empirica Gesellschaft für Kommunikations- und Technologieforschung mbH
Oxfordstr. 2, 53111 Bonn, Germany
e-Mail: info@empirica.com
Phone: +49 (228) 985 30 0
Fax: +49 (228) 985 30-12

e-Leadership:

e-Skills for Competitiveness and Innovation Vision, Roadmap and Foresight Scenarios

Final Report

Authors:
Tobias Hüsing, empirica
Werner B. Korte, empirica
Nils Fonstad, INSEAD
Bruno Lanvin, INSEAD
Gabriella Cattaneo, IDC Europe
Marianne Kolding, IDC Europe
Rosanna Lifonti, IDC Europe
Desirée van Welsum

submitted by

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About this document

This document is the Final Report of the study “Vision, Roadmap and Foresight Scenarios for Europe 2012-2020”, or short "eSkills VISION".

Disclaimer

About VISION

The VISION project on e-skills Vision, Roadmap and Foresight Scenarios provides sound, unbiased empirical evidence on how the supply and demand for different types of ICT-related skills is evolving in Europe under different socio-economic scenarios. This will allow the European Commission to prepare for targeted policy initiatives and encourage and facilitate the dialogue and cooperation between policy makers and relevant stakeholders at the EU and national levels about the implications and required actions to be taken to address current as well as anticipated skills gaps and shortages and to help reducing innovation skills shortages, gaps and mismatches in Europe. The study design required a combination of different data collection techniques, the application of foresight scenario techniques, and statistical modelling of the data for the various scenarios. The work was addressed to the development of foresight scenarios and a forecasting of e-skills demand and supply until 2020, a vision report and the development of a policy roadmap for future action in this area. It had a dual focus on ICT practitioner and professional skills on the one hand and e-leadership skills on the other.

About empirica GmbH

empirica is an internationally active research and consulting firm concentrating on concept development, the application and development of new information and communication technology and the information society. The institute has a permanent staff from a range of disciplines, including economic, social and political sciences, IT engineering and computer science. This mix of qualifications combined with a well established network of international partners allows easy formation of interdisciplinary and international teams well tuned to study implications of the information society for citizens, businesses and governments.

Contact

For further information, please contact:

empirica
Gesellschaft für Kommunikations- und Technologieforschung mbH
Oxfordstr. 2
53111 Bonn
Germany
Tel: (49-228) 98530-0 * e-Mail: info@empirica.com * Web: www.empirica.com

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Contents

1 Executive summary

The key objective of this study is to **help reduce innovation skills shortages, gaps and mismatches** in Europe, by providing sound, unbiased empirical evidence on how the supply and demand for different types of ICT-related skills is evolving in Europe under different socio-economic scenarios. A sufficient skills base in this domain is an important enabler for competitiveness and innovation in Europe. The evidence delivered by this study shall encourage and facilitate the dialogue and cooperation between policy makers and relevant stakeholders at the EU and national levels about the implications and required actions to be taken to address current as well as anticipated skills gaps and shortages.

A special focus of the study is on **higher-level innovation skills** (which we call "e-leadership skills") next to the analysis of the supply-demand developments for ICT practitioner and ICT user skills.

Definition

Already in 2004, the European e-Skills Forum in its synthesis report on "e-Skills for Europe: Towards 2010 and beyond" developed an e-skills framework and definition, which has been adopted in the present study. According to that definition the term "e-skills": 'encompasses a wide range of capabilities (knowledge, skills and competences) and issues with an e-skills dimension span over a number of economic and social dimensions. The ways individuals interact with ICT vary considerably, depending on the work organisation and context of a particular employer, or home environment'.

The focus in the present study has been on 'ICT practitioner skills' and 'e-leadership skills' whereby for the former the past developments and current status in terms of demand and supply are presented followed by scenario-based forecasts of the development until 2020. It is complemented by a pragmatic and applied definition of the term 'e-leadership skills', allowing for a first ballpark estimation of their prevalence and incidence in Europe.

Status Quo of e-skills demand and supply in Europe

The ICT workforce in Europe in 2011 amounted to 6.67[1] million, which is 3.1% of the overall workforce. 5.25 million of these come from the occupational groups representing ICT practitioners and 1.42 million can be described ICT professionals at management level and include CIOs, ICT operations managers, project managers but also those ICT workers responsible for planning and strategy such as enterprise architects, systems analysts and ICT consultants.

If we include the ICT mechanics and manual worker skills, 3.7% of the European Labour Force, or more than eight million workers in the EU are ICT professionals, based on job classifications used in the Labour Force Surveys. The share can go up to 6 percent in some countries.

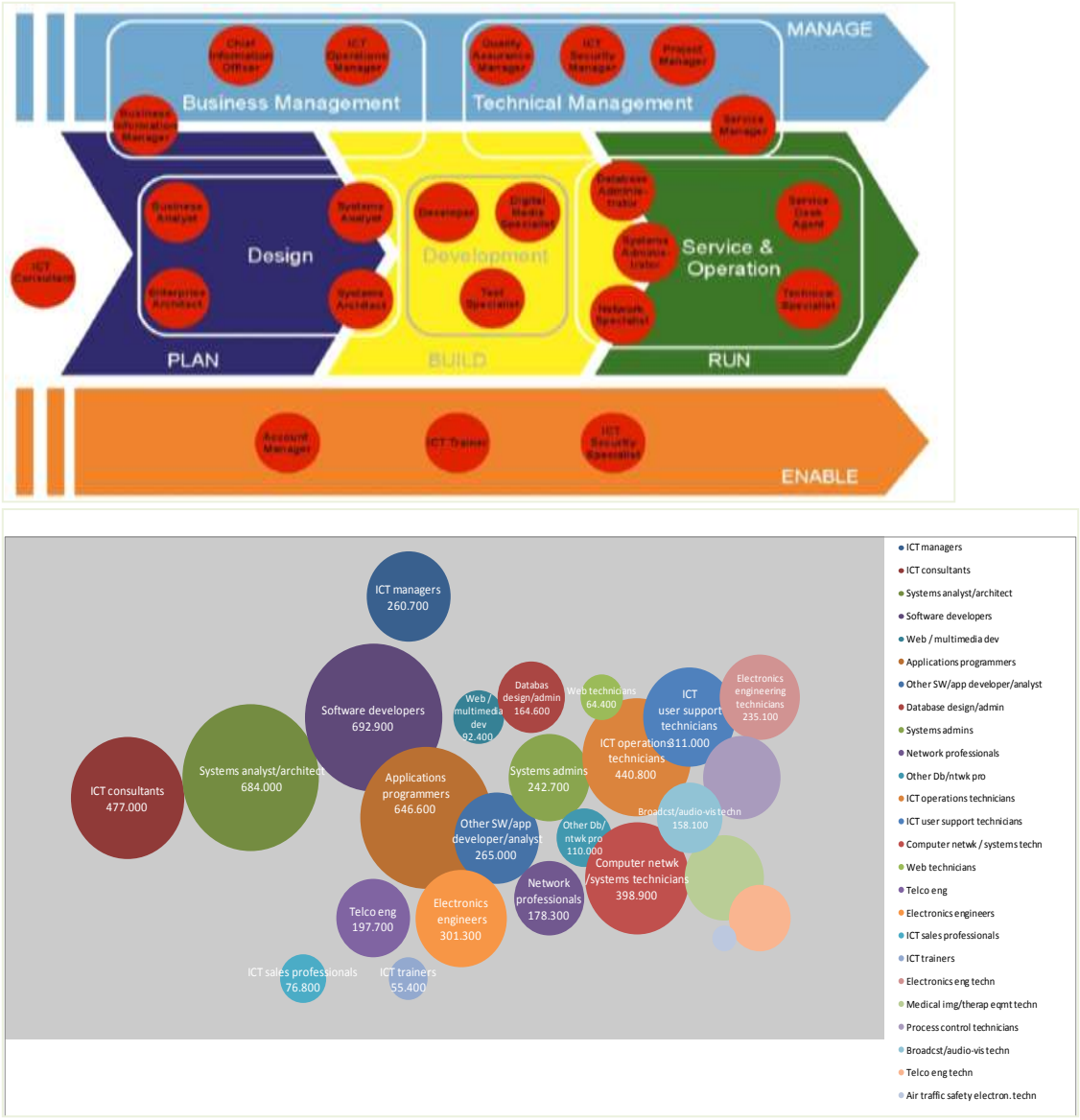
Of these ICT professionals, one in six is holding a highly skilled Management and / or Business Architecture level skills position but the vast majority can be found in the core group of ICT practitioners (for definitions see annex 1).

The ICT workforce in Europe has been growing over the past decades and will continue to grow in the future. There has been a steady increase in the number of ICT practitioners in the workforce.

[1] For our model calculations, we were encouraged by the experts attending our validation workshops to include in our model a 2% natural unemployment rate. We therefore speak in this report sometimes of a 6.67 million workforce and sometimes of 6.53 million jobs (equalling 98% of 6.67 million). 6.67 million is the number generated from Eurostat's Labour Force Survey database which counts people according to their occupation.

And there is no indication that this trend will change. The annual growth of ICT employment has remained very robust throughout the crisis so far.

Figure: ICT workforce definition and size 2011 – mapped against CWA-ICT profiles



Source ICT profiles: ftp://ftp.cen.eu/CEN/Sectors/List/ICT/Workshops/EU_ICT_Professional_Profiles_DRAFT_CWA.pdf.
Source of mapping: empirica. Data: Eurostat LFS, averages of 2011q1 and 2011q2. Assumptions and imputations apply.

From 2000 to 2010, the ICT workforce grew at an average annual rate (CAGR) of 4.26%. Even at the times of the economic and financial crisis, which Europe is undergoing since late 2008, growth remained at 2.65%. The labour market seems to absorb all ICT graduates even through the crisis.

Figure: ICT workforce growth 2000-2011

Source: Eurostat LFS. Narrow definition: 2000-2010 ISCO-88 groups 213, 312: "Computing professionals" and „Computer associate professionals". Break in series 2011: ISCO-08 groups 25 "ICT professionals", 35 "Information and communications technicians".

Interest in pursuing ICT careers seems to be diminishing among younger generations. The number of computer science graduates was growing in the past, but has been in continuous decline in Europe since 2005. Even more, the speed of decline is what makes the situation rather dramatic with the number of ICT graduates from university decreasing even more drastically than expected.

The effect of the decrease in the number of entrants to the ICT workforce is intensified in Europe by an increasing number of exits as ICT practitioners leave the workforce.

The most dramatic increase can be observed in the UK. In this country the number of graduates in 2009 decreased to just 68% of those who had graduated in 2006. Decreases can also be observed in most of the other countries. Consequently, it is likely that e-skills excess demand will increase rather significantly when the current economic crisis ends.

Today, demand for ICT workers is outnumbering the supply. The results of a representative empirica survey of CIO's and HR managers in eight European countries in 2012 show that the excess demand for e-skills, i.e. ICT professionals and practitioners, extrapolated to the whole of Europe (EU-27) can be estimated at around 255,000 in 2012. This is the number given by CIOs and HR managers in European organisations for the number of vacancies in ICT-related occupations.

Among these, we find a demand of about 72,000 vacancies for the EU-27 for "ICT management and business architecture" skills and about 183,000 for "Core ICT practitioners" and "Other ICT technicians" jobs.

It has been speculated that while demand for ICT practitioners and professionals massively exceeded supply in the boom phase of recent years, the current economic crisis would be suppressing demand to the extent that demand and supply of e-skills are close to numerical balance. However, these figures suggest that demand for ICT practitioners and professionals remains high, albeit geographically biased due to differences in the economic cycles.

70% of vacancies can be found in SMEs, which demand ICT skills in much greater aggregate numbers than large enterprises. SMEs have much larger problems in recruiting the relevant e-skilled professionals needed than larger organisations. There is no indication for this situation to change.

Future e-skills demand will increasingly occur in higher-level ICT jobs including the management, planning and strategy and ICT development specialist occupations and less in ICT support, delivery and operation, i.e. infrastructure type occupations.

Scenario-based forecasting of 'ICT practitioner and professional skills' in Europe 2012-2020

The focus of the e-skills demand and supply forecasting is on ICT professionals (i.e. management level ICT occupations and practitioner level ICT occupations).

Forecasting was done for different scenarios each of which is describing a 'possible future' in Europe. Five scenarios were initially created such that each of them should be comparably realistic or likely. In addition, two synthesis scenarios summarising consensus were produced as the outcome of a consultation and validation process.

The scenarios vary the different input factors of the model for future demand and supply, such as the number of ICT graduates, the number of graduates from other disciplines, especially STEM, to enter the ICT workforce, retirement and other exits patterns, side entries of self-trained or industry certified workers.

The key component of each scenario is of course an estimation of future demand for different types of ICT workers. Demand forecasts are based on IDC market data. The model builds on a statistical relationship that is derived from historical correlations between GDP growth and ICT investment on the one hand and ICT jobs on the other hand. These two variables, GDP growth and ICT investment, fed into the model already deliver a baseline trend of future demand.

This model output for ICT job demand is then enhanced by taking into account technology trends and their assessment of how and when this translates into which kinds of jobs are demanded, but also social trends, policy trends, etc. The five initial scenarios vary all these determinants.

These scenarios were put to the test of three expert workshops and experts there scrutinised the assumptions and contributed to honing the final model. So, our assumptions were subsequently adapted and a final model was developed with 5 scenarios with all kinds of differences in supply and demand variables.

After the aforementioned validation session with experts and European Commission, the study was encouraged to produce not only the set of five different scenarios but also a simplified set of two scenarios that synthesise those results deemed most likely and provide a baseline corridor for the forecast most importantly until 2015.

Five different initial scenarios have been developed which are further described in the report and in depth in the annex of this report. These have been entitled as follows:

- Two Speed Europe
- Struggling on
- Defying the odds
- Social Innovation wins
- Troubled Water

The two simplified scenarios are called

- Return to confidence and
- Cautious Growth.

"Return to confidence" features a slow return to GDP growth in the area of 2% until 2020 and a return to moderately optimistic ICT investment growth rates. The more cautious scenario,

"Cautious Growth", features rather flat GDP growth of 0.9% to 2015 and 1.7% afterwards and an ICT spending growth of 2.1 and 4.3% annually, respectively.

Scenario-based forecasting – results overview

Europe is currently faced with an excess demand of ICT practitioners and professionals which - based on the results of a European CIO and HR manager survey carried out by empirica in 2012 - amounts to an estimated number of 255,000 for the EU-27 countries.

Depending on the scenario taken it is likely to grow significantly until 2020 with the exception of the 'Troubled Water' scenario. Europe will up until 2015 experience a decline in excess demand in several of the five scenarios but grow again afterwards.

The scenarios were initially created such that each of them should be comparably realistic or likely.

e-Skills vacancies forecasts according to Scenarios in Europe (EU27) in 2011, 2015 and 2020

Scenario	2011	2015	2020
Two Speed Europe	255,000	208,000	488,000
Struggling on	255,000	227,000	616,000
Defying the odds	255,000	1,020,000	1,818,000
Social Innovation wins	255,000	810,000	1,541,000
Troubled Water	255,000	120,000	146,000
Synthesis 1: "Cautious Growth"	255,000	372,000	481,000
Synthesis 2: "Return to Confidence"	255,000	864,000	1,685,000

Note: 'Vacancies' are estimated by summing up of national excess demand figures, ***not*** *balanced with oversupply in other countries, but after migration.*

Synthesis scenario results - "Cautious Growth"

The first synthesis scenario called "Cautious Growth" features an economic growth scenario with a slow return to historical growth trajectories and slow recovery. GDP growth across Europe is assumed at an average of 0.92% compound annual growth rate between 2010 and 2015 and increases to 1.65% on average annually between 2015-2020.

Moderate IT investments will be reflected in 2.1% p.a. growth until 2015, with an increasing trend from 2014 on, so that the second half of the decade will see a growth rate of 4.3% on average. IT investments will not least build upon a rapid diffusion of mobile devices and apps and of cloud services and other new IT delivery models. Big data applications and services are expected to grow considerably from 2014 on.

SME investments in IT innovation will increase only very slowly because of the slow recovery and persistence of the credit crunch.

In the education domain, we will see a slight increase in the number of ICT graduates and some labour mobility. Private funding for education and training will be at a moderate level. In the social domain, data driven commercial services on the web, also driven by mobile devices, will imply some "big brother" risks. Politically we will see a continuing incremental process of building Europe step by step. Continuing negotiations between Member States will bring about gradual and cumulative progress in European cohesion.

In the 'Cautious Growth' scenario, the ICT workforce in Europe will grow from 6.53 million in 2011 to 7.09 million in 2020 whereby 5.15 million will be ICT practitioners and 1.95 million ICT management level employees. We see a slight upturn in the share and total number of application development jobs and a stable number of more infrastructure related jobs. In this scenario the demand potential for ICT workers will reach beyond the above 7.25 million in 2020 and amount to 7.98 million

While a general trends towards practitioner shortages can be observed, there will even be some practitioner unemployment in some countries but only for a few years, due to little / lacking mobility across the EU. These countries are most notably Poland and Spain. Poland sees an oversupply mainly due to the steady and strong output of graduates from tertiary and vocational education, while Spain suffers from a slump in demand.

The excess demand or shortage (calculated as the number of open posts) amounts to 373,000 in 2015 and 889,000 in 2020. This figure can best be described as 'demand potential' or 'job potential' for ICT jobs. It should be seen as a (theoretical) figure describing the demand potential for new ICT jobs, which – under the above assumptions – could theoretically and additionally be created in Europe due to an e-skills demand likely to occur especially in the years closer to 2020.

Synthesis scenario results - "Return to Confidence"

The second synthesis scenario called "Return to Confidence" features a slightly more optimistic economic growth scenario with a recovery from 2014 onwards. GDP growth across Europe is assumed at an average of 1.3% compound annual growth rate between 2010 and 2015 and increases to 2.0% on average annually between 2015-2020.

The economic recovery sets a favourable environment for IT investments, growing at 2.9% p.a. until 2015 and further increasing to a growth rate of 5.6% on average in the second half of the decade. IT investments will be grounded in a generally high level of innovation and fast diffusion throughout the business sector. Innovation will be addressed both at increasing productivity and at launching new products and services. In particular, also SMEs will participate in the innovation wave at show a high level of adoption of ICT innovation.

The education and labour mobility domain is unchanged compared to the "Cautious Growth" scenario, which features our baseline assumptions of a slightly increased supply of ICT graduates, a modest contribution of industry based training and certification to the supply of qualified workers and a modest rate of labour mobility.

In the social domain, we see a new wave of social (yet commercial) innovation, with a balance between the commercial and non-profit sectors. The impact of social uses of the internet will dodge the "big brother" threats and be more focused on collaborative and knowledge sharing aspects of the Internet. Politically, integration of Europe is fostered with a high level of governance in the ICT domain and a fast achievement of the Digital Agenda. Education policies succeed in coordinating standards, curricula and learning outcomes of the ICT profession.

We see an increase in the share and total number of application development jobs and a slight decrease in the number of more infrastructure related jobs. "Return to Confidence" features a robust general trend towards practitioner shortages so that any practitioner unemployment observed is at the rate of natural unemployment of about 2%. In this scenario, the demand potential for ICT workers will reach beyond the above 7.47 million in 2020 and amount to 8.99 million. Excess demand or shortage (calculated as the number of open posts) amounts to 866,000 in 2015 and 1,685,000 in 2020.

Summarising this scenario, while demand and supply for e-skills seem to be more or less balanced for 2011/2012, the situation is expected to deteriorate even more rapidly than in the previous scenario, and new demand is outnumbering supply for the period until 2015 even more. Demand

will be particularly high for ICT management-related jobs, but we will nevertheless see an increasing number of vacancies also for practitioner jobs. In 2015 we expect a skills shortage that translates into unfilled vacancies in the order of magnitude of 866,000 jobs.

Figure: Summary synthesis scenarios

e-leadership skills: definition, framework and estimates

The present chapter develops an applied concept and definition of e-leadership skills by drawing on recent academic literature. In the final section, very first estimates of the demand of e-leadership skills in industry based on the applied definition of e-leadership skills are provided. These are based on a series of assumptions. The definition, framework, and estimates have been presented to and validated by experts.

The chapter draws on recent academic research on leadership and the expanding roles of business leaders responsible for ICT (e.g., Chief Information Officers) to explain why e-leadership is increasingly important to enhanced organization performance and competitiveness and how e-leadership is similar and distinct to related concepts, such as leadership, entrepreneurship, and digital entrepreneurship.

A growing body of research is finding that as organizations rely more on ICT to operate their business processes, innovate and provision products and services they are demanding a new type of leader: leaders who are both business and ICT savvy. To make the most of their investments in ICT and enhance their productivity and competitiveness, firms are demanding ICT leaders to be more business-savvy and business leaders to be more ICT-savvy. And although outsourcing and automation may mitigate how many e-skilled professionals a specific organization needs to hire, organizations of all sizes and from all sectors nonetheless increasingly need at least one person who can lead and manage e-skilled professionals (whether they are internal and external to the organization).

e-Leadership definition and framework

E-leadership is defined as follows.

> *E-leadership is the accomplishment of a goal that relies on ICT through the direction of human resources and uses of ICT.*

E-leadership is a type of leadership, distinguished by the type of goal that needs to be accomplished and what resources a leader must coordinate and align. In the case of e-leadership, both the goal and the resources involve using ICT. Who and how many take on the role of an e-leader within an organization depends on the size of the organization, the extent to which an organization depends on ICT for operating its business processes and for developing and provisioning new products and services, and how the senior management team has decided to allocate key responsibilities that involve ICT, such as managing ICT services, operating enterprise-wide business processes; and innovating with external customers and partners. Examples of e-leaders may include a Chief Marketing Officer responsible for using social media to enhance promotion and the customer experience, a Chief Information Officer, a Chief Enterprise Architect, a relationship manager between IT and a business unit, or a founder of an enterprise that relies on ICT to operate and innovate.

Effective organizations are demanding e-leaders with a T-shaped portfolio of skills, representing expertise in both using ICT and developing organizations. Very simply, having a T-shaped portfolio of skills means that a leader is both business and ICT-savvy. More precisely, having a T-shaped portfolio of skills means that a leader has the following skills:

- A vertical set of skills that represent expertise or “deep knowledge” in a specific area (e.g., science; engineering; ICT; social sciences);
- A horizontal set of skills that represent “transversal skills” (e.g., negotiation; critical thinking; design and systems thinking, business and entrepreneurship, etc.) that enable collaboration across a variety of boundaries.
- Both vertical and horizontal sets of skills require a basic level of ICT user skills, as defined by the European Commission.

Several organizations have developed frameworks to describe more specifically what key activities organizations should engage in to maximize value from ICT (e.g., the most notable is the e-Competences Framework). In general, each set of activities demands either strategic understanding (knowing what is possible) or practical understanding (knowing how to do the possible) of a set of skills (see following figure). Depending on what sets of activities an e-leader is responsible for, s/he will need to have a strategic understanding of some areas of expertise and a practical understanding of other areas of expertise.

As a result, there are two broad types of e-leaders, depending on the make-up of the leader's T-shaped portfolio: technology-focused and management-focused. The T-shaped portfolio of skills varies for e-leaders, depending on what sets of activities they are responsible for, and consequently, what areas of expertise they need to have either a strategic or practical understanding of.

To be accomplished well, each key set of activities requires a different mix of strategic and practical understanding of the vertical and horizontal expertise.

	Literacy & basic skills	**Using ICT (Vertical Expertise)**				**Developing Organizations (Horizontal/Transversal Expertise) Global Knowledge Economy Talents**			
Key sets of activities	Reading, writing, math, digital literacy, etc.	ICT expertise	Function expertise	Product expertise	Customer & Sector expertise	Managing change and inventing	Developing a compelling vision	Building and aligning relationships across boundaries	Making sense of a situation
Business development, sales and marketing	+++	+	+	+	+	+++	+++	+++	+++
Business process management	+++	+	+	+	+	+++	+++	+++	+++
Program and project management	+++	+	+	+	+	+++	+++	+++	+++
Global sourcing management	+++	+	+	+	+	+++	+++	+++	+++
Enterprise architecture	+++	+++	+++	+++	+++	+	+	+	+
Solution development and implementation	+++	+++	+++	+++	+++	+	+	+	+
Information management and security	+++	+++	+++	+++	+++	+	+	+	+
IT services management and delivery	+++	+++	+++	+++	+++	+	+	+	+

+ = strategic understanding (knowing what is possible)
+++ = practical understanding (knowing how to do the possible)

e-Leadership demand and supply estimates

Chapter 3 also provides preliminary estimates for demand and supply of e-leadership. These are based on a number of assumptions all of which being made fully transparent in the descriptions

To estimate the demand of e-leaders, the research team assumed that some organizations need more e-leaders than others, depending on the two dimensions. One dimension is the size of organization. A very large firm will need more e-leaders. The second dimension is the degree to which organizations rely on technology for their business operations and for their innovating and provisioning services and products. Based on these two dimensions, we highlight different types of organizations:

- Gazelles / High-growth SMEs;
- ICT sector, medium sized and large or very large;
- High ICT intensity sectors; and
- Low ICT intensity sectors.

This resulted in a segmentation as described in the following table with 12 cells which can be grouped into four different types / segments differentiated by different colour in the table below. For each of the four categories, demand was estimated. These figures are included, below. The overall number of demand for e-leadership in Europe is estimated at 683,000 persons.

Summary of estimated e-leadership demand:

<table>
<tr><th></th><th>Micro</th><th>Small</th><th>Medium</th><th>Large</th><th>Very large</th></tr>
<tr><th></th><th>0-9 employees</th><th>10-49 employees</th><th>50-249 employees</th><th>250-999 employees</th><th>1000+ employees</th></tr>
<tr><td>ICT sector</td><td rowspan="3" colspan="2">70,000</td><td>26,000</td><td colspan="2">11,000</td></tr>
<tr><td>High ICT intensity sectors</td><td>120,000</td><td colspan="2">145,000</td></tr>
<tr><td>Low ICT intensity sectors</td><td>227,000</td><td colspan="2">84,000</td></tr>
</table>

With regards to estimating the supply of e-leaders, a key assumption that was made was with regards to the "e-leadership quota" (E-LS quota)of each NACE professional group – i.e., the estimated percentage of people within a particular type of profession (as classified by NACE) capable of leading projects related to using ICT to develop, manage and provision ICT systems, operate digitized business processes, and innovate digitized services and products (e.g., using ICT to improve business processes; using ICT to develop new products and services; developing new applications; managing contracts with external service providers; etc.). To estimate supply of e-leaders, the number of e-leaders within an NACE professional group was estimated by multiplying the number of people employed within the group by the estimated e-leadership quota. The total supply consists simply of the sum of estimated employed e-leaders from all NACE professional groups. As a result of these assumptions, the overall number of supply for e-leadership in Europe is estimated at 661,000 persons.

The aforementioned estimates of demand and supply of e-leaders are quite conservative. When the estimates were presented to experts from academia, industry and public policy, most agreed

that the real demand for e-leaders is probably higher, the real supply even lower, and consequently the actual gap between demand and supply is even greater than the estimated gap.

Chapter 3 concludes with a brief examination of the sensitivity of key assumption, to help the reader develop a better understanding of how sensitive the estimates are to each key assumption, and in the process, develop a better understanding of why demand and supply fluctuate. Readers are encouraged to examine, challenge and change each assumption and see how it affects the demand or supply. This will also help the reader appreciate how conservative the estimates are.

The final chapters present the recommendations for increasing the number of ICT practitioners and professionals (chapter 4) and on e-leadership skills (chapter 5). The focus is on recommendations relating to e-leadership skills and these can be seen as input for the development of a long-term agenda for actions at EU and national level which could be taken by public authorities and stakeholders.

The project developed the following seven recommendations.

1. Engage with a broader set of stakeholder groups to sharpen metrics for e-leadership skills
2. Regularly monitor demand and supply of e-leadership skills.
3. Develop and apply e-leadership curricula guidelines and quality labels
4. Create new formats and partnerships for teaching e-leadership skills
5. Align actions to develop e-leadership skills with efforts to foster entrepreneurship across the EU
6. Foster e-leadership in the context of entrepreneurship and self-employment
7. Build awareness of the relevance of e-leadership skills for innovation, competitiveness, and employability

Each recommendation is described in greater detail, using a common format followed by a tentative roadmap of preparatory actions specifying and developing concrete actions, initiatives and programmes under each recommendation which then get implemented to reveal concrete results afterwards and finally leading to full-scale implementation:

		2013	2014	2015	2016-2020
1.	**Engage with a broader set of stakeholder groups to sharpen metrics for e-leadership skills**	Preparation			
			First Results		
				Full-scale Implementation	
2.	**Regularly monitor demand and supply of e-leadership skills.**	Preparation			
			First results		
				Full-scale Implementation	
3.	**Develop and apply e-leadership curricula guidelines and quality labels**	Preparation			
			First results		
				Full-scale Implementation	
4.	**Create new formats and partnerships for teaching e-leadership skills**		Preparation		
				First Results	
					Full-scale Implementation
5.	**Align actions to develop e-leadership skills with efforts to foster entrepreneurship across the EU**		Preparation		
				First results	
					Full-scale Implementation
6.	**Foster e-leadership in the context of entrepreneurship and self-employment**		Preparation		
				First Results	
					Full-scale Implementation
7.	**Build awareness of the relevance of e-leadership skills for innovation, competitiveness, and employability**	Preparation			
			First Results		
				Full-scale Implementation	

2 Introduction

The key objective of this study is to **help reducing innovation skills shortages, gaps and mismatches** in Europe, by providing sound, unbiased empirical evidence how the supply and demand for different types of ICT-related skills is evolving in Europe under different socio-economic scenarios. A sufficient skills base in this domain is an important enabler for competitiveness and innovation in Europe. The evidence delivered by this study shall encourage and facilitate the dialogue and cooperation between policy makers and relevant stakeholders at the EU and national levels about the implications and required actions to be taken to address current as well as anticipated skills gaps and shortages.

A special focus of the study is on **higher-level innovation skills** (which we call "e-leadership skills") next to the analysis of the supply-demand developments for ICT practitioner and ICT user skills.

Empirica, IDC and INSEAD have been contracted by the European Commission to address in a coherent fashion the various aspects of e-skills for competitiveness and innovation. The resulting vision, roadmap and foresight scenarios will focus on how the European Union can seize opportunities in innovation, new technologies and emerging forms of organization and production, while maintaining its priority on inclusive growth. Understanding what jobs of the future will require and how the acquisition and combination of relevant skills can lead European citizens to live better lives while contributing to collective value creation needs to rest on rigorous, evidence-based analytical approaches. Yet, Europe's ability to generate value and competitiveness from knowledge and innovation also demands that such analytical rigour be meshed with the right dose of imagination and foresight.

2.1 e-Skills Framework and Definition

Already in 2004, the European e-Skills Forum in its synthesis report on "e-Skills for Europe: Towards 2010 and beyond" developed an e-skills framework and definition which has been adopted in the present study. According to that definition the term "e-skills": 'encompasses a wide range of capabilities (knowledge, skills and competences) and issues with an e-skills dimension span over a number of economic and social dimensions. The ways individuals interact with ICT vary considerably, depending on the work organisation and context of a particular employer, or home environment.'

According to the European e-Skills Forum definition the term e-skills covers mainly three categories:

ICT practitioner skills:

The capabilities required for researching, developing and designing, managing, the producing, consulting, marketing and selling, the integrating, installing and administrating, the maintaining, supporting and service of ICT systems;

ICT user skills:

The capabilities required for effective application of ICT systems and devices by the individual. ICT users apply systems as tools in support of their own work, which is, in most cases, not ICT. User skills cover the utilisation of common generic software tools and the use of specialised tools supporting business functions within industries other than the ICT industry;

e-Business skills (also called e-leadership skills):

The capabilities needed to exploit opportunities provided by ICT, notably the Internet, to ensure more efficient and effective performance of different types of organisations, to explore possibilities for new ways of conducting business and

organisational processes, and to establish new businesses. e-Business skills are strategic and related in particular to innovation management, rather than technology-management, skills - which are part of ICT practitioner skills.

The focus in the present study has been on 'ICT practitioner skills' and 'e-leadership skills' whereby for the former the past developments and current status in terms of demand and supply are presented followed by scenario-based forecasts of the development until 2020. It is complemented by a pragmatic and applied definition of the term 'e-leadership skills', allowing for a first ballpark estimation of their prevalence and incidence in Europe.

2.2 The need for an e-Skills Vision[2]

In any sector of activity, forecasting labour demand and supply is a perilous exercise, because it depends on a large array of external factors such as the rate of growth of the economy, the dynamism of relevant markets (at home and abroad), or the output of the education sector (formal and vocational), to name only a few. In ICT, that exercise is made even more complex by the continuous flow of innovations (technological, commercial, organizational) that has affected the sector for the last few decades, and shows no sign of weakening.

In this kind of environment, decision and policy makers need to make decisions in which the medium and long-term horizons are blurred by multiple layers of uncertainty. This is typically the context in which a vision is required. An e-skills vision is hence all the more necessary that curricula cannot be changed overnight, and that recruitment decisions also carry some inertia that needs to be factored in. An e-skills vision needs to include at least three key elements, namely (1) a strategic identification of the goals, capabilities and opportunities of the organization considered (large firm, SME, public entity), (2) a flexible definition of the skills required to fulfil them, and (3) an agile action plan to continuously adapt and acquire those same skills, depending on the evolution of markets and external constraints.

Much of the efforts necessary can be developed in-house, focusing on a continuous effort to maximize alignment between business strategies, IT strategies and skills/HR strategies. Agfa (see box below) offers an excellent example of how this can be done across the relevant activities of a particular firm.

Box 1: The Digital Transformation at Agfa

Agfa[3] Transformation Program is a strategic re-orientation of Agfa, company-wide, launched in 2006 to secure the successful future of the Business groups by implementing new business models and business processes and by increasing their strategic autonomy, operational flexibility, financial independence, competitiveness and innovation. HealthCare grabbed this opportunity to redesign the way they work, the processes and IT application architecture and to transform into an "IT Software and Services Company". Agfa is uniquely positioned because of the strong customer relationship with one hospital out of two in the world and one printer out of two as customer. Various **business drivers** forced Agfa to "re-invent" itself. Drastic

[2] This section is excerpted from van Welsum, D. and Lanvin, B. (2012). " VISION report on eLeadership Skills"

[3] The Agfa-Gevaert Group develops, manufactures and distributes an extensive range of analogue and digital imaging systems and IT solutions, mainly for the printing industry and the healthcare sector, as well as for specific industrial applications. Its headquarters are located in Mortsel, Belgium. The group achieved a turnover of 3,023 million Euro in 2011. Agfa is commercially active worldwide through wholly owned sales organizations in more than 40 countries. In countries where Agfa does not have its own sales organization, the market is served by a network of agents and representatives.

changes of the requirements of customers in the various businesses involved triggered the global change of moving rapidly to "digital" and to "IT" solutions. Agfa had to anticipate these changes by diversifying from being mainly a supplier of physical goods to also become a world class vendor of software and services. "The challenge is to transform the Businesses while transforming itself."

The **mission** has been to design and implement new world class business processes and models enabling the company to serve customers better while improving productivity, competitiveness and operational excellence. Business processes have been harmonized globally and improved continuously. A business-driven information systems platform covering end-to-end processes in an integrated way have been implemented requiring significant change management in roll-out and usage. The **approach** covers the setup of Program Governance and ensures Business leadership and sponsorship of the Program. Experienced Business/IT resources are involved and implementation partners have been chosen based on experience/knowledge with large programs and new technology. A Process Office has been set up to ensure Business Process ownership, leadership and focus on process domains. Dedication, hard work, knowledge, and a belief to get a successful start-up are ingredients for successful change management. Hypercare after start-up and rollout of efficient Support Model for Process/System (ITIL and CoBIT compliant) are key components including training and documentation. **Critical Success Factors** are the sponsorship of Agfa Board and Executive Committee, the Regional/Country Business Management support and continuous measurement of compliance. This is a journey with IT people learning business skills and business people learning IT skills. This is a **global change program** driving operational excellence, innovation and growth in new products, services and IT solutions. A mission for the CIO and IT organization is to enable and drive the business to achieve these challenging business objectives and mission.

Contributed by Freddy van den Wyngaert, Chief Information Officer at Agfa

Yet, such efforts run the risk of remaining isolated (or diverging) across firms and organizations, unless they can use a common set of references, as well as a common framework but which some key functions can be identified. Such functions would remain as vital elements of any productive organization, whatever the pace (and possible disruptive nature) of future innovations. The European e-Competence Framework for ICT Professionals (see Box below) offers this kind of common reference, by stressing (inter alia) the importance of five 'building blocs' of any productive organization, namely : PLAN, BUILD, RUN, ENABLE and MANAGE.

Box 2: The European e-Competence Framework for ICT professionals

The European e-Competence Framework is structured around four dimensions reflecting different levels of business and human resource planning requirements in addition to job/ work proficiency guidelines:

Dimension 1: Five e-Competence areas, derived from the ICT business processes: PLAN, BUILD, RUN, ENABLE and 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 e-CF 2.0.

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: Samples of knowledge and skills relate to e-Competences in dimension 2. They are provided to add value and context and are not intended to be exhaustive.

It can be argued that within the 5 competence areas, in particular some of the skills described under PLAN, ENABLE and MANAGE (see the list below) are at the cross-over between ICT professionals and e-leadership skills, much like the changing role of CIOs found in INSEAD (2011) and IBM (2011) discussed in Section 2.4.

Source: The European e-Competence Framework 2.0, www.ecompetences.eu/ (last accessed 09.03.2012)

Last but not least, an e-skills vision needs to consider the practical ways in which curricula can be improved in order to produce the skills mix that employers will seek in the coming years. This is particularly important when companies (and public entities to some extent) grant priority to

recruiting the visionaries and implementers who will drive their innovation efforts. Recent efforts have been made by INSEAD (see box below) among those lines. They helped identify success factors for e-skills strategies, and offered guidelines for curricula development along those lines.

Box 3: Improving curricula to produce the right e-skills for innovation

In 2010, INSEAD eLab was contracted by the European Commission to produce a report entitled 'Strengthening e-Skills for Innovation in Europe'. The report identifies a number of critical success factors in successful e-competence building, including: (1) e-competences must go beyond ICT skills, (2) it is important to embrace and reward life-long learning – key skills often needed for those already employed and experienced (enterprise architecture, strategy and innovation), (3) academia, business and public sectors should engage regularly, focusing on complementarities rather than differences, (4) curricula should be stable, yet flexible, and should be vendor neutral.

The report also proposes six guidelines for successful curriculum development: (1) create appetite for potential students, (2) create relevance for industry and potential employers generally, (3) design curricula as a set of modules, making them easy to combine with other curricula, fostering multi-disciplinary approaches to e-competences, (4) design curricula in a way that allows graduates to maximize their ability to keep their knowledge up-to-date throughout their professional lives, (5) monitor the curricula design/delivery process with a view to constantly improve on them, and (6) create relevance for industry and potential employers generally.

Academia, industry and governments each have a role to play in putting these recommendations into action. For example, academia should work in close cooperation with business to guarantee the relevance and durability of the approach taken to re-shape their curricula, and link them to a subsequent life-long learning effort. Industry should strengthen the component 'personal development' in staff career plans, including by making life-long learning an incentive and a basis for performance rating. The three actors should work together to ensure the right equipment, teacher and educators' education are available. Universities and governments can also contribute to improving curricula by enhancing their use of new communications tools, showing "they practice what they preach". European institutions contribute by continuing to raise awareness about e-competence issues, and by encouraging and guiding national governments to further align their policies and actions with the objectives of building "the right curricula for the right competences".

Source: INSEAD, 2010b.

3 ICT Practitioner skills

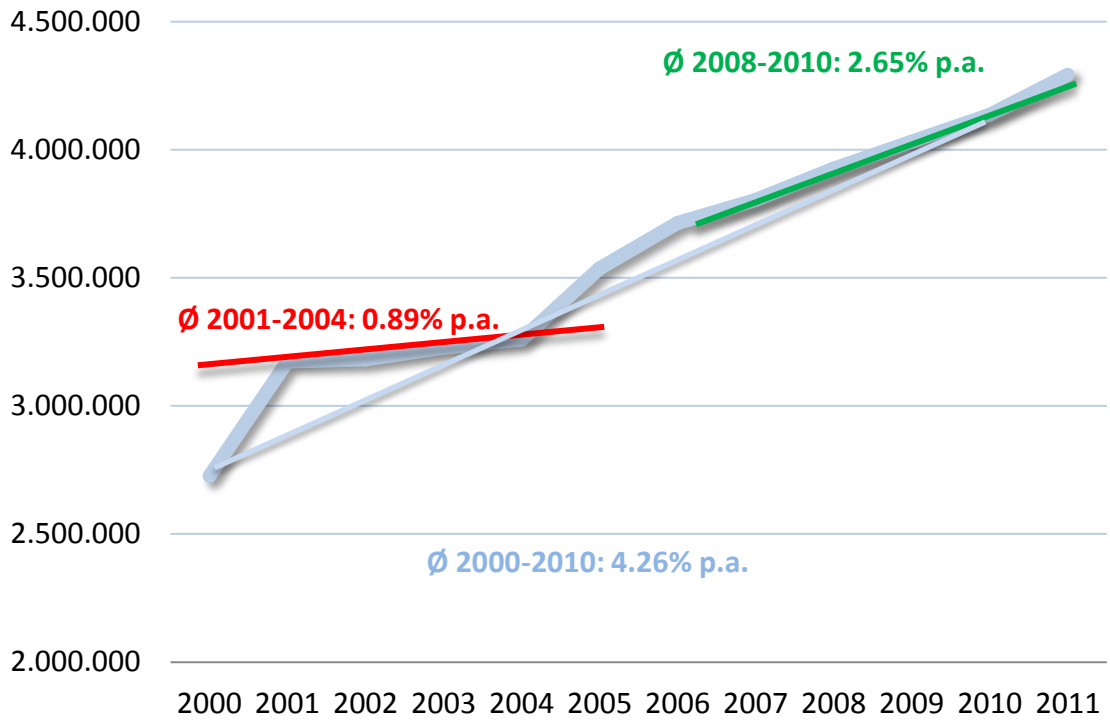
Authors: **Tobias Hüsing, Werner B. Korte, empirica GmbH**

3.1 ICT workforce in Europe today and developments from 2000 - 2010

The ICT workforce in Europe has been growing over the past decades and will continue to grow in the future. There has been a steady increase in the number of ICT practitioners in the workforce. And there is no indication that this trend will change. The annual growth of ICT employment has remained very robust throughout the crisis so far.

How large is the ICT workforce and how did it evolve in recent years? Using official statistics, we are limited to the latest data that is available, which at of the time of writing this report has been 2011 data. The development of the ICT workforce in Europe between 2000 and 2011 has been quite dynamic. The size of "ICT workforce" naturally depends on the definition used. If using a minimum definition, that only includes a core set of practitioners, in the first decade of the millennium, from 2000-2010, we have seen an average compound growth rate of 4.26%.

Figure: Development of Core ICT employment and annual growth rates in Europe 2000 - 2011



Source: Eurostat LFS. Narrow definition: 2000-2010 ISCO-88 groups 213, 312: "Computing professionals" and "Computer associate professionals". Break in series 2011: ISCO-08 groups 25 "ICT professionals", 35 "Information and communications technicians".

Growth of 4.26% means a doubling of stock every 17 years. It is arguably the case that continuous percentage growth (exponential growth) cannot be taken as trend-extrapolation in the longer to very long term, but for the short term horizon it will be a good heuristic to compare to.

