain. An element from curriculum support, Candidate's curriculum / portfolio, can be linked to an element from recruitment and selection, Internal / external job posting, by making connections to the European e-Competence framework .

Figure 11: An example of making e-Career services interoperable

Some **syntactic standards** (column 3) are identified to be used with different purposes:

- **Europass CV**: the XML structure of Europass allows definition of a candidate's curriculum with a precise distinction among personal information (name, surname, address, etc.), desired employment, education and training, driving licenses, etc.
- **HR XML Staffing Exchange Protocol**: this XML standard can be used by companies for a position opening, but also by candidates who apply. This process implies the definition of a position profile

Semantic relationships (column 4) can be expressed by applying the models and methods developed in the relevant EU projects mentioned in annex 3, the European e-Competence Framework and a common ICT qualifications language as proposed in chapter 5.4:

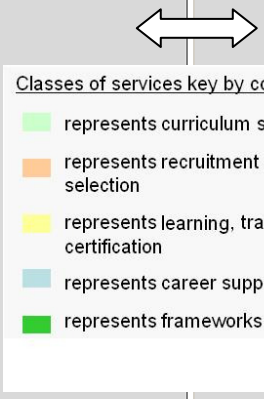
- **eCCO ontology:** candidate's learning experiences and work experiences could be related to competences. Also knowledge, skills and competence could be provided, according to specific job profiles, structured as a set of competences.
- Competences should be compliant to the **e-Competence framework**.
- **French SIRE ontology:** it could be used to structure a **position profile,** by defining links between hierarchical position, competence, learning experiences and requirements
- **Common ICT qualifications language:** it has the potential to relate qualifications to competences

If a candidate's curriculum is structured with Europass CV, the fields related to work experience enable linkage between Europass and HR XML SEP's Job Category. The fields listing personal skills and competences can be linked to competences related to the preferred position, as expressed in HR XML SEP. Some of the fields related to Education and Training allow linkage of curriculum to Competency Evidence in HR XML Competency. In addition, HR XML SEP must be used to link a position to the competences required by it, according to the eCCO model (job profiles are built as sets of competences). Finally, HR XML Competency is necessary to specify the competences coming from HR XML SEP and to link them to the European e-Competence framework.

TABLE 1 – Summary of available standards for implementing interoperability

e-Career Service 1[23] ⟺ e-Career Service 2		Syntactic standards (XML-based)			Semantic relationships		
Classes of services key by colours: represents curriculum support represents recruitment and selection represents learning, training and certification represents career support represents frameworks		e-Learning(SCORM, CEN MLO, XCRI)	e-Competences (HR XML SEP, HR XML Competencies, HR XML Education history, HR XML Employment history Europass CV,	Assessment (Hr XML Assessment, QTI)	Connecting ICT qualifications and ICT competences (s. Chapter 5.4.)	ICT competences and CV evaluation (eCCO, EU e-Competence Framework, AcKnowledge, SIRE)	Connecting learning Objects and ICT competences by context (S. Chapter 5.4.)
Local competence / job profile frameworks	Learning modules / resources	✓	✓			✓	
Local competence / job profile frameworks	Certification programs	✓	✓			✓	
Learning modules / resources	Learning programs	✓			✓		
Candidate's curriculum / portfolio	Internal / external job posting		✓			✓	
Diagnostic assessment	Learning modules / resources	✓	✓		✓	✓	
Diagnostic assessment	Learning programs	✓	✓	✓	✓		
Diagnostic assessment	Certification programs	✓	✓	✓		✓	
Internal / external job posting	Company profiles and competences (internal frameworks)		✓			✓	
Company profiles and	Project activities - Business		✓			✓	

[23] See Human Resources domain – helicopter and ground view (chapters 3.2. and 3.3.)

e-Career Service 1[23]	e-Career Service 2	Syntactic standards (XML-based)			Semantic relationships		
		e-Learning(SCORM, CEN MLO, XCRI)	e-Competences (HR XML SEP, HR XML Competencies, HR XML Education history, HR XML Employment history Europass CV,	Assessment (Hr XML Assessment, QTI)	Connecting ICT qualifications and ICT competences (s. Chapter 5.4.)	ICT competences and CV evaluation (eCCO, EU e-Competence Framework, AcKnowledge, SIRE)	Connecting learning Objects and ICT competences by context (S. Chapter 5.4.)
competences (internal frameworks)	processes / work activities						
European e-Competence Framework	Project activities - Business processes / work activities		✓		✓	✓	
	Company profiles and competences (internal frameworks)		✓			✓	
	Local competence / job profile frameworks		✓		✓	✓	
	Internal / external job posting		✓		✓	✓	✓
	Candidate's curriculum / portfolio		✓		✓	✓	✓
	Diagnostic assessment		✓	✓	✓	✓	
	Certification programs	✓	✓		✓	✓	
	Summative Assessment for certification	✓	✓	✓	✓	✓	
	Learning modules / resources	✓	✓			✓	
	Learning programs	✓	✓		✓	✓	✓