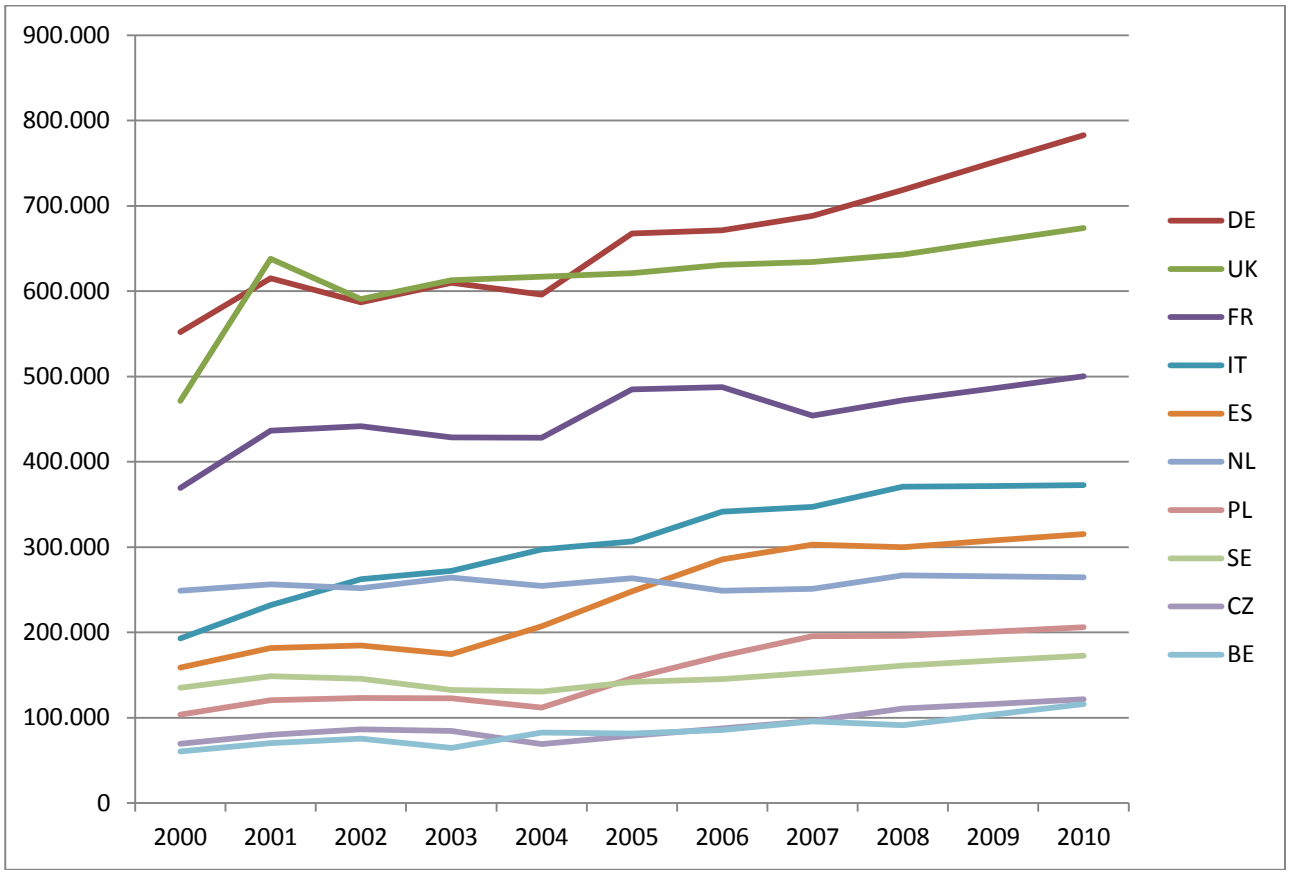
Europe and the world have seen two major economic crises in the first decade of the millennium. After the dot-com bubble burst in 2000, many firms in the ICT sector went bankrupt, were slashing employment or at least putting on the brakes in terms of new hiring. Consequently, ICT employment suffered as can be seen in the above diagram with only marginal increases for the years 2001-2004.

The banking crisis began to show in 2008, evolved into an economic crisis and sovereign debt crisis Europe is still trying to cope with today. Crass unemployment has been building up in many countries after 2009 until today. In terms of ICT employment, however, nothing similar seems to have happened. Between 2008 and 2010, ICT employment increased by on average 2.65% per year. For 2011, we even seem to see a slight acceleration but this may be due to a break in series.

From 2000 to 2010, the ICT workforce grew at an average annual rate (CAGR) of 4.26%. Even at the times of the economic and financial crisis, which Europe is undergoing since late 2008, growth remained at 2.65%. The labour market seems to absorb all ICT graduates even through the crisis.

ICT workforce developments at EU country level show an upward trend from 2000 across more or less all countries. The strongest percentage increase between 2000 and 2010 is found in Estonia, Luxemburg and Greece. Among the largest Member States, it is strongest in Poland and Spain.

Figure: ICT workforce (core) development in European countries 2000 - 2010



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
EU27	2.727,000	3.173,000	3.181,000	3.227,000	3.259,000	3.536,000	3.714,000	3.803,000	3.926,000	4.031,000	4.136,000
DE	552,000	615,000	587,000	610,000	596,000	668,000	671,000	688,000	719,000	751,000	783,000
UK	471,000	638,000	591,000	613,000	617,000	621,000	631,000	634,000	643,000	658,000	674,000
FR	369,000	436,000	442,000	429,000	428,000	485,000	488,000	454,000	472,000	486,000	500,000
IT	193,000	232,000	262,000	272,000	297,000	307,000	342,000	347,000	371,000	372,000	373,000
ES	159,000	182,000	185,000	175,000	207,000	248,000	286,000	303,000	300,000	308,000	315,000
NL	249,000	256,000	252,000	264,000	255,000	263,000	249,000	251,000	267,000	266,000	265,000
PL	104,000	121,000	123,000	123,000	112,000	146,000	173,000	196,000	196,000	201,000	206,000
SE	135,000	149,000	146,000	133,000	131,000	142,000	145,000	153,000	161,000	167,000	173,000
CZ	69,000	80,000	86,000	84,000	69,000	79,000	88,000	96,000	111,000	116,000	122,000
BE	60,000	70,000	75,000	65,000	83,000	81,000	86,000	96,000	91,000	104,000	116,000
DK	63,000	58,000	66,000	74,000	70,000	67,000	75,000	76,000	85,000	86,000	86,000
AT	56,000	63,000	70,000	69,000	58,000	67,000	67,000	67,000	74,000	76,000	77,000
FI	47,000	52,000	57,000	62,000	61,000	65,000	67,000	71,000	71,000	70,000	69,000
RO	:	:	:	:	:	39,000	56,000	62,000	64,000	64,000	65,000
HU	35,000	44,000	48,000	56,000	55,000	52,000	62,000	58,000	61,000	61,000	62,000
PT	32,000	44,000	47,000	46,000	43,000	51,000	58,000	62,000	52,000	53,000	54,000
SK	21,000	24,000	25,000	24,000	26,000	35,000	44,000	49,000	43,000	42,000	41,000
GR	15,000	14,000	19,000	19,000	23,000	24,000	24,000	27,000	25,000	29,000	32,000
IE	20,000	22,000	26,000	25,000	25,000	24,000	25,000	24,000	25,000	27,000	29,000
BG	13,000	14,000	12,000	14,000	18,000	21,000	23,000	28,000	29,000	28,000	27,000
SI	10,000	9,000	12,000	15,000	15,000	16,000	19,000	18,000	18,000	18,000	19,000
LV	10,000	7,000	8,000	11,000	12,000	14,000	13,000	14,000	14,000	14,000	14,000
LT	9,000	6,000	4,000	6,000	12,000	7,000	8,000	9,000	12,000	13,000	13,000
EE	4,000	5,000	9,000	5,000	4,000	5,000	7,000	8,000	9,000	10,000	10,000
LU	3,000	4,000	3,000	3,000	4,000	4,000	4,000	4,000	6,000	6,000	7,000
CY	2,000	3,000	2,000	3,000	3,000	3,000	3,000	4,000	4,000	4,000	3,000
MT	:	:	3,000	2,000	2,000	3,000	2,000	3,000	3,000	3,000	3,000

***Source**: Eurostat LFS: based on ISCO-88 codes 213, 312. Rounded to the next 1000.*

***Notes:** Not comparable to 2011 data using ISCO-08 codes. "Workforce" includes employed and self-employed persons.*

Regarding the size of the workforce, there are different definitions in use and therefore the next chapter shall define our usage of the term.

3.2 Definitions

The ICT workforce in Europe in 2011 amounted to 6.667[4] million, which is 3.1% of the overall workforce. 5.245 million of these come from the occupational groups representing ICT practitioners and 1.422 million can be described ICT professionals at management level and include CIOs, ICT operations managers, project managers but also those ICT workers responsible for planning and strategy such as enterprise architects, systems analysts and ICT consultants.

If we include the ICT mechanics and manual workers skills 3.7% of the European Labour Force, or more than eight million workers in the EU are ICT professionals, which is based on job classifications used in the Labour Force Surveys. As can be seen from the following figure the share can go up to 6 % in some countries.

Of these ICT professionals, one in six is holding a highly skilled Management and / or Business Architecture level skills position but the vast majority can be found in the core group of ICT practitioners (for definitions see annex 1).

The ICT workforce will be defined according to occupational categories from the ISCO – International Standard Classification of Occupations 2008 and the quantifications will make use of the figures from the Labour Force Surveys (LFS) of the EU-27 Member States provided by Eurostat. We have carried out a mapping of ISCO-08 codes to the e-CF based ICT profiles since data based on e-CF definitions is not directly available.

The ICT workforce as used in this report includes

- Management and Business Architecture level skills
- Core ICT practitioners skills
- Other ICT technicians skills

Our usage of the term will usually not include

- ICT mechanics and manual workers skills[5].
- Non-ICT professionals working in the ICT sector.

The relevant ISCO codes are as follows:

[4] For our model calculations, we were encouraged by the experts attending our validation workshops to include in our model a 2% natural unemployment rate. We therefore speak in this report sometimes of a 6.67 million workforce and sometimes of 6.53 million jobs (equalling 98% of 6.67 million). 6.67 million is the number generated from Eurostat's Labour Force Survey database which counts people according to their occupation.

[5] ICT mechanics and manual workers skills are not included in the ICT professional category and are not included in the vacancy calculations.

They comprise: 7421: Electronics mechanics and servicers; 7422: Information and communications technology installers and servicers; 8212: Electrical and electronic equipment assemblers.

Management and architect positions			
1330	Information and communications technology service managers		
2421	Management and organization analysts [6]		
2511	Systems analysts		
ICT Practitioners			
2152	Electronics engineers	3511	Information and communications technology operations technicians
2153	Telecommunications engineers	3512	Information and communications technology user support technicians
2356	Information technology trainers	3513	Computer network and systems technicians
2434	Information and communications technology sales professionals	3514	Web technicians
2512	Software developers	3114	Electronics engineering technicians
2513	Web and multimedia developers	3139	Process control technicians not elsewhere classified
2514	Applications programmers	3252	Medical records and health information technicians
2519	Software and applications developers and analysts not elsewhere classified	3155	Air traffic safety electronics technicians
2521	Database designers and administrators	3211	Medical imaging and therapeutic equipment technicians
2522	Systems administrators	3521	Broadcasting and audio-visual technicians
2523	Computer network professionals	3522	Telecommunications engineering technicians
2529	Database and network professionals not elsewhere classified		

As far as possible a distinction will be drawn in the subsequent quantifications between the management level skills and ICT practitioner skills.

More detailed descriptions are provided in annex 1.

ICT workforce in Europe in 2011

	i Management and Business Architecture level skills	ii Core ICT practitioners skills	iii Other ICT technicians skills	iv Total ICT professionals (i+ii+iii)	v ICT mechanics and manual workers skills	Total very broad ICT workforce (i+ii+iii+v)	Total as share of workforce
EU-27	1.422,000	4.239,000	1.006,000	6.667,000	1.390,000	8.058,000	3,7%
UK	383,400	918,300	40,800	1.342,500	138,800	1.481,300	5,1%
DE	304,600	677,200	164,900	1.146,700	225,900	1.372,600	3,5%
FR	95,900	499,600	244,700	840,100	90,900	931,100	3,6%
IT	64,600	409,700	91,500	565,800	172,000	737,800	3,2%
ES	74,200	322,600	75,500	472,300	132,300	604,500	3,3%
PL	51,300	220,500	91,000	362,800	126,700	489,400	3,1%
NL	127,700	154,900	33,300	315,800	23,300	339,100	4,1%
SE	87,400	118,700	28,900	235,000	37,500	272,500	5,9%
BE	38,800	108,200	21,500	168,500	33,000	201,500	4,5%
CZ	9,400	125,500	28,400	163,300	52,400	215,700	4,4%

[6] According to the ISCO code 2421 "Management and organization" includes non-ICT consultants as well as ICT consultants. Our estimation based on limited empirical evidence for Germany is that at least 50% are ICT consultants; therefore the number of jobs is multiplied with 0.5.

	i Management and Business Architecture level skills	ii Core ICT practitioners skills	iii Other ICT technicians skills	iv Total ICT professionals (i+ii+iii)	v ICT mechanics and manual workers skills	Total very broad ICT workforce (i+ii+iii+v)	Total as share of workforce
AT	25,400	77,700	28,100	131,300	22,500	153,800	3,7%
FI	28,900	85,600	10,700	125,200	19,700	144,900	5,9%
RO	20,900	81,800	19,100	121,700	80,100	201,800	2,2%
DK	21,700	75,500	17,800	115,000	9,300	124,300	4,6%
HU	6,500	70,200	11,600	88,200	75,000	163,200	4,3%
PT	10,400	55,800	20,400	86,600	22,100	108,600	2,2%
SK	8,800	41,200	35,200	85,200	43,700	128,900	5,5%
IE	11,500	48,400	2,100	62,000	20,200	82,100	4,5%
BG	15,000	35,400	10,700	61,100	16,600	77,700	2,7%
GR	9,100	38,300	12,900	60,300	12,900	73,300	1,8%
SI	7,700	16,800	4,300	28,700	12,700	41,400	4,4%
LV	5,900	15,800	2,600	24,300	2,100	26,400	2,8%
LT	4,700	12,800	4,400	21,900	5,700	27,600	2,0%
EE	2,700	14,000	2,800	19,500	8,500	28,000	4,7%
LU	2,100	6,500	1,300	9,800	1,000	10,800	4,8%
CY	1,900	4,200	1,000	7,000	2,600	9,500	2,5%
MT	1,300	3,800	1,200	6,200	3,200	9,400	5,6%

(according to Eurostat Labour Force Survey (LFS))7

Source: *empirica calculations based on an LFS data retrieval done by Eurostat.*

Notes: *The data are averages of Q1 and Q2 data 2011. ISCO08 -based definitions are found in the annex.*

The majority of ICT practitioners are working across the whole industry and in almost all sectors of the economy, and not just in the ICT industry sector, and it appears reasonable to assume that almost full employment[8] of this occupational group exists in Europe.

The share of the ICT workforce within the total workforce varies significantly across the European countries. Almost half of the EU Member States show shares below the EU-27 average with countries like Greece, Lithuania and Romania but also Portugal, Cyprus, Bulgaria and Latvia remaining at levels below, Greece even below 2%. The other extreme include countries like Sweden and Finland but also Malta, Slovakia and the United Kingdom with a share of above 5% and almost 6% in the above Nordic countries.

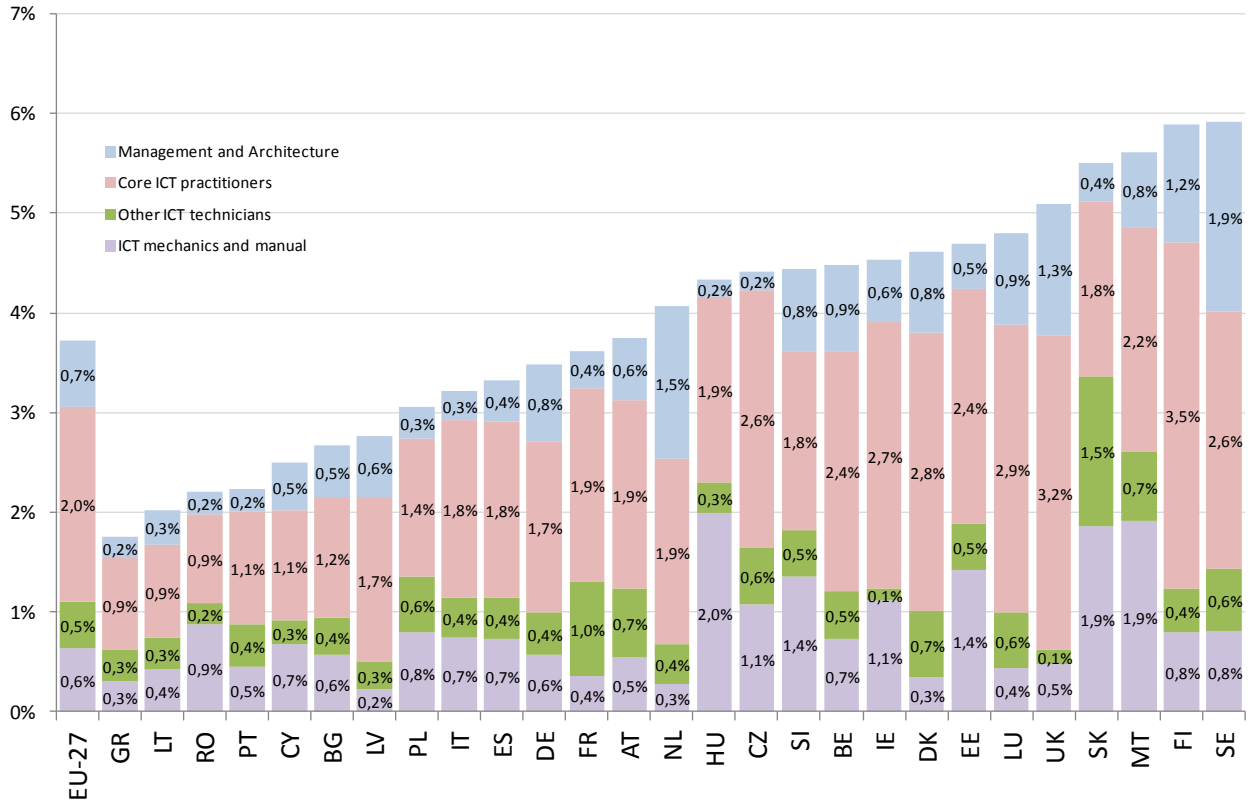
There are also large differences according to type of occupation and it becomes apparent that in those countries with the largest relative share of ICT workforce in the overall workforce, the management level occupations are at significantly higher levels. While in Sweden almost 2% of the ICT workers belong to this group, the figures reaches above 1% also in countries like the Netherlands, the United Kingdom and Finland followed by Luxembourg, Malta and Germany slightly below 1%. At least in these countries the trend towards higher-level skills in the ICT workforce is

[7] The underlying ISCO-08 codes to each of these categories are mapped in the Annex.

[8] As for the forecast model, we assume that full employment is reached at an unemployment rate of 2%. We model this as a natural rate of unemployment that will not be fallen short of.

already being reflected in the statistical figures with the share of lower skilled ICT workers showing comparatively low shares compared to other countries.

ICT workforce* by occupation type in Europe 2011



***Source**: Eurostat LFS: based on ISCO-88 codes 213, 312.*

***Note:** *Figures include ICT mechanics and manual workers skills, which are not part of the definition used above.*

3.3 ICT graduates in Europe 2000 - 2010

The major inflows into the ICT workforce obviously come from the ICT graduates from universities. The e-skills supply in Europe in 2010, i.e. the number of ICT graduates from universities summed up to 113,000 ICT graduates[9]. A closer look at the developments over the past 10 years shows a trend indicating decreasing numbers throughout Europe for the past years, but especially in the United Kingdom and Sweden. After a continuous increase and a peak of 127,000 ICT graduates leaving universities in 2006 the figures went down.

The interest in pursuing ICT careers seems to be diminishing. The number of computer science graduates was growing in the past, but has been in continuous decline in Europe since 2005. Even

[9] This figure represents a count of first degrees in ISCED 5A and first qualifications in 5B. The number of students entering the labour force in a given year does not equal but is approximated by this number of graduates, as many will go on to second or further degrees (master, PhD). However, also counting second degrees would mean that every student is counted more than once, even if in different years. By counting only first degrees/qualifications, every graduate will be counted only once (except the supposedly very rare cases of doing both a 5A and 5B degree), even if labour market entry may be at a later point in time. However, there may be an issue of double counting with initial vocational degrees (ISCED 3 and 4), to which individual learners may later add an ISCED level 5 degree.

more, the speed of decline is what makes the situation rather dramatic with the number of ICT graduates from university decreasing even more drastically than expected.

The effect of the decrease in the number of entrants to the ICT workforce is intensified in Europe by an increasing number of exits as ICT practitioners leave the workforce.

The most dramatic increase can be observed in the UK. In this country the number of graduates in 2009 went down to just 68% of those who had graduated in 2006. Decreases can also be observed in the other countries except Germany.

With these figures the UK contributes 17% of the European computer science graduates to the labour market, a figure which is significantly below what it had been with 31% in 2000.

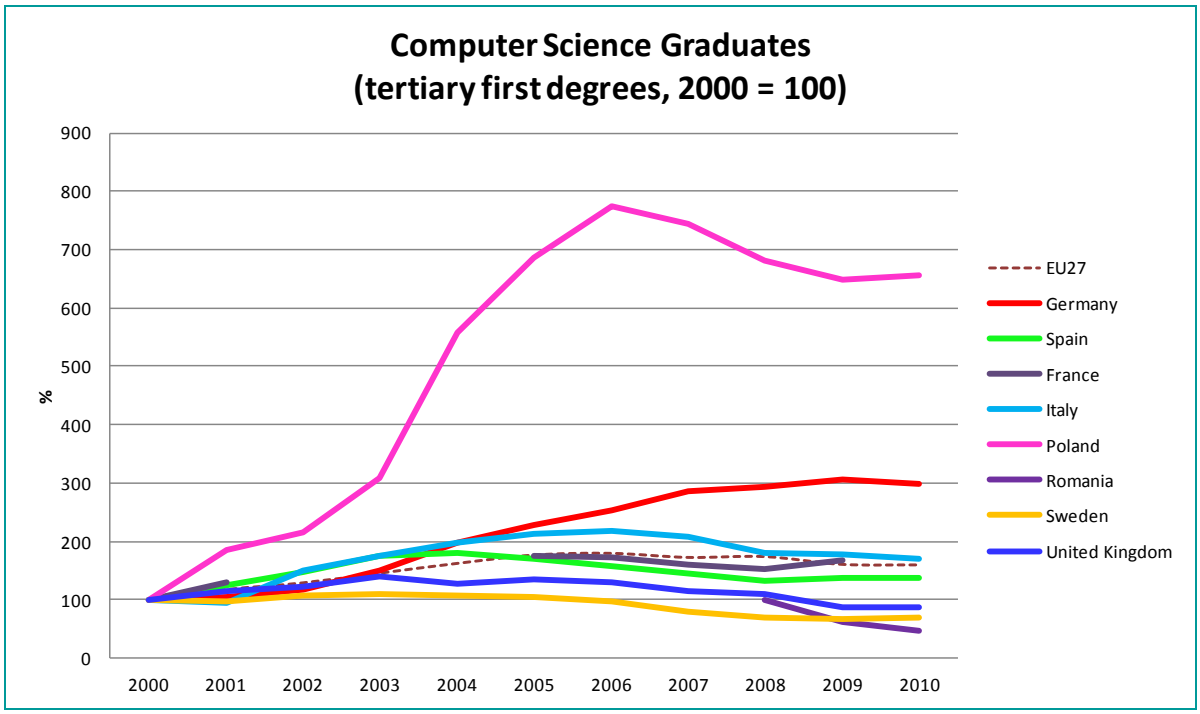
Development computer science graduates in European countries 2000 – 2010

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
EU-27	70.976	83.459	91.604	103.343	113.580	123.111	**124.999**	118.942	119.786	113.929	113.281
UK	21.918	24.992	27.009	**30.767**	27.670	29.557	28.239	25.156	23.802	19.154	19.180
France	11.447	14.841	14.841	16.081	16.081	**20.094**	19.673	18.409	17.551	19.136	19.136
Germany	5.630	5.860	6.617	8.368	11.090	12.767	14.238	16.092	16.515	**17.194**	16,800
Spain	10.963	13.727	16.152	19.323	**19.718**	18.559	17.298	15.760	14.551	15.071	15.068
Poland	1.912	3.542	4.112	5.879	10.681	13.116	**14.788**	14.209	13.023	12.406	12.535
Netherlands	1.308	1.454	1.645	1.620	3.511	3.902	**4.617**	4.385	4.078	3.918	3.858
Czech Republic	2.328	2.676	2.734	1.215	1.498	1.643	2.133	2.406	2.909	**3.047**	2.939
Italy	1.626	1.519	2.423	2.843	3.211	3.459	**3.541**	3.385	2.933	2.870	2.778
19 other Member States	13.844	14.848	16.071	17.247	20.078	20.014	20.472	19.140	**24.424**	21.133	20.987

Relative to peak

EU-27	57%	67%	73%	83%	91%	98%	100%	95%	96%	91%	91%
UK	71%	81%	88%	100%	90%	96%	92%	82%	77%	62%	62%
France	57%	74%	74%	80%	80%	100%	98%	92%	87%	95%	95%
Germany	33%	34%	38%	49%	64%	74%	83%	94%	96%	100%	98%
Spain	56%	70%	82%	98%	100%	94%	88%	80%	74%	76%	76%
Poland	13%	24%	28%	40%	72%	89%	100%	96%	88%	84%	85%
Netherlands	28%	31%	36%	35%	76%	85%	100%	95%	88%	85%	84%
Czech Republic	76%	88%	90%	40%	49%	54%	70%	79%	95%	100%	96%
Italy	46%	43%	68%	80%	91%	98%	100%	96%	83%	81%	78%
19 other Member States	57%	61%	66%	71%	82%	82%	84%	78%	100%	87%	86%

Source: *Eurostat*



Source: *Eurostat*

Should e-skills supply continue to evolve as it looks today, the European economy is faced with severe e-skills problems.

e-skills excess demand is likely to increase rather significantly when the current economic crisis comes to an end; the e-skills gap will widen and we may be faced with an increasing excess demand for e-skilled workers

3.4 E-skills demand in Europe 2012

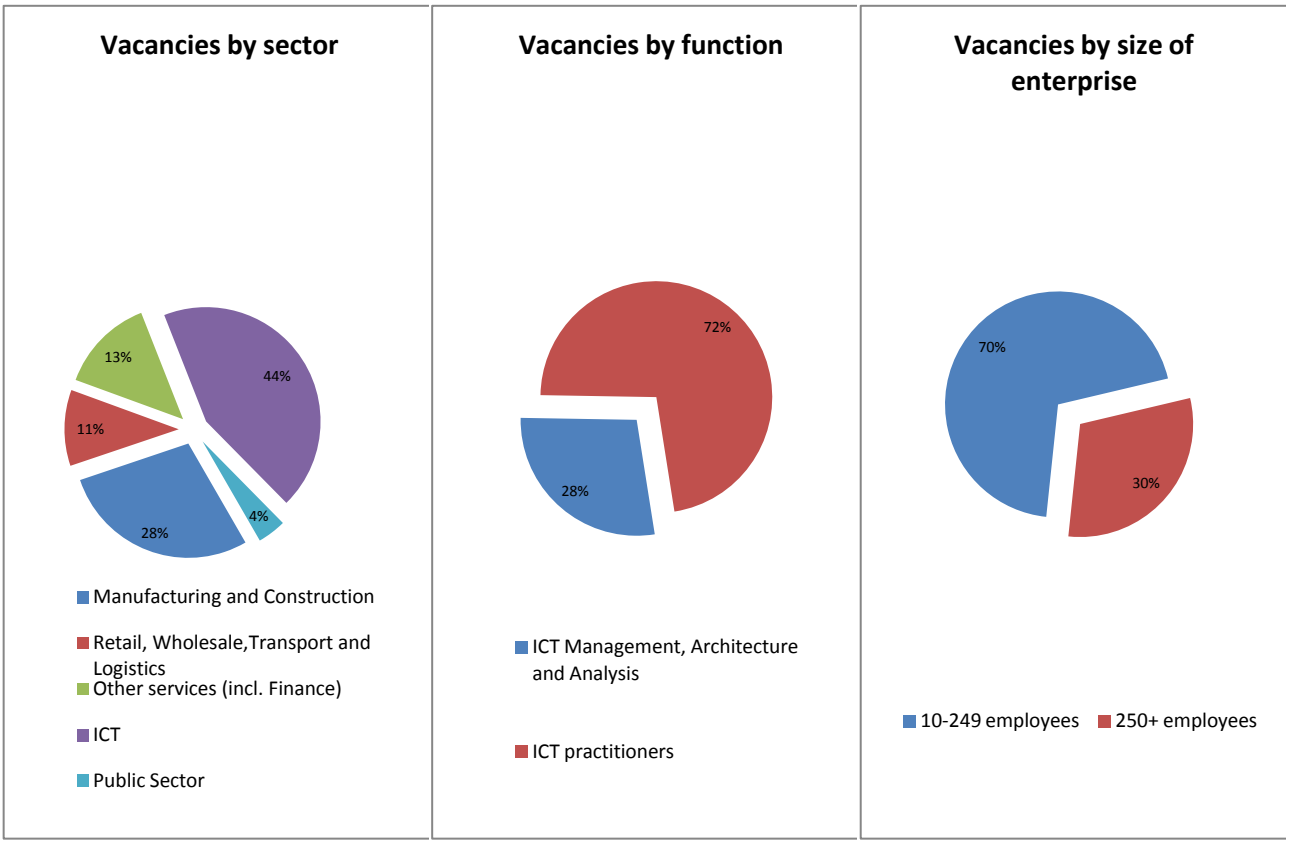
3.4.1 ICT skills shortages

Today, demand for ICT workers is outstripping supply. The results of a representative empirica survey of CIO's and HR managers in eight European countries in 2012 show that the demand for e-skills, i.e. ICT professionals and practitioners, extrapolated to the whole of Europe (EU-27) can be estimated at around 255,000 in 2012. This is the number given by CIOs and HR managers in European organisations for the number of vacancies in ICT-related occupations.

Among these, we find a demand of about 72,000 vacancies for the EU-27 for "ICT management and business architecture" skills and about 183,000 for "Core ICT practitioners" and "Other ICT technicians" jobs.

Of these vacancies, 73,000 are reported in Germany, which shows by far the largest excess demand of all countries. With the economic situation currently differing as it does between Member States, differences are visible with regards to national levels of demand. Relative to its ICT workforce, the excess demand is largest in Sweden, where one vacancy is reported per 13 existing ICT-jobs.

Figure: Vacancies for ICT professionals in European countries in 2012
(according to the empirica CIO and HR managers survey, 2012) 10



Source: Empirica, CIO and HR managers survey Apr-Jun 2012

It has been speculated that while demand for ICT practitioners and professionals massively exceeded supply in the boom phase of recent years, the current economic crisis would be suppressing demand to the extent that demand and supply of e-skills are close to numerical balance. However, these figures suggest that demand for ICT practitioners and professionals remains high, albeit geographically biased due to differences in the economic cycles.

70% of vacancies can be found in SMEs. SMEs have much larger problems in recruiting the relevant e-skilled professionals needed than larger organisations. There is no indication for this situation to change.

With almost 200,000 open posts, the number of vacancies is significantly higher for ICT Practitioners compared to the ICT management and business architect level professionals with around 75,000 vacancies. As percentage of existing workforce, there are 3.7% open positions for practitioners and 5.3% for management and architecture jobs.

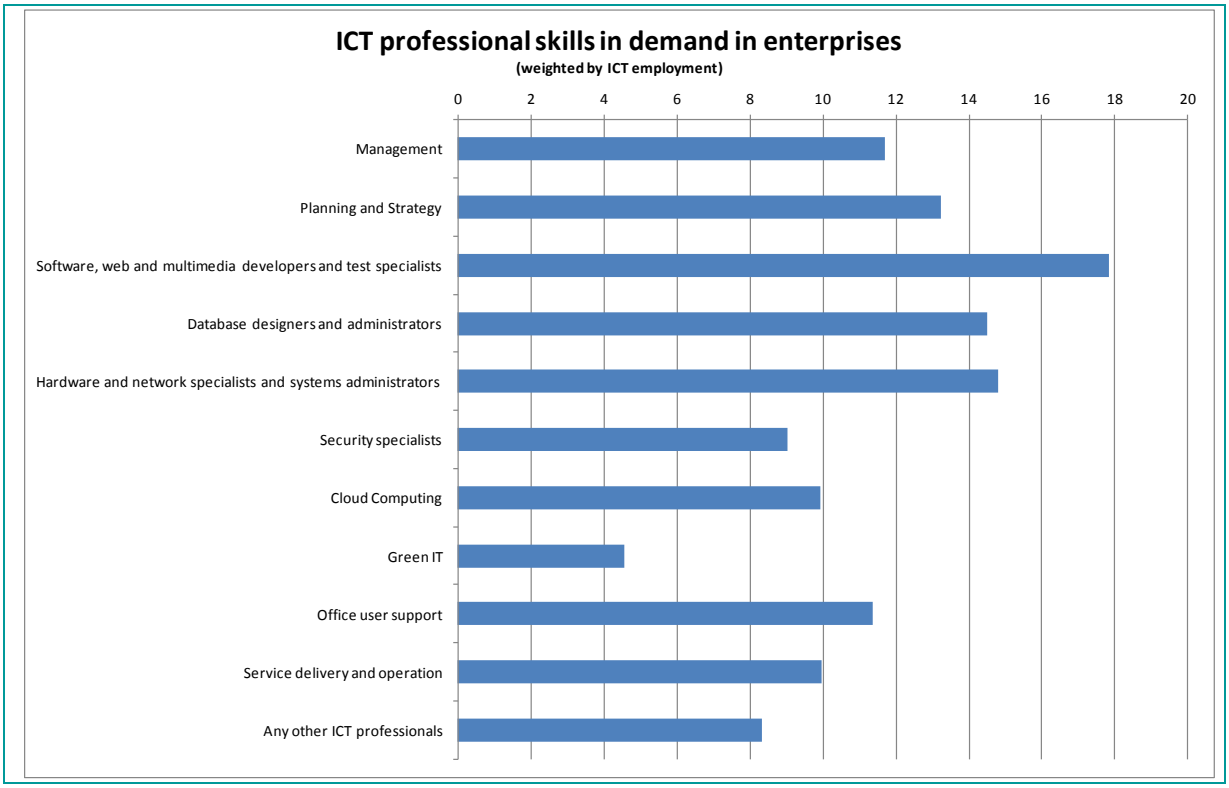
The ICT and telecommunications sectors with around 110,000 vacancies shows the highest demand for ICT professionals followed by the manufacturing industry with 72,000 vacancies and with the public sector at the tail end with 10,000 open posts for ICT practitioners in Europe.

3.4.2 Type of skills of ICT professionals in demand

[10] See brief methodological notes in the Annex

HR managers and CIO respondents see demand and vacancies for ICT professionals predominantly in the core ICT competency areas. Developers represent the group of skills that will be in highest demand. They were mentioned by enterprises representing 18% of ICT employment. They were followed by two other categories of core ICT worker skills, namely hardware and data base specialists. On rank 4 and 5 the higher-level skills categories "management" and "planning and strategy" were found.

Figure: Future e-skills demand in enterprises according to HR/CIO-survey



Source: *Empirica, HR/CIO survey Apr-Jun 2012. Note that figures are weighted by ICT employment, meaning percentages should be read as respondents representing x% of ICT employment.*

Note: *These figures cannot be added up and do not represent any actual number of vacancy information but just represent the skills and competences generally sought after (as a yes/no question) by HR managers in the next two years. Combinations of skills will apply for most job openings.*

Future e-skills demand will increasingly occur in higher-level ICT jobs including the management, planning and strategy and ICT development specialist occupations and less in ICT support, delivery and operation, i.e. infrastructure type occupations.

3.5 ICT professional workforce forecasts 2011 – 2020

Two synthesis scenarios and five initial scenarios have been prepared in the course of the study. The five initial scenarios are meant to span the space of likely possible futures. In order to condense the information contained in these five scenarios, it was later agreed to produce two synthesis scenarios, which set a corridor of most likely outcomes.

3.5.1 Methodology

Definition

The focus of the e-skills forecasting in this chapter will be on ICT professionals (i.e. management level ICT occupations and practitioner level ICT occupations) as exemplified previously in this document. For the purpose of forecasting demand and supply of e-skills we conceptually differentiate between stocks and flows, or between a baseline market and dynamic entries and exits. The baseline basically consists of a number of existing jobs, number of vacancies and number of unemployed ICT practitioners. Entries and exits are modelled as graduates.

Supply side model

The availability of individuals with the different types of e-skills who are either gainfully employed or seeking employment is termed e-skills supply to the labour market.

As mentioned above, the e-skills supply **stock** includes individuals in ICT practitioner positions and unemployed ICT practitioners. The scope of e-skills supply depends on the scope of the e-skills definition used and is obviously not static.

E-skills **inflows and outflows** to/from the labour market need to be identified and statistically measured and future developments modelled to gain a comprehensive and complete picture of e-skills supply in the market. To capture market dynamics, i.e. the inflows and outflows of individuals in the pertinent e-skills categories, specific approaches need to be developed.

New market entrants typically are computer science graduates of tertiary education entering the labour market. In many countries (Germany and Poland in particular) also post secondary vocational training plays a major role as supply pool.

Anecdotal evidence supports the observation that the share of computer science graduates has increased in ICT recruitment over the last decade[11], yet other graduates, from mathematics, natural sciences, engineering or social sciences who possess the IT skills demanded still today fill ICT positions that would otherwise remain vacant.

While it is relatively easy to approximate an adequately accurate annual supply of university leavers and vocational school leavers with a major in ICT, any attempt to distil a supply pool from the official statistics about natural science, maths, social sciences graduates has to rely on evidence

[11] A UK study of 2001 still found that „the majority of graduates working in ICT jobs do not hold a degree in an ICT related subject. While the most common degree subject is maths or computing (40 per cent), others include engineering and technology (21 per cent), physical sciences (11 per cent) and business studies (nine per cent). Graduates employed as computer analysts/programmers display the greatest range of degree subjects. Also, female graduates working in ICT occupations are more likely to have degrees in non-ICT or non-technical subjects (e.g. social sciences).

(THE INSTITUTE FOR EMPLOYMENT STUDIES (2001): An Assessment of Skill Needs in Information and Communication Technology.

http://dera.ioe.ac.uk/15250/1/An%20assessment%20of%20skill%20needs%20in%20ICT.pdf)

based assumptions and auxiliary hypotheses about the share of outsiders entering the ICT workforce.

Also career changers originally coming from a non-ICT background may take on ICT positions, furthermore re-entrants who had been out of the labour market previously. While recent research (e-skills QUALITY Study: www.eskills-quality.eu) shows that certification has become crucial for ICT practitioners across all backgrounds, it can be assumed that especially for "educational outsiders" certification and re-skilling programmes play a crucial role in adapting the workforce skills to the demand side requirements.

Finally, immigration is a source of additional supply to the market.

Certifications and re-skilling programmes play a crucial role in adapting the workforce skills to the demand side requirements.

Supply side exits may be due to retirement, temporary leave (e.g. parental leave) and emigration of ICT workers as well as promotion or other career change to non-ICT jobs (– or jobs at least not statistically captured as ICT jobs).

The necessary statistical data regarding university graduations is publicly available from Eurostat. Further inflow indicators of relevance - which could be considered subject to availability of the necessary data - include data from immigration and career changers or market re-entrants.

Outflow data would mainly include statistics on retirements, emigration, career changers or re-entrants. This kind of data is hardly available across countries and estimates have to be based on analogies.

Demand side model

What is "demand"? Conceptually, demand is the size of the workforce that the market would absorb shortly given that the current wage level prevailed. Markets tend to adjust via the price or quantity offered of the commodity. However, certain limitations apply in the labour market in the short term as regards the availability of skills, and obviously also with regards to the wages employers are willing to pay.

While a short-term demand can be computed by adding existing and open posts, future demand will be highly path dependent. A planned demand that cannot be satisfied today and over a longer period and where prospects of filling it are meagre will eventually lead to evasive movement on the demand side, i.e. changes in the production structure. Therefore it is crucial to understand the concept of future "demand potential" which will be a demand given the path described in the scenario is actually taken.

Demand potential up until 2020 is calculated and estimated using the following observations:

- ICT workforce growing over the past decade
- Annual growth of ICT employment has remained very robust throughout the crisis
- Correlation between the ICT workforce – GDP and IT investment disappearing somewhat
- Less influence of economic cycles
- Stronger indication of "mega-trend"
- Consequence for foresight: Heavier weighting of "trend" in favour of "economic situation"

The approach contains the following inputs:

- Market insight data on enterprise IT spending
- Market insight data on hardware, software, services: IT Budgets

- Market insight data on Consulting Budgets
- (Semi-) Official Statistics on IT spending / IT investment (EITO, Eurostat)
- An evidence based estimate on the split of IT budgets into hardware, software, services
- Estimation of Labour costs, internal and external
- Correlation with GDP growth, IT investment and IT labour market
- Scenario outputs on the assumptions of GDP growth, IT investment which leads to estimations of IT labour demand (costs)
- Assumptions on wage developments and IT labour costs result in an estimation of IT labour headcount
- Cloud computing is included to take massive effect from 2015 on
- Scenarios furthermore deliver assumptions on the distribution of IT labour costs into a) management / business architecture level, b) core ICT practitioners and c) ICT technicians. Cloud computing mainly puts pressure on ICT practitioner demand, while lifting demand for management / business architecture type of skills.

As is inherent in the concept of demand *potential*, adjustments to supply shortage need to be made in the scenarios.

Assumptions for forecasting future e-skills developments

Several assumptions for forecasting the future e-skills developments in Europe have been developed which build the basis for the calculation of e-skills demand and supply for the period up until 2020. These relate to the:

- Entry rate of ICT graduates, both from tertiary and vocational education (ISCED 3-5) into the ICT workforce;
- Development in the numbers of ICT graduates from tertiary education from 2011 to 2015 and 2020 varying between the different scenarios;
- Development in the numbers ICT graduates from vocational education from 2011 to 2015 and 2020;
- Entry rates of STEM graduates entering the ICT workforce;
- Upgrading of skills of outsiders and career changes through IBTC (estimated number of awarded industry-based ICT training certifications);
- Replacement demand of ICT practitioners and ICT management staff leaving the workforce annually (Cedefop based);
- Expansion demand varying according to scenario with a baseline based on applying historical correlations of GDP and ICT investment and a trend component;
- ICT Management recruitment (ICT managers, enterprise architects, ICT consultants) specifying a percentage of individuals from the ICT practitioner pool getting promoted to management level and those coming from the business management pool;
- Excess demand baseline 2011 based on empirica CIO / HR manager survey on ICT vacancies, 2012;
- Intra-EU migration from excess supply to excess demand countries (only in those years and from those countries where excess supply exists).

3.5.2 First synthesis scenario: "Cautious Growth"

The first synthesis scenario called "Cautious Growth" features an economic growth scenario with a slow return to historical growth trajectories and slow recovery. GDP growth across Europe is assumed at an average of 0.92% compound annual growth rate between 2010 and 2015 and increases to 1.65% on average annually between 2015-2020.

Moderate IT investments will be reflected in 2.1% p.a. growth until 2015, with an increasing trend from 2014 on, so that the second half of the decade will see a growth rate of 4.3% on average. IT investments will not least build upon a rapid diffusion of mobile devices and apps and of cloud services and other new IT delivery models. Big data applications and services are expected to grow considerably from 2014 on.

SME investments in IT innovation will increase only very slowly because of the slow recovery and persistence credit crunch.

In the education domain, we will see a slight increase in the number of ICT graduates and some labour mobility. Private funding for education and training will be at a moderate level. In the social domain, data driven commercial services on the web, also driven by mobile devices, will imply some "big brother" risks. Politically we will see a continuing incremental process of building Europe step by step. Continuing negotiations between Member States will bring about gradual and cumulative progress in European cohesion.

Forecasting results

In the 'Cautious Growth' scenario, the ICT workforce in Europe will grow from 6.53 million in 2011 to 7.09 million in 2020 whereby 5.15 million will be ICT practitioners and 1.95 million ICT management level employees.

e-Skills Jobs – 'Cautious Growth' scenario:
Development ICT Professional e-skills Jobs in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.39	1.40	1.42	1.46	1.51	1.59	1.67	1.76	1.85	1.95
ICT Practitioners	5.14	5.11	5.07	5.12	5.13	5.14	5.14	5.14	5.15	5.15
Of which: Application Development	*1.95*	*1.93*	*1.92*	*1.94*	*1.95*	*1.96*	*1.98*	*1.99*	*2.01*	*2.02*
Of which: Infrastructure	*2.37*	*2.36*	*2.35*	*2.37*	*2.37*	*2.38*	*2.37*	*2.37*	*2.37*	*2.36*
Total	**6.53**	**6.51**	**6.49**	**6.57**	**6.64**	**6.73**	**6.82**	**6.90**	**7.00**	**7.09**

Source: empirica model forecast.

We see a slight upturn in the share and total number of application development jobs and a stable number of more infrastructure related jobs[12].

[12] **Application development jobs** are defined to comprise in terms of ISCO-08 codes (in order of number of jobs in EU-27): Software developers (2512), Applications programmers (2514), Software and applications developers and analysts not elsewhere classified (2519), Database designers and administrators (2521), Database and network professionals not elsewhere classified (2529), and Web and multimedia developers (2513). **Infrastructure related jobs** are seen to comprise (in order of number of jobs in EU-27): Information and communications technology operations technicians (3511), Information and

While a general trends towards practitioner shortages can be observed, there will even be some practitioner unemployment in some countries but only for a few years, due to little / lacking mobility across the EU. These countries are most notably Poland and Spain. Poland sees an oversupply mainly due to the steady and strong output of graduates from tertiary and vocational education, while Spain suffers from a slump in demand.

e-Skills unemployment - 'Cautious Growth' scenario

EU27 - Cautious Growth	2011	2015	2020
Unemployment - Management	28,000	30,000	39,000
Unemployment - Practitioners	103,000	123,000	110,000
Unemployment - Total	**131,000**	**154,000**	**149,000**

Source: empirica model forecast.

e-Skills Supply - 'Cautious Growth' scenario:
Development ICT Professional e-skills Supply in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.42	1.43	1.45	1.49	1.54	1.62	1.71	1.80	1.89	1.99
ICT Practitioners	5.25	5.28	5.28	5.28	5.26	5.26	5.26	5.26	5.27	5.27
Total	**6.67**	**6.70**	**6.73**	**6.77**	**6.81**	**6.88**	**6.97**	**7.06**	**7.16**	**7.25**

Source: empirica model forecast.

In this scenario the demand potential for ICT workers will reach beyond the above 7.25 million in 2020 and amount to 7.98 million.

e-Skills Demand Potential - 'Cautious Growth' scenario:
Development of ICT Professional e-skills Demand Potential in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.47	1.50	1.54	1.62	1.71	1.81	1.91	2.01	2.11	2.21
ICT Practitioners	5.32	5.22	5.18	5.22	5.30	5.39	5.50	5.59	5.69	5.77
Total	6.79	6.72	6.72	6.83	7.02	7.21	7.41	7.60	7.80	7.98

communications technology user support technicians (3512), Computer network and systems technicians (3513), Electronics engineers (2152), Systems administrators (2522), Electronics engineering technicians (3114), Telecommunications engineers (2153), Computer network professionals (2523), Telecommunications engineering technicians (3522). We do not provide a specific forecast and therefore do not include in the above table **Specialist Technicians:** Web technicians (3514), Process control technicians not elsewhere classified (3139), Medical records and health information technicians (3253), Air traffic safety electronics technicians (3155), Medical imaging and therapeutic equipment technicians (3211), and Broadcasting and audio-visual technicians (3521). We do not provide a specific forecast and therefore do not include in the above table **Enablers:** Information technology trainers (2356) and Information and communications technology sales professionals (2434).

The **excess demand** or shortage (calculated as the number of open posts)[13] amounts to **373,000 in 2015** and **889,000 in 2020**. This figure can best be described as **'demand potential' or 'job potential' for ICT jobs**. It should be seen as a (theoretical) figure describing the demand potential for new ICT jobs which – under the above assumptions – could theoretically and additionally be created in Europe due to an e-skills demand likely to occur especially in the years closer to 2020.

When comparing the figures from the above tables it becomes apparent that in 2020 the labour market would be able to absorb 630,000 of these potential additional jobs which could be created in ICT practitioner occupations and around 260,000 at ICT management level.

e-Skills Vacancies Estimate- 'Cautious Growth' scenario:
Summing-up of National ICT Professional Excess Demand in Europe 2011 – 2020

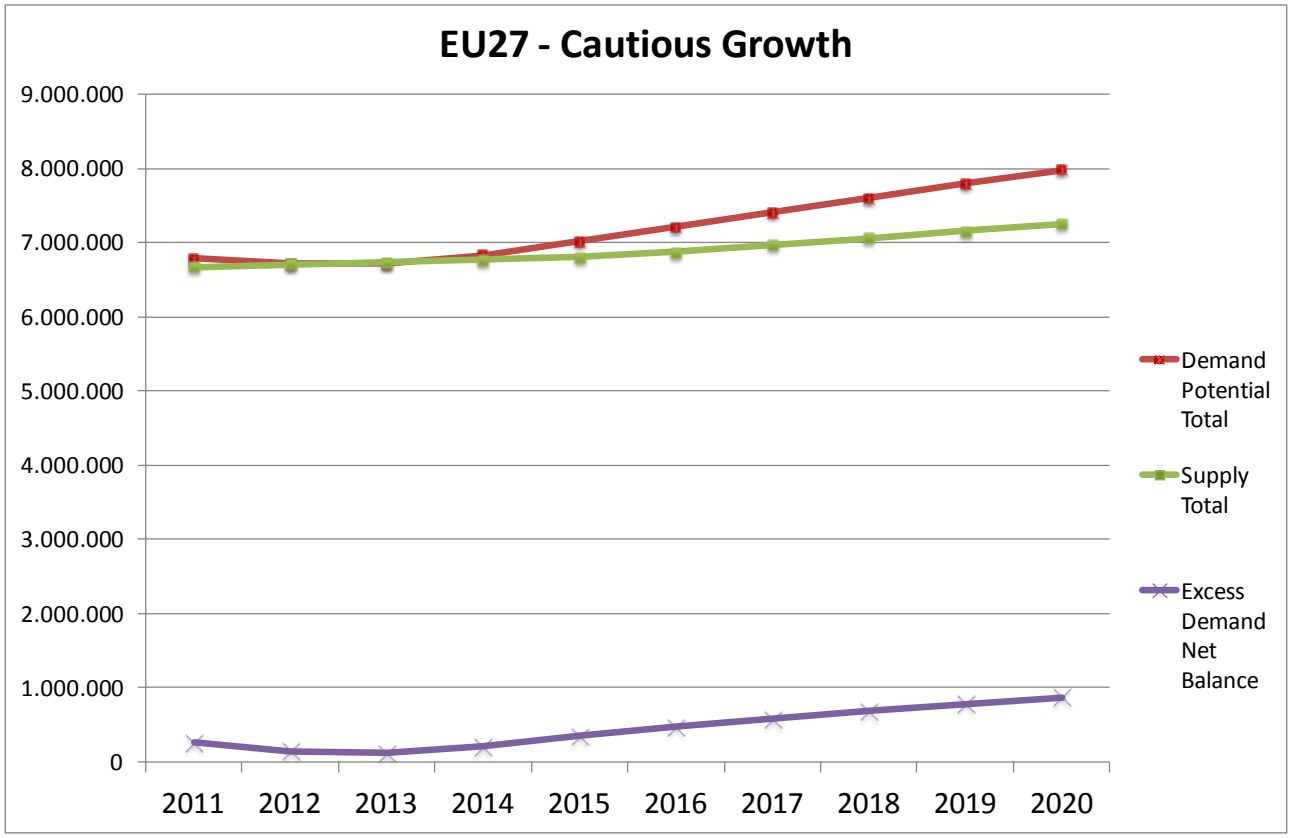
EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	0.07	0.10	0.12	0.16	0.20	0.22	0.24	0.25	0.26	0.26
ICT Practitioners	0.18	0.11	0.10	0.10	0.17	0.26	0.35	0.45	0.54	0.63
Total	**0.26**	**0.21**	**0.22**	**0.26**	**0.37**	**0.48**	**0.59**	**0.70**	**0.80**	**0.89**

Note: this is a summing up of national excess demand figures, **not** balanced with oversupply in other countries, but after migration.

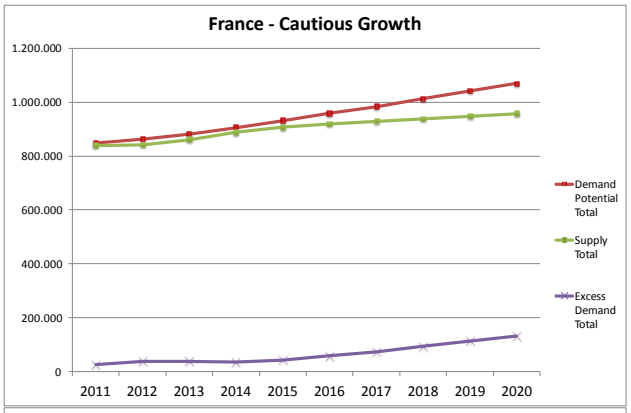
The development over the coming years will not be a straightforward and continuous one. According to our estimates and forecasts the demand for ICT practitioners will only in 2014 be at 2011 levels again and then slowly increase after 2015 and increase more strongly towards the end of the forecasting period, especially from 2017/18 onwards.

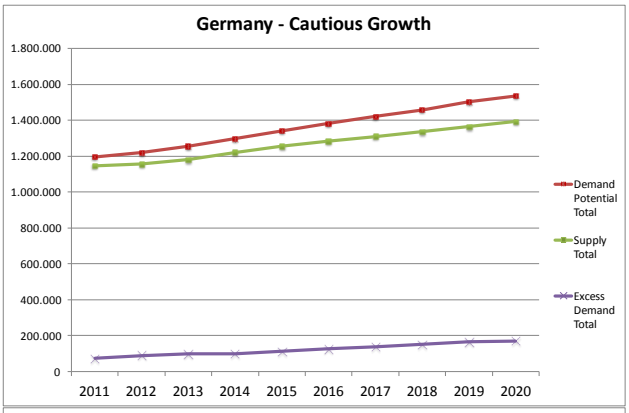
[13] This model simply adds up the national balances of supply and demand, but only where they reveal an excess demand. It should be noted that this is still a very conservative estimate, as within countries a perfect geographical match is assumed. Mismatches thus only occur between countries. Migration, which alleviates the geographical mismatch, is already built into the model, as described in the assumptions section. Apart from geographical mismatches, skills mismatches only exist between management and practitioner level skills, but the assumptions on management level recruitment out of the pool of practitioners are also conservatively estimated, rather overestimating the mobility between these categories.

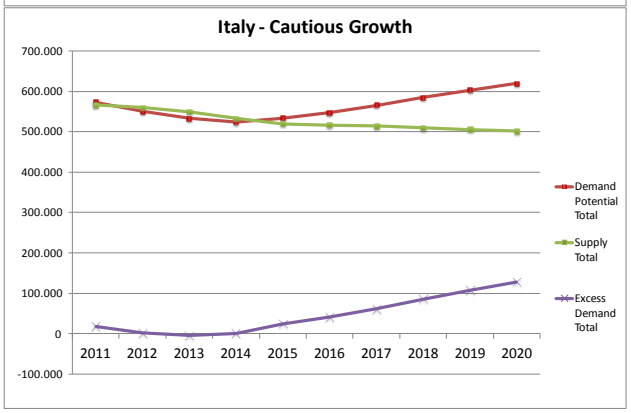
Development of ICT Professional e-skills supply and demand in Europe (EU-27) 2011 – 2020

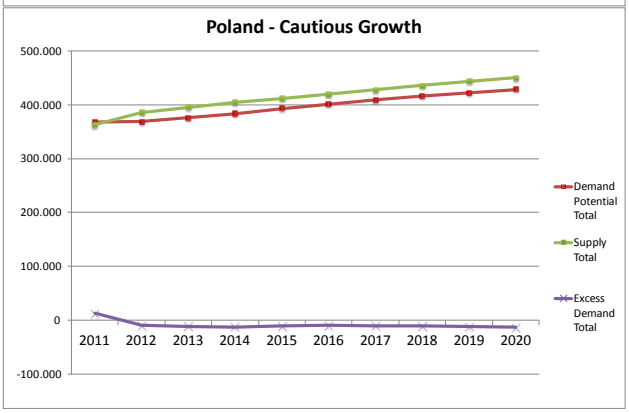


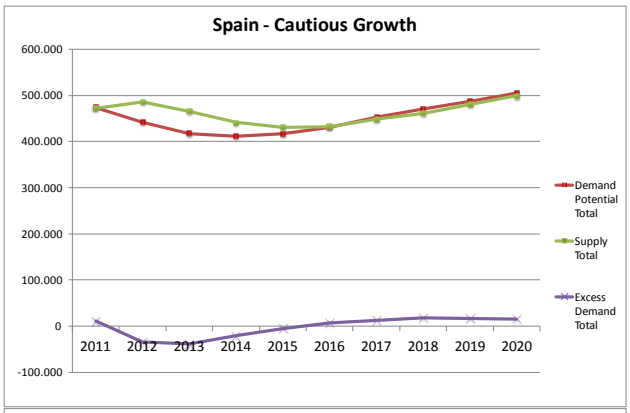
Development of ICT Practitioner and Professional e-skills supply and demand in European countries 2011 – 2020

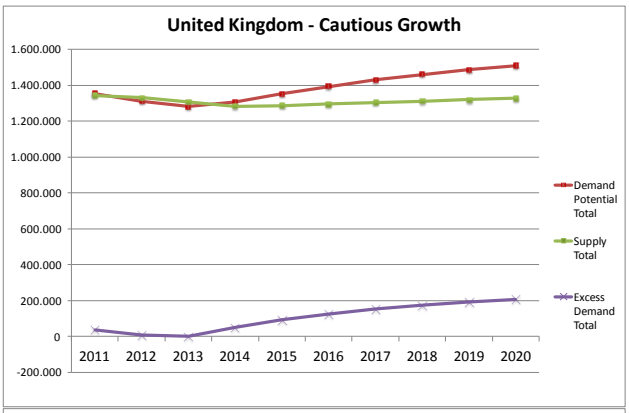


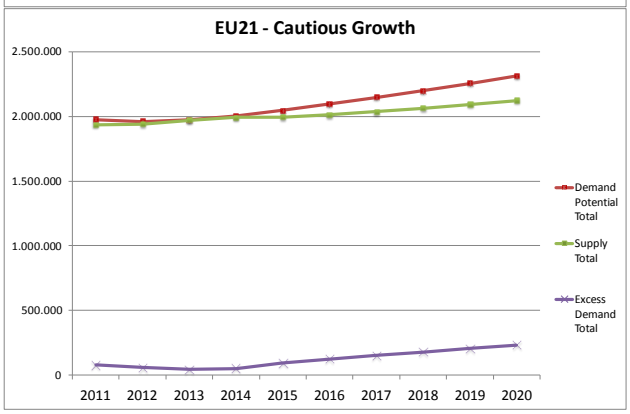


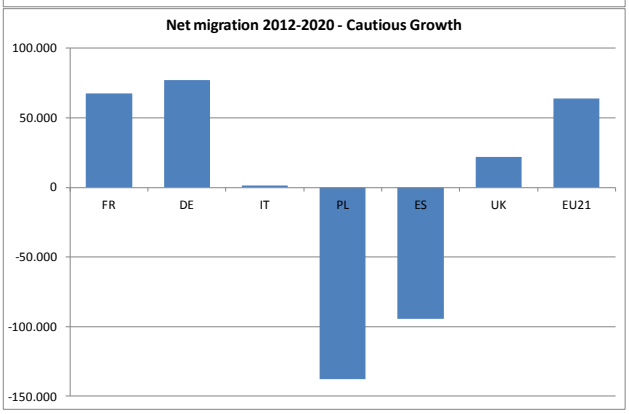












Bottom line

Due to the current and ongoing economic and financial crisis in Europe demand and supply for e-skills seem to be more or less balanced for 2011/2012. This situation is expected to deteriorate rapidly, as new demand is outstripping supply for the period until 2015 already. Demand will be particularly high for ICT management-related jobs, but we will nevertheless see an increasing number of vacancies also for practitioner jobs.

In 2015 we expect a skills shortage that translates into unfilled vacancies in the order of magnitude of 370,000 jobs.

3.5.3 Second synthesis scenario: "Return to Confidence"

The second synthesis scenario called "Return to Confidence" features a slightly more optimistic economic growth scenario with a recovery from 2014 onwards. GDP growth across Europe is assumed at an average of 1.3% compound annual growth rate between 2010 and 2015 and increases to 2.0% on average annually between 2015-2020.

The economic recovery sets a favourable environment for IT investments, growing at 2.9% p.a. until 2015 and further increasing to a growth rate of 5.6% on average in the second half of the decade. IT investments will be grounded in a generally high level of innovation and fast diffusion throughout the business sector. Innovation will be addressed both at increasing productivity and at launching new products and services. In particular, also SMEs will participate in the innovation wave at show a high level of adoption of ICT innovation.

The education and labour mobility domain is unchanged compared to the "Cautious Growth" scenario, which features our baseline assumptions of a slightly increased supply of ICT graduates, a modest contribution of industry based training and certification to the supply of qualified workers and a modest rate of labour mobility.

In the social domain, we see a new wave of social (yet commercial) innovation, with a balance between the commercial and non-profit sectors. The impact of social uses of the internet will dodge the "big brother" threats and be more focused on collaborative and knowledge sharing aspects of the Internet. Politically, integration of Europe is fostered with a high level of governance in the ICT domain and a fast achievement of the Digital Agenda. Education policies succeed in coordinating standards, curricula and learning outcomes of the ICT profession.

Forecasting results

e-Skills Jobs – 'Return to Confidence' scenario:
Development ICT Professional e-skills Jobs in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.39	1.40	1.46	1.52	1.60	1.70	1.81	1.91	2.03	2.14
ICT Practitioners	5.14	5.15	5.14	5.15	5.16	5.16	5.16	5.16	5.16	5.17
Of which: Application Development	*1.95*	*1.96*	*1.96*	*1.97*	*1.99*	*2.00*	*2.00*	*2.01*	*2.03*	*2.04*
Of which: Infrastructure	*2.37*	*2.36*	*2.34*	*2.34*	*2.34*	*2.33*	*2.33*	*2.32*	*2.32*	*2.32*
Total	**6.53**	**6.55**	**6.60**	**6.67**	**6.76**	**6.85**	**6.96**	**7.07**	**7.19**	**7.31**

We see an increase in the share and total number of application development jobs and a slight decrease in the number of more infrastructure related jobs.

"Return to Confidence" features a robust general trend towards practitioner shortages so that any practitioner unemployment observed is at the rate of natural unemployment of about 2%.

e-Skills unemployment - 'Return to Confidence' scenario

EU27 - Cautious Growth	2011	2015	2020
Unemployment - Management	28,000	32,000	43,000
Unemployment - Practitioners	103,000	93,000	112,000
Unemployment - Total	**131,000**	**125,000**	**155,000**

e-Skills Supply - 'Return to Confidence' scenario:
Development ICT Professional e-skills Supply in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.42	1.43	1.49	1.55	1.63	1.73	1.84	1.95	2.07	2.19
ICT Practitioners	5.25	5.28	5.26	5.26	5.27	5.26	5.26	5.27	5.27	5.28
Total	6.67	6.70	6.75	6.81	6.90	6.99	7.11	7.22	7.34	7.47

In this scenario the demand potential for ICT workers will reach beyond the above 7.47 million in 2020 and amount to 8.99 million.

e-Skills Demand Potential - 'Return to Confidence' scenario:
Development of ICT Professional e-skills Demand Potential in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.47	1.54	1.62	1.73	1.86	1.98	2.10	2.23	2.35	2.47
ICT Practitioners	5.32	5.37	5.46	5.62	5.77	5.94	6.10	6.25	6.40	6.53
Total	**6.79**	**6.91**	**7.09**	**7.35**	**7.63**	**7.92**	**8.21**	**8.48**	**8.75**	**8.99**

The **excess demand** or shortage (calculated as the number of open posts) amounts to **866,000 in 2015** and **1.685,000 in 2020**. This figure can best be described as **'demand potential' or 'job potential' for ICT jobs**. It should be seen as a (theoretical) figure describing the demand potential for new ICT jobs which – under the above assumptions – could theoretically and additionally be created in Europe due to an e-skills demand likely to occur especially in the years closer to 2020.

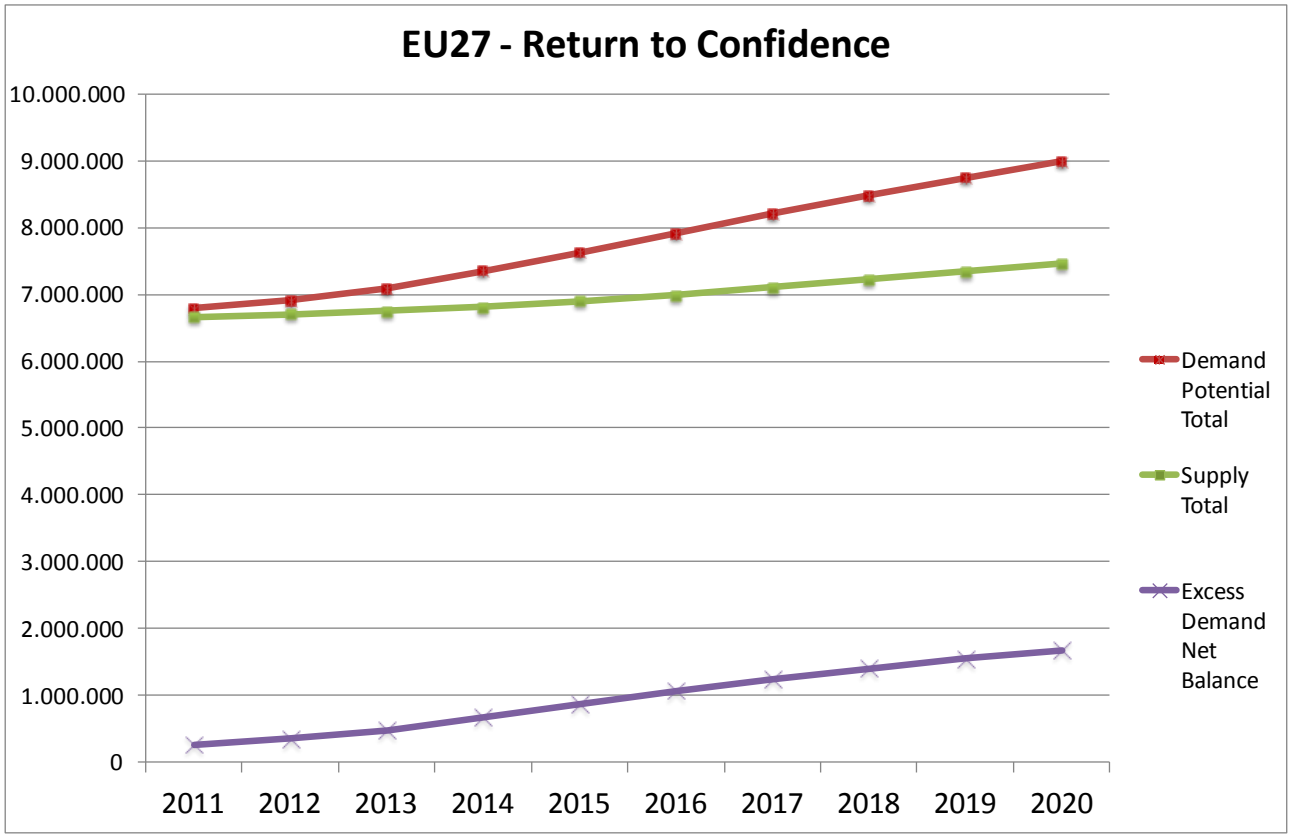
When comparing the figures from the above tables it becomes apparent that in 2020 the labour market would be able to absorb 1.360,000 of these potential additional jobs which could be created in ICT practitioner occupations and around 320,000 at ICT management level.

e-Skills Vacancies Estimate- 'Return to Confidence' scenario:
Summing-up of National ICT Professional Excess Demand in Europe 2011 – 2020

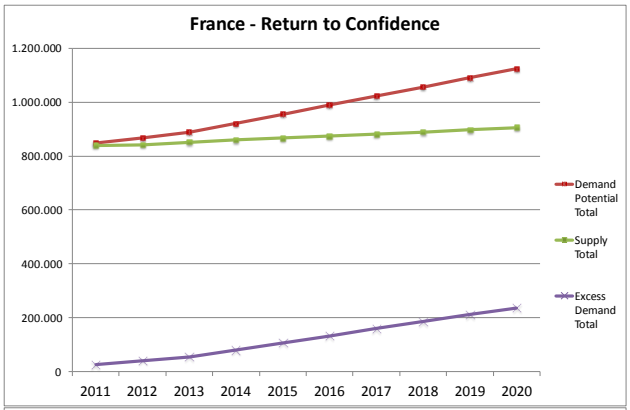
EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	0.07	0.14	0.17	0.22	0.25	0.28	0.30	0.31	0.32	0.32
ICT Practitioners	0.18	0.23	0.32	0.46	0.61	0.78	0.95	1.10	1.24	1.36
Total	**0.26**	**0.36**	**0.49**	**0.68**	**0.87**	**1.06**	**1.24**	**1.41**	**1.56**	**1.69**

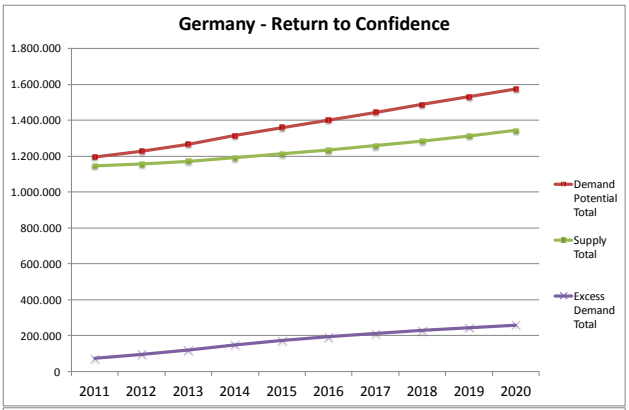
Note: this is a summing up of national excess demand figures, **not** balanced with oversupply in other countries, but after migration.

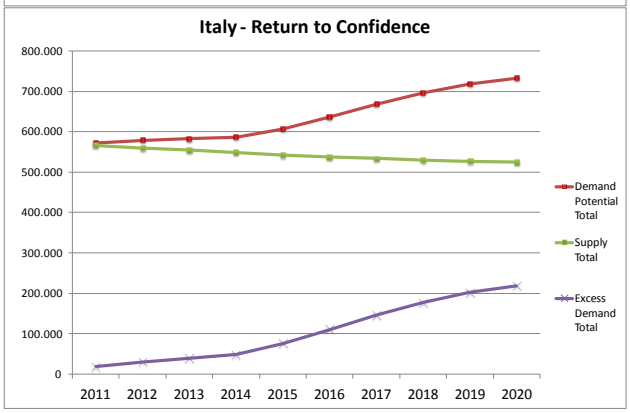
Development of ICT Professional e-skills supply and demand in Europe (EU-27) 2011 – 2020

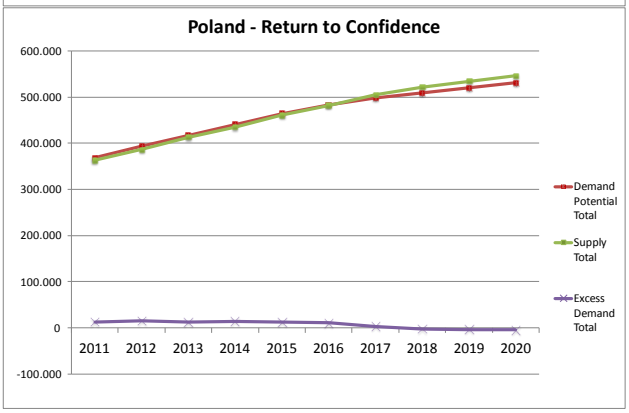


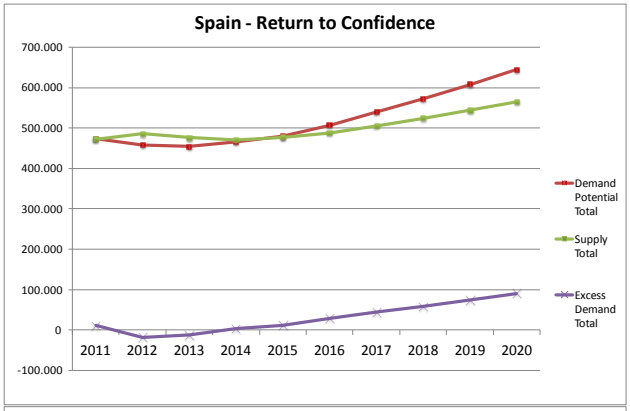
Development of ICT Practitioner and Professional e-skills supply and demand in European countries 2011 – 2020

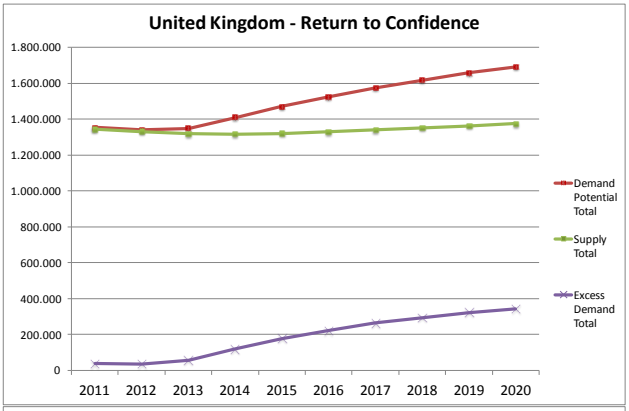


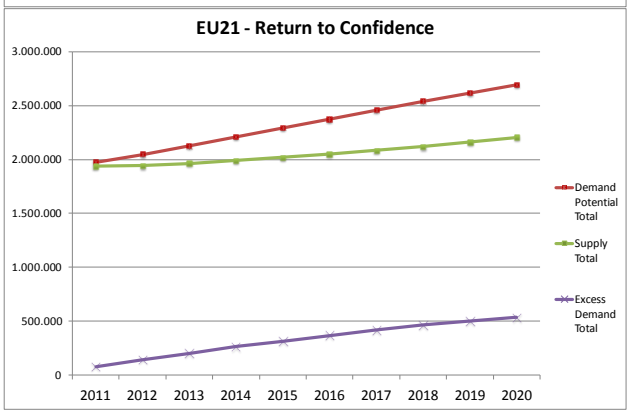


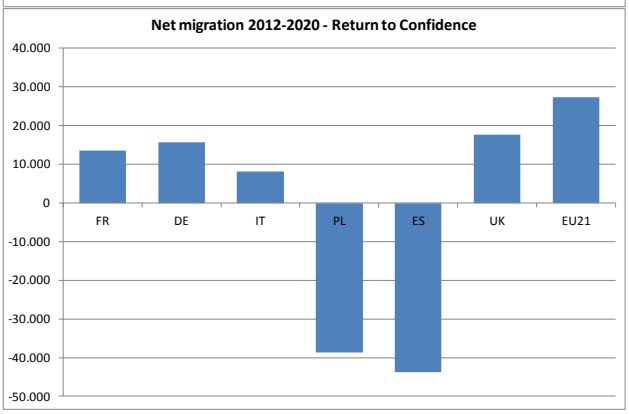












Bottom line

Due to the current and ongoing economic and financial crisis in Europe demand and supply for e-skills seem to be more or less balanced for 2011/2012. This situation is expected to deteriorate even more rapidly than in the previous scenario, and new demand is outnumbering supply for the period until 2015 even more. Demand will be particularly high for ICT management-related jobs, but we will nevertheless see an increasing number of vacancies also for practitioner jobs.

In 2015, we expect a skills shortage that translates into unfilled vacancies in the order of magnitude of 866,000 jobs.

3.5.4 Scenario 'Struggling on' forecasting of e-skills 2012-2020

This scenario is based on the assumption of a very slow return to the historical trajectory of GDP growth experienced before the crisis. What is nowadays definitely becoming clear is that the return to past trends may not be as easy as thought just a few months ago and for sure it will take more time than it took after any other crisis of the last 20 years. This is due, on the one hand, to the length of the crisis and on the other on to the fact that the crisis has been particularly dramatic in some countries.

The macroeconomic scenario foresees that after a difficult 2012, the EU27 economy will start recovering with definitely slow recovery rates until 2015 (lower than before the crisis) and with more positive growth, although smooth, from 2015 to 2020.

In this scenario, ICT will play a relevant role in the economic recovery since ICT is an important tool for cost savings. ICT investment will therefore mainly be addressed to cost savings and to achieving productivity gains. As a consequence the investments achieved by the private industry will be mainly short to medium term investments. The investments achieved by the public sector will also

be addressed to cost savings and rationalization of the public spending. Where possible, some countries may address investments to infrastructures in order to reduce the digital divide.

After a difficult time period (2011 -2012), ICT spending will evolve at a moderate pace throughout the forecast period. ICT spending will grow faster than GDP, with a slight increase of ICT spending to eventually return to the 2007/2008 trend.

In the short term, all vertical markets will feel the pressure of strong economic uncertainty and persisting concerns over sovereign risks in some EU countries. However, some vertical markets are impacted more (government, finance, automotive, air transport), others are more resilient (utilities, telecoms). In the longer term, the moderate economic recovery will accelerate investments across all vertical markets, in particular those, which have already a good IT sophistication (utilities, finance, telecom, large companies in manufacturing and distribution). With strong focus on cutting inefficiencies, centralizing procurement and reducing costs, growth in the government sector (especially central government) will remain subdued along the forecast period.

Within such a scenario, there will be differences by country in ICT spending growth and innovation diffusion. As a consequence, e-skills demand will follow different routes in different countries. Attractiveness of ICT careers will remain steady or may even be lost to some degree, also since there is no room for significant wage increases. Moreover, some of the Member States that are going through a severe economic crisis are also those countries with a weak ICT industry and historically weak support for higher education in ICT. Because of the prolonged crisis, there is a concrete risk that EU governments will only recognize a low-to-medium level of priority to research and innovation policies and to education development. Obviously, there will be an increase of digital natives, some of who will be entering the ICT labour market without ICT graduation, especially in countries with weaker ICT education systems. As a consequence, there will be an increasing need for lifelong learning and for training on the job. Nevertheless, because of the economic crisis, industry training budgets will not go back to the pre-crisis level.

Impact

During the first years of the forecasting period (2012-2015), demand for e-skills will slowdown because of economic and ICT industry trends. During this time period, digital natives without graduation may enter the labour market as ICT practitioners, taking advantage of the crisis. The young digital natives may in fact compete with the young graduates by working for lower wages.

The demand for Management skills will experience positive growth rate during the overall forecasting period. In fact, IT investments will mainly be addressed to cost savings and productivity gains, which will require some re-organization of the production processes both in industry and in services sectors.

During the second part of the forecasting period replacement cycles of infrastructures and the emergence of the cloud computing will increase demand of both management skills and practitioners.

The EU will face a moderate decline of the number of ICT graduates due to a lower level of the careers' attractiveness. The low level of the industry training budgets will limit the professional growth of digital natives who entered the labour market some years before.

All in all, the demand for e-skills will remain at a medium level during the complete forecasting period, driven in the long term by the demand of management skills. The demand for ICT practitioners will increase with a smooth trend.

Forecasting results

In the 'Struggling on' scenario and under the assumptions outlined above, the ICT workforce in Europe will grow from 6.53 million in 2011 to 6.86 million in 2020 whereby 5.02 million will be ICT practitioners and 1.84 million ICT management level employees.

e-Skills Jobs – 'Struggling on' scenario:
Development ICT Professional e-skills Jobs in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.39	1.40	1.40	1.42	1.47	1.53	1.60	1.68	1.76	1.84
ICT Practitioners	5.14	5.06	4.95	4.95	5.02	5.03	5.03	5.03	5.02	5.02
Of which: Application Development	*1.95*	*1.92*	*1.88*	*1.90*	*1.93*	*1.94*	*1.96*	*1.97*	*1.98*	*1.99*
Of which: Infrastructure	*2.37*	*2.32*	*2.26*	*2.25*	*2.27*	*2.27*	*2.26*	*2.26*	*2.25*	*2.24*
Total	**6.53**	**6.46**	**6.35**	**6.38**	**6.48**	**6.56**	**6.63**	**6.71**	**6.78**	**6.86**

We see a slight upturn in the share and total number of application development jobs and a slight decrease of the number of more infrastructure related jobs.

There will be some oversupply in some countries, due to little / lacking mobility across the EU. These countries are most notably Poland and Spain. Poland sees an oversupply mainly due to the steady and strong output of graduates from tertiary and vocational education, while Spain suffers from a slump in demand.

e-Skills Supply - 'Struggling on' scenario:
Development ICT Professional e-skills Supply in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.42	1.43	1.43	1.45	1.49	1.56	1.63	1.71	1.80	1.88
ICT Practitioners	5.25	5.27	5.28	5.28	5.27	5.24	5.22	5.20	5.19	5.18
Total	**6.67**	**6.70**	**6.71**	**6.73**	**6.77**	**6.80**	**6.85**	**6.92**	**6.99**	**7.06**

In this scenario, the demand potential for ICT workers will reach beyond the above 7.06 million in 2020 and amount to 7.48 million.

e-Skills Demand Potential - 'Struggling on' scenario:
Development of ICT Professional e-skills Demand Potential in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.47	1.47	1.50	1.56	1.64	1.73	1.82	1.90	1.99	2.08
ICT Practitioners	5.32	5.14	5.03	5.02	5.07	5.12	5.19	5.26	5.33	5.40
Total	**6.79**	**6.62**	**6.53**	**6.57**	**6.71**	**6.85**	**7.01**	**7.17**	**7.32**	**7.48**

The **excess demand** or shortage (calculated as the number of open posts) amounts to 230,000 in 2015 and **620,000 in 2020,** with 240,000 management level and 380,000 practitioner skills level vacancies. This figure can best be described as **'demand potential' or 'job potential' for ICT jobs**. It should be seen as a (theoretical) figure describing the demand potential for new ICT jobs which – under the above assumptions – could theoretically and additionally be created in Europe due to an e-skills demand likely to occur especially in the years closer to 2020.

e-Skills Vacancies Estimate- 'Struggling on' scenario:
Summing-up of National ICT Professional Excess Demand in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	0.07	0.08	0.10	0.14	0.18	0.20	0.21	0.22	0.23	0.24
ICT Practitioners	0.18	0.09	0.09	0.06	0.05	0.10	0.16	0.23	0.31	0.38
Total	**0.26**	**0.16**	**0.18**	**0.20**	**0.23**	**0.30**	**0.38**	**0.46**	**0.54**	**0.62**

Note: this is a summing up of national excess demand figures, **not** balanced with oversupply in other countries, but after migration.

The development over the coming years will not be a straightforward and continuous one. According to our estimates and forecasts, the demand for ICT practitioners will even decrease for the coming two years, slowly increase afterwards in 2015 and increase more strongly towards the end of the forecasting period, especially from 2017/18 onwards.

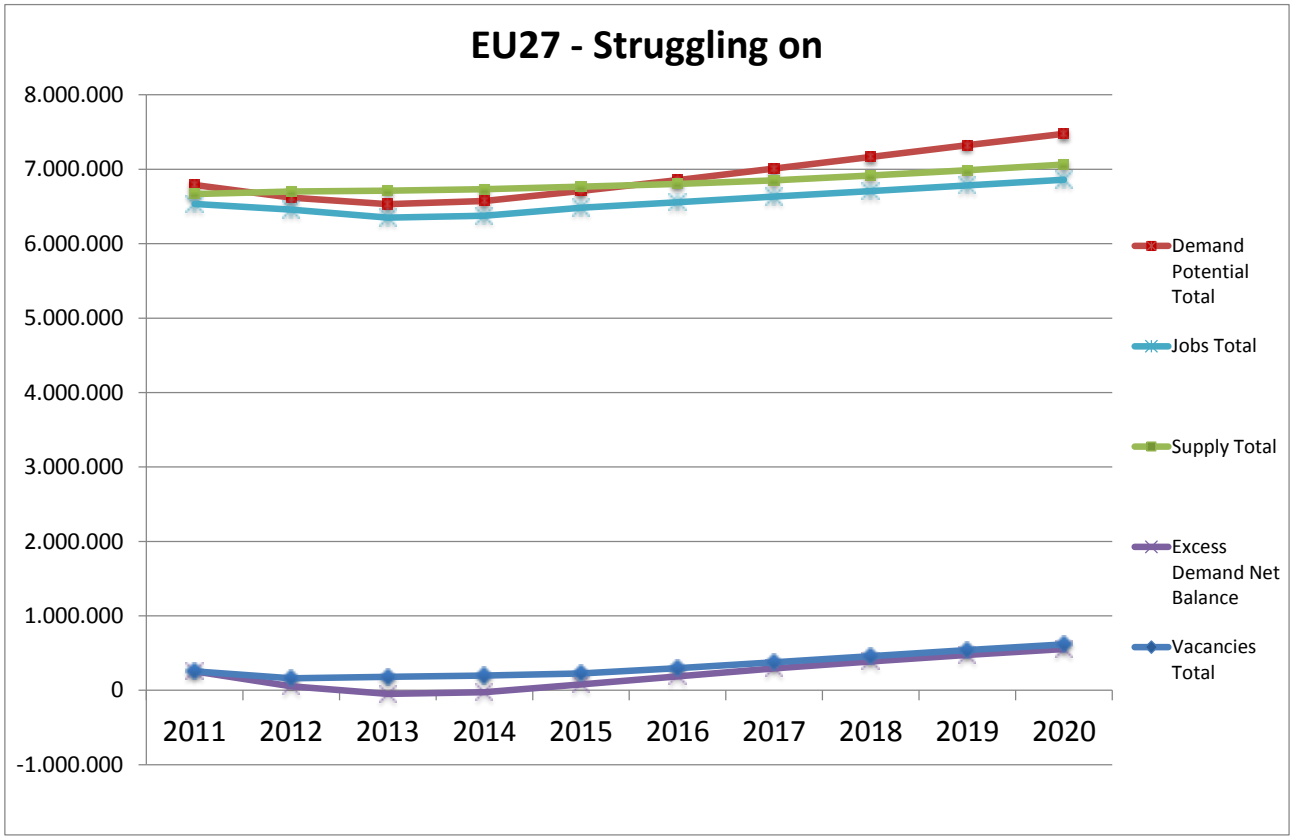
On balance, there will be a negative e-skills excess demand in 2013, i.e. an ICT professional oversupply of 10,000. This is almost identical with the previous forecast for 2012 from the e-Skills MONITOR project carried out in 2009[14] in the – most applicable scenario for the previous years – the 'Stagnation' scenario which was -11,000. In hindsight, this rather pessimistic scenario turned out to be the most applicable one and also best reflects the current and near future situation Europe is facing.

There are also significant variations across the countries and in 2014, Europe will be faced with a peak in oversupply of ICT practitioners of around 160,000 while there will be an excess demand of ICT management level employees of 140,000.

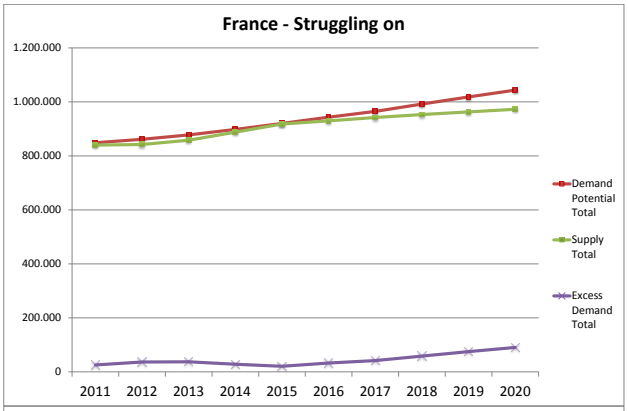
The negative development for Europe in the 'Struggling on' scenario for the years 2013-2015 only occurs when balancing excess demand in countries with e-skills oversupply in other countries. However and when just calculating the vacancies, the development is a positive one (by definition, as only vacancies are counted here) for all years and the vacancy figure is constantly growing to reach a figure of 620,000 in 2020. Compared to 2011, the number of vacancies figure will have more than doubled for ICT practitioners and tripled for ICT management, by 2020.

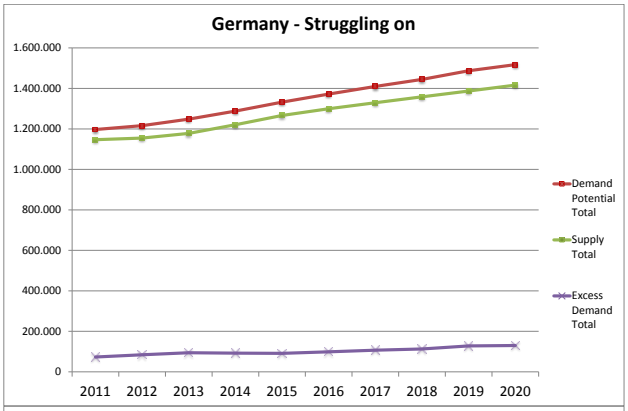
[14] Cattaneo, G; Kolding, M.; Lifonti, R.; Hüsing, T.; Korte, W.: Foresight Report "Anticipating the evolution of the supply and demand of e-skills in Europe (2010-2015)", 2009. Milan, Bonn, 2009.