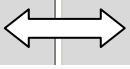
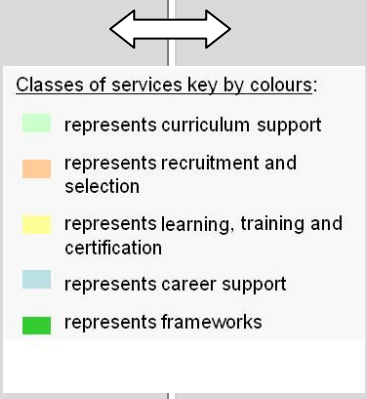
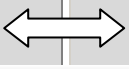
e-Career Service 1[23]	e-Career Service 2	Syntactic standards (XML-based)			Semantic relationships		
 Classes of services key by colours: represents curriculum support; represents recruitment and selection; represents learning, training and certification; represents career support; represents frameworks		e-Learning(SCORM, CEN MLO, XCRI)	e-Competences (HR XML SEP, HR XML Competencies, HR XML Education history, HR XML Employment history Europass CV,	Assessment (Hr XML Assessment, QTI)	Connecting ICT qualifications and ICT competences (s. Chapter 5.4.)	ICT competences and CV evaluation (eCCO, EU e-Competence Framework, AcKnowledge, SIRE)	Connecting learning Objects and ICT competences by context (S. Chapter 5.4.)
	Emerging competences on the job		✓		✓	✓	✓
	Market scenarios		✓			✓	
	Career information		✓			✓	
Learning modules / resources	Career information	✓	✓		✓		
Learning modules / resources	Formative assessment	✓			✓		
Learning / Training / Development programs	Certification programs	✓	✓		✓	✓	✓
Diagnostic assessment	Summative Assessment for certification	✓	✓	✓		✓	
Internal / external job posting	Internal assessment		✓	✓	✓	✓	
Internal assessment	Company profiles and competences (internal frameworks)		✓	✓	✓	✓	

TABLE 2 – Details of available standards for implementing interoperability

e-Career Service 1[24]	e-Career Service 2	Syntactic standards (XML-based)			Semantic relationships		
		e-Learning(SCORM, CEN MLO, XCRI)	e-Competences (HR XML SEP, HR XML Competencies, HR XML Education history, HR XML Employment history Europass CV, IEEE RCD)	Assessment (Hr XML Assessment, QTI)	Connecting ICT qualifications and ICT competences (s. Chapter 5.4.)	ICT competences and CV evaluation (eCCO, e-Competences framework, AcKnowledge, SIRE)	Connecting learning Objects and ICT competences by context (S. Chapter 5.4.)
Local competence / job profile frameworks	Learning modules / resources	CEN MLO	HR XML Comp			EU e-Competence Framework	
Local competence / job profile frameworks	Certification programs	CEN MLO	HR XML Comp HR XML SEP			EU e-Competence Framework eCCO	
Learning modules / resources	Learning programs	CEN MLO SCORM			ICT Qual. Language		
Candidate's curriculum / portfolio	Internal / external job posting		Europass CV HR XML SEP			EU e.Comp framework eCCO SIRE	
Diagnostic assessment	Learning modules / resources	CEN MLO	IEEE RCD HR XML Comp HR XML SEP	HR XML Assess QTI	ICT Qual. Language	eCCO AcKnowledge	
Diagnostic assessment	Learning programs	CEN MLO SCORM	IEEE RCD HR XML Comp HR XML SEP	HR XML Assess QTI	ICT Qual. Language	eCCO AcKnowledge	
Diagnostic assessment	Certification programs	CEN MLO	HR XML Comp HR XML SEP	HR XML Assess QTI		EU e.Comp framework eCCO	

[24] See Human Resources domain – helicopter and ground view (chapters 3.2. and 3.3.)

e-Career Service 1[24]	e-Career Service 2	Syntactic standards (XML-based)			Semantic relationships		
 Classes of services key by colours: represents curriculum support; represents recruitment and selection; represents learning, training and certification; represents career support; represents frameworks		e-Learning(SCORM, CEN MLO, XCRI)	e-Competences (HR XML SEP, HR XML Competencies, HR XML Education history, HR XML Employment history Europass CV, IEEE PCR)	Assessment (Hr XML Assessment, QTI)	Connecting ICT qualifications and ICT competences (s. Chapter 5.4.)	ICT competences and CV evaluation (eCCO, e-Competences framework, AcKnowledge, SIRE)	Connecting learning Objects and ICT competences by context (S. Chapter 5.4.)
Internal / external job posting	Company profiles and competences (internal frameworks)		HR XML Comp HR XML SEP			EU e.Comp framework	
Company profiles and competences (internal frameworks)	Project activities - Business processes / work activities		HR XML Comp HR XML SEP HR XML Empl			EU e.Comp framework eCCO AcKnowledge	
European e-Competence Framework	Project activities - Business processes / work activities		HR XML Comp HR XML SEP		ICT Qual. Lang uage	EU e.Comp framework AcKnowledge	
	Company profiles and competences (internal frameworks)		HR XML Comp			EU e.Comp framework	
	Local competence / job profile frameworks		HR XML Comp HR XML SEP		ICT Qual. Lang uage	EU e.Comp framework	
	Internal / external job posting		HR XML Comp HR XML SEP		ICT Qual. Lang uage	EU e.Comp framework SIRE	Context classificatio n & LO – e-CF connection

e-Career Service 1[24]	e-Career Service 2	Syntactic standards (XML-based)			Semantic relationships		
		e-Learning(SCORM, CEN MLO, XCRI)	e-Competences (HR XML SEP, HR XML Competencies, HR XML Education history, HR XML Employment history Europass CV, IEEE PCR)	Assessment (Hr XML Assessment, QTI)	Connecting ICT qualifications and ICT competences (s. Chapter 5.4.)	ICT competences and CV evaluation (eCCO, e-Competences framework, AcKnowledge, SIRE)	Connecting learning Objects and ICT competences by context (S. Chapter 5.4.)
	Candidate's curriculum / portfolio		HR XML Comp HR XML SEP HR XML Empl HR XML Edu Europass CV		ICT Qual. Language	EU e.Comp framework SIRE	Context classification & LO – e-CF connection
	Diagnostic assessment		HR XML Comp HR XML SEP	HR XML Assess QTI	ICT Qual. Language	EU e.Comp framework eCCO	
	Certification programs	CEN MLO XCRI	HR XML Comp HR XML SEP		ICT Qual. Language	EU e.Comp framework	
	Summative Assessment for certification	CEN MLO XCRI	HR XML Comp HR XML SEP	HR XML Assess QTI	ICT Qual. Language	EU e.Comp framework	
	Learning modules / resources	CEN MLO XCRI	HR XML Comp		ICT Qual. Language	EU e.Comp framework	
	Learning programs	CEN MLO SCORM XCRI	HR XML Comp		ICT Qual. Language	EU e.Comp framework	Context classification & LO – e-CF connection
	Emerging competences on the job		HR XML Comp HR XML SEP HR XML Empl		ICT Qual. Language	EU e.Comp framework	Context classification & LO – e-CF connection

Classes of services key by colours:

- represents curriculum support
- represents recruitment and selection
- represents learning, training and certification
- represents career support
- represents frameworks

e-Career Service 1[24]	e-Career Service 2	Syntactic standards (XML-based)			Semantic relationships		
		e-Learning(SCORM, CEN MLO, XCRI)	e-Competences (HR XML SEP, HR XML Competencies, HR XML Education history, HR XML Employment history Europass CV, IEEE PCR)	Assessment (Hr XML Assessment, QTI)	Connecting ICT qualifications and ICT competences (s. Chapter 5.4.)	ICT competences and CV evaluation (eCCO, e-Competences framework, AcKnowledge, SIRE)	Connecting learning Objects and ICT competences by context (S. Chapter 5.4.)
	Market scenarios		HR XML Comp			EU e.Comp framework	
	Career information		HR XML Comp HR XML Empl			EU e.Comp framework	
Learning modules / resources	Career information	CEN MLO SCORM XCRI	HR XML Comp HR XML Empl		ICT Qual. Lang uage	EU e.Comp framework	
Learning modules / resources	Formative assessment	CEN MLO SCORM XCRI			ICT Qual. Lang uage		
Learning / Training / Development programs	Certification programs	CEN MLO SCORM XCRI	HR XML Comp		ICT Qual. Lang uage	EU e.Comp framework	Context classificatio n & LO – e-CF connection
Diagnostic assessment	Summative Assessment for certification	CEN MLO SCORM XCRI	HR XML Comp	HR XML Assess QTI		eCCO	
Internal / external job posting	Internal assessment		HR XML Comp HR XML SEP	HR XML Assess QTI	ICT Qual. Lang uage	EU e.Comp framework	
Internal assessment	Company profiles and competences (internal frameworks)		HR XML Comp HR XML SEP	HR XML Assess QTI	ICT Qual. Lang uage	EU e.Comp framework	

Classes of services key by colours:

- represents curriculum support
- represents recruitment and selection
- represents learning, training and certification
- represents career support
- represents frameworks

Recommendation J The technical standards incorporated in tables 1 and 2 above should be deployed by website architects and developers across Europe.

5.4. Methodology guidelines for further development by qualification and certification providers

This topic is an important enabler for relating qualifications to competences and competence levels. The current state of the art is recognized by experts as insufficiently robust to link these associated but different entities.