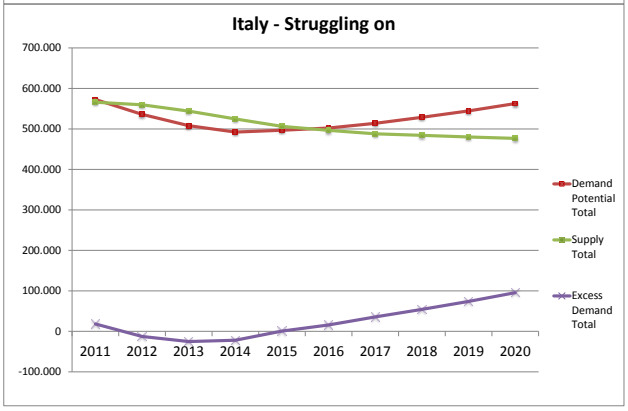
Development of ICT Professional e-skills supply and demand in Europe (EU-27) 2011 – 2020

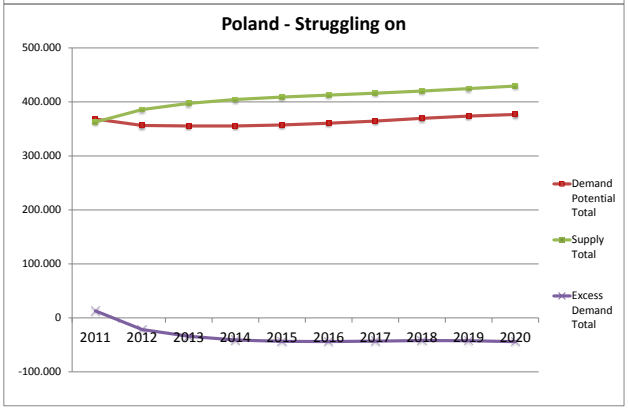


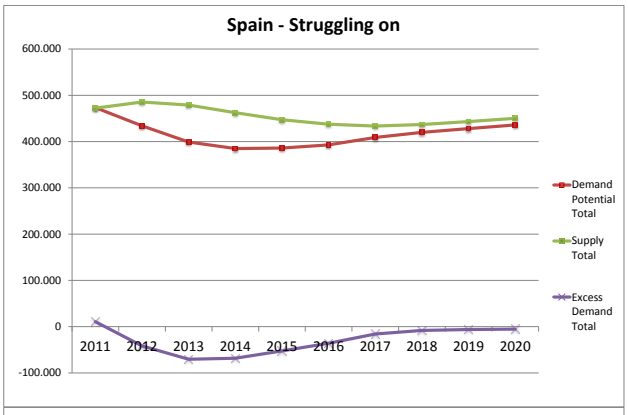
Development of ICT Practitioner and Professional e-skills supply and demand in European countries 2011 – 2020

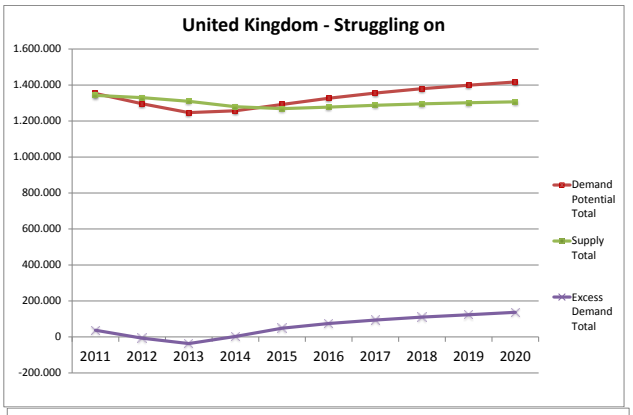


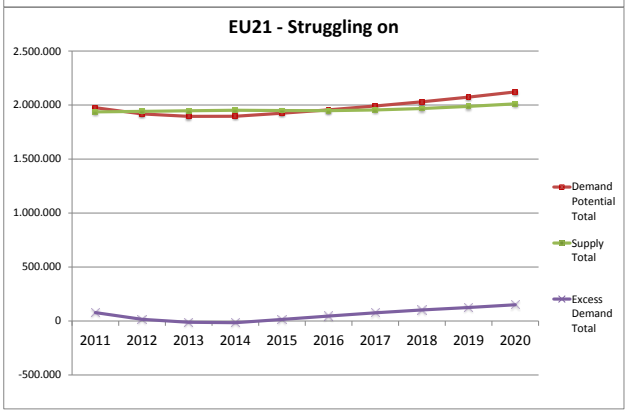


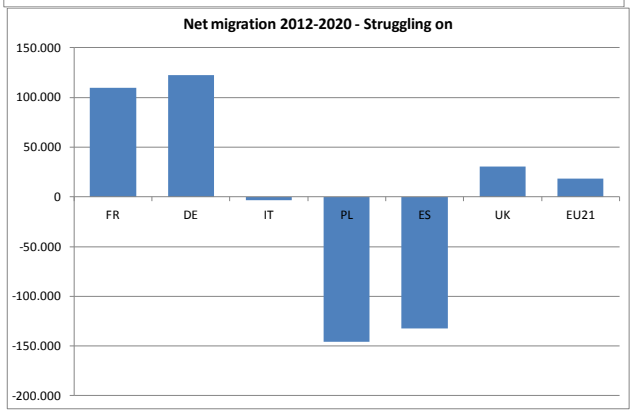












Bottom line

Due to the current and ongoing economic and financial crisis in Europe demand and supply for e-skills seem to be more or less balanced. This situation is expected to remain so for the next two years to come or we may even be faced with a small oversupply of ICT practitioners. This will not be the case in ICT management-related jobs, where there will always be an excess demand, and we will nevertheless see a number of vacancies also for practitioner jobs.

However, based on the 'struggling on' foresight scenario we will see a numerically balanced ICT labour market with only an e-skills excess demand starting in 2015. Geographical disparities will nevertheless lead to regional shortages.

3.5.5 Scenario 'Defying the Odds' forecasting of e-skills 2012-2020

The second scenario, 'Defying the Odds', is based on the assumption of a recovery from the crisis faster than in the previous scenario. This scenario is based on the assumption that most of the EU countries will face in 2013 a noticeable economic recovery because of an improvement of the sovereign debt crisis and because the policy actions taken against the crisis will quickly become effective. GDP growth strengthens along the forecast period. It is an optimistic scenario and it shows a positive deviation from growth rates of the realistic scenario. Nevertheless, growth does not rapidly become higher than it was before the crisis as it can be expected that a full recovery will definitely take a longer time period.

After such a long and severe economic crisis, the economic recovery will lead to strong business and consumer confidence, creating a favourable environment for IT investments. The effects of the economic recovery on ICT investment dynamics will gain traction from 2014 on and will become evident in the second forecasting period, from 2015 onwards.

ICT investments will predominantly be aimed at productivity gains, and the European economy will be competitive at global level.

Cloud computing, mobility and Web 2.0 will become integral part of European companies' strategies. The Internet economy and the Internet of things are possibly going to modify production processes and increase services contribution to the economic systems. The public sector concentrates resources on research and development and on new services addressed to rationalise public spending and to improve the quality of services delivered.

IT spending growth strengthens across all vertical markets, including those verticals with a strong penetration of SMEs (such as business services, distribution, manufacturing and construction).

Such a recovery will help to change the education system's capacity, making ICT courses more attractive for young people in a long time perspective. The number of ICT graduates will grow, stopping the decreasing trend in the number of ICT graduates. At the same time, enterprises will have an increased need for a trained and up-to-date labour force, so that industry will come back to the pre-crisis training budgets. The increase of "digital natives" entering the labour market will help the training on the job of "dual thinkers".

The fast recovery will contribute to avoiding the sovereignty risk and will consolidate the project and perspectives of a Federal Europe. The EU will succeed to implement strong governance and will achieve the Digital Agenda and the digital single market. In such a context, implementation of collaborative policies between EU institutions, MS governments, business and Academia will take place in order to address the most urgent e-skills gaps.

The Internet will be divided between commercial domination of the multinationals and of governments. Social networks will assume an increasingly commercial flavour and there will also be an increasing use of the Internet for mass democracy and participation.

Impact

The positive economic trend emerging from 2013 on and the increasing level of innovation inherent in this scenario addressed to both savings and to new products will bring about an increased adoption of innovation in both large companies and SMEs. Cloud computing, mobile devices and apps and the social technologies will require re-organisation and innovation in relationships with suppliers and with customers as well as into internal business processes. As a consequence, management skills will be a relevant component of the overall demand of e-skills. The demand for practitioners will be smoother.

The number of ICT graduates will slightly increase. Beside the ICT graduates, the digital natives without graduation may enter the labour market because of the increasing demand. The latter will take advantage from the positive innovation climate and from the training supplied by the enterprises. At the end of the first forecasting period the training budgets of the enterprises will increase and get slowly back to the pre-crisis level.

Because of the spread of ICT innovation in all the vertical markets, the demand for management skills will combine e-skills and other industry-specific skills. Such combination is not currently delivered by the formal education so that the training on the job will be very important for the management skills as well as for the practitioners.

Such a combination of skills will favour the spread of innovation in vertical industries where ICT in not an intensive production factor and could revitalise the innovation and productivity of traditional sectors or of low ICT intensive industries.

Forecasts

The e-skills' demand trend will be positive in the long term (2012-2020) with a CAGR over 3%. The leadership skills will definitely drive this growth (average annual growth almost 6%) while the practitioner skills demand trend will be positive but with an average annual growth below 2%.

e-Skills Jobs – 'Defying the Odds' scenario:
Development ICT Professional e-skills Jobs in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.39	1.40	1.47	1.54	1.63	1.73	1.84	1.95	2.06	2.18
ICT Practitioners	5.14	5.16	5.14	5.14	5.13	5.13	5.12	5.12	5.12	5.12
Of which: Application Development	*1.95*	*1.95*	*1.96*	*1.96*	*1.97*	*1.98*	*1.99*	*2.00*	*2.01*	*2.03*
Of which: Infrastructure	*2.37*	*2.37*	*2.37*	*2.37*	*2.36*	*2.35*	*2.34*	*2.34*	*2.33*	*2.33*
Total	**6.53**	**6.55**	**6.61**	**6.68**	**6.76**	**6.86**	**6.96**	**7.07**	**7.18**	**7.30**

We see an increase of the number of jobs from 6.53 million in 2011 to 6.76 million in 2015 and 7.3 million in 2020. This is driven by a sky-rocketing demand potential, which will have surpassed the 9 million mark by 2020.

The increase is mainly due to the surge in management skills level jobs, i.e. ICT managers, consultants and architects. There is also an increase in the number of development jobs, while infrastructure struggles to keep its level of employment.

If such a positive scenario becomes a reality, it can be expected, that employers will not sit back and do nothing about a structural over-demand off more than a million. It can be expected, that other ways of supply not currently included in our simplified model will be open up, be it immigration or the up skilling of outsiders.

e-Skills Supply- 'Defying the Odds' scenario:
Development ICT Professional e-skills Supply in Europe 2011 – 2020

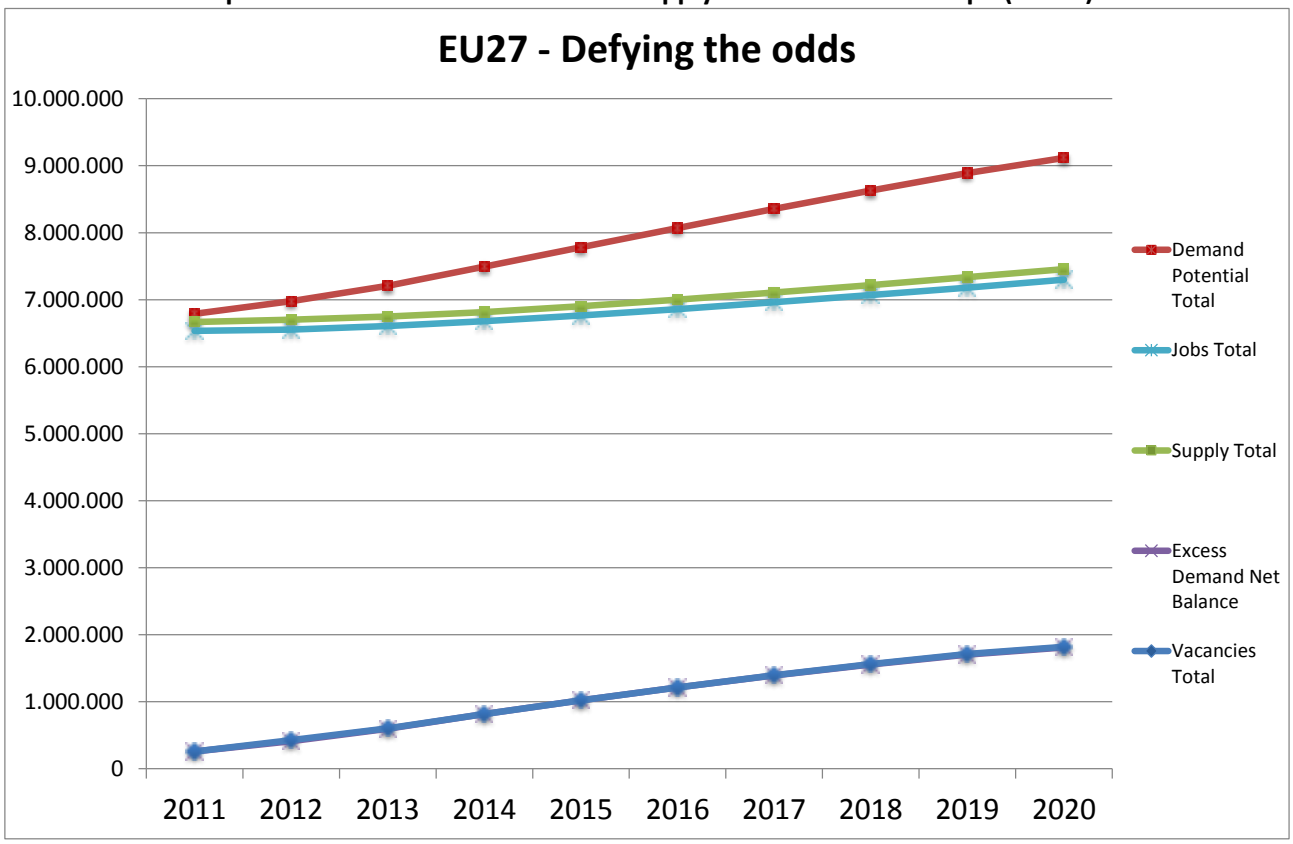
EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.42	1.43	1.50	1.57	1.67	1.77	1.88	1.99	2.11	2.23
ICT Practitioners	5.25	5.27	5.25	5.24	5.24	5.23	5.23	5.23	5.23	5.23
Total	**6.67**	**6.70**	**6.75**	**6.82**	**6.90**	**7.00**	**7.11**	**7.22**	**7.34**	**7.46**

e-Skills Demand Potential- 'Defying the Odds' scenario:
Development of ICT Professional e-skills Demand Potential in Europe 2011 – 2020

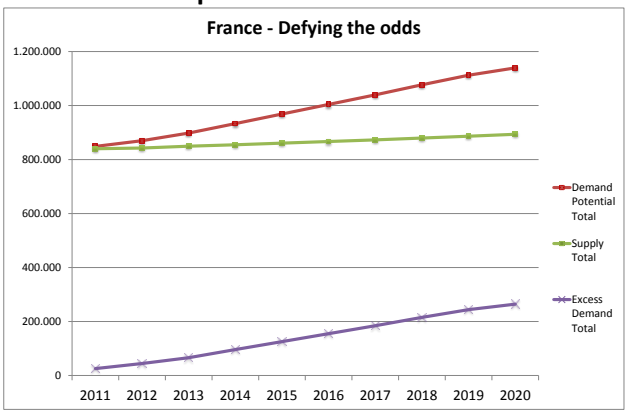
EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.47	1.56	1.65	1.77	1.90	2.02	2.15	2.27	2.39	2.51
ICT Practitioners	5.32	5.42	5.56	5.72	5.89	6.05	6.21	6.36	6.50	6.61

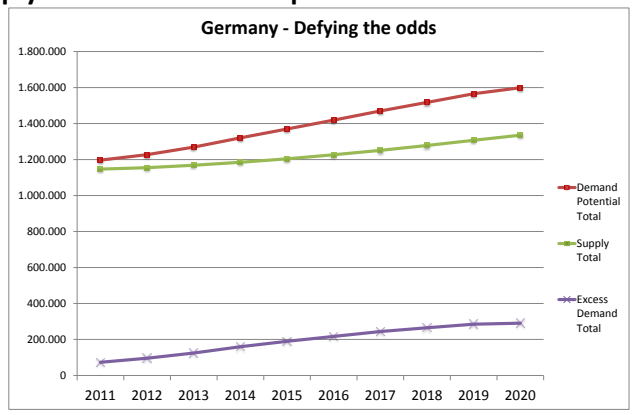
Total	6.79	6.98	7.21	7.49	7.78	8.07	8.36	8.63	8.89	9.12

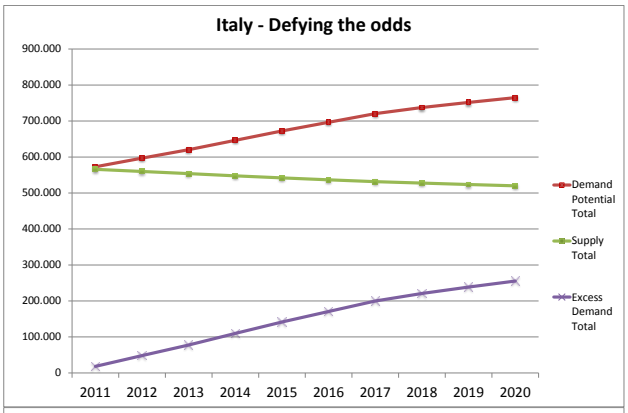
'Defying the Odds' scenario:
Development of ICT Professional e-skills supply and demand in Europe (EU-27) 2011 – 2020

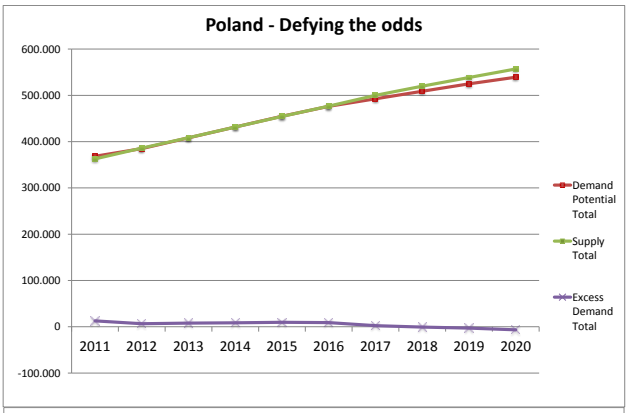


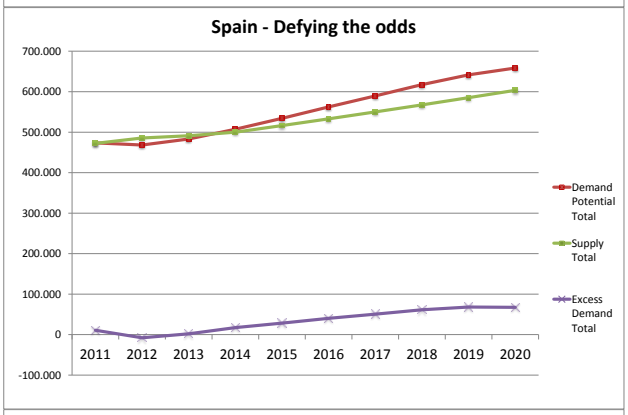
'Defying the Odds' scenario:
Development of ICT Professional e-skills supply and demand in European countries 2011 – 2020

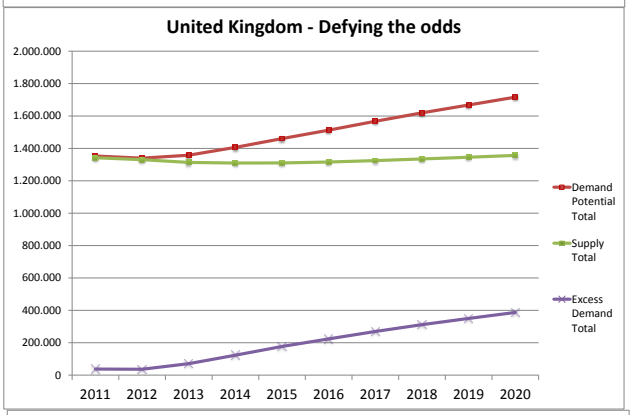


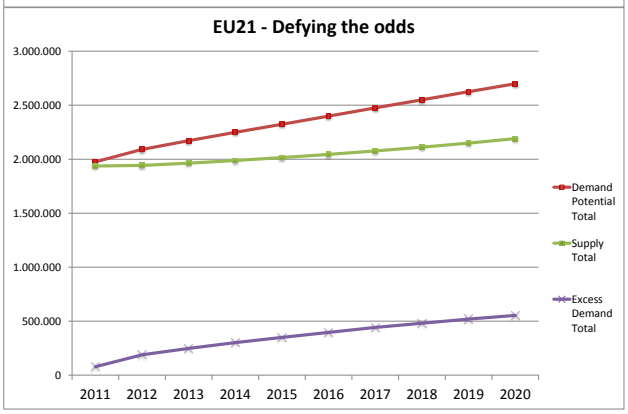


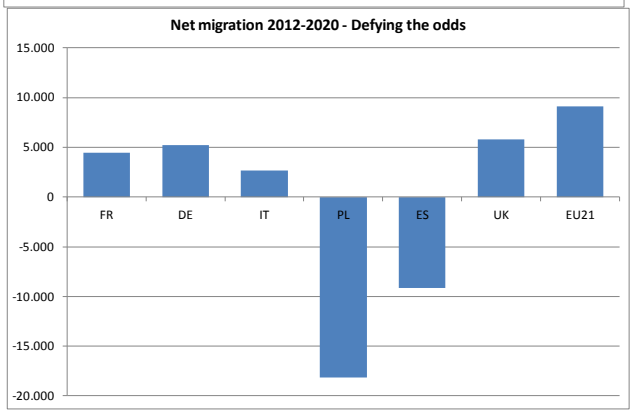












Excess demand and number of vacancies are a phenomenon across all countries and thus indicate that little efficiency can be added by enhancing worker mobility – simply because the shortage is ubiquitous.

In this scenario, we already see 1 million open posts in 2015, of which one quarter is managements related and three quarters refer to practitioner jobs.

e-Skills Vacancies Estimate- 'Defying the Odds':
Summing-up of National ICT Professional Excess Demand in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	0.07	0.16	0.19	0.23	0.26	0.29	0.31	0.32	0.33	0.33
ICT Practitioners	0.18	0.27	0.41	0.59	0.76	0.92	1.09	1.24	1.38	1.49
Total	**0.26**	**0.42**	**0.60**	**0.81**	**1.02**	**1.21**	**1.39**	**1.56**	**1.71**	**1.82**

Note: *this is a summing up of national excess demand figures,* ***not*** *balanced with oversupply in other countries, but after migration.*

3.5.6 Scenario 'Troubled waters' forecasting of e-skills 2012-2020

The third global scenario is named 'Troubled Waters' and is based on pessimistic macroeconomic trends taking effect. Such trends could be the result of a failure of the vulnerable countries in undertaking a correction process of their imbalances and in undergoing an adjustment process with structural reforms. In this scenario the recovery from the economic crisis fails to take off: the EU will not recover from the crisis within the forecasting period. The 2013 GDP growth is limited to some 0.5%; growth strengthens in the following years, but remains definitely below the levels of the Struggling on scenario. Nevertheless, this pessimistic scenario doesn't foresee a collapse of the Euro.

As a consequence, companies postpone investments in IT projects and focus on maintenance/ optimization of the existing IT infrastructure. IT investments remain subdued. Innovation and replacement of devices, infrastructures and IT systems are far away from being a priority of the European industry. Despite outpacing the rest of the market, investments in smart devices will also be affected by declining business and consumer confidence.

The uncertain economic environment will slow down the major transformation process the software industry is undertaking. Despite growing much higher than average and being somewhat "anti-cyclical", adoption of public cloud services will also slow down. Large IT projects are postponed with a negative demand for IT services. Length of contracts is reduced, so are fees.

Companies with less than 250 employees are strongly impacted across the forecast period. Issues around liquidity and access to credit keep on affecting SMEs' IT demand. The short-term tactical approach of most SMEs limits also their ability to innovate the products and services they offer and/or leverage in their business operations. Only large enterprises may start investments; nevertheless, they will only start limited and short-term investments.

All vertical industries are impacted by the prolonged downturn in the economy. The government sector needs to cut further public expenditure. This will negatively impact IT spending as well, which will be therefore weaker than in the realistic scenario (where we already predict small growth). Cuts in public expenditure have a similar negative impact on education and healthcare. Utilities keep on growing above average but there is a delay in the implementation of smart meters' projects in some countries. The launch of smart services that could be enabled through smart grids is also delayed.

The EU industry and services sectors will suffer from permanent declines in non-price competitiveness in both high tech and traditional sectors. Consequently, productivity of the European productivity will continue slowing down. Such a negative trend in economics and in IT investments will consolidate the decrease in ICT graduates. The education system will fail in the long term in making ICT courses and careers more attractive, which will provide less management skills to the labour market. In the meanwhile, companies will not get back to the pre-crisis training budgets and training projects will be pushed back by most of the enterprises. Enterprises will count on "digital natives", who may have some basic IT practitioner skills, but there will be a shortage of management skills. Demographic trends will definitely increase the demand of life-long-learning and e-learning but, because of the decrease of training budgets, private funding will not compensate the insufficiency of public education.

This lack of recovery from the crisis will weaken the European and federal governance, so that innovation and growth policy will be mainly driven at national levels; the coordination among nations will require relevant efforts. Most of the countries' policy agenda will need to focus on socio-economic issues due to anaemic labour markets. Innovation as well as the development and

implementation of the Digital Agenda will be postpone, which makes it difficult to start a virtuous circle.

Impact

Innovation adoption both in private and public sectors will be addressed to reduce costs and only when unavoidable. Technology delivery models will be characterised by a patchwork adoption while all the other technology investments (mobility, Internet economy, big data) will have very low priority. Most of the efforts will be addressed to the delivery of basic services and traditional products.

Such a negative trend in economics and IT investments will consolidate the decrease in ICT graduates. The education system will fail in the long term in making ICT courses and careers more attractive, which will provide less management skills to the labour market. In the meanwhile, companies will not get back to the pre-crisis training budgets and training projects will be pushed back by most of the enterprises. Enterprises will count on "digital natives", who may have some basic IT practitioner skills, but there will be a shortage of management skills. The shortage of the management skills may be supplied by foreigners professional from countries with low wages. Demographic trends will definitely increase the demand of life-long-learning and e-learning but, because of the decrease of training budgets, private funding will not compensate the insufficiency of public education. All in all, EU will experience an impoverishment of the professional skills.

The impact on the skills demand will show a decrease of the core skills demand while the leadership skills will be characterised by a medium/low demand accompanied by a shortage of such skills.

Forecasts

The demand for e-skills will experience a decreasing trend for at least all the first forecasting period and probably until 2017, while in the following years the trend will be positive and nearly flat. The demand for ICT practitioners will decrease all over the period while management skills will smoothly increase.

We see a slight increase in the number of management level jobs from 1.4 to 1.7 million, while practitioners with fewer skills will have a hard time. Infrastructure level jobs will be cut from 2.4 to 2.1 million, while developers can keep their level more or less. In total, Europe will employ 400,000 practitioners less in 2020 than today.

e-Skills Jobs – 'Troubled Waters' scenario:
Development ICT Professional e-skills Jobs in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.39	1.40	1.43	1.44	1.46	1.50	1.54	1.58	1.63	1.68
ICT Practitioners	5.14	5.11	4.99	4.91	4.85	4.78	4.73	4.72	4.71	4.72
Of which: Application Development	*1.95*	*1.94*	*1.91*	*1.89*	*1.88*	*1.87*	*1.86*	*1.87*	*1.88*	*1.90*
Of which: Infrastructure	*2.37*	*2.35*	*2.29*	*2.25*	*2.21*	*2.18*	*2.15*	*2.14*	*2.13*	*2.12*
Total	**6.53**	**6.51**	**6.42**	**6.35**	**6.31**	**6.29**	**6.28**	**6.30**	**6.34**	**6.40**

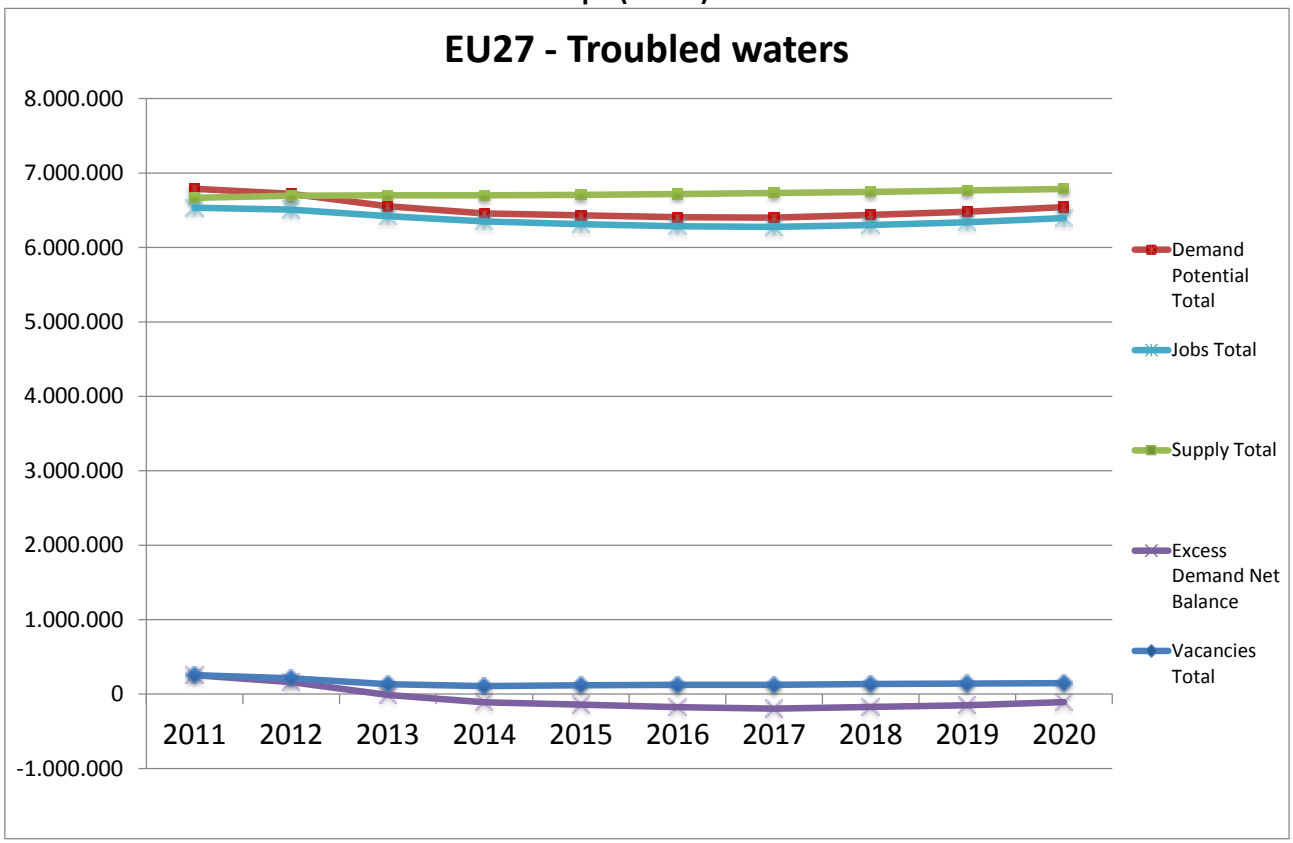
e-Skills Supply- 'Troubled Waters' scenario:
Development ICT Professional e-skills Supply in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.42	1.43	1.46	1.47	1.49	1.53	1.58	1.62	1.66	1.71
ICT Practitioners	5.25	5.27	5.24	5.23	5.21	5.18	5.16	5.13	5.10	5.08
Total	6.67	6.69	6.70	6.70	6.71	6.72	6.73	6.75	6.77	6.79

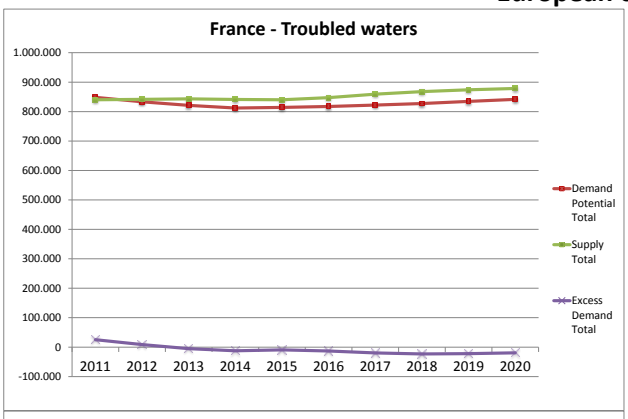
e-Skills Demand Potential- 'Troubled Waters' scenario:
Development of ICT Professional e-skills Demand Potential in Europe 2011 – 2020

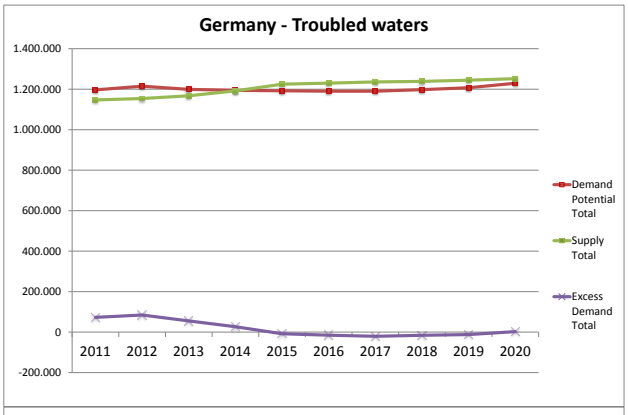
EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.47	1.51	1.51	1.54	1.58	1.63	1.67	1.72	1.77	1.82
ICT Practitioners	5.32	5.22	5.04	4.92	4.85	4.78	4.73	4.72	4.71	4.72
Total	6.79	6.72	6.55	6.46	6.43	6.41	6.40	6.44	6.48	6.54

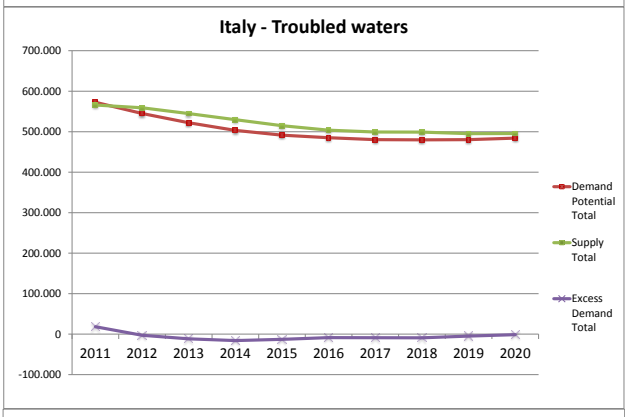
'Troubled Waters' scenario: Development of ICT Professional e-skills supply and demand in Europe (EU-27) 2011 – 2020

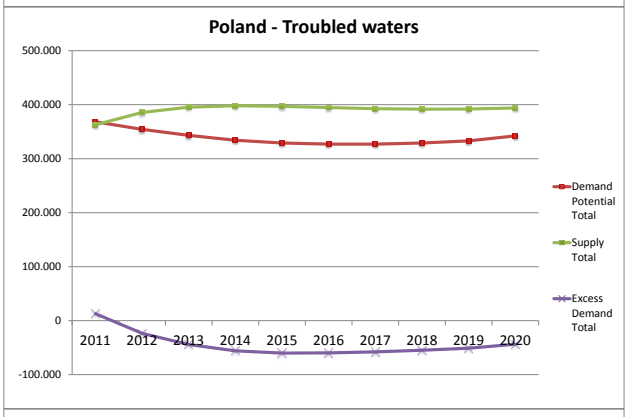


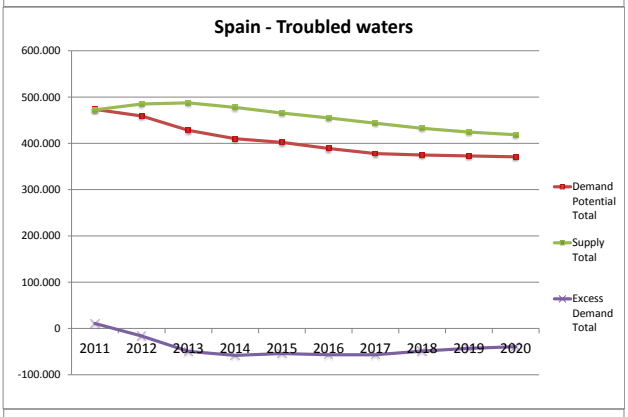
'Troubled Waters' scenario: Development of ICT Professional e-skills supply and demand in European countries 2011 – 2020

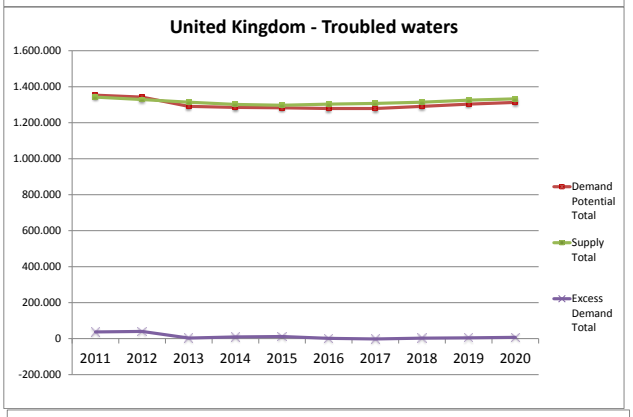


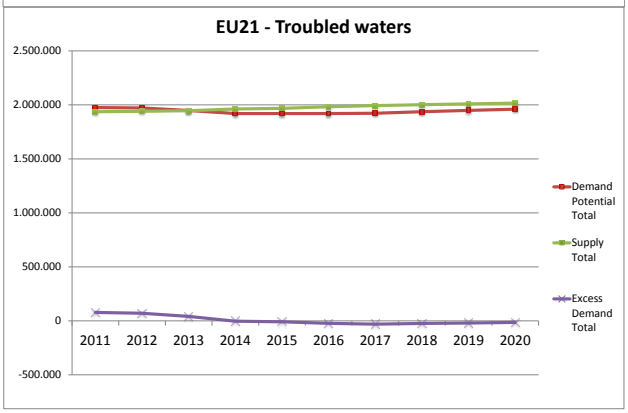


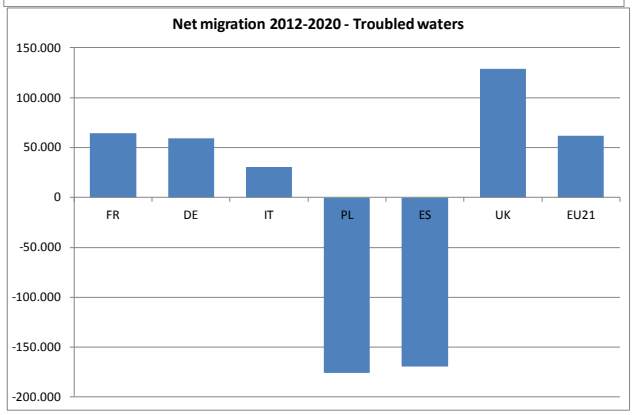












Due to the oversupply of practitioners, in this scenario we actually see unemployment beyond the natural rate.[15] It will peak in 2017 with 6.7%. It should be noted that this is modelled in an economic environment, where 6.7% will be a comparably low rate of unemployment.

e-Skills Excess Supply- 'Troubled Waters' scenario:
Development of ICT Professional unemployment rate in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
ICT Practitioners	2.0%	2.6%	4.6%	6.1%	7.0%	7.8%	8.2%	8.0%	7.7%	7.0%
Total	**2.0%**	**2.5%**	**4.0%**	**5.2%**	**5.8%**	**6.4%**	**6.7%**	**6.6%**	**6.3%**	**5.8%**

e-Skills Vacancies Estimate- 'Troubled Waters' scenario:
Summing-up of National ICT Professional Excess Demand in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	0.07	0.11	0.08	0.10	0.12	0.12	0.12	0.14	0.14	0.15
ICT Practitioners	0.18	0.11	0.05	0.01	-	-	-	-	-	-
Total	**0.26**	**0.21**	**0.13**	**0.11**	**0.12**	**0.12**	**0.12**	**0.14**	**0.14**	**0.15**

Note: *this is a summing up of national excess demand figures,* ***not*** *balanced with oversupply in other countries, but after migration.*

3.5.7 Scenario 'Two speed Europe' forecasting of e-skills 2012-2020

In this scenario, the current crisis is going to impact in a very different way in the different European countries. Some countries will recover before 2015; others will experience a very pessimistic macroeconomic scenario.

This does not mean a break-up of the Euro zone, but a continuing divergence between north and south Europe growth rates. On the overall, the balance between this divergence and consequently difficult governance of Europe will provide a macroeconomic pessimistic scenario and the failure of EU policies addressed to recovery and structural reforms.

A number of countries, especially those with competitive industries and with balanced public accounts, will recover fast and will show strong business and consumer confidence so that IT investments will show an increasing trend. In these countries, a high diffusion of innovation will be addressed both to savings and to introduction of new products.

In southern Europe and countries with high budget constraints and very slow recovery, innovation will not be a priority, except where it will be addressed to achieve savings.

An outcome of the crisis started in mid-2007, in fact, shall be that all European countries must balance their public accounts and keep public debt under strict control; nevertheless, individual countries have widely different abilities to achieve this goal.

[15] The model assumes a natural rate of unemployment of 2% that may only be underrun in the short term

Therefore, whereas governments in some countries shall be able to devote to innovation and ICT investments all the resources required by political will, other countries shall have to make difficult choices.

Within this second group of countries, some will forgo public investment and current expenditure in innovative activities in order to defend current levels of traditional service provision and of public employment. Other countries might be willing (or forced) to do the opposite, especially for cost saving innovation. In sum, for countries' strict budget constraints, three alternative strategies can be envisaged:

- A conservative strategy: this strategy defends the service provision and public employment as is. This strategy minimises investments in IT infrastructures and new technologies and consequently will lead to an increase in the international digital divide;
- A cost saving strategy: this strategy is addressed to investments able to produce savings and to increase productivity. As a consequence, it leads to a short-term reduction in the digital divide which however may not last in the long run (this seems for example to be the option currently adopted by the Italian government);
- A growth inducing strategy: the strategy is oriented to all investments able to induce economic growth. This will ensure a long run reduction in the international digital divide which however may take time to materialize.

Which of these strategies will be pursued shall depend on the national (and regional) political will. It is also clear that the fate of the labour market and the education system will very much depend on which of the above strategies will be pursued by most of the countries that currently have to balance their public accounts

In the Two Speed Europe scenario we make two important assumptions. The first assumption is that most of the countries having budget constraints will adopt a conservative or a cost saving strategy. The second assumption is that the EU will fail in the governance of the economic crisis so that the vulnerable countries will only be slightly supported by EU policy and infrastructures and by competitive countries.

Impact

This two-speed economy will produce a labour market characterised by a high level of labour mobility at least within the European area. Northern Europe will probably absorb part of the workers of Southern Europe, while Southern Europe may be affected by a risk of brain drain. The labour single market may be very useful in such a situation, since it may help compensating local mismatch of demand-supply of e-skills.

As explained, it is currently difficult to know what strategies the single countries are going to adopt and, as a consequence, it is difficult to foresee the impacts of such a scenario. Nevertheless, we can say that on the overall, the European area will be characterized by a moderate innovation dynamic, driven by large companies. Innovation diffusion will be fast in Northern Europe and in countries with low budget constraints and it will be very patchwork in the rest of Europe.

Northern Europe will experience steady competitive levels of its industry, while countries with high budget constraints will lose competitiveness and productivity. The gap between vulnerable countries and the other countries will widen so that it will be more and more difficult to establish and agree within EU common policy objectives and agenda especially where innovation and investments are required. The will be clearly Digital Agenda disregard.

Forecasts

E-skills demand will on the overall stand on a medium/low level. Countries with low budget constraints will show a high demand of e-skills demand, especially for management skills. In the vulnerable countries, it will very much depend on which strategy they will adopt. In any case e-skills demand will be at medium/low levels in the countries with high budget constraints. Because of this high uncertainty level, internal mobility of workers will compensate the mismatch of demand and supply.

Practitioner skills will experience positive although smooth trends in the European competitive countries while in the vulnerable countries they are going to experience decreasing trends.