Relating qualifications and certifications to workplace competence from an ICT employers perspective, as expressed by the European e-Competence Framework (e-CF), is a valuable ingredient for building the bridge between e-Skills demand and supply.

Recommendation K This CWA recognises this challenging issue; it does not seek to provide a fool proof prescriptive solution but offers a 'start point' for further research. It recommends that experts in the qualification and certification area evaluate the concepts detailed below and continue the quest for a sound and consistent methodological process. *It should be further noted that the use of the word 'rules' in this chapter expresses a need to establish a consistent base to work from. However in the context of this CWA, the 'rules' are offered to be tested and if necessary amended.*

Addressing this issue and exploiting consistent relationships between competence and qualification frameworks expressing competence demand and qualification supply, has been recommended by European key multistakeholders on various occasions.[25]

If competence is to be related to qualifications or e-Skills certifications with consistency and reliability then, a methodology is required.

Knowledge and skills are common objects, shared between the e-Competence Framework and ICT Qualifications. Knowledge and skills are encompassed in the learning outcome approach promoted by the EQF and also represented in the 4th dimension of the e-Competence Framework[26].

[25] See CWA 15515 2005, EQF Implementation Conference Brussels 2008, www.ict-lane.eu

[26] The European e-Competence Framework is structured from four dimensions. These dimensions reflect different levels of business and human resource planning requirements in addition to job/ work proficiency guidelines and are specified as follows:
Dimension 1: 5 e-Competence areas, derived from the ICT business processes PLAN – BUILD – RUN – ENABLE – MANAGE
Dimension 2: A set of reference e-Competences for each area, with a generic description for each competence. 32 competences identified in total provide the European generic reference definitions of the framework.
Dimension 3: Proficiency levels of each e-Competence provide European reference level specifications on e-Competence levels e-1 to e-5, which are related to the EQF levels 3 to 8.
Dimension 4: Knowledge and skills related to the e-Competences are indicated as optional framework components for inspiration. They are not intended to be exhaustive.

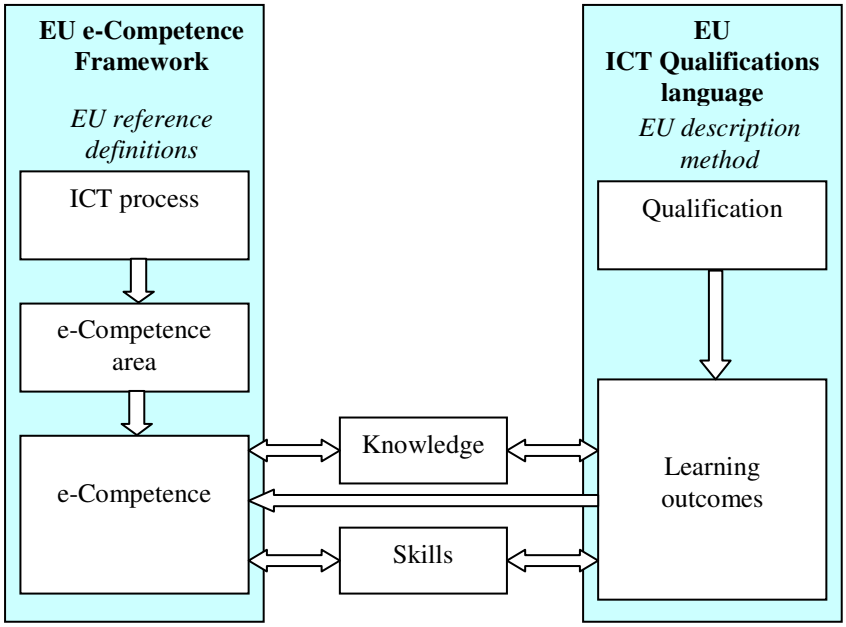


Figure 12: Connecting ICT Qualifications and e-Competences through shared definitions

To connect competences to learning outcomes, they need to be expressed in the same way, using the same semantic rules, or at least referring to the same vocabulary (and synonyms).

In the e-CF, definitions of competence are in line with the EQF. In particular:

- both competences and learning outcomes are described through "operational descriptions", i.e. verifiable and provable statements
- learning outcomes are: "statements of what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and competence" (EQF)
- competences are:
    a. the proven ability to use knowledge, skills and personal, social and/ or methodological abilities, in work or study situations and in professional and personal development. (EQF)
    b. "demonstrated abilities to apply knowledge, skills and attitudes for achieving observable results" (e-CF)

Both learning outcomes in (EQF) and competences in (EQF, e-CF) mention "knowledge" and "skills" hence, these two mutual components can become the "loop-line" between them.