E-Skills Jobs – 'Two Speed Europe' scenario:
Development ICT Professional e-skills Jobs in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.39	1.40	1.41	1.43	1.47	1.53	1.60	1.67	1.75	1.83
ICT Practitioners	5.14	5.09	4.99	5.01	5.05	5.05	5.02	5.03	5.02	5.02
Of which: Application Development	*1.95*	*1.93*	*1.90*	*1.93*	*1.96*	*1.98*	*1.99*	*2.00*	*2.02*	*2.04*
Of which: Infrastructure	*2.37*	*2.34*	*2.29*	*2.28*	*2.28*	*2.27*	*2.25*	*2.25*	*2.24*	*2.23*
Total	**6.53**	**6.49**	**6.40**	**6.44**	**6.52**	**6.58**	**6.62**	**6.70**	**6.77**	**6.85**

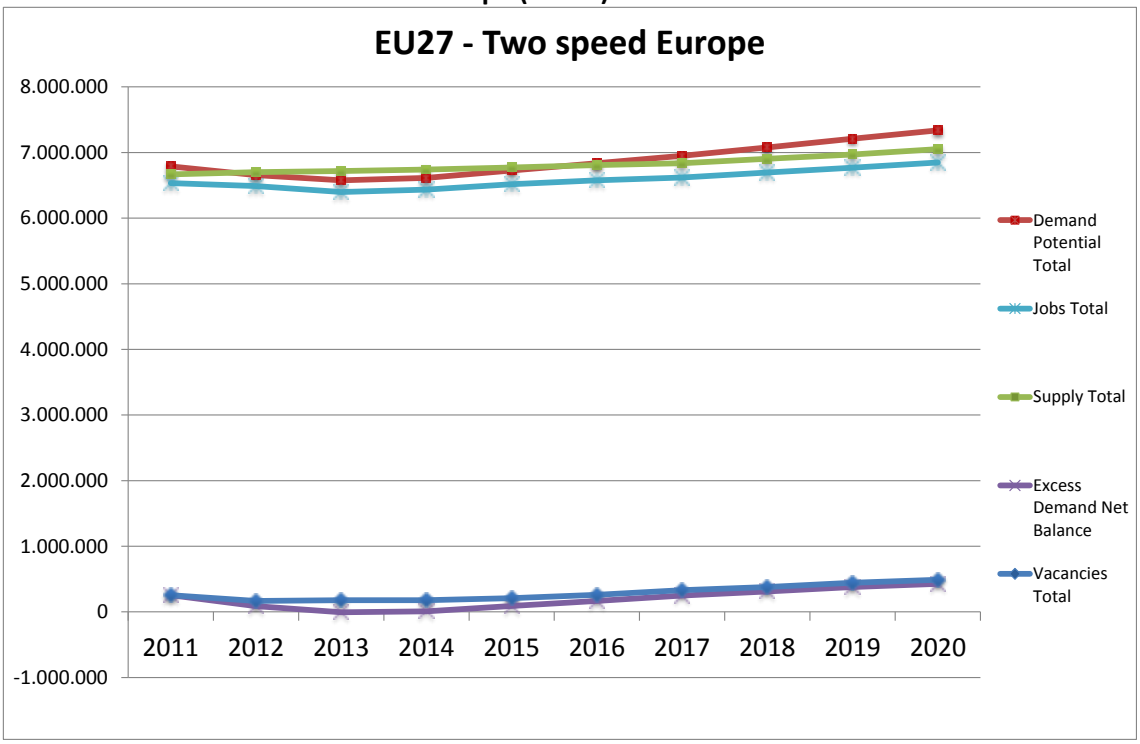
E-Skills Supply- 'Two Speed Europe' scenario:
Development ICT Professional e-skills Supply in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.42	1.43	1.44	1.46	1.50	1.56	1.63	1.70	1.78	1.86
ICT Practitioners	5.25	5.27	5.28	5.28	5.27	5.25	5.21	5.20	5.19	5.19
Total	6.67	6.70	6.72	6.74	6.77	6.81	6.84	6.90	6.97	7.05

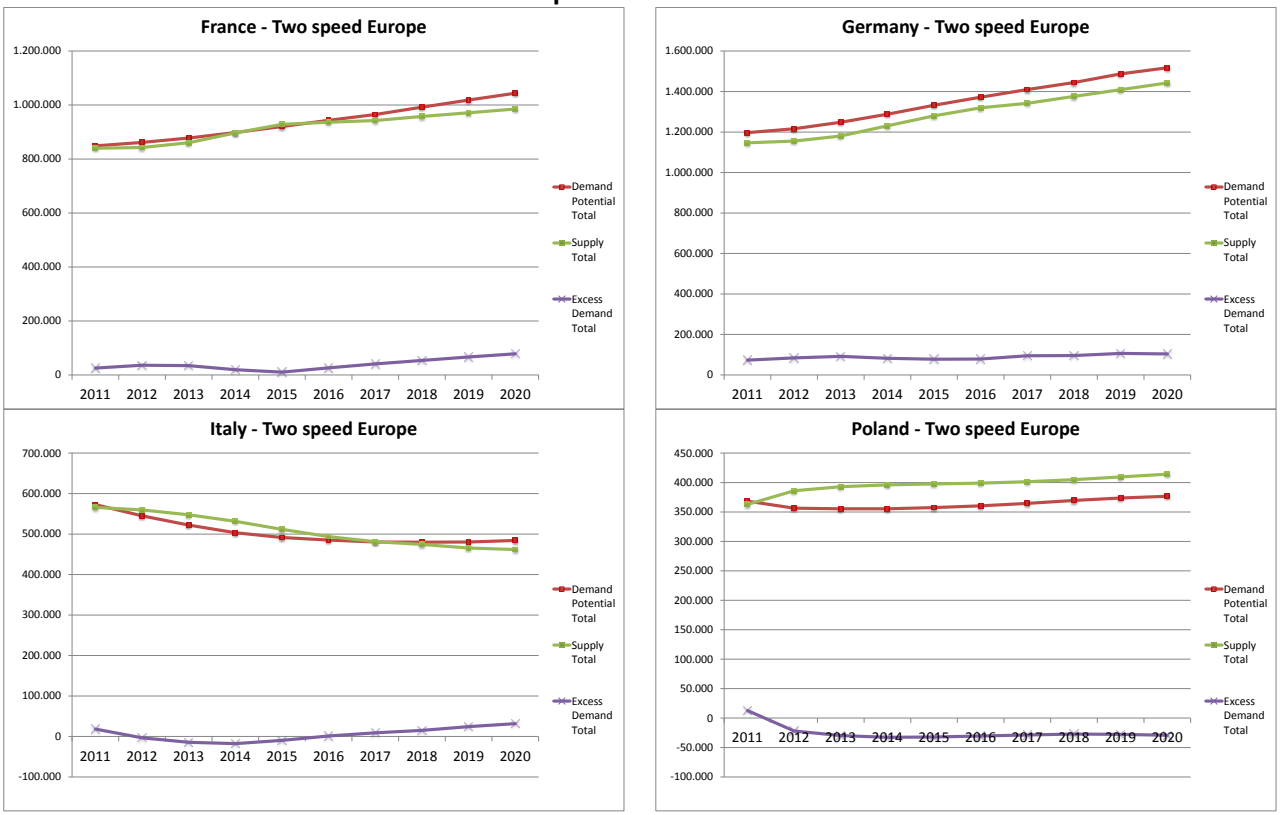
E-Skills Demand Potential- 'Two Speed Europe' scenario:
Development of ICT Professional e-skills Demand Potential in Europe 2011 – 2020

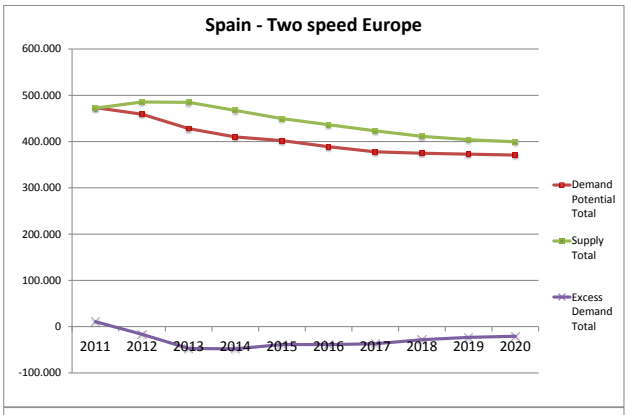
EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.47	1.48	1.51	1.56	1.64	1.73	1.81	1.89	1.97	2.05
ICT Practitioners	5.32	5.18	5.07	5.05	5.08	5.11	5.14	5.19	5.24	5.29
Total	6.79	6.66	6.58	6.61	6.73	6.84	6.95	7.08	7.21	7.34

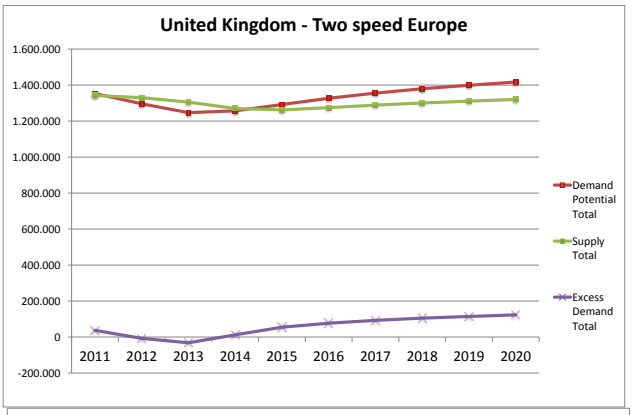
'Two Speed Europe' scenario: Development of ICT Professional e-skills supply and demand in Europe (EU-27) 2011 – 2020

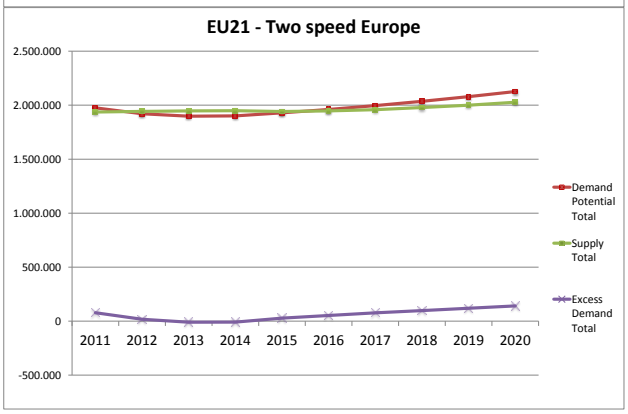


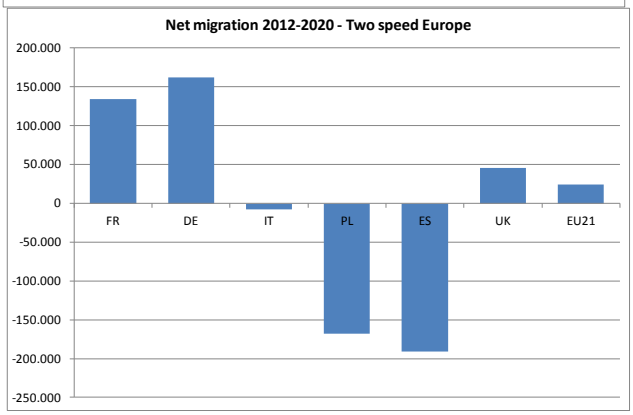
'Two Speed Europe' scenario: Development of ICT Professional e-skills supply and demand in European countries 2011 – 2020











e-Skills Vacancies Estimate- 'Two Speed Europe' scenario:
Summing-up of National ICT Professional Excess Demand in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	0.07	0.08	0.10	0.13	0.17	0.20	0.21	0.22	0.23	0.22
ICT Practitioners	0.18	0.09	0.08	0.04	0.04	0.07	0.13	0.16	0.22	0.27
Total	**0.26**	**0.17**	**0.18**	**0.18**	**0.21**	**0.26**	**0.33**	**0.38**	**0.44**	**0.49**

Note: *this is a summing up of national excess demand figures,* ***not*** *balanced with oversupply in other countries, but after migration.*

3.5.8 Scenario 'Social Innovation Wins' forecasting of e-skills 2012-2020

The last scenario, 'Social Innovation Win' is based on the assumption of a realistic GDP growth after the crisis and on an optimistic IT spending policy. This is mainly based on the idea that most of the European governments, supported by the EU, will adopt a growth inducing policy where the ICTs will play a relevant role. All the European countries, supported by the EU, will orient their efforts to investments able to induce the growth thanks. The countries with severe budget constraints will at least adopt a cost saving strategy and will start with growth strategy as soon as this will be possible.

After a difficult 2012, the economy starts recovering, with definitely slow recovery rates until 2015 (lower than before the crisis) and with more positive growth expected from 2015 to 2020. In the meanwhile, the majority of the European governments adopt an optimistic innovation policy with high propensity to invest in the ICT (investment/GDP). Most of the countries show a strong political will addressed to recover fast from the crisis. This is, among other things, based on a proactive ICT policy. This will lead to an increase in ICT investments addressed to telecommunication infrastructures and to fast diffusion of the new ITs.

The EU growth will be driven by the most competitive countries, although the countries with budget constraints will follow closely.

ICT innovation will accelerate after 2015: widespread benefits and impacts of such an innovation policy will be expected after 2015 even if some countries and the most advanced enterprises will start reaping efficiency benefits before that. The digital divide among countries and between the Northern and Southern countries will decrease, from 2015 to 2020. At the same time, the diffusion of ICT innovations in the user industry will be fast.

Innovation, in both ICT industry and user industry, will be addressed at first to achieve relevant cost savings and to permanent gain of productivity and competitiveness at global level. In a second phase, innovation will be addressed to the introduction of new products and services supported by careful strategies focusing on developing competitive advantages and leadership in specific industries or technologies.

This innovation policy will need strong coordination and governance at European level. This will consolidate the Federal Europe and the achievement of the current Digital Agenda. The ICTs innovation will spread in the vertical industries lead to important waves of cost savings and innovation in all industries.

The growth inducing strategy will accelerate the recovery and EU economy will return to pre-crisis levels of growth. The relevant result of such a scenario is that the innovation policy will provide to Europe permanent productivity gain and the decrease of structural gaps with the most innovative economies at international level. Inside the EU as well, the digital divide among regions will be reduced.

Impact

The fast innovation policy and the acceleration of innovations after 2015 will increase the demand for e-skills, for both leadership skills and core skills. The mismatch of demand-supply of e-skills will be met through internal movement within the European Union. After 2015, the entry of non-European workers may be necessary.

Bearing in mind that the effects of an education policy takes time to show its effects, private funding for training will be necessary to balance e-skills demand in the short term. In the meanwhile, the attractiveness of the ICT careers will improve and EU will need to start new policy education campaign.

Enterprises will have to come back to pre-crisis levels of training budgets.

Forecasts

The demand for e-skills will experience a positive trend initially driven by the most competitive countries.

The demand for management skills will be very relevant since such the strong innovation policy will start with investments addressed to cost savings. During the second forecasting period, the practitioner skills will increase as well thanks to the widespread diffusion of innovation.

e-Skills Jobs – 'Social Innovation Wins' scenario:
Development ICT Professional e-skills Jobs in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.39	1.40	1.46	1.52	1.60	1.70	1.81	1.92	2.03	2.15
ICT Practitioners	5.14	5.16	5.18	5.19	5.21	5.22	5.24	5.26	5.28	5.30

Of which: Application Development	*1.95*	*1.96*	*1.97*	*1.98*	*2.00*	*2.02*	*2.04*	*2.06*	*2.08*	*2.11*
Of which: Infrastructure	*2.37*	*2.38*	*2.38*	*2.38*	*2.39*	*2.39*	*2.39*	*2.40*	*2.40*	*2.41*
Total	**6.53**	**6.56**	**6.63**	**6.71**	**6.81**	**6.92**	**7.04**	**7.17**	**7.31**	**7.45**

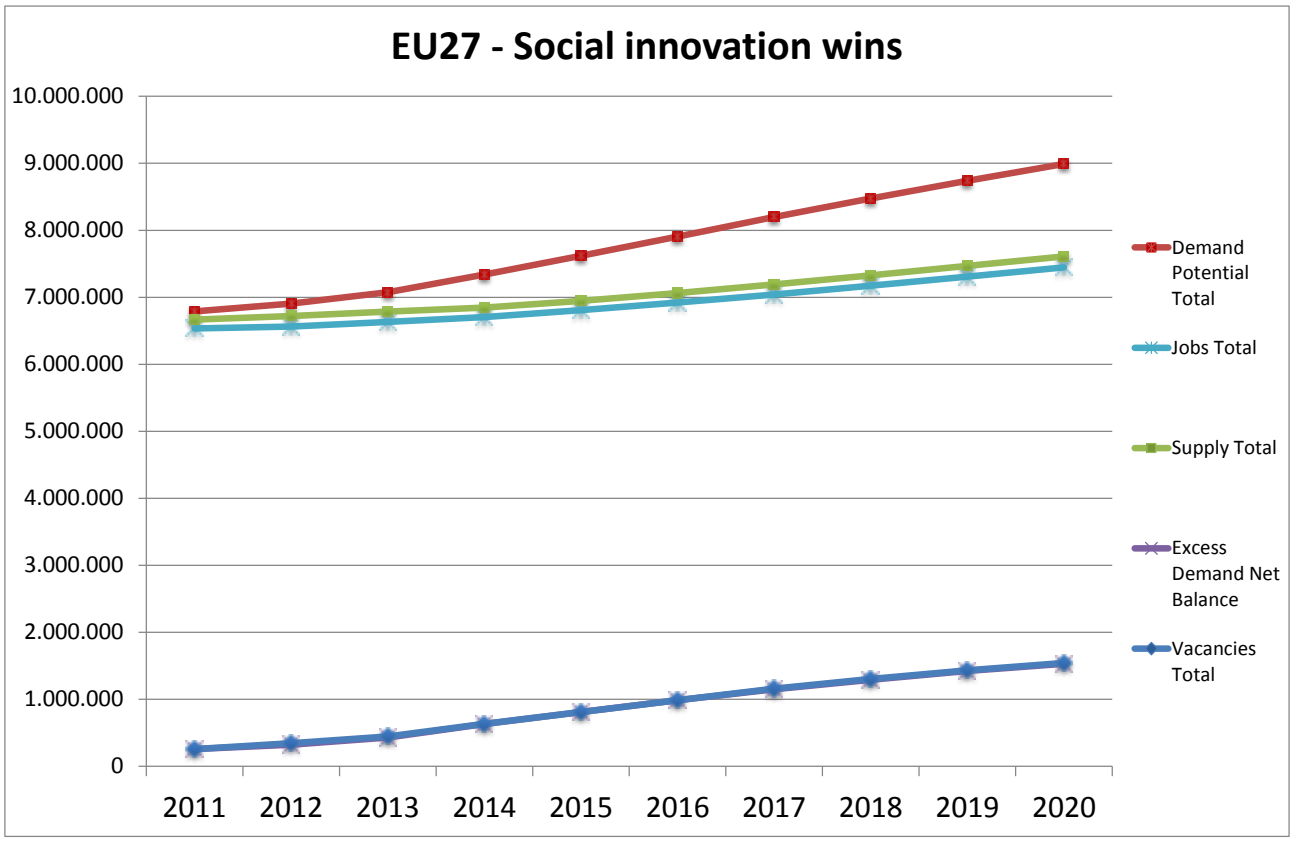
e-Skills Supply- 'Social Innovation Wins' scenario:
Development ICT Professional e-skills Supply in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.42	1.43	1.49	1.55	1.63	1.73	1.84	1.96	2.07	2.19
ICT Practitioners	5.25	5.29	5.30	5.30	5.31	5.33	5.35	5.37	5.40	5.42
Total	**6.67**	**6.72**	**6.79**	**6.85**	**6.95**	**7.06**	**7.19**	**7.33**	**7.47**	**7.61**

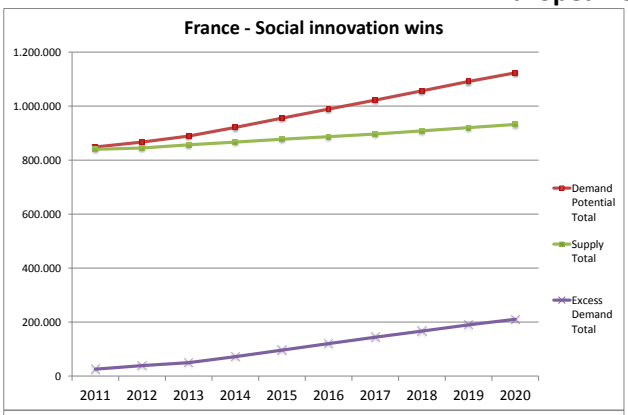
e-Skills Demand Potential- 'Social Innovation Wins' scenario:
Development of ICT Professional e-skills Demand Potential in Europe 2011 – 2020

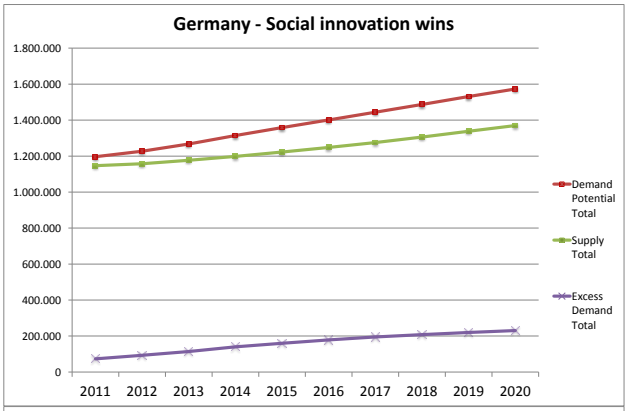
EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	1.47	1.54	1.62	1.73	1.86	1.98	2.10	2.23	2.35	2.47
ICT Practitioners	5.32	5.37	5.45	5.60	5.76	5.93	6.10	6.25	6.39	6.52
Total	6.79	6.91	7.08	7.34	7.62	7.91	8.20	8.47	8.74	8.99

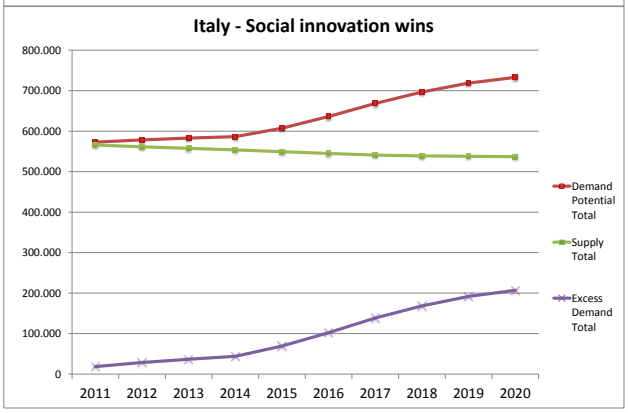
'Social Innovation Wins' scenario: Development of ICT Professional e-skills supply and demand in Europe (EU-27) 2011 – 2020

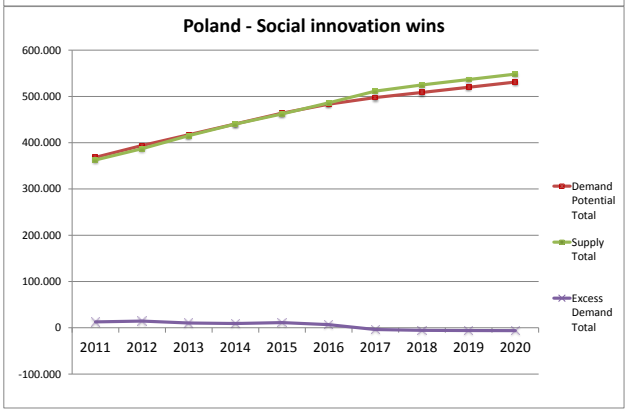


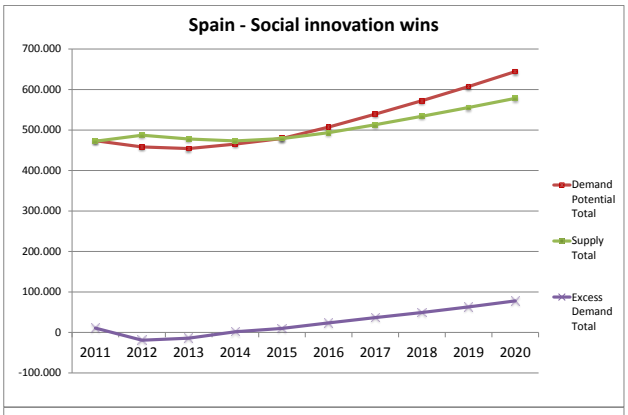
'Social Innovation Wins' scenario: Development of ICT Professional e-skills supply and demand in European countries 2011 – 2020

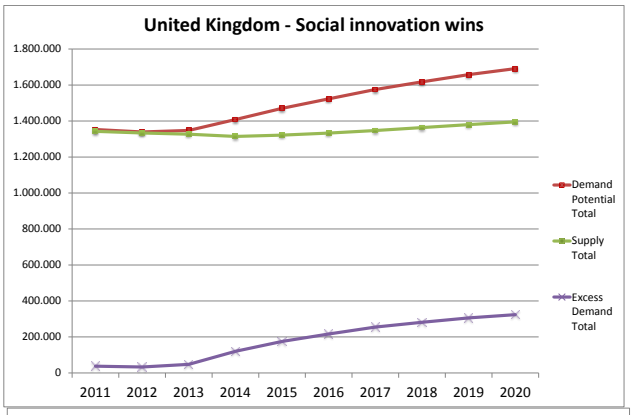


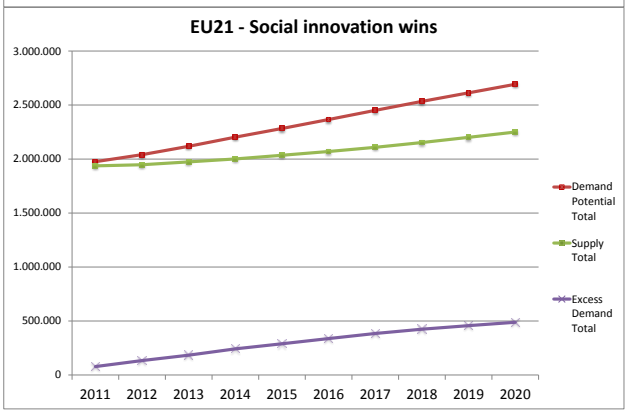


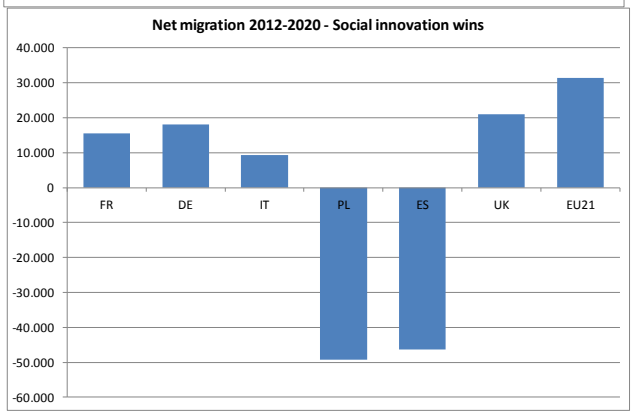












e-Skills Vacancies Estimate- 'Social Innovation Wins' scenario:
Summing-up of National ICT Professional Excess Demand in Europe 2011 – 2020

EU27 (millions)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Management	0.07	0.14	0.17	0.22	0.25	0.28	0.30	0.31	0.32	0.32
ICT Practitioners	0.18	0.21	0.28	0.42	0.56	0.70	0.86	0.99	1.11	1.22
Total	**0.26**	**0.34**	**0.44**	**0.63**	**0.81**	**0.98**	**1.16**	**1.30**	**1.43**	**1.54**

*Note: this is a summing up of national excess demand figures, **not** balanced with oversupply in other countries, but after migration.*

4 E-Leadership skills

Author: Nils Fonstad, INSEAD

4.1 Overview

The present chapter develops an applied concept and definition of e-leadership skills by drawing on recent academic literature. In the final section very first estimates of the demand of e-leadership skills in industry based on the applied definition of e-leadership skills are provided. These are based on a series of assumptions. The definition, framework, and estimates have been presented to and validated by experts.

E-leadership is defined as follows.

> *E-leadership is the accomplishment of a goal that relies on ICT through the direction of human resources and uses of ICT.*

E-leadership skills consist of a T-shaped portfolio of skills, representing expertise in both using ICT and developing organizations. Typically, the "vertical" set of skills represent expertise in using ICT – i.e., "deep knowledge" in a specific area related to the application and maintenance of ICT (e.g., technical; functional; product; customer experience); the "horizontal" or "transversal" set of skills represent expertise in developing organizations – i.e., competence in leadership and management (e.g., sense making; building and aligning relationships across boundaries; visioning; inventing).

The chapter draws on recent academic research on leadership and the expanding roles of business leaders responsible for ICT (e.g., Chief Information Officers) to explain why e-leadership is increasingly important to enhanced organization performance and competitiveness and how e-leadership is similar and distinct to related concepts, such as leadership, entrepreneurship, and digital entrepreneurship.

4.2 Defining e-Leadership

4.2.1 Understanding the growing demand for e-leadership skills

To enhance their productivity and competitiveness, organizations are increasingly relying on information and communications technology (ICT) to operate their business processes and to innovate and provision products and services.[16]

As noted in previous chapters, as organizations invest more in technology and digitize their business operations and innovations, they are demanding people who can develop, apply and manage systems of digital technologies – i.e., professionals who are e-skilled. Outsourcing and automation are two trends that complicate efforts to estimate the demand for e-skilled professionals. Outsourcing enables well-coordinated organizations to isolate key responsibilities and contract an external service provider to take care of. Outsourcing enables organizations to meet part of their demand for e-skilled professionals without having to hire additional employees or re-skill existing ones. It is one way that the market has learned to pool and re-use e-skilled professionals. Automation reduces the demand for e-skilled professionals who perform very routine tasks.

As organizations rely more on ICT, they are demanding a new type of leader: leaders who are both business and ICT savvy; they are demanding ICT leaders to be more business-savvy and business

[16] Aral, Brynjolfsson and Wu 2012; Brynjolfsson and Saunders 2010; Hunter and Westerman 2010; and Weil and Ross 2010

leaders to be more ICT-savvy.[17] And although outsourcing and automation may mitigate the growing demand for e-skilled professionals due to the aforementioned development, organizations of all sizes and from all sectors nonetheless increasingly need at least one person who can lead and manage e-skilled professionals. Three significant changes are contributing to a growing demand for e-leadership skills by organisations:

- *Organisations are developing more uses of ICT to operate and innovate.* The first factor is that a wide range of leading organisations are innovating new uses of ICT for both enhancing business operations and expanding the ways they innovate. This is the result of three main developments: the cost of ICT and ICT services has decreased, ICT vendors are offering better and more relevant products and services, and, as more organisations use ICT, the network value of ICT has increased. With regards to operating business processes, firms are learning to automate their most routine tasks (e.g., repetitive tasks in manufacturing and accounting) and to support and facilitate non-routine processes. With regards to innovating products and services, firms are learning to open their innovation processes to users and partners and they are exploring ways to integrate ICT into traditionally non-ICT products (e.g., adding RFID and GPS technology into shipping containers) and create new services from the data generated by the integrated products (e.g., developing services that help customers track containers and manage other aspects of transportation logistics).
- *Organisations are learning to manage their ICT infrastructure more efficiently and effectively.* The second factor is that there are a greater number of organisations cleaning up their ICT infrastructure from disparate islands of solutions that require increasingly complex, expensive and risky ways to connect to inter-operable and reusable solutions. This is enabling to spend less of their ICT budget on operations and maintenance and more on developing new applications.
- *Organisations can increasingly access ICT resources without having to own them.* The third factor that advances in ICT enable ICT and non-ICT services to be provided in different parts of the world by independent organisations. Increasing demands for access to ICT resources and services no longer means owning those ICT resources and services.

A growing demand for ICT leaders to be more business-savvy

As a result of these three developments, researchers are finding that the strategic roles of Chief Information Officers (CIOs) and their IT Groups are expanding. Since 2009, INSEAD researchers have worked with CIONET on an annual survey of European CIOs. CIOs were asked to estimate what percentage of their time last year was spent across four areas of activity: managing ICT services; working with non-IT colleagues; managing enterprise-wide business processes; and working with external customers and partners. Contrary to traditional perceptions of what CIOs do, the results consistently show that:

- CIOs spend a significant percentage of their time outside of managing ICT services;
- CIOs spend about a third of their time working with non-IT colleagues, whereas IT Groups spend about a quarter of their time. In both cases, they anticipate the percentage of time working with non-IT colleagues to grow by at least 20%; and
- CIOs and their IT groups anticipate spending an increasingly smaller percentage time managing ICT services and a growing percentage of their time working with non-IT colleagues; managing enterprise-wide business processes; and working with external customers and partners.

[17] For recent examples, see Austin et al. 2009; Fonstad 2011, 2012; Peppard 2010, 2013; Spitze and Lee 2012; Woerner and Weill 2009.

These trends are described in greater detail in section 3.2.3 "The expanding strategic roles of e-leaders."

A growing demand for non-ICT leaders to become more ICT-savvy

As the strategic roles of CIOs are expanding, forcing them to become more business-savvy, non-ICT business leaders are also finding they must become more ICT-savvy, both in terms of understanding specific technologies and in terms of understanding systems of technologies. In April 2012, the prestigious international executive placement firm Spencer Stuart published a report on the growing demand for "Digital Directors." The report notes:[18]

> [Boards of Directors] have taken notice of the rapid pace of change [of ICT] and have acknowledged the importance of augmenting their ranks with executives at the forefront of these technology advancements. As companies increase their investments in digital technologies and social media and mobile platforms, more boards are looking to recruit "digital directors." According to the 2011 Spencer Stuart Board Index, demand for directors with digital or technology backgrounds has increased more than 20 percent in the past year. For individuals possessing the requisite understanding of the digital landscape, opportunities in the boardroom are at an all-time high.
>
> The greatest demand is for technology-savvy directors who also have broad operational or management experience, particularly in newer digital fields. Executives with these profiles, especially those with prior board experience, are scarce, and consequently, boards have become more willing to consider candidates with digital profiles even if they have less operational or general management experience.

Based on a global survey of 685 CIOs working in large public and private sector organizations, data from a survey of 88 large global organizations, and 10 detailed case studies on effective ICT-enabled innovation, Peppard and Thorp (2012) note:[19]

> Our research reveals that CEOs and their CxO colleagues play a pivotal role in determining whether or not their organisations maximise value from their IT spend. CEOs, in particular, set the tone for IT and whether it ultimately generates value. Unfortunately, most CEOs don't seem to understand this. This quest for IT value is definitely not something that can be abdicated to the CIO (although they certainly have an important role to play, but more about that later). Many so-called IT decisions are essentially business decisions and executing those decisions raises business responsibilities – all chief officers must recognise that delivering value from IT is a shared responsibility. This is more than acknowledging that IT is of strategic importance – which most CEOs do – but requires their active participation and oversight. Ultimately, CEOs must accept their accountability for IT and understand and accept their essential role.

In summary, the growing demand for e-leaders is reflected in both the expanding strategic roles of CIOs and their ICT Groups and in research that examines the new types of leaders that businesses are demanding in order to be innovative and competitive.

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[18] SpencerStuart. (2012). Digital Directors: Putting your expertise to work in the boardroom. Report released April 2012. Available at: http://content.spencerstuart.com/sswebsite/pdf/lib/DD_Expertise_linear.pdf

[19] Peppard, J. and Thorp, J. (2012). "What every CEO should know and do about IT." Working Paper under review. Request latest copy from j.peppard@cranfield.ac.uk

E-leadership in the context of e-skills efforts at the European Commission

Amidst these changes, for almost a decade, the European Commission has been at the forefront of tracking the evolving demand and supply of e-skills. In 2004, the European e-skills Forum adopted the following definition for e-skills (European Commission, 2004):

- *ICT user skills*: the capabilities required for the effective application of ICT systems and devices by the individual. ICT users apply systems as tools in support of their own work. User skills cover the use of common software tools and of specialised tools supporting business functions within industry. At the general level, they cover "digital literacy": the skills required for the confident and critical use of ICT for work, leisure, learning and communication.
- *ICT practitioner skills*: the capabilities required for researching, developing, designing, strategic planning, managing, producing, consulting, marketing, selling, integrating, installing, administering, maintaining, supporting and servicing ICT systems.
- *E-business skills (also called e-leadership)*: the capabilities needed to exploit opportunities provided by ICT, notably the Internet; to ensure more efficient and effective performance of different types of organisations; to explore possibilities for new ways of conducting business/administrative and organisational processes; and/or to establish new businesses.[20]

This report represents a key deliverable from collaboration between empirica, IDC and INSEAD for the European Commission's Directorate General Enterprise and Industry to develop a vision for Europe's e-skills for competitiveness and innovation and examine ways to face current and future challenges. The focus in this chapter is on e-leadership skills.[21]

4.2.2 The definition of e-leadership in the context of leadership and entrepreneurship

More than 50 years ago, a researcher with an eye for detail grasped the core characteristics of leadership. In 1961, W.C.H. Prentice published an article on "Understanding Leadership" in the Harvard Business Review (HBR), which proved so relevant that HBR republished it in 2004, as part of a special issue on leadership. Many management teachers continue to offer it as a fundamental reading in their leadership courses. In the article, Prentice offers the following definition of leadership.[22]

> Leadership is the accomplishment of a goal through the direction of human assistants. The man who successfully marshals his human collaborators to achieve particular ends is a leader. A great leader is one who can do so day after day, and year after year, in a wide variety of circumstances.[23]

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[20] It is important to note that the aforementioned definitions are not exclusive – i.e., someone may be skilled at more than one of the three types of skills. In some settings, such as small and medium-sized enterprises in the ICT sector, an organisation may have many employees that practice all three types of skills.

[21] One of the recommendations of the evaluation of "e-skills for 21st century" report was: "Continuation of the long term e-skills agenda with new focused e-skills activities to fill well identified gaps, in particular the promotion of "e-leadership skills" for competitiveness and innovation to match new requirements emerging from industry" (Huesing and Korte, 2010).

[22] Prentice 2004: 102-3

[23] Prentice (2004: 112-3) continues to explain: He may not possess or display power; force or the threat of harm may never enter into his dealings. He may not be popular; his followers may never do what he wishes out of love or admiration for him. He may not ever be a colourful person; he may never use memorable devices to dramatize the

After Prentice opened up the field 50 years ago, a vast body of research on leadership has developed, identifying critical activities and skills that constitute effective leadership and describing how leadership activities and responsibilities are distributed across several people. Research on leadership consistently highlights four general activities that leaders must be able to accomplish well:[24]

1. Making sense of a situation (e.g., identify interdependencies);
2. Building and aligning relationship across boundaries (e.g., build relationships within and across organizations);
3. Developing a compelling vision for an initiative that creates value (e.g., identify risks and synergies from interdependencies); and
4. Managing change and Inventing - access, negotiate, coordinate, and motivate a variety of resources throughout the processes of realizing the initiative and of achieving and sustaining value from it (e.g., active experimentation).

In essence, a good leader will always know how to motivate people to achieve the goals of the organization. But today's organizations bear little resemblance to those in the Prentice epoch, simply because achieving any goals nowadays has become so intricately linked to an organization's investments in technologies. As a result of the pervasion of ICT-dependent goals, organizations need leaders who are capable of effectively guiding teams to use ICT to accomplish, develop, and sustain such goals.

Differences between leadership and management

Management and leadership are distinct yet inseparable. In his 1989 book "On Becoming a Leader," Warren Bennis composed a list of the differences. What follow are some examples:

- The manager administers; the leader innovates.
- The manager maintains; the leader develops.
- The manager focuses on systems and structure; the leader focuses on people.
- The manager relies on control; the leader inspires trust.
- The manager has a short-range view; the leader has a long-range perspective.
- The manager asks how and when; the leader asks what and why.
- The manager imitates; the leader originates.
- The manager does things right; the leader does the right thing.

Deriving e-leadership from leadership

Drawing on Prentice, the following definition of e-leadership is proposed.

> *E-leadership is the accomplishment of a goal that relies on ICT through the direction of human assistants and uses of ICT.*

E-leadership is a type of leadership, distinguished by the type of goal that needs to be accomplished and what resources a leader must coordinate and align. In the case of e-leadership, both the goal and the resources involve using ICT. As a result, as discussed later on in this section, this creates additional demands on the competences of an effective e-leader.

In the case of e-leaders, in addition to engaging in these four general leadership activities, they engage in activities related to uses of ICT in organizations to operate and innovate.

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purposes of his group or to focus attention on his leadership. As for the important matter of setting goals, he may actually be a man of little influence, or even of little skill; as a leader he may merely carry out the plans of others. His *unique* achievement is a human and social one which stems from his understanding of his fellow workers and the relationship of their individual goals to the group goal that he must carry out.

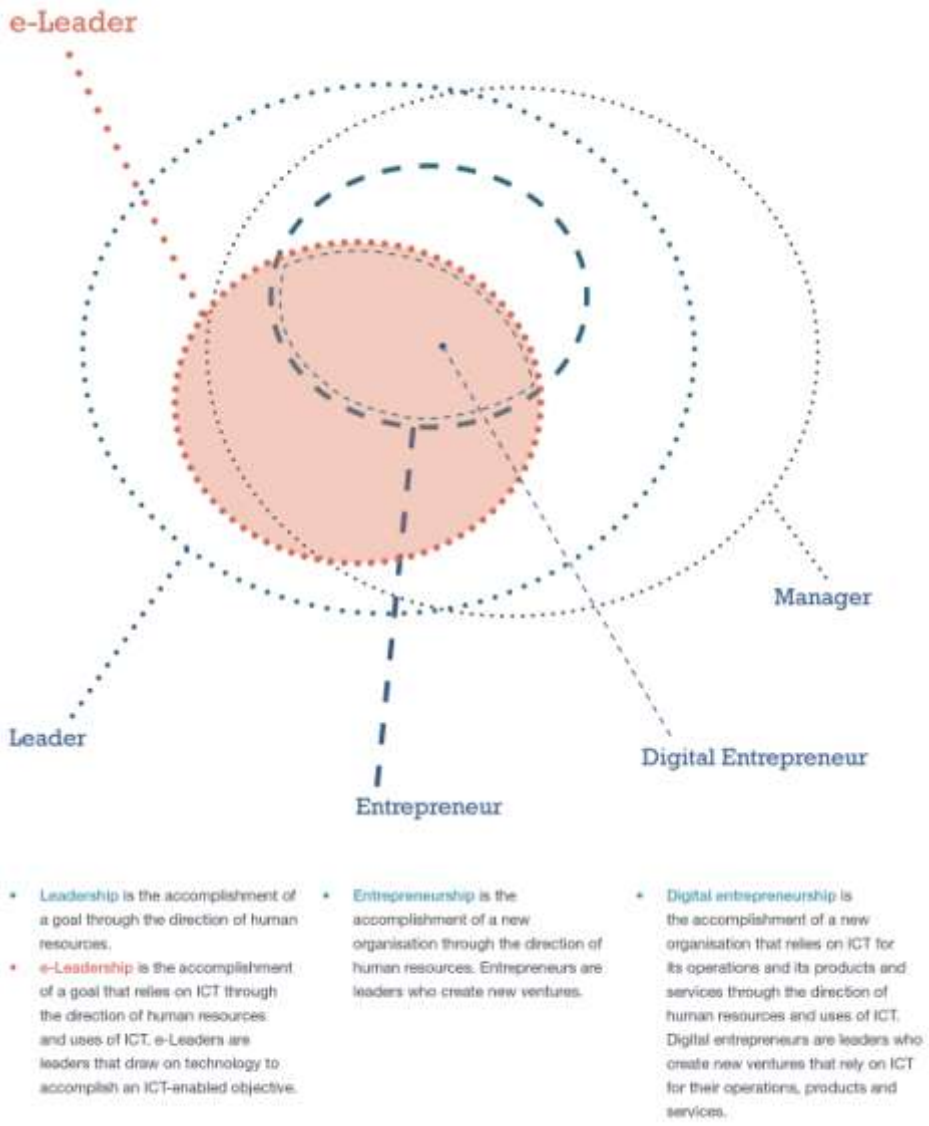
[24] Ancona et al. 2007; Goleman 1998; Senge 1990; Prentice 2004

E-leadership in the context of entrepreneurship

Entrepreneurship and digital entrepreneurship are also defined in relation to the definitions of leadership and e-leadership.

> *Entrepreneurship is the accomplishment of a new organization through the direction of human assistants.*
>
> *Digital entrepreneurship is the accomplishment of a new organization that relies on ICT for its operations and/or its products and services through the direction of human assistants and uses of ICT.*

In summary, as the figure below illustrates, e-leaders have several overlapping aspects with leaders, managers, and entrepreneurs. Nonetheless, they are a distinct type of leader. E-leaders are leaders that draw on ICT to accomplish an ICT-enabled objective. Entrepreneurs are leaders who create new ventures. Digital entrepreneurs are leaders who create new ventures that rely on ICT - e.g., for operations and/or for products and services.



4.2.3 The expanding strategic roles of e-leaders

Recent research on the roles of e-leaders, such as Chief Information Officers (CIOs) and IT professionals in both ICT-sector and non-ICT sector organisations, has found that their roles and responsibilities are expanding beyond traditional application development and operation and maintenance of ICT services (Fonstad 2011 and 2012; Weill and Woerner, 2009 and 2010).

As ICT becomes a more integral part of their operations, organisations are discovering new strategic uses and roles for ICT professionals, such as managing projects and pursuing synergies across traditionally independent business units (e.g., standardizing technology and integrating data to develop a "single face" to the customer), innovating collaboratively, and involving their consumers, partners and even competitors in new ways of creating value.

In 2011 and 2012, together with CIONET, INSEAD eLab developed an annual report on the expanding strategic roles of CIOs.[25] They collected primary data from two sources: a survey of CIOs and interviews with Europe's most distinguished CIOs, as judged by their peers. Together, these findings highlight the consistent extent by which CIOs and their IT Groups are engaged in several key strategic activities beyond simply managing essential ICT services.

It was found that leading organisations in Europe – from both the public and private sectors and from both IT and non-IT sectors – are relying on three types of IT-enabled leaders, such as CIOs and members of their teams, to provide three distinct types of value to their organisations (Fonstad, 2011 and 2012).

The survey data that was collected from CIOs included data on how they distributed their time in 2011 across four broad sets of activities:[26]

1. Managing ICT services;
2. Working with non-IT colleagues;
3. Managing enterprise-wide business processes; and
4. Working with external customers and

[25] CIONET is a network of over 3500 CIOs, CTO's and IT Directors across from 11 European countries (www.cionet.com)

[26] These four categories and their descriptions are adapted from Weill & Woerner (2009 and 2010).

From their responses, three distinct types of CIOs and IT Groups emerged.