5.4.1. Common European ICT language: applying EQF and e-CF to ICT qualifications

This subchapter describes the basis for semantic interoperability between qualifications and competences to manage:

- Comparison of training courses
- Detecting suitable training courses according to diagnostic assessment results
- Elaboration of job postings
- Matching of CVs with companies' jobs

Detailed analysis documented in Annex 2, shows that e-Career services are mainly based on expression of competences and/ or learning outcomes. If we take diagnostic assessments or CVs and job profiles, job posting, certifications they all relate to competence models/ definitions/ descriptions. If we take qualifications, learning and training programmes, formative assessment, learning modules and even summative assessments, they relate to "learning outcome" specifications.

The Frameworks developed at national and European level aim to provide qualification and certification providers, companies and all the interested parties with common standards and shared language. A question arises how to use competence frameworks to develop curricula and syllabi; or alternatively how to relate qualifications to job related competence. A semantic pattern (based on qualification or competence frameworks) is required.

Basic semantic rules for the writing ICT-related learning outcomes and e-competences have been defined according to the following principles:

1. ICT related learning outcomes and e-competences have to be consistent with the EQF definitions[27], consequently,
    - composed of separate items distinguishing knowledge, skills and competences
    - described in terms of action verb(s)[28] and objects (e.g. "carry out a task", "solve problems", "develop procedures", "evaluate problems", "supervise work", "review performances", "manage projects" , "transform contexts", "innovate", etc.), beginning implicitly with "to be able to"

[27] Learning outcomes means statement of what a learner knows, understands and is able to do on completion of a learning process and are defined in terms of knowledge, skills and competence.

[28] "Action verbs" have been studied by several psychologists and express "observable behaviours" addressed both to practical performances and to cognitive processes, see e.g. Bloom, 1956; Mansfield, B., Mitchell, L., 1996; See also Europass "action verbs" glossary: http://europass.cedefop.europa.eu/europass/home/vernav/InformationOn/EuropassCertificateSupplement/Restricted/CSDownload/VerbsApp.csp

- related to work (or study) situations / contexts

2. ICT related learning outcomes need to be linkable to at least one e-Competence (coming from the European e-Competence Framework)

The standardised writing of the ICT-related learning outcomes and e-competences:

According to the principles listed above, an initial approach to building learning outcomes is described in the box below. It assumes that curricula and syllabi creators / designers can refer to data banks of learning outcomes, objects, action verbs and contexts.

Currently, data banks of action verbs are available.[29] To complement this, the CWA has initiated examples of professional contexts which are shown in the annex.

a) Verify if the learning outcome related to the reference qualification is already in the provided list of learning outcomes. If it is not, then you can create a new learning outcome

b) If the learning outcome to be created is a skill, then:
I. verify if the action verb required to build the skill-learning outcome is in the provided list of action verbs (AVs)
II. If it is not, then you can propose a new A.V

c) Describe the reference skill-learning outcome with
I. the action-verb - AV- selected or created +
II. a direct object – DO - +
III. in case, an indirect object – IO
E.g.: Connect a computer to a large bandwidth network
(AV) (DO) (IO)

d) If the learning outcome to be created is a competence, then
I. add contexts to the created or selected skills

e) If the learning outcome to be created is a piece of knowledge, then
I. use the verb Know + an object
E.g.: know application tools.

f) Objects and Contexts can be also picked up from the data bank or created if not available

Table 4: Standardised writing of learning outcomes

Therefore, a common construct is developed based upon:

1. shared knowledge and skill descriptions
2. an effective way to "build" knowledge (to know + object) and skills (action verb + objects)

[29] see e.g. Europass action verbs glossary or Mansfield,, B., Mitchell, L., 1996.

3. an open “dictionary” of objects and action verbs to make increase and to crop through stakeholders’ communities
4. clusters of contexts and conditions, that can help identify the concrete reference environments and the specific objectives

An example is provided below.

to connect a computer to a large bandwidth network *to check that the connection operates* *to demonstrate its functioning to the client* **actions or behaviours (Skills)** *according to the agreed specifications* **conditions or criteria** *“In a Small Office Home Office (SOHO) or a private environment* **context**

Table 5: A common pattern to build competences and learning outcome - example

Representing proficiency/ learning levels

The ontology provided above implies a “flat universe” of learning outcomes/competences, learning levels (for qualifications) and proficiency levels (for competences) are omitted.. Therefore this CWA has started to elaborate some basic hints to enrich the initial ontology.

From a detailed analysis of the EQF descriptors, the previous CWA “e-Competence Framework CWA User Guidelines”, 2008, highlighted that proficiency and learning outcome levels can be defined through three dimensions:

1. **Autonomy** ranging between “Responding to instructions” and “Making personal choices”
2. **Context complexity** ranging between “Structured – Predictable” situations and “Unpredictable – Unstructured” situations
3. **Behaviour** here representing an observable outcome and ranging between “the ability to apply” and “the ability to conceive”.