Researchers have identified three types of CIOs and IT Groups, based on how they distribute their time across four broad sets of activities

Types	Description	Definition in Relation to Four Areas of Activities	Types in 2011
Technology-Driven	CIOs and IT Groups that are primarily focused on managing the IT organization to ensure delivery of IT infrastructure, applications, and related services across the company at the desired cost and service levels.	If C+D < 25%	CIOs 37% IT Groups 60%
Business Process-Driven	CIOs and IT Groups who spend a greater than average percentage of time managing enterprise business processes, such as shared services, global supply chain, operations, and customer experience.	If C+D >= 15 AND C > D	CIOs 41% IT Groups 31%
Client-Driven	CIOs and IT Groups who spend a greater than average percentage of time meeting with external customers and partners as part of the sales, service delivery or innovation process.	If C+D >= 15 AND C <= D	CIOs 22% IT Groups 10%

Source: Fonstad (2012).

The data indicate that CIOs are increasingly working with non-IT colleagues to manage IT services, design and manage business processes, and engage with external customers. On average, all three types of CIOs spend at least a quarter of their time working with non-IT colleagues. Interestingly, INSEAD data consistently show that this area of activity is not a significantly distinguishing factor of the three types of CIOs, as on average, all three types spend a considerable amount of their time with non-IT colleagues.

Technology-driven CIOs – are CIOs who are primarily focused on managing the IT organisation to ensure delivery of IT infrastructure, applications, and related services. Technology-driven leaders ensure the organisation is spending more on innovation and less on operations and maintenance. Daniel Lebeau, VP of Information & Management Systems at GlaxoSmithKline Biologicals, won in this category. To supply 25 percent of the world's vaccines, GSK Biologicals relies on 12,000 employees, about half in manufacturing and a quarter in research and development. Lebeau and his team (bioIT) ensure they get the IT services they need to get their job done while keeping the total spend on IT 29% lower than the peer group average and 14% lower than the 25th percentile of the best performing peer companies. One of the most striking aspects of bioIT is its size: 100 people total and only one member has a degree in computer science.

Business Process-driven CIOs – Leaders who spend a greater than average percentage of time managing enterprise business processes, such as shared services, global supply chain, operations, and customer experience. Business process-driven leaders help non-IT colleagues map, re-design and improve how things get done in the organisation. Marcello Cordioli, Group CIO of Permasteelisa, is a good example of a business process-driven leader. Think of either the world's tallest or most modern-looking buildings and chances are Permasteelisa developed the exterior. IT has helped the organisation develop new ways to coordinate resources across its 50 offices located worldwide, across multiple cultures, time zones, and occupations. In 2010, Cordioli's IT team co-developed with Autodesk (one of Permasteelisa's largest service providers) a system to accelerate the firm's ability to react to customers from initial inquiry to final installation. The project involved bringing experts throughout the firm who had not worked together before.

Client-driven CIOs – are leaders who spend a greater than average percentage of time meeting with external customers and partners as part of the sales, service delivery or innovation process. Client-driven leaders help extend their organisation's capacity to innovate with customers. Pascale Avargues, CIO of the French city Bordeaux, has led "Bordeaux Digital City," an ambitious project to design and deploy digital services to residents and tourists to enhance business and city services. A critical success factor to the project has been the Carte de Ville de Brodeuax (Carte Bordeaux). Initiated and managed by Avargues and her team, the Carte de Bordueaux is an ongoing project that enables anyone to securely deposit money into one's account, and then use a special card to pay and participate in a wide range of city services. When a card holder arrives for a specific service (e.g., school meals and childcare, parking meter, public transportation, sports facilities, libraries), their status and corresponding options and rates are recognised, thus speeding access to the service(s).

INSEAD eLab survey data from CIOs from 2011 and 2012 consistently highlight several important trends that reflect the growing strategic role of IT in organisations. Two general findings stand out from all the others:

1. CIOs and their IT Groups are engaged in several key activities beyond simply managing ICT services
2. Over the next three years, many CIOs and their IT Groups anticipate their strategic roles will change significantly. For example, our findings indicate that almost a quarter of participating CIOs anticipate their roles changing from either Technology-driven or Client-driven to Business Process-driven

Over the next 3 years, 35% of CIOs anticipate they will become a different type of CIO

Source: Fonstad (2012).

Similar to CIOs, over the next 3 years, it is expected that 32% of IT Groups will become a different type

Source: Fonstad (2012).

4.2.4 Accomplishing a growing set of responsibilities by distributing e-leadership across more than one person

To get value from ICT, organizations are engaging in a variety of activities more specific than the aforementioned four broad sets of activities. Several organizations have developed frameworks to describe more specifically what activities organizations engage in to maximize value from ICT.

Using technology to competitively operate and innovate entails a broad set of activities. Box 1 summarizes eight more specific sets of responsibilities and related activities that successful organizations engage to maximize value from technology. These eight are derived from academic research and national government efforts, such as the UK's National Occupation Standards for IT and Telecom (NOS ITT), which has identified different sets of activities that organizations must be able to accomplish (whether with internal or external resources) in order to use ICT competitively. These eight are comparable to other e-skills frameworks, such as those developed by EuroCIO and by The European e-Competences Framework.

In many medium and large organizations, it is insufficient to simply have a single e-leader who responsible for all eight sets activities. Instead, leadership responsibility is distributed across more than one person.[27]

In many large organizations, in addition to having a single person responsible for the overall development and management of ICT systems, such as a Chief Information Officer, there is also a person who is accountable for leading a more specific set of activities, such as one of the eight listed in Box 2. For example, many organizations now have a Chief Enterprise Architect who is responsible for ensuring that ICT systems, business processes and data are all coordinated and aligned to the organization's operating model.[28] The Chief Enterprise Architect must often lead a team of internal and external ICT professionals, who are experts in areas such as networks and ICT systems. In several organizations, there are high-level business-IT relationship managers who also report to the CIO. Often, these relationship managers must lead teams of business managers and ICT developers to ensure the demands of a particular business unit are prioritized, aligned, and met.

[27] For general research on the importance of distributed leadership see Ancona and Bresman (2007), Ancona et al. (2007), and Ancona et al. (2009).

[28] Weill and Ross (2009) define the *operating model* as the desired level of business process integration and business process standardization for delivering goods and services to customers. Enterprise architecture is developed in response to an organization's operating model. Enterprise architecture is the organizing logic for key business process and IT capabilities reflecting the integration and standardization requirements of the firm's operating model

Organizations needs e-leaders who can coordinate and align the following eight general sets of activities

1. **Business development, sales and marketing:** Services related to consulting business managers on developing business markets, brands and values, and communicating these to the marketplace – e.g., consultancy provision; strategic business development; brand and value proposition development; sector marketing and lead generation; market intelligence and research; market communications; sales management and operations; etc.
2. **Business process management:** Services related to conducting business analysis, designing/redesigning business processes; managing the implementation of business change; designing/redesigning organisations; and ensuring benefits realization.
3. **Programme and project management:** Services related to ensuring projects and programmes are completed successfully – e.g., Project inception and scope management; project planning and scheduling; project execution, monitoring and control; and project completion, acceptance and review.
4. **Solutions architecture:** Services related to ensuring data, applications and systems are sufficiently integrated and standardized to support business operations – e.g., Systems Architecture; Data Analysis; Human Needs Analysis; Systems Analysis; Data Design; Human Computer Interaction/ Interface (HCI) Design; Systems Design; IT/Technology Infrastructure Design and Planning.
5. **Solution development and implementation:** Services related to creating, testing, integrating and implementing software solutions – e.g., Systems Development; Software Development; IT/Technology Solution Testing; Systems Integration; IT/technology systems installation, implementation and handover.
6. **Information management and security:** Services related to information management and security activities within an organisation – e.g., Information management; IT security management; IT disaster recovery.
7. **IT services management and delivery:** Services related to management of service delivery and the delivery itself of IT services, systems and assets to an organisation to support business functions. IT service operations and event management; Service Help Desk and Incident Management; Problem Management; Application Management / Support; IT Management And Support; Availability Management; Capacity Management; Service Level Management; Measuring and reporting.
8. **Global sourcing management:** Services related to defining and operating a sourcing strategy – e.g., Management of suppliers and supplier performance; Procurement of external IT resources, such as people, software, hardware, and licenses.

4.2.5 Two general types of e-leaders, each representing a different t-shaped portfolio of skills

Effective organizations are demanding e-leaders with a T-shaped portfolio of skills - whether an e-leader is a CIO, a Chief Enterprise Architect, a relationship manager between IT and a business unit, or a leader of any of the aforementioned sets of activities. Very simply: having a T-shaped portfolio of skills means that a leader is both business and ICT-savvy. More precisely, having a T-shaped portfolio of skills means that a leader has the following skills:

- A vertical set of skills that represent expertise or "deep knowledge" in a specific area (e.g., science; engineering; ICT; social sciences);
- A horizontal set of skills that represent "transversal skills" (e.g., negotiation; critical thinking; design and systems thinking, business and entrepreneurship, etc.) that enable collaboration across a variety of boundaries.
- BOTH vertical and horizontal sets of skills require a basic level of ICT user skills, as defined by the European Commission.

Although all e-leaders require a T-shaped portfolio of skills, the distribution of expertise may vary, depending on what sets of activities an e-leader is responsible for. The following figure shows how, in general, each set of activities demands either strategic understanding (knowing what is possible) or practical understanding (knowing how to do the possible) of a set of skills. For example, enterprise architects need to have a practical understanding of ICT systems and how to define and manage interdependencies (e.g., between ICT, business processes and data) as well as functional, product and sector expertise to ensure that the enterprise architecture supports an operating model that is best for the organization, given its strategy and the environment it is working in. The Chief Enterprise Architect of a large enterprise is also a critical e-leader, leading a team of enterprise architects and generally ensuring that all projects are in compliance with the enterprise architecture (and any exceptions are under control).

To be accomplished well, each key set of activities requires a different mix of strategic and practical understanding of the vertical and horizontal expertise.

	Literacy & basic skills	Using ICT (Vertical Expertise)				Developing Organizations (Horizontal/Transversal Expertise) Global Knowledge Economy Talents			
Key sets of activities	Reading, writing, math, digital literacy, etc.	ICT expertise	Function expertise	Product expertise	Customer & Sector expertise	Managing change and inventing	Developing a compelling vision	Building and aligning relationships across boundaries	Making sense of a situation
Business development, sales and marketing	+++	+	+	+	+	+++	+++	+++	+++
Business process management	+++	+	+	+	+	+++	+++	+++	+++
Program and project management	+++	+	+	+	+	+++	+++	+++	+++
Global sourcing management	+++	+	+	+	+	+++	+++	+++	+++
Enterprise architecture	+++	+++	+++	+++	+++	+	+	+	+
Solution development and implementation	+++	+++	+++	+++	+++	+	+	+	+
Information management and security	+++	+++	+++	+++	+++	+	+	+	+
IT services management and delivery	+++	+++	+++	+++	+++	+	+	+	+

+ = strategic understanding (knowing what is possible)
+++ = practical understanding (knowing how to do the possible)

In general, depending on what sets of activities an e-leader is responsible for, s/he will need to have a strategic understanding of some areas of expertise and a practical understanding of other areas of expertise (please see Table, below). As a result, there are two broad types of e-leaders, depending on the make-up of the leader's T-shaped portfolio: technology-focused and management-focused. The T-shaped portfolio of skills varies for e-leaders, depending on what sets of activities they are responsible for, and consequently, what areas of expertise they need to have either a strategic or practical understanding of.

Two general types of e-leaders: Depending on what key sets of activities a leader is responsible for, the leader may be either a technology-focused or management-focuses e-leaders.

Key sets of activities	Type of e-leadership
Business development, sales and marketing	Management-focused
Business process management	Management-focused
Program and project management	Management-focused
Global sourcing management	Management-focused
Enterprise architecture	Technology-Focused
Solution development and implementation	Technology-Focused
Information management and security	Technology-Focused
IT services management and delivery	Technology-Focused

Box: E-skills and e-leaders at 3 Suisses International Group

3 Suisses International Group is one of the most important distance-selling companies in France and Europe. The Group's business activities include multichannel retail, services and financial services in 16 countries across Europe and Asia. In total, Group 3 Suisses International generated sales of EUR 2 billion in 2011, and has more than 8,000 employees. 70 percent of its revenues are generated from the Internet and 30 percent through mail orders and phone. Gressier's goal is to "shift from catalog-centric IT, processes and organization to a web-centric one."

Pierre Gressier has been the CIO of Group 3 Suisses International since September 2009, after having been CIO of the payTV group Canal+ and of the French ECG retailer FNAC. He has responsibility over all of 3 Suisses' Business-to-Consumer companies. In less than three years, Gressier has transformed the entire IT system of Europe's seventh largest e-commerce group.

Gressier's modernization project, aptly named Vinci, is turning out to be one of the largest and most comprehensive IT transformation stories currently being undertaken in Europe. In 2010, Group 3 Suisses International invested EUR 70 million in Gressier's plan to develop their online presence in more than 30 countries.

When Gressier arrived, the Group was a disparate collection of IT silos with no shared services, no integration of projects, no process culture within business, no business involvement in the IT projects, and no centralized logistics and call centres. Drawing from his previous award-winning experience as a CIO in the retail sector, Gressier launched the Vinci plan, which is named after Leonardo Da Vinci who was both an artist and a scientist, and though perfectly represents the close alliance between business and IT which is the main success factor of such a program.

Vinci has involved completely redesigning the entire information system AND business processes, from the purchasing department to the marketing department, including the complete supply chain. So Vinci is not only an ERP implementation, it is a complete rethinking of all the processes, company-wide, and the implementation of a completely new and redesigned best of breed Information System, with the integration of several major ERPs, with a Service Oriented Architecture, and a private cloud infrastructure.

And furthermore, the approach is not brand per brand, but for all the brands of the company, enabling the creation of several Shared Service Centers, including critical business services such as warehouses and customers call centers. To this end, he implemented a sophisticated warehouse management system and laid the foundation for the building of France's largest warehouse among e-commerce companies. With a capacity of more than 25 million items, the new warehouse, near the city of Lille, will process all the customer orders for all the brands within 3Suisses, with highly automated tools.

Also, all the customer call centres have been centralized into a single call centre serving all the mass-market brands. This new shared services organization is a complete turnaround of the former organization: In total, 2,000 employees of the brand's former 2,500-strong workforce have been transferred to the Group's logistics and call centre organization, without laying off any permanent worker.

In devising the most ambitious business plan of his career, the Vinci plan, Gressier pitched it to management in terms they could understand. He showed the Board how he could yield EUR 100 million to the bottom line through cost reduction, value addition and improved customer service. After getting the buy-in from the top, Gressier rolled up his sleeves and got down to work to implement this 100,000+ man-days program. To lead and coordinate all the various components of this ambitious change program, Gressier has relied on a handful of key leaders who understand both ICT systems and business processes.

One of his first ideas was to put business managers and IT professionals under a single roof, whereby development could march in step with the business needs of the brands. "We've got 450 people working together in a large open space building: IT people, business people, service integrators, all of them unblocking the Group's business potential. What we did was completely integrate the Vinci project into a one-team project."

None of Gressier's ideas could have been brought to fruition without change management: a successful transformation program means comprehensive buy-in by employees and management. That includes extensive employee training: each employee will have in average a 9 days training courses, with more than 400 training sessions for the purchasing department. This will enable staff to learn new business processes and tools, while gaining deeper knowledge of the internet. With the right platforms and skills in place, Gressier is keen to take 3 Suisses to the next level of digital commerce.

This profile was adapted from Fonstad (2012).

Box: E-leaders at Azko Nobel

In 2012, the CIO of Azko Nobel, Pieter Schoehuijs, earned the title of European CIO of the Year, Business-Process Driven. AzkoNobel is the largest decorative paints and performance coatings company in the world, and a leading producer of specialty chemicals. It operates in over 80 countries worldwide and has 56,000 employees globally. AzkoNobel has 3 main business areas, each of which has 5 business units. In 2011, each sub-unit generated 1bn EUR on average, for a total of 15.7bn.

About 8 years ago, to compete more efficiently and enter new markets, senior management at AzkoNobel decided to transform the company from a financial holding firm of separate businesses to a more matrixed organization where operations and activities of the business units are coordinated for efficiencies and synergies. ICT was fundamental to this transition.

ICT has been critical to AzkoNobel's success because it has enabled them to not only transform their internal operations but to also strategically integrate their supply chain with key customers and suppliers. Today, the ICT Group at AzkoNobel has an annual IT operating budget of 300mn EUR and is responsible for all systems for AzkoNobel, including those supporting functional organizations such as ICT, finance, supply chain, HR, and legal. About 930 people work in ICT at AzkoNobel in 43 countries around the world.

Ensuring rapid consolidation is sustained with new skills

Since joining AzkoNobel in 2009, Pieter Schoehuijs has helped the organization transform itself. The result of 15 companies evolving separately was "a very diverse systems landscape with literally thousands of systems on even more servers."

Whereas similar companies have approached the challenge of consolidation by implementing a single instance of an ERP across the entire firm, AzkoNobel decided to support 6 different systems to give individual business units greater agility. "When I joined three years ago, we had 183 ERP systems. Today we have 96. And we've established roadmaps and strategy plans to go to six, which means that in the last three years we have retired more than two ERP systems per month on average, and we are planning to continue to do so for the next four years. This is business transformation by process harmonization on a global scale."

This massive consolidation, coupled with a greater use of external service providers, has significantly changed the skill set needed by the ICT Group at AzkoNobel. Before, there was a greater need for technical people who knew how to perform services such as install servers, manage systems, and apply patches. Now, there is a greater demand for professionals who are more skilled at service delivery management, systems planning (e.g., enterprise architecture) and business processes.

To help increase the pool of future ICT-leaders, Schoehuijs works closely with HR leaders at AzkoNobel and participates actively in two innovative efforts. One is a trainee program lead by a consulting firm (Kirkman) in partnership with other leading Dutch companies, where recent university graduates spend 6 month internships in each company. Schoehuijs also serves on the program review board of an MBA program in business and IT, hosted by Nyenrode University and co-founded by EuroCIO (http://www.nyenrode.nl/Education/MBA/MBA-BIT/)

This profile was adapted from Fonstad (2012).

4.3 What can we learn from existing sources?[29]

A body of literature on strategic and e-leadership skills, as defined in Chapter 2, does not yet exist. In this chapter we explore avenues to explore in other parts of the (academic) literature that can provide insights into strategic and e-leadership skills. This is important in order to start analysing and understanding these skills, to be able to identify barriers and needs, and know how and where policy intervention, both at the European and Member State levels will be most effective. This is key to Europe's future as not using talents and creativity puts innovation and both current and future competitiveness at risk.

4.3.1 An overview of the (academic) literature

In order to understand strategic and e-leadership skills, we are interested in the literature related to innovative e-leadership, innovative and high-growth enterprises led by innovative entrepreneurs, and the skills that distinguish them from other managers and leaders.

Dyer *et al.* (2008) define an innovative entrepreneur as "(1) the founder of a new venture that offered a unique value proposition relative to incumbents; and (2) the person who came up with the original idea to start the venture". In addition, they argue that innovative entrepreneurs can be distinguished from executives on the basis of four behavioural patterns through which they acquire information: (1) questioning; (2) observing; (3) experimenting; and (4) idea networking. Entrepreneurs distinguish themselves from non-entrepreneurs in their ability to recognize (business) opportunities. This ability is influenced by factors such as personality differences, cognitive differences, and social network differences. It can be argued that ICT have an influence on several of these characteristics by providing new ways of accessing, acquiring and processing information, idea networking and opportunities to build and exploit social networks. Thus, ICT can enhance the features that make people (innovative) entrepreneurs.

As part of their research, Dyer *et al.* (2008) interviewed a sample of innovative entrepreneurs, founders of at least one highly successful new venture (but who often also had experienced some

[29] This section is excerpted from van Welsum, D. and Lanvin, B. (2012). " VISION report on eLeadership Skills"

failures). Interestingly, many of these innovative entrepreneurs[30] who were interviewed are directly or indirectly related to ICT goods or services, and/or have had an innovative idea using ICT. Another noteworthy fact is that most of these innovative and highly successful ICT-related ventures more generally originated in the US (e.g. Android, Apple, Google, Microsoft, Amazon, etc.). In addition to well-known influences on entrepreneurship, such as regulation and access to capital, culture, and being allowed "to fail", it would be interesting to analyze more closely if and where differences in skills and attitudes can be identified. For example, a commonly mentioned factor that is thought to differentiate attitudes in the US and Europe is the willingness to take risks; business skills and differences in the attitude towards "selling", yourself or a product, are other factors thought to shape cross-Atlantic entrepreneurial differences.[31]

The interviews carried out by Dyer *et al.* (2008) revealed some of the nuances of the distinguishing features between innovative entrepreneurs and other executives. For example, both groups engage in networking, but the manner, frequency and use that the network is put to differ. Whereas executives were found to use networking mainly to promote themselves, their careers, their current company, or to build friendships with "the right people", innovative entrepreneurs were found to use networking as a tool to build networks of people with diverse ideas and perspectives that they could tap into to test ideas and come up with new ideas and insights.

The characteristics of the entrepreneur, and therefore his/her behaviour, tend to be linked to the characteristics of small businesses and how innovative they are, especially at the time of their creation and in the early development phase,[32] and also vary significantly across sectors (Romero and Martinez-Roman, 2012).[33] For example, the impact of education on innovation in small businesses appears through two main channels, (i) its effect on self-employed motivations, and (ii) its influence on the management style of small businesses. In addition to education, previous work experiences, cultural values, personality, attitude, and behavioural traits, the motivation for becoming an entrepreneur has also been found to matter: whether it is to exploit a business opportunity or out of necessity because people are unemployed or unhappy in their job (Reynolds *et al.*, 2002). This is an important distinction as, especially in the current difficult economic times, more people might become self-employed entrepreneurs out of necessity (because they are unemployed), but their ventures tend to be less innovative (Romero and Martinez-Roman, 2012).

According to a survey carried out by Gallup in December 2009, 55% of respondents in the EU who had started up a business or were currently taking steps to start one said they were doing so because they saw an opportunity, 28% said it was out of necessity. In the US, 62% considered themselves an opportunity-driven entrepreneur. In contrast, in Korea this percentage was as low as 18% (and 64% necessity-driven). In China and Japan, 50% of respondents answered that they had

[30] They included Pierre Omidyar (eBay), Jeff Bezos (Amazon.com), Michael Dell (Dell), Mike Lazaridis (Research-in-Motion), Herb Kelleher (Southwest), Marc Benioff (Salesforce.com), Scott Cook (Intuit), David Neeleman (JetBlue), Diane Greene (VMware), Niklas Zennstrom (Skype), and Peter Thiel (PayPal).

[31] For example, in a survey carried out by Gallup (2010), American respondents were more likely than EU citizens and Chinese respondents to say they were risk-takers (82%) and liked competition (77%), versus 55% and 65% in the EU, and 65% and 69% in China, respectively.

[32] Although one surprising and not yet well understood finding of Bloom *et al.* (2012) is that, on average, founder-owned, founder-CEO firms are the worst managed. One possible explanation offered by the authors is that the entrepreneurial skills required of a start-up (e.g., creativity and risk taking) are not the same skills required when a firm grows large enough to be included in the research sample (at least 100 employees).

[33] Using data for firms in Sri Lanka, de Mel *et al.* (2009) also found that owner ability, personality traits, and ethnicity had a significant and substantial impact on the likelihood of a firm innovating.

starting/were starting a business out of necessity (Gallup, 2010). The Global Entrepreneurship Monitor – GEM (2011), and its Extended Report (Bosma *et al.*, 2012) also provide an overview of entrepreneurial attitudes and perceptions across countries. The crisis in Europe transpires in these data in the low perceptions of entrepreneurial opportunities in many European countries, including Greece, Hungary, Portugal and Spain. However, some Asian countries, including Japan and South Korea, also report very low perceived opportunities. In the US, the perception of opportunities is also relatively low, but they report greater confidence in their abilities than Europeans, combined with a lower fear of failure, overall (Table 4). More than half of the population aged 18-64 considers entrepreneurship a good career choice in all but three of the countries included in the sample (Japan, Finland and Ireland). Media attention for entrepreneurship in Europe (measured by whether or not people think there are many news and other media items on new and/or growing firms) is perceived to be especially low in Greece and Hungary.

4.3.2 How can leadership and strategic skills be expected to differ in the e-world?

Some argue that most of the leadership characteristics found in traditional bricks and mortar organisations are equally valued in the digital economy, but that some characteristics are emphasised within e-businesses, including a propensity for risk taking, entrepreneurialism, networking ability, as well as the requisite technical skills. However, the environment in which e-businesses operate can be considered to be significantly different from that in which traditional bricks and mortar businesses operate in terms of three key variables: (i) the task environment, (ii) the motivation and skills of the workforce, and (iii) the lifecycle stage of the organisations (Horner-Long and Schoenberg, 2002).[34] The unprecedented speed of technological change and the new opportunities continuously being created and offered by and over the Internet and associated technologies reinforces the finding by Francalanci *et al.* (2001) over a decade ago that e-leadership is likely to require a greater technical awareness of the capabilities and limitations of ICT than may be expected of traditional CEOs.

A recent Harvard Business Review article also argues that "the world of work has changed dramatically over the past decade", with increasingly global companies and operations, diversified employee groups, less hierarchical and more collaborative organizational models, and fully networked offices. The article identifies three specific skills executives should cultivate to deal with the challenges that arise from being a manager in this new environment: (i) Code Switching Between Cultures ("managers must overcome psychological barriers in order to act in ways that other cultures find appropriate"), (ii) Wielding Digital Influence ("the devolution of hierarchy has increased the value of building and wielding influence through digital networks"), and (iii) Dividing Attention Deliberately (managers should "get over their fears about distraction and embrace the brain's natural tendency to divide attention") (Molinsky *et al*., 2012). Using a Delphi model, Lin and Hsia (2011) identify thirteen core capabilities for e-business innovation[35] in three main areas:

[34] Similarly, many senior managers interviewed by Zhoa (2007) indicated that, fundamentally, there is no difference in entrepreneurship on- or offline – you still need a good idea and a good business model. However, the interviewed entrepreneurs also indicated they saw some differences in terms of the skills required, with more emphasis put on social and networking skills for e-entrepreneurs in order to be able to build relationships and partnerships in other disciplines and sectors.

[35] Lin and Hsia (2011) define an e-business innovation as where new business technology, business models, and value networks converge. Examples of new business technologies include, for example, new IT infrastructure (e.g. mobile connectivity); computing utilities (e.g. cloud computing); architectural principles (e.g. Service-Oriented Architecture); or service delivery (e.g. web 2.0).

Business technology

1. Planning new IT infrastructure and architecture
2. Aligning and integrating emerging IT applications with business operations
3. Enabling the new IT to deliver novel process and coordination services
4. Managing the sourcing of the new IT
5. Ensuring IT and information security

Business management

1. Fostering business agility and market responsiveness
2. Identifying customer value propositions
3. Reinventing business models
4. Developing enterprise absorptive capacity

Collaboration

1. Developing partnerships
2. Governing the value network
3. Enabling open innovation
4. Improving co-production and co-creating value

Successful e-business firms are often found to "exploit e-business innovations through value networks outside of their current operations in order to generate value co-creation" (Lin and Hsia, 2011). Thus, clearly, at least some knowledge about what IT can do for the enterprise and the business model is crucial to have a vision about where to take the company and identify new business opportunities. Knowing how to optimize the use of social and other networks in new and innovative ways to business and innovation purposes will become increasingly important.[36]

Petrie (2011) notes that over time, the leadership environment has become more complex, volatile and unpredictable, and that the skills needed for leadership increasingly require more complex and adaptive thinking abilities. These changes can be expected to be even more acute in the e-world, which is increasingly complex and interconnected. In addition, the Internet and social networking tools enable new organizational structures with flatter hierarchies and more decentralized control.[37] As McGonagill and Doerffer (2010) argue, "a new leadership paradigm seems to be emerging that is marked by an inexorable shift away from one-way, hierarchical, organization-centric communication toward two-way, network-centric, participatory and collaborative leadership styles. Most of all, a new mind-set seems necessary, apart from new skills and knowledge. All the tools in the world will not change anything if the mind-set does not allow and support change." That study recommends managers and organisations to take the following 7 steps to encourage "a strategic approach to adapting to a new culture of transparency, openness, interaction and collaboration", each related to people acquiring some knowledge about how to put the Web to good use:

- Managers should become Web literate and should encourage members of their team to do the same.
- A strategic planning process should be adopted to develop Web strategies.

[36] An interesting illustration of this point is the citation of Professor Sreenivasan (from Columbia's Graduate School of Journalism) in the New York Times: "We have to think about social media in a new strategic way. It is no longer something that we can ignore. It is not a place to just wish your friends happy birthday. It is a place of business. It is a place where your career will be enhanced or degraded, depending on your use of these tools and services" (Preston, 2012).

[37] The importance of social media and social media skills was also highlighted in February 2012 when it was identified by hiring experts in the US as one of "5 hot sectors for job seekers"; at the same time there was also a strong overall labor demand for computer and mathematical science workers (Fottrell, 2012).

- Organisations need to develop policies regarding the use of social media.[38]
- Members of the organisation's "C-suite"[39] should be encouraged to start a blog.
- Human resources, marketing and communications departments should be encouraged to experiment with social media.
- Organizations should learn about common barriers and pitfalls of adopting Web tools.
- Sole ownership of Web strategies by the IT department should be discouraged.

How can things be expected to be different in an "e"-world? True, you still need a good business idea. But, the environment in which these ideas can be exploited is changing dramatically, creating new opportunities in the process, but also new challenges. In addition, changes and innovations are taking place at unprecedented speed.

Some of the challenges created by new opportunities include:

- Operations and teams can be/are increasingly decentralized;
- Competition for inputs and outputs is global and fierce: indeed, inputs (talents, ideas, skills, human resources) can be sourced globally and can be increasingly tailored to specific needs (Box 4), and small firms can increasingly also compete in markets for intermediates and outputs;
- There are new ways of communicating with clients, suppliers, government administrations, and employees or sourced resources;
- An increasing number of cultures come together and have to find a way to effectively work together, with different corporate cultures, but also nationalities, languages, and different generations;
- The new state of the world requires increased flexibility, including in contracts, teams, and places and times of work.

Box 4: Global sourcing of talent, skills and ideas

Offshoring – the international sourcing of IT and ICT-enabled business support services such as customer services, back-office services and professional services – is an important trend in the globalisation of services sectors. It arose out of a need to cut costs and fill skills shortages, was enabled by rapid technological developments, and competition has created a self-reinforcing dynamic. Thus, faced with intensifying competition and globalisation, market deregulation and rapid technological change, firms increasingly adopt new organisational forms, e.g. through mergers and acquisitions, joint ventures and strategic alliances, and by sourcing activities to foreign affiliates or outsourcing them to external suppliers. "Knowledge work" in particular (e.g. data entry, information processing, research and consultancy services can easily be carried out via the Internet and e-mail, as well as tele- and videoconferencing (ICT-enabled services provision). Based on four assumptions about the use of ICT in occupations, or "offshorability attributes": i) intensive use of ICT, ii) an output that can be traded/transmitted enabled by ICT, iii) high codifiable knowledge content, and iv) no face-to-face contact requirements, van Welsum and Vickery (2005) and van Welsum and Reif (2006) estimated that some 20% of total employment is "potentially offshorable". Similar approaches came up with numbers of the same order of magnitude, including 20% of employment in "impersonally deliverable services" potentially offshorable in the US for Blinder (2005), later revised up to some 22-29% to become

[38] This includes being mindful of avoiding a 'brand dilution trap' caused by over-sharing and over-joining (Yaverbaum, 2012).

[39] The C-suite refers to the acronyms given to various management positions in organisations, such as CEO, COO CFO, CTO, and CIO.

potentially offshorable over the next two decades (Blinder, 2007), and 30% of "tradable employment" in the US for Jensen and Kletzer (2005).

It is important to note that these are estimates of employment that is potentially offshorable, not estimates of how much employment will actually be offshored. In addition, some jobs that were offshored have come back. Indeed, some companies are finding managing relationships with outsourcers difficult to combine with responding to the need for increased speed in adapting to changes and increased customization. In addition, as technologies and attitudes continue to evolve, companies are also finding cheaper ways to do the work themselves, thereby avoiding some of the overhead costs that come with managing remote sourcing. In addition, by using a so-called shared service model, which allows companies to centralize IT functions across business units within a company, companies are managing to achieve economies of scale similar to those realized by outsourcers who pool the work of many different companies. Nonetheless, with IT budgets under pressure, some companies still outsource their more basic business processes, allowing them "to do more with less" (Schectman, 2012).

The ability to source work, talent, skills and ideas globally lies at the heart of the internationalization of the operations of SMEs, giving rise to so-called micro-multinationals (Varian, 2005), and is a pre-requisite for these companies to be able to grow, mature, and create local jobs. Varian also notes that it is, in fact, easier for micro-multinationals to deal with the inconvenience of outsourcing than it is for the big international corporations, as some of these inconveniences also come with being small, and/or new, such as being up at all hours of the day and night for constant supervision, communication and coordination at a distance, using ever cheaper ICT. Thus, Varian argues, while large companies were among the first to benefit from the changes enabled by ICT, their impact on SMEs "may yet turn out to have the most impact on the economy." The same idea is also behind what Mettler and Williams (2012a) refer to as the "talent-as-a-service model", and the "project economy", in which more and more tasks are performed by temporary teams of workers that come together (sometimes even just 'virtually') for a particular task or project, and then go their separate ways again. Such a model responds to business' need for adaptability and flexibility, but also to how current and future generations are likely to increasingly want to work: having the freedom to work with the world's most talented people on projects they are passionate about, giving them the opportunity to "meet and collaborate with other talented people in an environment that thrives on innovation, and a meritocratic incentive system where value-creators share in the profits."[40] In the same vein, Cherny (2011) argues that "America and other modern economies have entered what might be called the new work order – an economy where most workers are untethered from large institutions and bouncing from one job to the next. In this economy, each worker is, in effect, their own small business – responsible for guiding their own career and economic future."

Crowd-sourcing is another phenomenon which allows firms of any size to access the talents and skills of many across the globe. Recent examples include tech-firms crowd-sourcing research into "prior art" in patent litigation cases, giving out rewards to those who find the most interesting and useful information (Vascellaro, 2012b), and 99designs.com, a platform that allows people to crowd-source graphic designs: you post your project on the platform and receive bids and ideas from interested and talented designers worldwide (Strauss, 2012).

Silicon Valley is probably the ultimate example of an "e- world" eco-system. Indeed, "Silicon Valley is widely regarded as the ultimate success as an incubator of start-ups and entrepreneurship. Yet most business people, leaders and innovators around the world have learned the wrong lessons from it," according to Hwang (2012). It is not enough to merely assemble the ingredients that make up Silicon Valley, you also need to have the recipe, the culture that makes it work, that makes it a

[40] Although trends are changing here too. These days, Silicon Valley's privately held start-ups and tech companies are increasingly boosting their cash compensation (salaries and cash bonuses) to compete for talent with publicly traded firms. This is a change from earlier days when start-ups often paid relatively lower salaries and little or no annual cash bonuses, and relied more on equity awards (stock options, mainly) to attract new recruits hoping to share in a bigger pay-out further down the line (Tam, 2012).

special place. An innovative eco-system needs three crucial ingredients: talent, ideas and capital. Culture is the recipe that makes them flourish. Silicon Valley has the ingredients and the recipe, "Silicon Valley is a state of mind much more than a location" (Hwang, 2012).

Silicon Valley is a great example of an agglomeration around a centre of excellence, Stanford University. Many of the best and brightest Stanford graduates go to work in the many companies located around it, some do not even bother to graduate. Often times, there is "a process of creative reassembly, as people join forces on temporary projects and then re-circulate and recombine for other projects later" (Hwang, 2012). "Creating apps and companies is just really kind of emblazoned into the culture here," and "the rich history of successful companies born at Stanford makes everyone feel like they have an opportunity to do the next great thing" according to a Stanford student quoted in Graham (2012). In fact, one of the most popular Stanford courses is on how to develop apps for iPhones and iPads; while it is difficult to get into, it is also available for free online and had already been downloaded more than 10 million times by April 2012 (Graham, 2012). Furthermore, as Brent Izutsu, a senior program manager in the digital department, notes, there is an "entrepreneurial spirit at Stanford, and students are highly motivated by the examples of what other students have achieved (Graham, 2012), highlighting the importance of both culture and role models.

It is often argued that the willingness to share information is one of the success factors of Silicon Valley, with people working there effectively sharing information, including by changing companies and exchanging ideas informally. For example, Saxenian (1990) identified the interaction of employees as key to the emergence of Silicon Valley and Boston's Route 128 as major innovation clusters.[41] The increased exposure of people to new ideas has been found to be crucial for the emergence of radical innovation, and can take place in different ways, for example through employees changing firms more regularly, or with scientists being more autonomous and performance oriented in their choice of research projects (Herrmann and Peine, 2011). Add to all that a culture of investment, a willingness to take risks, and the availability of venture and seed capital, and you get something that might resemble Silicon Valley.

4.3.3 What do we know about how to foster e-leadership?

Can (e-)leadership skills be taught? Entrepreneurship education and training can be provided at all levels of schooling,[42] from primary and secondary schools, to vocational colleges and tertiary and university education. Such training is often aimed at creating an entrepreneurial spirit or mind-set, creating a disposition in people to want to create their own businesses (OECD, 2010a). However, the OECD report also points out that there is often a "learning-by-doing" aspect to it, with entrepreneurs learning in practice in the working environment rather than through formal education.[43] In addition, the evidence shows that people employed in SMEs participate less in formal and informal training than their counterparts in larger firms. This has been shown to hold back innovation and is, therefore, an important issue to address.

Both general education and specific business education programs were found to be a major influence on the innovative behaviour of self-employed people in the study by Romero and

[41] See Cummings (2003) and the references therein for the importance of sharing knowledge.

[42] Entrepreneurship education has been noted to show great variety in both focus and approach, and a challenge for teachers and trainers will be to "conceptualize and articulate entrepreneurship as a way of thinking, as a multidisciplinary approach to the process of creating economic and social value in the face of uncertainty and limited resources" (Klein and Bullock, 2006).

[43] It has also been shown that training and mentoring can help entrepreneurs in acquiring certain types of skills, e.g. in presenting their business case to potential investors or in enforcing contracts (OECD, 2010a).

Martinez (2011), with self-employed people with tertiary education being more motivated towards entrepreneurship, and adopting management styles more conducive to innovation. These results are found to vary by the type of motivation that drives these self-employed: intrinsic ("entrepreneurs undertake their activity for the mere pleasure of carrying it out, that is, for vocational reasons or for the need of personal development"), extrinsic ("the entrepreneurs' activity is driven by the desire of gaining an economic reward or a material achievement"), or by necessity (because the person is unemployed or unhappy in their job rather than because they want to pursue an opportunity). In addition, taking entrepreneurship and management related courses, seminars or other educational initiatives was also found to stimulate innovative behaviour among the self-employed.

The effect of entrepreneurship education on entrepreneurial intentions has also been found to depend on the mode of education (active, e.g. business plan seminars, vs. reflective, e.g. theory lectures), on the regional (economic and entrepreneurial) context, and was found to be complemented by individual characteristics (e.g. role models or work experience) (Dohse and Walter, 2010).[44] Specifically, active modes of entrepreneurship education are found to directly increase intentions and attitudes, whereas the impact of reflective modes depends on the regional context[45] and is weaker in regions that do not have an entrepreneurial tradition or 'local role models'.

In the US, the U.S. Department of Labor and the Small Business Administration (SBA) created Project Growing America through Entrepreneurship (GATE) to evaluate the effectiveness of offering free training to any individual interested in starting or improving a business (Benus et al., 2009). However, a study of this GATE experiment, found no lasting effects, i.e. not beyond 6 months (Fairlie *et al.*, 2012). While training is found to increase short run business ownership and employment, there is no evidence of broader or longer run effects. In addition, like many studies trying to evaluate the impact of training, it is not really possible to take out the 'selection into training' effect, which makes it difficult to verify some of the arguments often used to justify public spending on such training policy initiatives.

Leadership skills development more generally also needs to change, as do people's mindsets. Petrie (2011) observes that even though (i) the leadership environment has changed (more complex, volatile and unpredictable), and (ii) the skills needed for leadership have changed (necessitating more complex and adaptive thinking abilities), the methods that are being used to develop leaders have not changed much, and even current leaders who are 'trained and mentored' on-the-job seem to lag behind in the adaptive changes that are needed.[46] Based on a study of the approaches taken

[44] This study examined the impact of entrepreneurship education on the entrepreneurial intentions of students in computer science, electrical engineering and business university departments in Germany.

[45] In addition, the level of regional development, the availability of human capital in the region and the skills composition are also found to matter for entrepreneurship (Mendonca and Grimpe, 2009).

[46] Recruiters and human resources executives also recommend people who are aiming for promotions into the C-suite to accept multiple postings abroad as this is thought to develop "their ability to manage complex, interconnected operations—skills that just can't be developed back at headquarters or in one brief foreign assignment" (Kwoh, 2012). This confirms the finding that "cross-functional experience and international exposure have also been shown to be early discriminators for chief executives, providing skills in general management and cross-cultural understanding respectively (Horner-Long and Schoenberg, 2002). In addition, the study argues that managers require technical skills (to solve problems, evaluate performance and direct subordinates), interpersonal skills, and especially communication skills (to build relationships with employees and other stakeholders, to articulate organisational goals and to persuade others to commit to them), and conceptual skills such as analytical ability and industry understanding (essential for effective planning, problem solving and strategy formation).

to developing leaders at several schools at Harvard University (Education, Business, Law, Government, and Psychology), a literature review of the field of leadership development, as well as interviews with 30 experts in the field, the author identifies 4 major trends for the future of leadership development:

- Increase the focus on vertical development: relatively more time is being spent on competencies (horizontal) development, which can be transmitted by experts, but not enough on development stages (vertical), which an individual needs to 'earn'.
- Transfer greater development ownership to the individual: if people feel they are responsible for their own development (rather than the HR departments, managers or trainers) they will progress faster.
- Increase the focus on collective rather than individual leadership: leadership capacity will increasingly spread throughout the organization rather than sit with one person or role.
- Greatly increase the focus on innovation in leadership development methods. "An era of rapid innovation will be needed in which organizations experiment with new approaches that combine diverse ideas in new ways and share these with others. Technology and the web will both provide the infrastructure and drive the change. Organizations that embrace the changes will do better than those who resist it." In addition, "pivoting" and "iterating" are also becoming increasingly common, especially in start-ups in Silicon Valley, with people trying out new ideas until one works, or until their money runs out (Chapman, 2012).

Reflecting these changes, the interviewed experts by Petrie (2011) identified the following skills, abilities and attributes as crucial to future leaders(hip): (i) adaptability, (ii) self-awareness, (iii) boundary spanning, (iv) collaboration, and (v) network thinking; in addition, the literature review also pointed to (i) creativity, (ii) collaboration, (iii) strategic thinking, (iv) change management, and (v) system thinkers comfortable with ambiguity.

Petrie (2011) also provides a neat illustration of different and new approaches to how to start a business taught at two top Boston universities. At one school students are now told "not to bother writing business plans, as it is impossible to foresee all the important things which will happen once you begin. Instead they are taught to adopt the 'drunken man stumble,' in which you keep staggering forward in the general direction of your vision, without feeling the need to go anywhere in a straight line." At the other school the approach is called "the 'heat-seeking missile' approach. First you launch in the direction of some potential targets, then you flail around until you lock onto a good one and try to hit it."

As for school education, Tony Wagner, from the Harvard Graduate School of Education and the Technology & Entrepreneurship Center at Harvard, notes that "young Americans learn how to innovate most often despite their schooling—not because of it" (Wagner, 2012). This feeling is also echoed in a survey carried out by Gallup (2010). An equal share of EU citizens agreed, "or rather disagreed," that their school education had helped them to develop a sort of entrepreneurial attitude (49%-49%). Furthermore, 39% of EU citizens agreed that their school education gave them the skills and know-how to enable them to become an entrepreneur; only 25% agreed that their education had also made them interested in becoming an entrepreneur. In Turkey, the US and China between 68% and 73% agreed that that their school education had helped them to develop an entrepreneurial attitude.

Gallup (2010) also found the US and China to be ahead of the EU when measuring the impact of school education on entrepreneurship. When asked to agree that a sense of initiative had been engendered, an understanding of entrepreneurship gained, and the necessary skills and interest developed, the proportions of Americans and Chinese respondents agreeing were, respectively,

51%-73% and 53%-75%, but only 25%-49% for the EU. Furthermore, in the US these numbers have increased since 2007, whereas in the EU they have been decreasing.

Wagner recommends that students should not merely be passive 'consumers' of education, but should be 'creators', acquiring skills and knowledge as part of solving a problem, creating a product or generating a new understanding. In order to succeed in the new world, "students must learn to analyze and solve problems, collaborate, persevere, take calculated risks and learn from failure" (Wagner, 2012). In addition, he argues that in today's world, knowledge has become a commodity that everyone can obtain, what matters is what you can do with it.[47] He argues that "the set of core competencies that every student must master before the end of high school is:

- Critical thinking and problem solving (the ability to ask the right questions)
- Collaboration across networks and leading by influence
- Agility and adaptability
- Initiative and entrepreneurialism
- Accessing and analysing information
- Effective written and oral communication
- Curiosity and imagination" (reported by Swallow, 2012).

"Inter-disciplinarity" is increasingly important, both in education with interdisciplinary courses, as well as in the composition of a company's workforce. It has been found to be important for innovation and product-market strategies (Hermann and Peine, 2011), and e-leaders and e-entrepreneurs need to be 'dual thinkers'. Judy Gilbert, Google's director of talent, quoted in Wagner (2012), argues that "expertise is important, but the most important thing educators can do to prepare students for work in companies like Google is to teach them that problems can never be understood or solved in the context of a single academic discipline." And Wagner notes that "at Stanford's d.school and MIT's Media Lab, all courses are interdisciplinary and based on the exploration of a problem or new opportunity. At Olin College, half the students create interdisciplinary majors like 'Design for Sustainable Development' or 'Mathematical Biology'." Multi-stakeholder partnerships can also help to achieve more interdisciplinary curricula, as well as greater links between industry and the educational sector to improve the match between the skills that businesses need and those supplied by the educational system (Box 5).

Box 5: Multi-stakeholder partnerships to face the e-skills challenge

INSEAD (2010b) finds that industry and business have often taken the lead in successful efforts to build better curricula for e-competences. The report derives best practices from the experiences providing insights into how multi-stakeholders partnerships can help Europe face its current and future e-skills challenges.

Industry-led efforts: There are examples of ICT vendors having developed successful courses and certification processes offered by academic institutions, including the Microsoft Academy, SAP University Alliance, and IBM's efforts at developing Services Science.

University-led efforts: University-led efforts at developing e-competence curricula have tended to involve not only Universities, but also industry and government entities. Notable examples include Aalto University (in Finland), CEFRIEL (led by Politecnico Milano in Italy), Foundation Degrees (gathering a wide range of educational institutions in the UK), It-vest (led by three universities in Denmark, including Aarhus School of Business), and the Petroleum Learning Centre at Tomsk Polytechnic University (a joint effort in Russia with Edinburgh's Heriot-Watt University).

Source: INSEAD (2010b).

[47] This is also true for ICT: investing in ICT is not enough, what matters is the use that is being made of them.

4.3.4 Can we measure e-leadership skills?

The academic and other studies referred to in the above sections that have looked into aspects of e-business and e-leadership were all based on ad-hoc surveys. In addition to the estimates produced as part of this study based on occupational data, other official data sources can provide some approximations of 'target groups' to provide a rough idea of how many people and firms could potentially be concerned. Such statistics would, ideally, include numbers on tertiary education (for example in science and technology, but also management, entrepreneurship and MBA courses), entrepreneurship training and vocational training/life-long learning, some occupational data, but also data on start-ups (ICT, cloud, and other 'innovative' start-ups, high-growth SMEs, internationally operating SMEs) etc. These sources combined will help to form a picture of the importance of what this group may represent in an economy. It will have to be complemented with information obtained through surveys and questionnaires, as well as targeted interviews.

What do we know about the current situation? The European Commission has noted that the EU lags behind other advanced economies in numbers of tertiary education graduates, which puts innovation and current and future competitiveness of Europe's economies at risk as highly skilled people are crucial for the generation, diffusion and use of knowledge which, in turn, is key to innovation. In the EU in 2009, 32.3% of the population aged 25–34 had a university degree, and while this percentage has increased in recent years, it is still much lower relative to that in other advanced economies, with, for example, 41.6% in the US, 55.1% in Japan, and 57.9% in South Korea (European Commission, 2011).

The approach taken to measuring user and practitioner skills on the basis of occupational data will be less precise in the case of e-Leaders as many of the skills are more 'intangible' and diffuse, spread out across occupational groups.

Data from a variety of sources are put together in the annexes in order to build up a picture of the target groups for e-leadership skills, of the extent and spread of where e-leadership skills may be found and developed. This includes educational data, but also data on SMEs. The main target of the report are those SMEs with the ambition and potential to grow fast and develop internationally, especially those who with the help of ICT tools find new business models and new ways of doing things.

Available literature and research has provided significant amount of data on various aspects of the 'e-skills eco-system'. Those include in particular:

- Education-related data
- SME-specific data
- CIO-education data

4.3.5 What is missing in Europe?

From available research and data, one can point at several 'missing links' in Europe's approach to e-skills:

- We are still lacking an appropriate framework and set of definitions to identify the critical skills that Europe needs to foster innovation and competitiveness across its various sectors;
- No comprehensive action plan is yet available to allow various players (European institutions, member countries, businesses, educators, individuals) to make informed choices about how much they should invest in generating the skills required;

- The notion of 'e-skills' has often been confined to the concerns of the IT sector, and hence disconnected from non IT objectives (typically innovation, competitiveness) or diluted into broader social objectives (e.g. inclusion)
- We are now reaching a critical point, where new definitions can lead to new objectives and plans of action. This is the focus of the subsequent sections of this report.

4.4 Estimates of e-leadership skills supply and demand potential

In the present chapter, very first estimates for e-leadership skills as described above will be provided. These are based on a number of assumptions all of which being made fully transparent in the descriptions

To estimate the demand of e-leaders, the research team assumed that some organizations need more e-leaders than others, depending on the two dimensions. One dimension is the size of organization. A very large firm will need more e-leaders. The second dimension is the degree to which organizations rely on technology for their business operations and for their innovating and provisioning services and products. Based on these two dimensions, we highlight different types of organizations:

- Gazelles / High-growth SMEs;
- ICT sector, medium sized and large or very large;
- High ICT intensity sectors; and
- Low ICT intensity sectors.

4.4.1 Segmentation

The approach for estimating e-leadership skills is based on the number of enterprises in different

- sectors according to the NACE classification,
- different company size classes and a
- differentiation according to ICT usage intensity.

The NACE sector differentiation and allocation to different groups / segments can be seen below.

Four size classes have been defined:

- Micro: 0-9 employees
- Small: 10-49 employees
- Medium: 50-249 employees
- Large: 250-99 employees
- Very large: 1000+ employees

Enterprises a further differentiated in

- Those in the ICT sector
- High ICT intensity sectors
- Low ICT intensity sectors

This resulted in a segmentation as described in the following table with 12 cells which can be grouped into four different types / segments differentiated by different colour in the table and each further described below.

	Micro	Small	Medium	Large	Very large
	0-9 employees	10-49 employees	50-249 employees	250-999 employees	1000+ employees
ICT sector	A1	A2	A3	A4	A5
High ICT intensity sectors	B1	B2	B3	B4	B5
Low ICT intensity sectors	C1	C2	C3	C4	C5

4.4.2 e-leadership skills demand estimates

e-leadership demand estimates have been carried out separately for each of the following groups:

- A1-C2: Gazelles / High-growth SMEs (only these have been selected from the groups of micro and small enterprises)
- A3-A5: ICT sector, medium sized and large or very large
- B3-B5: High ICT intensity sectors
- C3-C5: Low ICT intensity sectors

A1-C2: Gazelles / High-growth SMEs

In this group we decided to focus on what has been described by Eurostat as 'gazelles' and 'high-growth enterprises (SMSs):

Within micro and small enterprises, the estimate of demand for e-leaders focused on what has been described by Eurostat as 'gazelles' and 'high-growth enterprises (SMSs):

- **Gazelles** are enterprises up to five years old with average annualized growth greater than 20% per annum, over a three-year period. Gazelles are a subset of high-growth enterprises up to five years old.
- **High growth enterprises** are enterprises with average annualized growth greater than 20% per annum, over a three year period should be considered as high-growth enterprises. Growth can be measured by the number of employees or by turnover.

Key Assumption(s):
For the purpose of the present study the e-leadership demand for 'gazelles' and 'high-growth SMEs' (A1-C2) has been defined as follows: one e-leadership skilled person per high growth enterprise, including an estimate for missing countries.

Resulting estimated demand from Gazelles / High-growth SMEs: 70,000

The numbers of these for 2010 were obtained from Eurostat and are as follows:

2010	Gazelles	High growth enterprises
BE	212	922
BG	1368	3570
CY	78	218
DE	400	9206
DK	286	3274
EL	32	252
ES	1174	5838

2010	Gazelles	High growth enterprises
FI	156	806
FR	1432	6801
IE	315	890
IT	1388	6996
LT	432	112
LU	0	4
LV	136	906
MT	0	28
NL	666	3258
PL	571	6008
SE	178	732
SK	56	760
UK	1214	10586
TOTAL	**10,094**	**61,167**

Missing countries: AT, CZ, EE, HU, PT, RO, SI

Source: Eurostat: http://epp.eurostat.ec.europa.eu/statistics_explained/images/9/96/Number_of_small_and_medium-sized_enterprises_with_10_to_249_employees%2C_2007_and_2010.png

A3-A5: ICT sector, medium sized and large or very large

The ICT Sector consists of the following three sub-sectors.

- Telecommunications (NACE Rev.2 J61)
- Computer programming, consultancy and related activities (NACE Rev.2 J62); and
- Information service activities (NACE Rev.2 J63).

Summing up the number of enterprises in the relevant size classes for this group reveals the following result (details, in table, below; Source: Eurostat [sbs_sc_1b_se_r2]):

- Total medium size firms in ICT sector in 2010: 6,513 firms
- Total large size firms in ICT sector in 2010: 1,379 firms

The number of enterprises in these sectors by company size classes for Europe (EU-27) in 2010 is depicted in the following table.

NACE Rev.2	J61	J62	J63
	Telecommunications	Computer programming, consultancy and related activities	Information service activities
	2010	2010	2010
Total	40,190	500,000	109,000
250 persons employed or more	304	900	175
From 50 to 249 persons employed	674	5,000	839

From 20 to 49 persons employed	1,170	9,416	1,500
From 10 to 19 persons employed	1,572	15,000	3.217
From 2 to 9 persons employed	13,000	120,000	32,911
From 0 to 1 person employed	23,500	360,000	70,000

Source: *Eurostat [sbs_sc_1b_se_r2].*

Key Assumption(s):

The demand for e-Leadership skills in this segment A3-A5: 'ICT services' is as follows:

- Medium sized enterprises: four e-leadership skilled person per organization
- Large enterprises: eight e-leadership skilled person per organization

Resulting estimated demand

- **Medium sized enterprises in ICT sector: 11,032 (= 1,379 x 4)**
- **Large enterprises in ICT sector: 26,052 (= 6,513 x 8)**

B3-B5: High ICT intensity sectors

The number of enterprises in the high ICT intensity sector by company size classes for Europe (EU-27) in 2010 is depicted in the following table.

Industry	**Number of enterprises**	
	From 50 to 249 persons employed	250 persons employed or more
C18 Printing and reproduction of recorded media	2135	240
C26 Manufacture of computer, electronic and optical products	2560	717
C27 Manufacture of electrical equipment	3050	930
C28 Manufacture of machinery and equipment n.e.c.	7807	1760
C29 Manufacture of motor vehicles, trailers and semi-trailers	2234	1200
J58 Publishing activities	2174	530
J59 Motion picture, video and television programme production, sound recording and music publishing activities	781	122
J60 Programming and broadcasting activities	344	128
L Real estate activities	3151	541
M Professional, scientific and technical activities	14100	2460
N Administrative and support service activities	21900	5800
TOTAL:	**60236**	**14428**
K Finance	**~15000**	

Source: *Eurostat*

Key Assumption(s):

Demand for e-Leadership skills in this segment B3-B5: 'High ICT intensity sectors' is as follows:

-- Medium sized enterprises: 2 e-leadership skilled person/organisation

-- Large enterprises and Finance enterprises: 5 e-leadership skilled person/organisation

Resulting estimated demand:

-- 60,000 * 2 = 120,000

-- 29,000 * 5 = 145,000

C3-C5 Low ICT intensity sectors

The number of enterprises in the low ICT intensity sector by company size classes for Europe (EU-27) in 2010 is depicted in the following table.

Industry	Number of enterprises	
	From 50 to 249 persons employed	250 persons employed or more
B Mining and quarrying	815	232
C Manufacturing	72000	15700
C10 Manufacture of food products	9900	2250
C11 Manufacture of beverages	962	290
C12 Manufacture of tobacco products	44	58
C13 Manufacture of textiles	2170	290
C14 Manufacture of wearing apparel	2997	416
C15 Manufacture of leather and related products	1298	148
C16 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	2400	304
C17 Manufacture of paper and paper products	2000	500
C19 Manufacture of coke and refined petroleum products	117	96
C20 Manufacture of chemicals and chemical products	2844	853
C21 Manufacture of basic pharmaceutical products and pharmaceutical preparations	730	459
C22 Manufacture of rubber and plastic products	5480	939
C23 Manufacture of other non-metallic mineral products	3369	800
C24 Manufacture of basic metals	1960	710
C25 Manufacture of fabricated metal products, except machinery and equipment	10300	1145
C30 Manufacture of other transport equipment	837	410
C31 Manufacture of furniture	2758	420
C32 Other manufacturing	1700	311
C33 Repair and installation of machinery and equipment	2353	480
D Electricity, gas, steam and air conditioning supply	1320	616
E Water supply; sewerage, waste management and remediation activities	3622	805
F Construction	20531	2225

G Wholesale and retail trade; repair of motor vehicles and motorcycles	45925	7095
H Transportation and storage	15500	3200
I Accommodation and food service activities	13183	1520
S Repair of computers and personal and household goods	371	71
TOTAL	**227486**	**42343**
Industry by employment size classes (NACE Rev.2 B-E) [sbs_sc_ind_r2]		

Key Assumptions:

The demand for e-Leadership skills in this segment C3-C5: 'Low ICT intensity sectors' is as follows:

-- Medium sized enterprises: 1 e-leadership skilled person/organisation

-- Large enterprises: 2 e-leadership skilled person/organisation

Resulting estimated demand:

-- 227,000 * 1 = 227,000

-- 42,000 * 2 = 84,000

Summary of estimated e-leadership demand:

	Micro	Small	Medium	Large	Very large
	0-9 employees	10-49 employees	50-249 employees	250-999 employees	1000+ employees
ICT sector	70,000		26,000	11,000	
High ICT intensity sectors			120,000	145,000	
Low ICT intensity sectors			227.00	84,000	

Total: 683,000

Demand summary:

The overall number of demand for e-leadership in Europe is estimated at 683,000 persons.

4.4.3 Estimating Europe's supply of e-leaders

A key assumption for estimating the supply of e-leaders is the "e-leadership quota" (E-LS quota) – i.e., the estimated percentage of people within a particular type of profession (as classified by NACE) capable of leading projects related to the eight sets of responsibilities described in Section 3.2.4 (e.g., using ICT to improve business processes; using ICT to develop new products and services; developing new applications; managing contracts with external service providers; etc.)

We encourage readers to explore our assumptions based on their own research and experiences, to develop a better understanding of how sensitive our assumptions are.

For the purposes of this report, we have taken a very conservative approach. That is, we have made generous assumptions regarding what percentage of a professional group is capable of assuming e-leadership roles. We expect readers to generally reach estimates of supply that are even less than ours.

For the following groups, we assumed their e-leadership quota to be 100% - that is, all people related to these groups could serve as effective e-leaders.

- Gazelles: estimate incl. missing countries: 12,000
- ICT service managers (ISCO 1330): 260,000 and
- A percentage of persons occupied as managers (ISCO 112, 121, 123, 131, 1332. 134, 141, 142, 143) as described in the table below: 389,000

In the table (following page), we provide the estimated e-leadership quota for other professions. For example, we assume that 50% of "Research and development managers" (NACE 1223) are capable of serving as e-leaders. We also assume that only 5% of Europe's 2.2 million "Business services and administrative managers" (NACE 1210) are capable of serving as e-leaders.

As a result of these assumptions, the overall number of supply for e-leadership in Europe is estimated at 661,000 persons.

Again, we strongly encourage readers to explore our assumptions based on their own research and experiences, to develop a better understanding of how sensitive our assumptions are. In the following section, we examine some of these assumptions.

NACE Code			Number of jobs	E-LS quota	Number of E-LS
1120		Managing directors and chief executives	1.495.180	3,0%	44.855
1210		Business services and administration managers			
	1211	Finance managers	941.865	5,0%	47.093
	1212	Human resource managers	434.410	5,0%	21.721
	1213	Policy and planning managers	419.696	5,0%	20.985
	1219	Business services and administration managers not elsewhere classified	487.399	5,0%	24.370
1220		Sales, marketing and development managers			
	1221	Sales and marketing managers	1.094.997	5,0%	54.750
	1222	Advertising and public relations managers	168.067	5,0%	8.403
	1223	Research and development managers	129.445	50,0%	64.723
1310		Production managers in agriculture, forestry and fisheries	109.833	0,5%	549
1320		Manufacturing, mining, construction, and distribution managers			
	1321	Manufacturing managers	827.163	0,5%	4.136
	1322	Mining managers	33.608	0,5%	168
	1323	Construction managers	676.890	0,5%	3.384
	1324	Supply, distribution and related managers	635.012	3,0%	19.050
1340		Professional services managers			
	1341	Child care services managers	27.893	0,5%	139
	1342	Health services managers	175.800	0,5%	879
	1343	Aged care services managers	83.808	0,5%	419
	1344	Social welfare managers	144.812	0,5%	724
	1345	Education managers	362.723	0,5%	1.814
	1346	Financial and insurance services branch managers	540.507	3,0%	16.215
	1349	Professional services managers not elsewhere classified	135.759	0,5%	679
1410		Hotel and restaurant managers	1.318.053	0,5%	6.590
1420		Retail and wholesale trade managers	1.439.225	3,0%	43.177
1430		Other services managers	871.699	0,5%	4.358
		Other managers	12.553.845	3,10%	389.182
1330		Information and communications technology service managers	260.697	100,0%	260.697

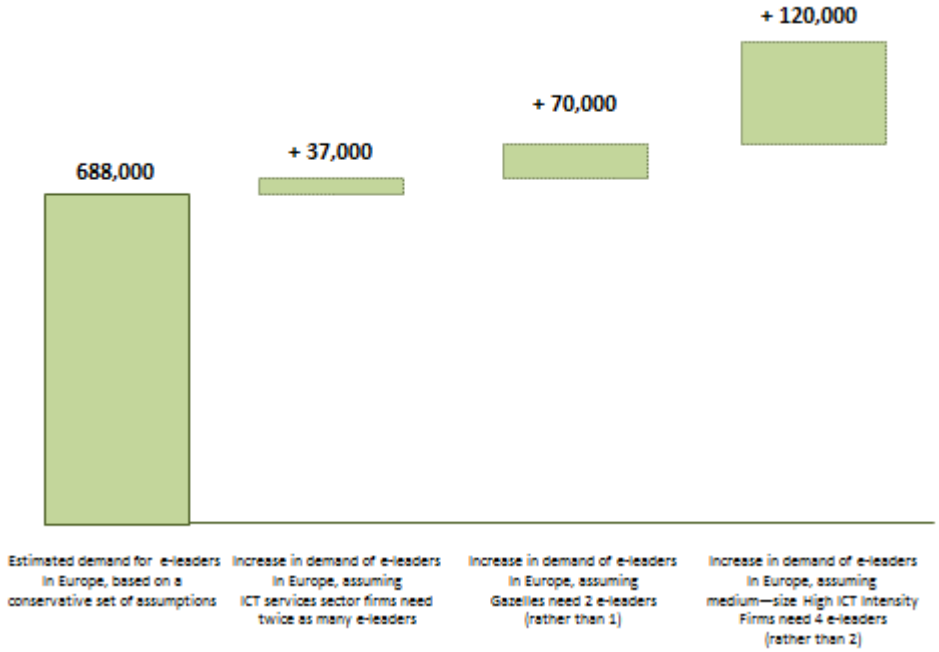
4.4.4 Changing the assumptions reveals an even greater gap between demand and supply of e-leaders

The aforementioned estimates of demand and supply of e-leaders are quite conservative. When the estimates were presented to experts from academia, industry and public policy, most agreed that the real demand for e-leaders is probably higher, the real supply even lower, and consequently the actual gap between demand and supply is even greater than the estimated gap.

To develop a better understanding of how sensitive the estimates are to each key assumption, and in the process, develop a better understanding of why demand and supply fluctuate, readers are encouraged to examine, challenge and change each assumption and see how it affects the demand or supply. This will also help the reader appreciate how conservative the estimates are.

The sensitivity of demand to key assumptions

The figure below explores the sensitivity of key assumptions regarding estimates of Europe's demand of e-leaders.



With regards to assumptions pertaining to demand, an important assumption is that medium-size firms in the ICT services sector need only four e-leaders to be productive and large-size firms need eight e-leaders. It could be easily argued that this assumption is off the mark by a long shot, as firms in the ICT services sector need e-leaders to build bridges with internal clients and to engage with external customers. If it is assumed that these firms need twice as many e-leaders as originally assumed (and it could be easily argued that this is still not enough e-leaders – especially for any firm that has more than 100 employees), then demand for e-leaders in Europe increases by 37,000.

Another assumption influencing demand is that Gazelles need only one e-leader to succeed. It could be argued that in today's digital economy, any start-up that has succeeded in achieving 20% growth per annum for its first five years relies heavily on technology for its operations and its new products and services. As a result, most Gazelles would need at least two e-leaders, one to lead projects related to operations and the other to lead projects related to new products and services.

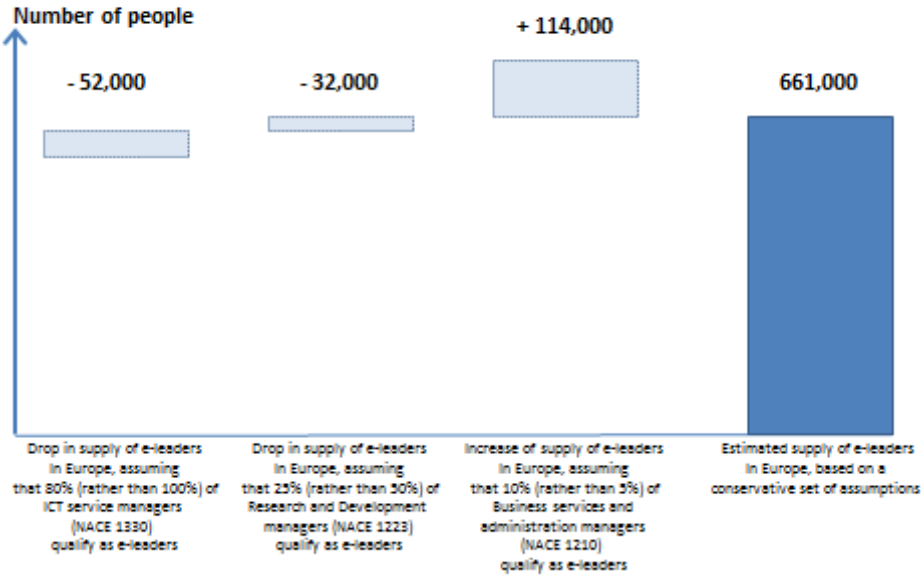
If all Gazelles need two e-leaders, then demand for e-leaders in Europe increases significantly by an additional 70,000.

An especially significant assumption is with regards to how many e-leaders medium-size firms in high ICT intensity sectors need. The current estimate for demand assumes they only need two e-leaders, however it could be argued that because they are in high ICT intensive sectors, these firms need at least four e-leaders, where each could be responsible for two of the eight sets of activities described earlier. If medium-size firms in high ICT intensity sectors each demand four e-leaders, rather than two, then demand increases by 120,000 e-leaders.

When all these assumptions are taken into account, the gap between demand and supply rises to 224,000 e-leaders.

The sensitivity of supply to key assumptions

The figure below explores the sensitivity of key assumptions regarding estimates of Europe's supply of e-leaders.



An important assumption regarding Europe's supply of e-leaders is that 100% of all ICT service managers qualify as e-leaders. It could be argued that this is a generous assumption, especially if all of these managers are expected to inspire and work closely with non-ICT managers. For example, organizations that have consolidated and centralized their ICT functions into a shared services organization have had to dismiss some managers while at the same time have had to hire new managers. These organizations have realized that yesterday's e-leaders may no longer be capable of leading today's relevant projects. If this assumption is relaxed from 100% to 80%, (i.e., that 20% of all ICT service managers are yesterday's e-leaders), then there are 52,000 fewer e-leaders in Europe.

Another important assumption is that 50% of all those currently working in Research & Development departments qualify as e-leaders. It could be argued that this too is a generous assumption, as many scientists working in R&D labs, while extremely intelligent and capable of conducting experiments, do not necessarily have the ability to inspire and guide teams of people to create ICT-based solutions. If this assumption is relaxed by half, from 50% to 25%, then there are 32,000 fewer e-leaders in Europe.

Some assumptions could be argued as being too limiting. For example, it could be assumed that twice as many Business services and administrative managers are sufficiently ICT-savvy to be e-

leaders (i.e., they do not simply know about emerging applications of ICT, such as cloud and mobility, they also sufficient knowledge on how the technology, processes and data related to one solution should relate to all the others to lead the development of solutions that complement existing solutions). In this case, the supply would increase dramatically to 144,000 fewer e-leaders in Europe. This strongly suggests that Europe's supply of e-leaders can be increased both by building the horizontal expertise of ICT experts and by building the ICT expertise of business experts.

Overall, the assumptions used to develop the conservative estimates of demand and supply represent provide important insights into how academic institutions, policy makers, and businesses can work together to predict demand more accurately and ensure there is a sufficient supply. The following section ("Recommendations") includes more specific actions that can be taken to eliminate the gap.

5 Recommendations for increasing the number of ICT practitioners

Authors: **Werner B. Korte, Tobias Hüsing, empirica GmbH**

5.1 Policy background

Already in 2007 and in its Communication to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions of 7 September 2007, entitled "e-Skills for the 21st Century: Fostering Competitiveness, Growth and Jobs", the European Commission showed how it intended to promote a long-term e-skills agenda and corresponding actions in the field of information and communication technologies (ICT). The European Commission stressed the importance to establish a long-term e-skills agenda at the national and EU levels. The implementation of these measures was to take place mainly under the responsibility of the Member States, and supporting actions at EU level had to bring real added value.

After extensive stakeholders' consultations and exploratory studies, the European Commission defined the key components of the long term e-skills agenda and proposed five action lines at EU level with clear objectives and concrete results to be delivered by 2010.

After the publication of the Communication, the Council of Ministers adopted Conclusions on a long term e-skills strategy at the Competitiveness Council meeting of 22-23 November 2007. The Council of Ministers welcomed the European Commission's Communication proposing a long-term e-skills agenda in response to the need to address e-skills as a way of contributing to the development of an economy based on knowledge-intensive products and services and a more inclusive society.

The Council emphasised the need to rapidly implement a long-term e-skills agenda; improve cooperation and mobilisation of all stakeholders and adopt best strategies and practices in order to better face global competitive challenges, while recalling the central role of Member States in developing national policies and actions[48].

An evaluation of the European e-skills agenda and the related actions from late 2010 concluded positively on the relevance and the achievements of EU activities. It also formulated useful recommendations for the continuation of the EU long term e-skills agenda and support to Member States e-skills strategies.

Slightly more than two years later it now becomes apparent that an intensification of some of these actions probably coupled with some few further ones is needed to more rapidly close the e-skills gap.

The present chapter will start with some empirical results from the present study demonstrating the extent and type of e-skills excess demand in Europe today and in the future followed by a description of the key components and action lines of the European e-skills strategy and end with recommendations for further action and intensifying existing one which can help to more quickly close the existing and further increasing e-skills gap. These include actions which the European Commission, national governments and other key stakeholders may want to carry out to help reducing the e-skills shortages, mismatches and gaps further described in this report and may be installed within and under the 'Grand Coalition for Digital Jobs' launched by the European Commission in early March 2013.

The actions are mainly those targeted towards

[48] http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/intm/97225.pdf

- increasing the number of ICT graduates and professionals through different activities directly addressed to students,
- making more intensive use of industry-based training and certification to increase the number of e-skilled workers and
- fostering mobility within Europe and immigration from outside Europe to close gaps in countries with e-skills excess demand with ICT professionals from countries with an e-skills oversupply.

5.2 Empirical evidence: excess demand of ICT practitioners in Europe

The present study revealed that the ICT workforce in Europe has grown over recent decades and will continue to do so. The annual growth of ICT employment has remained robust so far, despite the crisis. From 2000 to 2010, the ICT workforce grew at an average annual rate of more than 4%. Even throughout the economic and financial crisis affecting Europe since late 2008, growth has averaged 2.65% per year.

The ICT workforce in Europe in 2011 totalled 6.67 million - 3.1% of the overall workforce. 5.25 million are classified as ICT practitioners and 1.42 million can be described as ICT professionals at management level. This includes CIOs, ICT operations managers, project managers, and ICT workers responsible for planning and strategy, such as enterprise architects, systems analysts and ICT consultants.

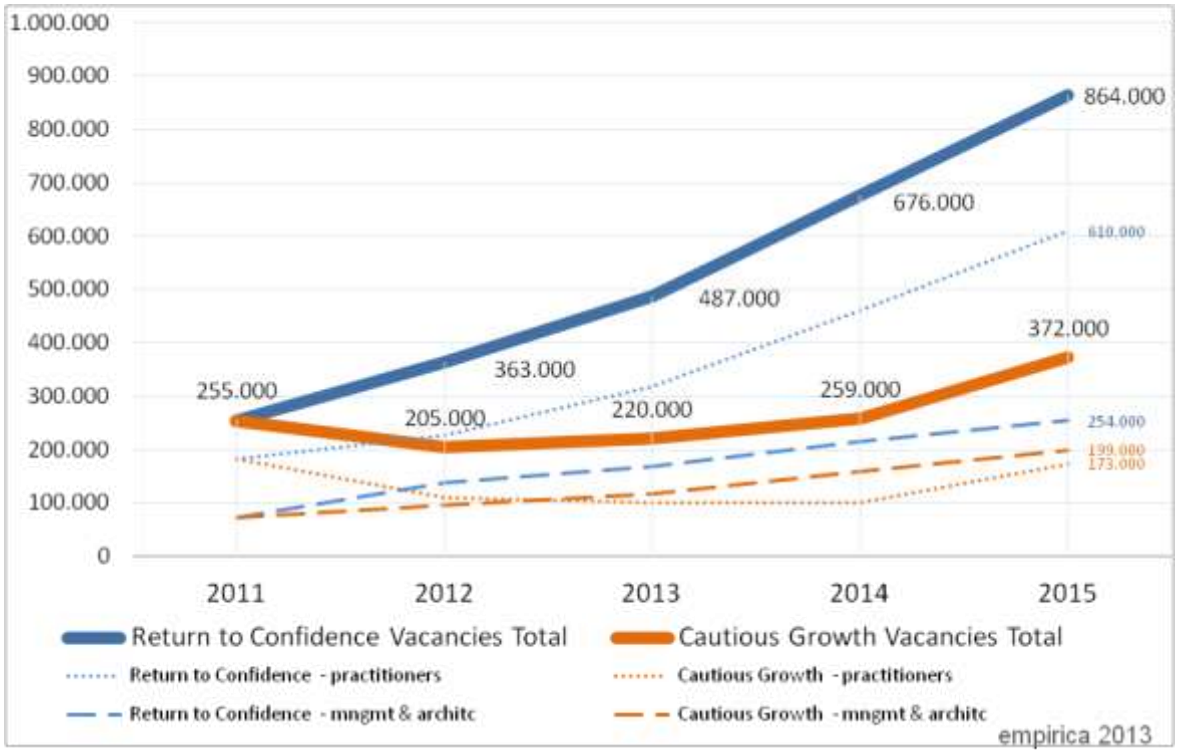
If the ICT skills of mechanics and manual workers are included, the total rises to more than eight million workers, or 3.7% of the European workforce - and as high as 6% in some countries.

One in six ICT professionals holds a highly skilled management and / or business architecture level position.

What is evident is the job-security of ICT practitioners. The labour market has easily absorbed all ICT graduates and remains hungry for more.

On the contrary, interest in ICT education and careers is declining in Europe. The number of computer science graduates has been falling steadily since 2005. The rate of the decline in ICT graduates is exceeding any forecasts, and threatens to create a dramatic shortfall of skills.

An empirica survey of CIOs and HR managers in eight European countries in 2012 suggested that there were 255,000 unfilled vacancies across the EU. Of these, some 72,000 were for “ICT management and business architecture” skills and about 183,000 for “Core ICT practitioners” and “Other ICT technicians”. The forecasts in the present report suggest that the unmet demand could rise by 2015 to between 372,000 and 864,000.



5.3 Key components of the European e-skills agenda

Already in 2007, the European Commission has developed a long-term e-skills agenda with several key components. The main policy objective is to contribute to improve framework conditions in Europe for the provision of a world-class e-skilled workforce to achieve stronger productivity, economic and social benefits and for the reduction of the digital divide. This objective can only be reached through the mobilisation of Member States and stakeholders to address the e-Skills issue in Europe and an optimal use of existing resources and instruments at all levels: local, regional, national and European.[49]

In the e-skills agenda, it is stated that the European Union needs to:

- Develop optimal policies to prepare new workers and support current ones as they face the challenges of ICT led change and globalisation;
- Reduce the digital divide and ensure that its citizens are digitally literate;
- Provide a co-ordinated and timely response to implement change successfully

The five key components of the agenda are described as follows:

1. Longer term cooperation

Strengthening cooperation between public authorities and the private sector, academia, unions and associations through the promotion of multi-stakeholder partnerships and joint initiatives including monitoring supply and demand, anticipating change, adapting curricula, attracting foreign students and highly skilled ICT workers and promoting ICT education on a long-term basis.

[49] http://ec.europa.eu/enterprise/sectors/ict/e-skills/extended/index_en.htm

2. Human resources investment

Ensuring sufficient public and private investment in human resources and e-Skills and appropriate financial support and fiscal incentives, in full respect of State aid rules, as well as developing an e-competence framework and tools facilitating mobility, transparency of qualifications, and promoting recognition and credit transfer between formal, non-formal and industry ICT education and certifications.

3. ***Attractiveness***

Promoting science, maths, ICT, e-Skills, job profiles, role models and career perspectives with a particular focus on young people, especially girls, and providing parents, teachers and pupils with an accurate understanding of opportunities arising from an ICT education and an ICT career to counter the alarming decline in young people's interest for science and technology careers in Europe.

4. Employability and e-Inclusion

Developing digital literacy and e-competence actions tailored to the needs of the workforce both in the public and in the private sector, with a particular emphasis on SMEs, and also to the needs of the unemployed, elderly people, people with low education levels, people with disabilities and marginalised young people.

5. Lifelong acquisition of e-Skills

Ensuring that workers can regularly update their e-Skills and encouraging better and more user-centric ICT-enhanced learning and training approaches (e-learning). Government should promote good practices for the training of employees using e-learning, with a particular emphasis on SMEs, and should publicise successful solutions and business models.

5.4 European e-skills strategy action lines

The Commission has developed five action lines whereby the efforts of the Commission are concentrated on the promotion of a shared long-term e-skills agenda for getting the involvement and the long-term commitment of Member States and stakeholders; and on the implementation of key actions at EU level, brining added-value to Member States and industry efforts. The action lines are as follows:

Promoting long-term cooperation and monitoring progress

- promoting a regular dialogue with Member States and stakeholders;
- monitoring the supply and demand of e-skills;
- assessing the impact of global sourcing on ICT jobs

Developing supporting actions and tools

- supporting the development and the promotion of a European e-competences framework;
- fostering multi-stakeholder partnerships and the European e-skills and careers portal;
- promoting mobility of highly-skilled professionals and the Europass initiative;
- encouraging the development of European quality criteria for existing e-Skills industry-based training and certifications;
- supporting the development and promotion of European e-competences curriculum guidelines;
- encouraging appropriate financial and fiscal incentives

Raising awareness

- exchanging good practices for the promotion of science, maths, ICT and e-skills;
- supporting awareness campaigns at EU and national levels (i.e. European e-Skills Week);
- promoting ICT education and training to young people, especially girls

Fostering employability and social inclusion

- further implementing the Communication on e-inclusion adopted at the end of 2007;
- encouraging corporate social responsibility and partnerships with job placement support services;
- investigating how public and private funding can support stakeholders initiatives

Promoting better and greater use of e-learning

- promoting successful strategies and policies for e-learning;
- promoting the development of e-learning courses and exchange mechanisms for e-skills training resources.

An external evaluation was launched at the end of 2009 and stakeholders were invited to comment on the results and formulate recommendations. The evaluation was completed in October 2010 and concluded positively on the relevance and the achievements of EU activities. It also formulated useful recommendations for the continuation of the EU long term e-skills agenda and support to Member States e-skills strategies.

5.5 Recommendations for further and intensifying existing actions

It is against this background that some recommendations for further action and intensification of existing ones within the European e-skills strategy are provided which can help to more quickly close the existing and further increasing e-skills gap. These include actions which the European Commission, national governments and other key stakeholders may want to carry out to help reducing the e-skills shortages, mismatches and gaps further described in this report and may be installed within and under the 'Grand Coalition for Digital Jobs' launched by the European Commission in early March 2013.

The actions are mainly those targeted towards

- increasing the number of ICT graduates and professionals through different activities directly addressed to students,
- making more intensive use of industry-based training and certification to increase the number of e-skilled workers and
- fostering mobility within Europe and immigration from outside Europe to close gaps in countries with e-skills excess demand with ICT professionals from countries with an e-skills oversupply.

For each recommendation concrete targets which policy and the stakeholders concerned my want to aim at in the given period of time together with figures regarding the possible quantitative contributions to closing the e-skills gap which would be achievable when putting the recommendations into reality are given. The recommendations are as follows:

1. Boost ICT graduates: Increase the number of tertiary ICT graduates in Europe by an additional 10%-points per year by 2015
2. Reduce the rate of university dropouts in ICT studies by one fifth

3. Increase recruitment and job placement of non-ICT STEM (Science, Technology, Engineering, Mathematics) university graduates into ICT jobs by 50% compared to current levels
4. Increase industry based training and certification (IBTC) offers for up-skilling ICT practitioners but also for re-training side-entries and career changers and achieve an additional 10,000 new certified ICT experts per year in Europe
5. Increase inter-European mobility of ICT professionals for better balancing regional differences in e-skills demand and supply and closing vacancies
6. Increase third-party country immigration of ICT practitioners and professionals to European countries with an e-skills excess demand by 10,000 per annum.

Each recommendation is further described below.

5.5.1 Boost ICT graduates

Objective:

Increase the number of tertiary ICT graduates in Europe by an additional 10%-points per year by 2015

Today we are faced with a decreasing number of ICT graduates from university every year which is by far not matching the demand. Assuming that all 113,000 ICT graduates successfully leaving university every year enter into ICT occupations and that Europe is facing an e-skills demand which amounts to 255,000 in 2012, we are left with a substantial number of vacant posts for ICT jobs at present. Since without intervention the numbers of ICT graduates which have shown a decline since 2006 are at best likely to stagnate at current levels, e-skills demand will increase and reach a substantial demand potential and number of vacancies for new ICT jobs until 2015 ranging between 372,000 and 864,000. As a consequence the e-skills gap will widen. In order to meet this demand, short-term activities may need to be addressed and include activities with the potential to increase the number of tertiary ICT graduates.

Action:

Increase the number of tertiary ICT graduates in Europe by 2015 by an additional 10%-points per year. This figure appears to be realistic for the set period of time until 2015 and may become higher afterwards. The focus of these activities needs to be on higher-level ICT skills of a specific type of ICT jobs for which the highest demand is being articulated by industry (see above) which also is in line with the observable general trend towards demand for professionals with higher qualification.

Result:

A stepwise increase of the number of ICT graduates from its current level set at 100 to 113 in 2015 and 115 in 2020 would result in a reduction of the e-skills excess demand by 120,000.

Who:

Key actors to initiate and run the necessary activities of this recommendation will be Europe's **universities – especially their computer science but also economics and business departments**. They either need to become active on their own or be approached through European and national associations which represent them to motivate the relevant decision makers and ensure that actions and activities are directed into the desired directions. The **Council of European Professional Informatics Societies (CEPIS)** as a non-profit organisation seeking to improve and promote a high standard among informatics professionals in recognition of the impact that Informatics has on employment, business and society with its 35 Member Societies in 32 countries across Europe could play an important role here.

National governments, other key stakeholders (e.g. relevant associations and federations) but also the **European Commission** could to be seen as the actors for the necessary awareness raising and promotion campaigns.

How and when:

Different activities and related actions are required for a successful implementation of this recommendation. These can be differentiated between 'content' related and 'awareness and promotion' related activities.

In terms of the former activities universities may want to move towards study courses for their students with modules more closely geared towards the demands of the market and a stronger focus on gaining practical experiences for instance through internships during the study phase helping graduates to enter the labour market with a much stronger business understanding in combination with ICT skills. There is a link to the activities relating to the development of an 'ICT Profession'. Activities for fostering and maturing the ICT profession in Europe have already been started by the European Commission and CEN. It is expected that those can help in rectifying the image and perception of the ICT profession and jobs towards the better. Clear value propositions for the different stakeholders have been provided which could allow for rapid action[50]. It would also allow (potential) students to develop a closer relationship to computer science and ICT-related subjects, make these more attractive since it would provide them with a clearer view of their potential future jobs.

Since there is a well-established and recognised trend towards higher and management level skills including 'soft' skills, tertiary education in this field may also want to put a stronger focus on management-level and strategy and planning skills to help closing the gap in the e-leadership skills area.

In terms of awareness raising and promotion activities there continues to be the strong need to improve the image of computer science as a subject to study at universities and the occupation of ICT practitioner and professional jobs. Persons employed in ICT-related jobs are still strongly associated with a negative image of a nerd, i.e. a person, typically described as being overly intellectual, obsessive, or socially impaired spending inordinate amounts of time on unpopular, obscure, or non-mainstream activities, which are generally highly technical, to the exclusion of more mainstream activities. It needs to be demonstrated through promotion and awareness raising campaigns that ICT-related occupations are different, multifaceted and offering vast and varied employment opportunities. National government, other key stakeholders (e.g. relevant associations and federations) but also the European Commission could play a role through the organisation of awareness raising campaigns involving pupils and (potential) students. Current formats like the 'European e-Skills Week' may be taken as a format which could be re-visited with the aim of developing a strong focus on and target it on the above issues for future events.

Actions under this recommendation need to be started quickly and in 2013 since it takes time for investments in tertiary education to reveal results and typically these take a minimum of 4 and probably even 5 years to show any results. An increased number of ICT practitioners and professionals resulting from an increase of the number of ICT graduates from universities leaving universities at around 2017/18 would coincide with the projected steep increase of demand.

Timing:

- **Start:** 2013
- **Preparation:** 2013
- **Implementation:** 2013/14
- **First effects / results:** 2017

[50] IVI / CEPIS: e-Skills and ICT Professionalism. Fostering the ICT Profession in Europe, May 2012

5.5.2 Reduce the rate of university dropouts in ICT studies

Objective:

Reduce the rate of university dropouts in ICT studies by one fifth

Background:

ICT and STEM university studies are faced with high student dropout rates in Europe. In Ireland, for instance a recent Forfás report from January 2012 states that 16% of computing and electronic engineering students are not progressing from first to second year of study. The average for all students and studies is at 9%, only around half that figure.[51]

In Germany, the dropout rate in Engineering in all Bachelor studies in 2010 reached 48%. It is highest in electronics engineering with 53%. This compares to an average dropout rate of 20% at German universities. This situation bears some tragic aspects since it occurs despite excellent career perspectives: there are 6 vacancies for each qualified unemployed electronics engineer in Germany in October 2012. The corresponding figure is 4.5 for informatics / computer science graduates but only one for mathematicians and physicians. In addition only 14% of foreign STEM students graduating from university move into a job in the German labour market, 40% leave the country to find a job elsewhere, 46% drop out during their studies.[52] At present, these dropouts present a loss of the potential e-skills supply pool.

Based on statistical data from Eurostat on student enrolments and graduates in computer science from 1999 – 2010 we have calculated the number of enrolments from 1999-2006 at 1,142,502 which compares to a number of graduates from a period of 4 years later, i.e. from 2003-2010, which is 930,971[53]. This shows that 81% of enrolled students complete their studies successfully, i.e. the average student dropout rate for computer science students in Europe seems to be at around 19%.

Action:

Reduce the rate of university dropouts in ICT studies by one fifth from 19% to 15%.

Result:

A reduction of the university dropout rate in ICT studies by one fifth from 19% to 15% followed by an assumed 100% of these new ICT graduates moving into the ICT workforce would reduce the shortage of ICT jobs by approx. 54,000[54] in 2020.

Who, how and when:

The starting point for this activity could be a thorough analysis and evaluation of the reasons for dropout (if not already done) by the **responsible national authorities and governmental institutions**. Based on the evaluation results ICT-related education and study programmes should be re-visited and thought should be given to the development of alternative course progression

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[51] Forfás: Addressing High-Level ICT Skills Recruitment Needs - Research Findings, January 2012

[52] VDMA quoted in: Handelsblatt: Hilfe für ein besseres Studium, 22 November 2012, p. 14; Die Welt: Jede fehlende Fachkraft kostet 230.000 Euro, 22 November 2012, p. 9

[53] Please note that these figures are not readily available and had to be calculated. Since for several countries data is not available for several years and a number of extreme values and outliers could be identified, the results need to be treated with caution and should only be taken as an indication.

[54] Calculation: ICT graduates in Europe in 2010 = 113,000 = 81% of those enrolled at universities 4 years before (~ 140,000). 140,000 – 113,000 = 27,000 * 20% = 5,400 * 10 years (from 2010-2020) = 54,000 new graduates

routes to be provided to students, which bears the chance for potential dropout candidates to continue and complete their studies and find a way into the ICT workforce.