Relating to **1. Autonomy**, the classification provided in the e-Competence Framework CWA User Guidelines, 2008, from analysis of the EQF, was as follows:

"Responds to instructions; Works under general supervision; Interprets instructions, makes choices, works under broad direction; Has defined authority and responsibility for a significant area of work; Makes personal choices"[30]

Relating to **2. context complexity**, this e-Career CWA has started to formalize it. The purpose was to consider learning/proficiency levels from the EQF and e-CF to design curricula and syllabi to create interoperability options at the ground level.

As a contribution to formalising context complexity, this CWA has started to identify context examples of the most relevant predictable-structured and unpredictable-unstructured classes of professional context and professional contexts[31] in line with the e-Competence Framework. These context examples are pioneering definitions which warrant further research. Some practical testing can be found in Annex 5 and 6.

Relating to **3. behaviour**, intended as "observable behaviour", Europass shows a leading example on how it can be formalized by action verbs. Europass gives a list of action verbs to be used to fill in curricula and related documents to harmonize and standardize language. However, it states that these action verbs do not refer to learning/ proficiency levels.

Nonetheless, the EQF uses different action verbs for different level descriptors.

Several studies have tried to identify classes of action verbs and relate them to different grades and types of capabilities (ranging between operative, cognitive and relational capacities) and thus "structure performance domains".[32]

As a result, within previous multistakeholder initiatives such as ICT Lane and the development of the European e-Competence Framework, attempts were made to formalize and link action verbs to EQF and e-CF levels. Examples were reported in the e-CF and EQF levels schema published in the EU e-Competence Framework accompanying user guidelines.[33] Hence, these initial linkages are based on the above studies and come from analysis of the EQF descriptors.

[30] See User guidelines of the European e-Competence Framwork, Annex EQF – e-CF level table
[31] Study contexts are not considered here

[32] see e.g. Bloom's taxonomy, Bloom, B.S. et al. *Taxonomy of educational objectives: The classification of educational goals*, Handbook I: Cognitive domain, 1956, *NY;* McGuire*,* C. *H.*, *Evaluation of student and practitioner competence*, 1983, Jossey-Bass Inc, Publishers; Mansfield, B., Mitchell, L. *Towards a Competent Workforce*, 1996, Gower.

[33] User Guidlines for the application of the European e-Competence Framework, CEN/ EC 2008

A basic ontology for applying e-CF and EQF to ICT qualifications and certifications

The concepts and findings explained above can be formalized in a basic ontology. This ontology needs further development and validation, nevertheless it provides a valuable contribution to a consistent European ICT language to bridge e-Skills demand and supply. It is described in the table 8 below:

(1) Knowledge = to know + object
(2) Skill = action verb + object
(3) Competence = skill + class of context (and criteria)
(4) Learning outcome = knowledge and/or skill and/or competence
(5) Class of context = a set of contexts grouped according to their scope
(6) Context = work environment identified according to its grade of complexity ranging between "structured – predictable", "unstructured – unpredictable" situations and related to a class of context (see annex 5 and 6)
(7) Action verbs = verbs that range between "the ability to apply" and "the ability to conceive" (see e.g. Europass)
(8) Autonomy = increasing capability to work without supervision, by personal understanding and choices (ranging between respond to instructions – make strategic decisions)
(9) An e-Competence proficiency level is defined by action verbs, context complexity (I.e. it is an instantiated competence), grades of autonomy
(10) A learning-outcome level is defined by action verbs, context complexity, grades of autonomy
(11) If (3) *or* (4) and (8), then (9) *and* (10)
(12) ….

Table 8: A basic ontology to connect competences and learning outcomes

Conclusions

Application of the rules explained above provide an initial basis to implement a consistent language to manage a large variety of functions, e.g. comparing training courses, detecting suitable training courses according to diagnostic assessment results, elaborating a job posting and matching CVs with companies' jobs.

5.5. Sustainability

Change will not take place immediately and interoperability established overnight. Stakeholders and multistakeholder partnerships need access to common tools and frameworks to establish homogeneous communities. Interoperability can only be achieved through the adoption of common standards which are accepted and adopted.
Promotion of the recommendations of this report will provide the basis for stakeholders, including commercial service providers, to add value to their offerings and provide the basis for step by step improvement of interoperability.

The ability to find and to manage relevant information on the web will provide an opportunity for new business models and to plan for new ways of conceiving products and services. For example it is now common practice when using online current account banking systems to be offered complimentary services such as savings, investments or mortgages relevant to the individual. In the same way e-career service providers will be able to fully exploit additional opportunities provided by improved interoperability.

Standards are the basis for interoperability and open source solutions are recommended. The reason is not cost reduction but the potential for diffusion acceleration and continuous improvement. Adopting open source solutions creates communities around software technologies. If developers seek interoperability, they are able to use the technologies developed so far and improve upon them, based on an “open” approach. This concept supports continuous improvement and facilitates an increase in standard-sharing, making interoperability easier. A virtuous circle of interoperability expansion is then created.

6. Summary of recommendations

The substantive finding of this report is recognition of a significant absence of interoperability for ICT career services across Europe. The following recommendations build upon this finding and address realistic solutions.

For clarity this summary provides a consolidated list of references to key recommendations made in this CWA:

	RECOMMENDATION	**Section**
A	Communication of the standards and principles articulated in this CWA are an essential ingredient in the propagation and achievement of interoperability, they should be promoted.	5.1
B	The use of EQF, e-CF and Europass should be promoted collectively with their combined ability to establish interoperability stressed.	5.1
C	e-Career services can be directly connect to the e-CF or alternatively they can refer to national or local frameworks that in turn are related to the e-CF. It is recommended that website creators, designers and architects consider and verify these relationships.	5.2
D	The e-CF, EQF and the Europass have been subject to public consultations. These frameworks therefore satisfy ontology conditions and it is recommended that they are considered and deployed by website creators, designers and architects.	5.2
E	It is recommended, that website creators, designers and architects link diagnostic assessments and summative assessments.	5.2
F	Through virtual communities and social networks, ICT professionals can identify emerging e-competences.	5.2
G	Services such as the European e-Skills Portal should be developed on the basis of the new European Frameworks: e-CF, EQF etc.	5.2
H	Hyperlinks currently used by most e-Career Services to provide interoperability should be integrated and replaced by portlet standards.	5.3

I	General data exchange standard, such as RSS[34], should be used to exchange news and non structured information. More structured information can be modelled by using vertical standards, such as HR XML for the "classic" HR domain or XCRI for course-related information.	5.3
J	Promote awareness and use of all technical standards described and tabled in Section 5.3	5.3.
K	Experts in the qualification and certification area should evaluate links between ICT qualifications and the European e-Competence Framework and continue the quest for a sound and consistent methodological process.	5.4.
L	Implement integration of European Standards: Make explicit reference to the European e-Competence Framework in Europass, as successfully achieved with the Common European reference framework for languages (CEF).	

Table 9: Summary of recommendations

[34] Really Simple Syndication

7. Acknowledgements

We are grateful and indebted to the wide group of contributors to the CWA development, including

- the members of the CEN/ISSS ICT Skills workshop Plenary, coming from *(to be updated)* Afpa, Aica, Airbus, Alexis BV, Asociación de Técnicos en Informática, Association Pasc@line, BCS, BIBB, Bitkom, Breyer Publico, HBO-I, Cap Gemini, Cedefop, CEPIS, CIGREF, Cisco Systems, Comptia, Danube University / CEPA, DEKRA, ECABO, ECDL Foundation, e-Skills ILB, e-Skills UK, European Metalworkers' Federation, EXIN International, Fondazione Politecnico di Milano, IG Metall, Intel Corporation, IT Star, IWA Italia, KWB e.V., Microsoft, French Ministery for Education and Research, MTA, Norwegian Computer Society, NTT Data CCS Corporation, Oracle, PMI, Skillsnet Europe, Trinity College, Uni Europa, University of Gent, University of Karlsruhe / Institute AIFB,
- the contact persons engaged with the e-Skills and ICT career websites in Europe analysed for this CWA, namely coming from AFPA, AICA, ANPE, ECWT, e-Skills Europe, e-skills UK, iProfile, Le Portail des Métiers de l'Internet, Passinformatique, Learndirect, Italialavoro, Xformare.it, Kibnet, EADS, Gesellschaft für Informatik E. V., Monster, CompTIA TECH Career Compass, Germany Occuprofiler
- the members of the pilot-experimental network of stakeholders (PEN), coming from Afpa, Aica, Airbus Deutschland, Assolombarda, Breyer Publico, Cedefop, CEN/ISSS (project on e-Certification), CNE-CSE / Uni Europa, Cigref, e-Skills UK, European Center for Women and Technology, Fondazione Politecnico di Milano, HBO-I, EMF, EUN, Eurocadres, IG Metall, Italia Lavoro, NIOC, Ministère de l'enseignement supérieure et de la recherche, Regione Lombardia.

8. Glossary, references, linkography

Classification	Item	Definition/ description for CWA context
Project underpinning methodology – basic definitions	e-Career Services	Services that help people grow from a professional point of view in their career development through online tools. In this project, they are related to the ICT work. They can provide online information (e.g. most simple: website), but also complexe online performances (e.g. most advanced: online assessments). Target audiences of such services are e.g.: - Individuals (work related to ICT: practitioners and ICT/ HR managers, job seekers, looking for ICT career orientation) - companies, certification and training bodies (…).
	Interoperability	Interoperability means the ability of information and communication technology (ICT) systems and of the business processes they support to exchange data and to enable the sharing of information and knowledge. There are two types: 1) Syntactic/technical interoperability Technical interoperability covers the technical issues of linking computer systems and services. Key aspects include open interfaces, interconnection services, data integration and middleware, data presentation and exchange, accessibility and security services 2) Semantic interoperability Semantic Interoperability is concerned with ensuring that the precise meaning of exchanged information is understandable by any other application that was not initially developed for this purpose. It thus enables systems to combine received information with other information resources.
	Ontology	Describes a domain – a piece of world – by identifying and defining the "core" objects inside and relationships between them. Accordingly, it is necessary to involve European relevant stakeholders in the definition phase because any "reference universe" can be defined in many different ways. Example of the e-Career project work: - e.g. objects: e-Career Services to be identified (core objects and objects inside) - e.g. relationships: Curricula and Job matching
HR domain element – Class of services CURRICULUM SUPPORT	Candidate's curriculum / portfolio	Services related to competences profiling
HR domain element – Class of services RECRUITMENT AND SELECTION	Internal / external job posting	Services related to the possibility, for companies, to post their job requirements towards companies inside the same group or towards the outside
	Business processes / work activities	Services which allow a company to define competences according to business process or work activity analysis

	Company profiles and competences (Internal frameworks)	Internal services of a company, providing job areas and business units with profiles and competences information and tools
	Internal assessment	Services related to the possibility, for companies, to make an internal assessment of their employees
	Project activities	Services which allow a company to define competences according to project activities
	Formative assessment	Services which give the possibility to evaluate the learning outcomes reached at the end of each learning module through periodical tests
	Summative assessment (for certification)	Services that allow to evaluate people's competences to issue certifications, i.e. final assessments
	Emerging competences on the job	Services that enable recognition of capabilities acquired inside a work environment and not gained by learning programs nor certified
HR domain elements – Class of services LEARNING, TRAINING AND CERTIFICATION	Certification programs	Services which enable to identify useful certification programmes
	Diagnostic assessment	Services related to the evaluation of people's capabilities
	Learning modules/resources	Services involving the offering of learning modules, distributed by Training Bodies or providing learning resources (e.g. documents)
	Learning programs	Services that enable to identify possible learning paths and learning processes within non formal – informal learning environments
HR domain elements – Class of services CAREER SUPPORT	Career information	Services providing people with useful information about trends inside work environments (e.g. news, procedures, bulletins, documents, etc.)
	Market scenarios	Services which enable to explore current market trends and individuate the better strategy to fit them (e.g. wage confronting services)
HR domain elements – Class of services FRAMEWORKS	European e-Competence Framework	Services which make use fo the semantic classification defined by the e-Competence framework to provide contents related to competences
	Local competence / job profile frameworks	Services which base their semantic structure upon local classifications, not recognized at European level

Analysed portals - website references

Name of the portal	URL	Country/EU level
AFPA	www.afpa.fr	France
AICA	www.aicanet.it	Italy
ANPE	www.anpe.fr	France
ECWT	www.womenandtechnology.eu	Europe
e-Skills Europe	http://eskills.eun.org	Europe
e-skills UK	www.e-skills.com	UK
iProfile	www.iprofile.org	UK
Le Portail des Métiers de l'Internet	www.metiers.internet.gouv.fr	France

Name of the portal	URL	Country/EU level
Passinformatique	www.passinformatique.com	France
Learndirect	www.learndirect.co.uk	UK
Italialavoro	www.italialavoro.it	Italy
Xformare.it	www.xformare.it	Italy
Kibnet	www.kibnet.org	Germany
EADS	www.eads.net	Germany
Gesellschaft für Informatik E. V.	www.gi-ev.de	Germany
Monster	http://it.monster.de	Germany
CompTIA TECH Career Compass	http://tcc.comptia.org	USA
Germany Occuprofiler (Occupational Profiling)	http://de.occuprofiler.com	Germany

Pilot-experimental Network of Stakeholders (PEN)

Afpa	France
Aica	Italy
Airbus Deutschland	Germany
Assolombarda	Italy
Breyer Publico	Germany
Cedefop	EU
CEN/ISSS (project on e-Certification)	EU
CNE-CSE / Uni Europa	EU / Belgium
Cigref	France
e-Skills UK	UK
European Center for Women and Technology	EU/ Norway
Fondazione Politecnico di Milano	Italy
HBO-I	The Netherlands
EMF	EU
EUN	EU
Eurocadres	EU / Austria
IG Metall (Kibnet)	Germany
Italia Lavoro	Italy
NIOC	The Netherlands
Ministère de l'enseignement supérieure et de la recherche	France
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eCCO
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http://www.imsglobal.org/ep/epv1p0/imsep_infov1p0.html

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