Irrespective of the above it appears to be necessary for **universities in general and computer science departments in particular** to move towards more one-to-one counselling, individual mentoring and the provision of more assistance especially to newly enrolled students which can help them to more precisely estimate the time needed for their studies since lack of this ability seems to be one of the main reasons for dropout and provide them with the confidence that their knowledge is sufficient for completing the studies which had been given as the second major reason by students for dropping out of computer science studies followed by reasons like insufficient assistance by tutors.[55]

The development and promotion of best practice examples including national or even European best practice award campaigns in this area could also become a worthwhile action and to be included in national and Europe-wide awareness raising campaigns of **national governments and the European Commission** informing about successful strategies for reducing dropout rates of computer science students.

Actions under this recommendation can be started immediately and in 2013.

Timing:

- **Start:** 2013
- **Preparation:** 2013
- **Implementation:** 2013/14
- **First effects / results:** 2016/17

5.5.3 More suitable non-ICT STEM graduates into ICT jobs

Objective:

Increase recruitment and job placement of non-ICT STEM (Science, Technology, Engineering, Mathematics) university graduates into ICT jobs by 50% compared to current levels

Background:

The majority of STEM-graduates do not have well-formed career plans and are therefore open to be attracted by large corporate recruiters into other sectors like accountancy or consultancy (i.e. occupations mostly outside STEM), or to drift into employment unrelated to STEM. However, most final-year students who do have career ideas would like a job related to their degree subject, primarily because they think it will provide interesting work. These are two key messages of a report on STEM graduates in non-STEM jobs from the UK Department for Business Innovation & Skills from 2011.[56] There is the likelihood that some of these non-ICT STEM graduates (without well-formed career plans) are moving into the ICT domain and there is anecdotal evidence that some university graduates from STEM (Science, Technology, Engineering, Mathematics) subjects outside computer science have found their way into ICT jobs.

Depending on the subject studied but also the country, employment opportunities for non-ICT STEM graduates vary and consequently also the interest of individuals in pursuing a career outside

[55] Xenos, M.; Pierrakeas, C.; Pintelas, P.: A survey on student dropout rates and dropout causes concerning the students in the Course of Informatics of the Hellenic Open University, in: Computers & Education 39 (2002) 361–377

[56] http://www.bis.gov.uk/assets/biscore/further-education-skills/docs/s/11-771-stem-graduates-in-non-stem-jobs.pdf

the traditional career path. In principle, non-ICT STEM graduates seem to have good potential for pursuing a career as ICT practitioners and professionals. Companies – not successful in directly recruiting ICT professionals to fill related vacancies - also seem to regard them as an interesting pool for recruiting staff to enter into ICT-related jobs after some further training.

However, we could not find any statistical evidence on the quantitative dimension of this phenomenon and have based our forecasting on assumptions and educated expert guesses (see above).

In the present study we are assuming an entry rate potential of 5% of all non-ICT STEM graduates into the ICT workforce. Should this figure be increased by half, the European ICT workforce has the potential to grow and help to reduce the e-skills excess demand.

Action:

Increase the number of non-ICT STEM graduates from European universities entering the ICT workforce up to an entry rate of 7.5%.

Note: this action may be expanded to also include graduates from business schools and universities graduating in subjects like economics, accountancy, sociology, geography.

Result:

An increase of the share of non-ICT STEM graduates into ICT jobs by half to 7.5% would reduce the shortage of ICT jobs by approx. 70,000 in 2020.

Who, how and when:

National employment agencies and staffing and recruitment companies could become key players in the implementation of actions relating to this recommendation. In fulfilling their job placement role for industry and the public sector and satisfy the demand for more ICT practitioners and professionals, they could be asked to intensify their effort in identifying suitable candidates from the non-ICT STEM area (or in principle any other area). This activity may even run beyond national borders in order to provide employment opportunities especially for suitable candidates from countries with a surplus of non-ICT STEM graduates.

However, and at present employment agencies and staffing / recruitment industry are faced with the problem of specifying the relevant, ICT-related skills and competences of non-ICT STEM graduates identified and interested in an ICT career but also any candidate in general. They would need a commonly agreed and widely used competence framework and an associated tool which would allow them to profile their candidates using such an ICT skills competence framework broadly recognised in industry and by themselves. Ideally this would be based on a Europe-wide competence framework. The European e-Competence Framework (e-CF) could provide this 'common language' and framework desperately needed.

This would require the e-CF is to become widely adopted by the **governments in European countries**. The Dutch government has started this process and will deploy e-CF in its adoption and training, but also in its recruitment and tendering policy.

Again, actions under this recommendation need to be started quickly and in 2013 since it takes time for investments in tertiary education to reveal results and typically these take a minimum of 4 and probably even 5 years to show any results.

Timing:

- **Start:** 2013
- **Preparation:** 2013
- **Implementation:** 2013/14
- **First effects / results:** 2014

5.5.4 Increase industry based training and certification offers (IBTC) for up-skilling ICT practitioners but also for re-training side-entries and career changers

***Objective*:**

Increase industry based training and certification (IBTC) offers for up-skilling ICT practitioners but also for re-training side-entries and career changers and achieve an additional 10,000 new certified ICT experts per year in Europe

Background:

Europe requires an additional number of e-skilled workers at a) development level but also and increasing rather strongly at b) higher ICT management level which the present education system in Europe is not able to come up with.

To fill the emerging gap, Europe requires more students and workers to move into ICT specialist occupations. The type of management level persons required include managers with e-leadership skills, i.e. a T-shaped portfolio of skills which includes a vertical set of skills that represent expertise or "deep knowledge" in a specific area (e.g., science; engineering; ICT; social sciences) and a horizontal set of skills that represent "transversal skills" (e.g., negotiation; critical thinking; design and systems thinking, business and entrepreneurship, etc.) that enable collaboration across a variety of boundaries.

In a recent empirica survey in June 2012 HR managers and CIO respondents articulated a demand in terms of existing vacancies for ICT professionals predominantly in the core ICT competency areas. Developers represent the group of skills that will be in highest demand. They were mentioned by enterprises representing 18% of ICT employment. They were followed by two other categories of core ICT worker skills, namely hardware and data base specialists. On rank 4 and 5 the higher-level skills categories "management" and "planning and strategy" were found.

The demand for ICT workers of both types is outreaching their supply. The results of a representative empirica survey of CIO's and HR managers in eight European countries in 2012 show that the demand for e-skills, i.e. ICT professionals and practitioners, extrapolated to the whole of Europe (EU-27) can be estimated at around 255,000 in 2012. This is the number given by CIOs and HR managers in European organisations for the number of vacancies in ICT-related occupations. Among these we find a demand of about 72,000 vacancies for the EU-27 for "ICT management and business architecture" skills and about 183,000 for "Core ICT practitioners" and "Other ICT technicians" jobs.

Action:

In order to best address the above challenges and quickly reach the necessary number of management level ICT professionals it is recommended to use suitable industry-based training and certification to up-skill ICT practitioners to come up with the necessary skills. This requires to first, identify those suitable IBTCs which can be used for teaching the necessary ICT management skills and e-leadership skills specified and described above in this report. The current range and number of suitable industry based training and certification courses for ICT practitioners to advance their career to enter management positions is likely to be rather limited. It therefore needs to be complimented by suitable Executive MBA and similar courses at universities and business schools offering a combination of ICT and business skills. Today such courses are still rather scarce at European universities and business schools and only on the verge of development.

Retraining side entries and career changers from different groups (including newcomers and individuals who originally had no intention to move into ICT like job and also career changers, temporarily unemployed or individuals returning from parental leave) is another means to increase

the number of ICT practitioners with the skills demanded in the market (see above). It is recommended to not re-invent the wheel for setting up such schemes but to look at and learn from already existing successful schemes like for instance FIT "Fast Track to IT" in Ireland.

Result:

Increased re-training via IBTC and succeeding in training newcomers on the one hand and up-skilling ICT practitioners to move into ICT management positions in the order of 10,000 per year would help to reduce the forecasted e-skills gap in 2020 by around 80,000.

Who:

ICT vendors and IBTC providers together with other stakeholders like **national ministries of education, employment agencies** and where appropriate supported by **European Commission programmes and EU Structural Funds or other European funding sources**.

How and when:

It is recommended to prepare the necessary activities, adapt relevant IBTCs and develop programmes for training side entries and career changers but also up-skilling ICT practitioners to management levels. This will allow for the first successful graduates from these courses to enter the market right in time when the demand for e-skills is likely to further increase.

Timing:

- **Start:** 2013
- **Preparation:** 2013
- **Implementation:** 2013/14
- **First effects / results:** 2015

5.5.5 Increase inter-European mobility of ICT professionals for better balancing e-skills demand and supply in Europe

***Objective*:**

Increase inter-European mobility of ICT professionals for better balancing regional differences in e-skills demand and supply and closing vacancies

Background:

The present project has revealed that the ratio between e-skills supply and demand varies between the different EU Member States. Currently (2012) we can observe an excess demand for e-skills in many countries which – depending on the development scenario to become reality - is likely to remain at similar levels or even increase until 2020. However, other countries are showing an oversupply of e-skilled workers. In Poland for instance a larger number of ICT graduates than can be absorbed in the national market leave universities while in countries like Germany there exists a significant excess demand for such skills. The situation is similar in Spain also having an oversupply of e-skills but for different reasons since the Spanish labour market is currently not able to provide jobs for them. This shows that some more ICT experts needed in some countries are available but in the 'wrong' countries and obviously not sufficiently mobile for getting a job. Offering incentives to further increase mobility of already educated and trained ICT experts in countries with an ICT expert oversupply to other European countries would contribute to solving the problems associated with an e-skills access demand in other countries.

Action:

National governments in EU Member States with an excess demand for ICT practitioners and professionals need to become active in launching targeted initiatives to attract ICT experts from

other Member States with an oversupply in order to better balance e-skills demand and supply across Europe.

Result:

Better balance of e-skills demand and supply across Europe reducing the e-skills gap in several European countries and unemployment of ICT experts in European countries with an oversupply of e-skilled workers.

Who:

National EU-27 governments need to start activities (in countries with an e-skills excess demand) with the aim to attract ICT experts from other European countries.

How and when:

This activity could be started immediately.

Timing:

- **Start:** 2013
- **Preparation:** 2013
- **Implementation:** 2013/14
- **First effects / results:** 2014

5.5.6 Increase third-party country immigration of ICT practitioners and professionals

***Objective*:**

Increase third-party country immigration of ICT practitioners and professionals to European countries with an e-skills excess demand

Background:

Immigration from third-party countries could be a means to contribute also to closing existing e-skills gaps and shortages in those European countries with a (future) excess demand for ICT practitioners and professionals.

However, little suitable and reliable European statistical data are available which could be used to quantify this phenomenon. Only exemplary data for some countries exist. According to a report of the German Bundesamt für Migration und Flüchtlinge (Federal German migration office)[57] 7.3% of migrants from third-party countries living in Germany have an informatics / computer science occupation or background. In 2011 the total of this group of workers living in Germany reached 78,000. 7.3% of these (see figure above) would sum up to 5,700 being computer scientists according to the above figures from the Federal German migration office. However, it is unknown how many of these have migrated to Germany every year.

Germany - although economically the strongest economy in Europe at present - still does not belong to the most attractive countries for migrants. Where statistical date is available like for instance for Spain and Ireland these show that the main target countries for migrants are the United Kingdom, the US and France followed by Germany.[58]

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[57] Bundesamt für Migration und Flüchtlinge: Zuwanderung von Fachkräften nach § 18 AufenthG aus Drittstaaten nach Deutschland. Ergebnisse einer schriftlichen Befragung von Arbeitsmigranten. Working Paper 44, 2012

[58] Dieter Bräuninger, Deutsche Bank Research: Arbeitskräftemobilität in der Eurozone. Beiträge zur europäischen Integration. EU-Monitor 85, 10. August 2011

Different to Europe better statistical data is available for the USA. The USA is well-known for its high number of immigrants from third-party countries in general and with an ICT or computer science background in particular. However, we can observe a reduction in approved H-1B petitions, from 267,131 in 2005 to 192,990 in 2010. Not surprisingly, the trend in H-1Bs follows the overall downturn in the domestic economy, which saw unemployment rise from 6.6 percent to 9.6 percent from 2008 to 2011, climbing over 10 percent at one point. In 2010, 90,802 (47 percent) of H-1B recipients were approved in computer-related occupations. Altogether the visas in STEM occupations fields totalled 115,573 people, 59.8 percent of H-1B visa recipients.

Number of H-1B visas granted in the USA between 2005 and 2010

H-1B Applications Granted	2005	2006	2007	2008	2009	2010
All Occupations	267,131	270.981	281.444	276.252	214.270	192.990
Computer-Related Occupations	113.867	130.556	139.628	137.010	88.960	90.802

Source: Department of Professional Employees, AFL-CIO: http://dpeaflcio.org/guest-worker-programs-and-the-science-technology-engineering-and-mathematics-stem-workforce/

In Europe, such high immigration figures seem to be unachievable. But in order to develop a baseline and define a point of departure for any further action in this area Europe needs to get a clear overview of the current annual immigration figures from third-party countries in order to set a target for an achievable number of third-party country immigrants with an ICT / computer science background.

Action:

National statistical offices together with and coordinated by Eurostat need to find ways to either homogenise existing statistics and / or newly develop reliable and comparable immigration statistics providing more detailed information on the migrants from third-party countries (plus EU-27 Member States) which would allow for a necessary planning about ICT labour markets and workforce developments.

Without any reliable baseline data but assuming that there is a potential for increasing third-country immigration of ICT practitioners and professionals to European countries with an e-skills excess demand, Europe may want to set itself a realistic target of increasing this number whereby this target may be set at an additional 10,000 p.a. At a first glance this target (which is less than 10% of what the USA attracts in terms of third-party country immigration) appears to be achievable and even looks like a rather conservative estimate.

National governments especially in those EU Member States with an excess demand for ICT practitioners and professionals need to become active in launching targeted initiatives to attract experts from third-party countries.

Result:

An increase of the number of third-country immigrants with an ICT / computer science background to Europe by 10,000 p.a. would result in a reduction of the e-skills excess demand ranging between 70,000 and 100,000 in 2020.

Who, how and when:

1. **Eurostat together with the European national statistical offices:** Relevant activities to provide the necessary statistical data as described above would need to be carried out by the national

statistical offices together with and under the responsibility of and coordinated by Eurostat. Actions under this recommendation - at least an initial screening of the presently available statistical sources in the EU-27 Member States - could be started immediately and in 2013.

2. **EU Member State governments:** The same holds true for appropriate national government activities (in countries with an e-skills excess demand) with the aim to attract experts from third-party countries. However, and before starting such activities one should carefully analyse past successful but in particular also unsuccessful activities in this area in Member States like for instance the ones of the Federal German government. Here the minimum wage levels set at a high EUR 65,000 as annual income resulted as a disincentive for companies to employ foreign IT experts. In the meantime it got reduced to EUR 34,944 or EUR 44,800 depending on the type of occupation (http://bluecard-eu.eu/).

Timing 'Eurostat together with the European national statistical offices':

- **Start:** 2013
- **Preparation:** 2013
- **Implementation:** 2013/14
- **First effects / results:** 2014

Timing 'EU Member State governments':

- **Start:** 2013
- **Preparation:** 2013
- **Implementation:** 2013/14
- **First effects / results:** 2014

6 Recommendations on e-leadership skills

Authors: **Werner B. Korte, Tobias Hüsing, empirica GmbH, Nils Fonstad, INSEAD eLab**

This chapter presents specific recommendations on e-leadership skills.

They constitute a contribution for the development and the implementation of a coherent long-term agenda (2013-2020) for actions at EU and national level which could be taken by public authorities and stakeholders. It will complement and enrich the existing EU e-skills strategy.

The recommendations focus on seven action lines:

1. Engage with a larger number of stakeholders and a broader set of stakeholder groups to sharpen the vision, concept, definitions and metrics for e-leadership skills;
2. Monitor regularly demand and supply of e-leadership skills and benchmark relevant public policies and multi-stakeholder initiatives in this field at EU and national level;
3. Develop and demonstrate new approaches to deliver e-leadership skills in cooperation with universities and business schools based on curricula guidelines and quality labels;
4. Support the creation of new formats and larger multi-stakeholder partnerships for teaching and acquiring e-leadership skills;
5. Align actions to develop e-leadership skills with on-going efforts to foster entrepreneurship across the EU;
6. Foster e-leadership in the context of entrepreneurship and self-employment and advance e-leadership skills to improve entrepreneurial learning across the EU;
7. Organise pan-European communication campaigns to share critical insights about the need of e-leadership skills for innovation and competitiveness and to disseminate best practices.

In the following pages, each action line is described in greater detail, using a common format.

They have been discussed at several workshops with leading experts and relevant stakeholders. In addition, they have been presented at a high level conference on e-leadership organised at INSEAD on 5 February 2013. There is strong consensus on both the relevance and the importance of these recommendations for action over the period 2013-2020.

6.1 Recommendation 1

Engage with a larger number of stakeholders and a broader set of stakeholder groups to sharpen the vision, concept, definitions and metrics for e-leadership skills

Background:

There is a need for more precise definitions and metrics of e-leadership skills and competencies to demonstrate what kinds of e-leaders are associated with specific kinds of business and social value creation; ensure curricula and e-leadership development efforts are relevant; improve monitoring of demand and supply of e-leadership skills; and increase the effectiveness of policy decision making.

Until now, Chief Information Officers (CIOs) have played a very active role, because there is a now a broad recognition on the strategic importance of the evolution of their role and because they are increasingly part of well-organized pan-European networks. This enabled them to express clear needs and requirements. Now there is a need for the future to involve more systematically business line managers, CEOs, CFOs etc. as well as entrepreneurs and freelancers. This will be more challenging as these groups are less organized and aware of their e-skills needs.

Actions:

To accelerate the development of e-leadership, it is important to engage with non-IT business leaders, such as Chief Executive Officers (CEOs), Chief Financial Officers (CFOs) and Chief Marketing Officers (CMOs), human resources managers etc. During this project considerable insight and input has been provided by Chief information Officers. Senior management teams can identify new critical skills required by their strategy and create a detailed inventory of how to access them. The same information will be necessary from entrepreneurs and freelancer communities. A trusted neutral party can collect and synthesize lessons from applications of e-leadership to ensure the definitions are broad enough to cover all relevant cases of ICT-informed leadership in today's enterprises and precise enough to be practical and insightful.

Further attention needs to be paid to using these results for the development of an e-leadership skills framework as an extension of the existing European e-Competence Framework (e-CF) for ICT practitioners. This would be used by organizations in the public and private sector to identify and inventory key skills for accomplishing their strategic objectives.

The Commission is best placed to facilitate the further development and sharpening of metrics for e-leadership skills. Essential to the success of such an initiative is regular engagement with a broad set of stakeholder groups, such as CxO-level business executives and digital entrepreneurs. The Commission may want to initiate such an activity as an integral part of on-going policy initiatives in which all relevant stakeholders need to be involved in dialogue. Stakeholders include industry, education, training and certification institutions, academia, the CEN Workshop on ICT skills, Eurostat, the national statistical institutes, national employment agencies and staffing industry representatives at national and European levels.

6.2 Recommendation 2

Monitor regularly demand and supply of e-leadership skills and benchmark relevant public policies and multi-stakeholder initiatives in this field at EU and national level

Background:

There is still insufficient quantitative data and relevant statistics to define and anticipate shortages, gaps and mismatches. Existing data sets from other sources are scarce and have limited relevance. The lack of data significantly restricts the actions of a broad set of stakeholder groups. New and better data would help defining priorities and measuring progress.

Actions:

Building on the first recommendation, the following action line would help establish trusted regular monitoring of demand and supply of e-leadership skills.

Three actions would be needed:

- Identify and specify data requirements for establishing meaningful measurements for use in a monitoring system consisting of data collected from two types of surveys: those of demand side actors (e.g. HR managers, CIOs in organisations) and those of suppliers (e.g. Universities and business schools);

- Identify and analyse secondary data sources for suitable data (mainly from Eurostat to ensure homogenous data across all EU Member States) to extract information on demand and supply of e-leadership skills required by policy makers as a basis for decision making.

- Monitor key performance indicators and scenarios on the supply side and demand side of e-leadership skills and benchmark these KPIs against national policy initiatives and multi-stakeholder partnerships in all Member States.

These actions should be started as a coordinated Europe-wide activity.

Therefore they should be initiated and facilitated by the Commission. They should be implemented in close cooperation with Member States, Eurostat and national statistical institutes. The results, especially data on expected demand, should be made available to national policy makers, business leaders, universities and business schools in order to initiate appropriate course development on the supply side. Industry and individuals could then be made aware of new e-leadership courses from education and training organisations, including online courses on the Internet.

Regular benchmarking (every 2 to 3 years) will provide a robust basis for understanding the impact of the policies, initiatives and actions launched at the EU and national level. Such insights would enable policy makers to propose and coordinate better ways and more efficient means to reduce e-leadership skills shortages, gaps and mismatches through multi-stakeholder partnerships.

6.3 Recommendation 3

Develop and demonstrate new approaches to deliver e-leadership skills in cooperation with Universities and business schools based on curricula guidelines and quality labels

Background:

Despite growing levels of unemployment in Europe, the demand for ICT workers outstrips the supply and this gap will predictably continue to grow. The mismatch between the current skills available and the needs of the labour market concerns all EU Member States, even if it affects some of them to a lesser degree.

According to our research and based on the synthesis scenarios, the number of expected ICT vacancies in Europe will be between 372,000 and 864,000 by 2015. Unless more is done to attract young people into computer science degrees and to retrain the unemployed, many of these positions will remain unfilled.

More specifically, with regards to e-leadership, even with the most conservative assumptions, there are an estimated 19,000 vacancies. These are the leaders of tomorrow and these are critical positions of strategic importance for the future growth, competitiveness and innovation potential of the European industry.

Actions:

There is a growing need of e-leadership skills and even more critically of opportunities to acquire them. This requires new innovative and efficient solutions, i.e. to develop and to demonstrate new approaches to deliver e-leadership skills.

A first step would be to develop curricula guidelines in conjunction with key stakeholders in Europe: on the supply side these are universities and business schools already at the forefront on the development of e-leadership skills, on the demand side these are leading ICT using companies in Europe, the ICT industry in general, and associations representing European enterprises, SMEs, CxOs and HR Directors etc. Together, they could develop, demonstrate and disseminate European guidelines and quality labels for new curricula fostering e-leadership skills.

The guidelines and quality labels can build on the activities of the ICT Skills Workshop of CEN, and in particular the European e-Competence Framework (e-CF). They must also be compatible with the best recognised pan-European quality assurance frameworks. By applying e-leadership curricula guidelines, key stakeholders can accelerate the scaling of Europe's successes.

A starting point is the pioneering initiative launched the Commission in January 2013 aiming at the first attempt to develop pan-European e-leadership skills curricula guidelines (in this particular case with a focus on the needs of CIOs) and at formulating proposals for quality labels. To this end, a selected number of universities and business schools will take part in a demonstration of their implementation in 2013-2014. In addition, a large number of promotion and dissemination activities are planned to increase awareness and recognition of the results and achievements.

6.4 Recommendation 4

Support the creation of new formats and larger multi-stakeholder partnerships for teaching and acquiring e-leadership skills

Background:

Although there are several on-going activities at developing e-leaders in Europe (e.g., IT-vest in Denmark; the Professional Programme in Business & Enterprise Architecture in the Netherlands; the Cranfield IT Leadership Programme in the United Kingdom), a much larger number of multi-stakeholder partnerships are needed to sustain efforts in the longer term and scale successes and help efficiently individuals entering or currently in the workforce develop the portfolio of skills and competences that e-leaders require.

Actions:

A greater number of educational institutions could team up with industry and roll out a range of e-leadership curricula and e-skills courses (both onsite and online), while re-defining and enhancing teaching formats. According to EuroCIO, many universities want to add technological depth to their programs but do not have the resources to do so. By working with demand side actors, these schools can have access to these necessary resources and thus be able to deliver new content, course and program development.

European Universities and business schools should consider taking greater advantage of Massive Open Online Courses (MOOC) to encourage far more students to enrol in their e-leadership skills courses. Despite the challenges presented by this online format, MOOCs can open up a whole new range of opportunities for teachers and students alike. Developed as entry-level courses, MOOCs can be designed to attract greater numbers of students to study e-leadership skills.

The Commission and Member States should support e-leadership MOOC demonstrations. With relevant support and incentives, universities and business schools could compete in a Europe-wide competition for the best and most successful e-leadership MOOC. Such an initiative could be operated by key stakeholders such as the ICT industry, ICT and CIO associations etc., representing both the demand and the supply side of the market. This would help in promoting and raising awareness of MOOCs throughout Europe on the one hand and their wider dissemination throughout the educational sector on the other.

6.5 Recommendation 5

Align actions to develop e-leadership skills with on-going efforts to foster entrepreneurship across the EU

Background:

To boost entrepreneurial activity in Europe, the Commission launched an Entrepreneurship 2020 Action Plan (COM (2012) 795 final). This is designed to "unleash Europe's entrepreneurial potential, to remove existing obstacles and to revolutionise the culture of entrepreneurship in Europe". It should change the public perception of entrepreneurs and of entrepreneurship education.

An increasingly important aspect of entrepreneurship is digital entrepreneurship. Therefore it is important that future efforts from the Commission help create a digital entrepreneurial culture and help attract, develop and retain digital entrepreneurial skills and talent.

Actions:

Aligning efforts with the Entrepreneurship 2020 Action Plan is essential to foster e-leadership skills successfully across a variety of firms and sectors. The role of ICT and e-leadership skills as enablers of successful entrepreneurial activity needs to be emphasised in the entrepreneurial learning initiative. Experience suggests that becoming a digital entrepreneur has a strong appeal to highly educated young people – a fact which should be exploited for reaching out to the target audience of the learning initiative.

EU Member States have also been urged to offer pre-university students the opportunity to have at least one practical entrepreneurial experience before leaving compulsory education, such as running a mini-company, being responsible for an entrepreneurial project for a company, or engaging in a social project. The acquisition of entrepreneurial abilities enhances the employability of the youth: according to recent research, 78% of entrepreneurship education alumni were employed directly after graduating at university, against 59 % of a control group of higher education students.

Universities and business schools are urged to provide and encourage participants to develop a t-shaped portfolio of skills through collaborative projects consisting of multi-disciplinary teams, including teachers, students, companies, the public sector, and other stakeholders, that draw on ICT to develop solutions to the opportunities and challenges of their choosing. In Europe, there are already a number of successful programs, such as Aalto University's Factories (Finland) and it-vest (Denmark). Projects are organized as multidisciplinary programs and workshops where academic teams and companies are interacting to find a better approach for teaching, learning, and innovating. In addition to develop a t-shaped portfolio of skills through practice, students are provided role models and mentors – a critical success factor for attracting more students to become e-leaders. Accreditation agencies are urged to develop guidelines that translate participation into university credits, depending on the length of the program (e.g., from a semester to more than a full-year).

From these activities the Commission concludes that "EU higher education in entrepreneurship can boost high-tech enterprises and high-growth companies by supporting business ecosystems, partnerships and industrial alliances." It is further proposed to apply the guidance framework to entrepreneurial schools and VET institutions, developed by the Commission in collaboration with the OECD and currently being promoted across Europe. These schools should take full account of the essential role of e-leadership skills for 21st century entrepreneurs.

6.6 Recommendation 6

Foster e-leadership in the context of entrepreneurship and self-employment and advance e-leadership skills to improve entrepreneurial learning across the EU

Background:

There is a widespread consensus in Europe that its management is old fashioned and lags behind that of the new world, notably the USA and parts of Asia, in its ability to turn innovative potential into business opportunities. Among e-leaders, it is important to keep in mind, that entrepreneurs (not only digital entrepreneurs) and freelancers will play an increasing important role. While it is easier to mobilise groups and associations of ICT practitioners, CIOs and managers, it will be crucial to address the needs of entrepreneurs and freelancers.

Education for entrepreneurship is already high on the agenda in most EU Member States, which have put in place a wide variety of programmes and activities. Here, e-leadership skills are of essential importance. The Commission's Entrepreneurship 2020 Action Plan (COM (2012) 795 final) already includes a reference to e-leadership skills.

Action:

As a first step, European and national Member State policy initiatives and programmes targeting entrepreneurs and business start-ups should be assessed as to whether and how e-leadership skills are taken into account. Then e-leadership skills should be mainstreamed within entrepreneur-training programmes and in the requirements specifications for funding: for example, in the context of structural funds spending related to business start-ups in knowledge-intensive parts of the economy. Secondly, an assessment of the impact of the identified e-leadership initiatives could be carried out.

Thirdly, as e-leadership are increasingly fundamental to a successful start-up team – including social entrepreneurship – an important way to increase the quantity and quality of digital entrepreneurial skills and talent is to explicitly foster such leadership in business plan competitions. Similarly, reinforce an "ERASMUS for young entrepreneurs in the digital era" initiative to encourage exchanges and traineeships between digital entrepreneurs and existing for-profit and non-profit organizations, as well as self-employed individuals.[59]

Finally, there is a need to support research, cooperation and exchange of information on European and national Member State policies initiatives and policy documents, along with key stakeholder initiatives, projects, best practices, reports and studies. This cooperation should be centred on thematic areas or major initiatives and where appropriate, the results of an impact assessment of identified e-leadership initiatives would be discussed. For example, support and coordinate research that identifies critical success factors for fostering self-employed e-leaders.

[59] For more, please refer to findings from DG Enterprise project "Doing business in the digital age: the impact of new ICT developments in the global business landscape."

6.7 Recommendation 7

Organise pan-European communication campaigns to share critical insights about the need of e-leadership skills for innovation and competitiveness and to disseminate best practices

Background:

There is a need to change misperceptions and increase awareness on the attractive opportunities for people with e-leadership skills. Promoting the acquisition of e-skills as an excellent choice for young Europeans has been at the centre of the EU long term e-skills strategy. Having organised events surrounding the European e-Skills Week in 2010 and 2012, the Commission is actively planning further awareness raising activities in the context of the "Grand Coalition for Digital Jobs". To this end, the Commission wish to involve a larger number of stakeholders in a variety of activities to promote e-skills and digital jobs throughout Europe and in all EU Member States. This should be complemented by specific communication activities focusing on e-leadership skills.

Actions:

The Commission, national governments and other key stakeholders including relevant associations and federations need to continue to play a key role in awareness creation and promotion of e-skills. Formats like the e-Skills Week and the Get Online Week have proven to be a suitable format for addressing a broad range of target groups. It is therefore recommended to continue to use existing formats but adapt them to specific new requirements for e-leadership.

Additional formats for awareness raising and promotion of e-leadership skills, such as a better use of social networks and the media (including business and academic publications) as well as mentorship programs, need to develop and moreover involve different actors, which are likely to be the many associations and federations representing the demand side of the ICT job market.

Key actors that need to be activated include bodies that represent Higher Education organisations, European CIOs and HR managers, EAPM (European Association for People Management), EHRF (European Human Resource Forum), EURES (EURopean Employment Services), and eurociett (European Confederation of Private Employment Agencies). Raising awareness of e-leadership skills needs to achieve recognition in the academic community and to become an integral part of European and national agendas, including those designed for their annual conferences and events.

7 Roadmap (2013-2020)

Implementing these recommendations will require time and the need to adopt a coherent and consistent approach. Policy dialogue and cooperation with Member States and stakeholders must happen on a regular and yearly basis. Actions related to monitoring and benchmarking will require a certain periodicity (e.g. every 2 to 3 years) to ensure that major trends can be identified and that progress can be measured again well-defined indicators. Communication and awareness activities must be sustained and consistent over time to ensure that the messages can reach the target groups and contribute to improve perceptions. Actions related to the provision of new and better curricula and training opportunities must be very focused at the start and be scaled over time to ensure that change really happen.

Getting a strong consensus on these recommendations as well policy agreement, securing the necessary funding and resources and mobilising a critical number of key stakeholders to start implementing them will realistically take time. Concrete and successful results will also need to be demonstrated before moving to full fledge implementation at larger scale.

The logic is that a recommendation is executed in three stages:

1. Preparation: stakeholders prepare by developing concrete actions, initiatives and programmes and come up with first implementations which are leading to;
2. First results by putting the recommendation actions into practice finally leading to;
3. Full-scale implementations of the actions and initiatives from the recommendations.

Therefore we propose the following tentative roadmap of preparatory actions specifying and developing concrete actions, initiatives and programmes under each recommendation which then get implemented to reveal concrete results afterwards and finally leading to full-scale implementation:

		2013	2014	2015	2016-2020
1.	Engage with a broader set of stakeholder groups to sharpen metrics for e-leadership skills	Preparation			
			First Results		
				Full-scale Implementation	
2.	Regularly monitor demand and supply of e-leadership skills.	Preparation			
			First results		
				Full-scale Implementation	
3.	Develop and apply e-leadership curricula guidelines and quality labels	Preparation			
			First results		
				Full-scale Implementation	
4.	Create new formats and partnerships for teaching e-leadership skills		Preparation		
				First Results	
					Full-scale Implementation
5.	Align actions to develop e-leadership skills with efforts to foster entrepreneurship across the EU		Preparation		
				First results	
					Full-scale Implementation
6.	Foster e-leadership in the context of entrepreneurship and self-employment		Preparation		
				First Results	
					Full-scale Implementation
7.	Build awareness of the relevance of e-leadership skills for innovation, competitiveness, and employability	Preparation			
			First Results		
				Full-scale Implementation	

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9 Annex 1: The Sub-scenarios

Authors: **Rosanna Lifonti, Gabriella Cattaneo, Marianne Kolding, IDC Europe**

9.1 Overview

The availability of e-skills is a key factor for the achievement of European competitiveness and growth; nowadays most of the European countries have policies aimed at developing -leadership and practitioner e-skills. Furthermore, as EU moves forward on the vision of being a leading innovation society, e-skills issues and shortages are becoming very urgent.

The balance between the demand and supply of e-skills is the result of complex interactions between the economic, technological, political and social trends affecting the overall socio-economic development of the European Union. The high level of uncertainty resulting from the economic crisis makes urgently necessary to understand better how demand and supply of e-skills will evolve in the next years in order to eventually face and manage relevant mismatches.

Predicting the future is impossible especially with high uncertainty, while exploring the likely or possible interactions between the main trends allows building alternative scenarios presenting the main paths opening in front of us. This in turns helps to evaluate possible actions, their consequences and the risks if no action is taken.

In order to build global scenarios catching the complexity of the socioeconomic environment, we have identified the main focal issues and we have developed as many sub-scenarios, one for each focal issue.

The focal issues affecting the demand and supply of e-skills were identified and investigated through the help of in-depth interviews with leading European experts, brainstorming sessions by the study team, and the 125 experts responding to the experts' survey.

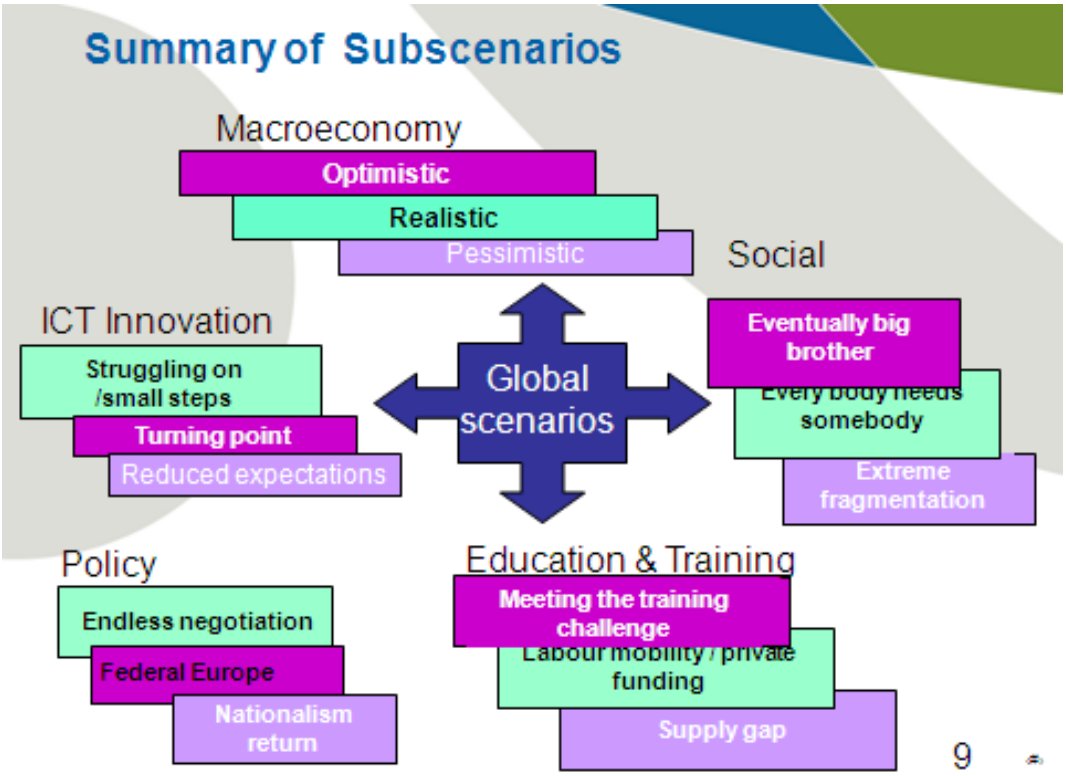
The socioeconomic environment determining supply and demand of e-skills is very complex so that we have chosen to investigate the main focal issues through the development of sub-scenarios which in turn are combined to model the global demand-supply scenarios.

The global e-skills scenarios are based on the complex interaction of 5 main dimensions, which were developed as sub-scenarios, including

- macroeconomic growth,
- the dynamics of ICT-based innovation,
- the impacts of, ICT education and training trends (resulting in lower or higher attractiveness of ICT careers),
- the impacts of the policy trends
- the impacts of the social trends.

The scenario methodology is built on possible futures rather than a projection and is based on the combination of known or possible facts of the future with plausible alternative trends, which we define as the key factors. The time period considered is from now until 2020.

Fig. 1: Focal issues and sub-scenarios



As already explained each sub-scenario focuses on one focal issue of demand and supply of e-skills. The scenario methodology is built on possible futures rather than a projection of the focal issues and is based on the combination of known or possible facts of the future with plausible alternative trends, which we defined as the key factors. Clearly each focal issue has a different level of relevance in terms of direct or indirect impact on the evolution of the e-skills market. The five sub-scenarios are the following:

1. The macroeconomic sub-scenario: in this study macroeconomic dynamics are taken as largely exogenous to the e-skills scenarios so that we mainly focus on their impact on the development of the IT industry and market, particularly on the demand of e-skills, since the correlation with supply of e-skills is more indirect and difficult to quantify. The macro-economic sub-scenarios present three different alternatives based on different hypotheses of economic and employment growth. The hypotheses are based on the forecasts made available by the most important public sources.
2. The ICT innovation sub-scenario: alternative visions of the main trends of ICT innovation, their diffusion in the EU, the evolution of ICT delivery and business models, and the changes of the interactions between ICT producer and user industries in the examined period. These sub-scenarios describe the main drivers of the demand of e-skills by focusing on the possible development paths of the ICT industry and (even more important) of the ICT market.
3. The education and training sub-scenario: these sub-scenarios explore the possible trajectories of e-skills supply in the examined period, focusing on the formal education system and the training system. The rate of change of the formal education system is slow and usually takes more than the 3-5 years of our scenarios horizon, so the sub-scenarios are based on an expected high level of continuity with present trends. On the other hand,

the training system is much more flexible and shaped by enterprises and workers choices, as well as by the general economic climate, so its future developments present a higher level of uncertainty and differentiate the sub-scenarios. Unfortunately, it is also quite difficult to estimate the quantitative impacts of education and training trends evolution on the supply of e-skills in a given period.

4. The social sub-scenario: this sub-scenario explores the possible alternative social trends and their direct and indirect impacts on e-skills supply and demand. Specifically, the social sub-scenario explores the relationship between main trends of technological innovation and the social behaviour of individuals. The social attitude of individuals is in fact influenced by technological innovation and the Internet is shaping a new way of keeping contacts, participating in political debates and the job market.
5. The policy sub-scenario: it focuses on the role of governments, on their impacts on ICT innovation and how their policies may affect demand and supply of e-skills. We expect for example that the development and governance towards the implementation of the Digital Agenda may affect demand and supply of e-skills.

The sub-scenarios are presented in the following paragraphs, through a description of the main trends, of the qualitative assumptions defining the alternative visions of possible futures, and their level of uncertainty and likeliness. For each group of sub-scenarios we have developed quantitative indicators feeding into the demand-supply foresight model.

9.2 The macro-economic sub-scenarios

The basic assumption adopted to build the global scenarios is that macroeconomic growth is the main driver of the IT spending growth and in turn of the e-skills demand. Within the conceptual framework of the e-skills demand and supply model, GDP growth trends, IT spending growth and their relative ratios are the main drivers of the variation of the demand of e-skills.

At the time these forecasts and sub-scenarios were developed (summer – autumn 2012), the EU economy was continuing to deal with difficult post-financial crisis corrections, which is heavily bearing on its GDP growth and on the employment performance. The aggravation of the sovereign debt crisis in the first half of the year 2012 and the negative feedbacks on the EU economic activity, with an unexpected slowdown of the non EU GDP growths is leading to a bad growth performance in the EU area during the 2012. Moreover, the continued mistress in the more vulnerable MSs is progressively affecting the other MSs or at least it raises the uncertainty affecting the EU economy for the next years.

During the first half of the current year, domestic EU demand has continued to contract because of consumers and businesses pessimistic perspectives. The EU economy contraction started in the second quarter and, currently, further weakness is expected till the end of the year. Overall unemployment has risen, although this trend does not affect all the EU countries so that cross-countries divergences are widening. At the time we are writing this report, most of the public sources agree on an expected return to very slow growth during the first half of the year 2013. Nevertheless, there is still a widespread uncertainty about the effects of the policy measures announced and on the correction of vulnerable Member States' imbalances. As a consequence, there is still uncertainty about the precise level of the EU GDP decrease in 2012 and about the expected moderate growth in the first half of 2013.

The macroeconomic sub-scenarios are based on alternative hypotheses of economic growth of the main European Union economies in the period 2012-2020. The macro-economic sub-scenarios are built on a comparative assessment of existing forecasts of the main public sources, which are OECD, the European Commission and the Economist Intelligence Unit. For the IT spending estimates we have used the IDC data.

The GDP and IT spending forecasts were developed with a bottom-up process, starting from the estimates of the EU27 growth data and assessing the total EU27 as a result.

The preparation of the three macroeconomic sub-scenarios and the calculation of the GDP growth rates were developed as follows:

- a moderate scenario developed on the basis of existing forecasts from the main public sources (EIU, OECD, EC);
- a pessimistic growth scenario, calculated as a negative deviation from growth rates in the realistic scenario. The estimate of this negative deviation was based on existing studies from ECFIN and applied to most recent GDP forecasts developed within the moderate scenario;
- an optimistic growth scenario, calculated as a positive deviation from growth rates in the realistic scenario. The estimate of this positive deviation was based on existing studies from ECFIN and applied to most recent GDP forecasts developed within the moderate scenario.

The calculation of GDP values for the period 2010 - 2020 for the three scenarios was done by applying the estimated growth rates to Eurostat GDP values for the year 2010.

The macroeconomic sub-scenario also includes the impact of the GDP trends on the IT spending. The calculation of the the value and growth rate of the IT spending for the three scenarios above is based on applying different elasticity rates of IT spending growth to the GDP growth for the three scenarios.

9.2.1 Realistic

Description

The realistic sub-scenario is based on the hypothesis of a very slow recovery starting during the first half of the year 2013 because of a slow correction of vulnerable Member States' imbalances so that EU domestic demand from both consumers and businesses will start recovering very slowly.

Such a realistic trend will not bring back the macroeconomic trends, at least in the short term, to the historical development trajectory experienced before the crisis, in terms of growth rates and IT innovation, but it will be necessary to wait at least until 2015 to observe moderate growth rate similar to the ones experienced before the financial crisis.

For the first part of the forecast period, the GDP will decrease in 2012 and will start to grow very slowly since 2013 to 2015, then in the second part of the forecast period (2015-2020) the growth rates will be moderate but without reaching the pre-crisis levels.

In this sub-scenario, the contraction of the European economy stops in 2012 but the pre-crisis growth levels may be reached only at the end of the second forecast period. The average annual growth rate is estimated around 1% before 2015 and around 1.65% for the period 2015-2020.

In such a scenario, and after difficult years such as 2011 and 2012, the IT spending will progress at a moderate pace throughout the forecast period. During the first part of the forecasting period, the average annual growth rate of the IT investments will nearly reach 1.7% while from 2015 to 2020 it will reach 3.7%.

Exhibit 1: Annual GDP growth, in a realistic macroeconomic sub-scenario

S

	2012	2015	2020	CAGR 2011-2015	CAGR 2015-2020	CAGR 2011-2020
France	0,7%	1,7%	2,1%	1,3%	1,9%	1,6%
Germany	1,0%	1,8%	2,2%	1,6%	1,9%	1,8%
Italy	-1,3%	1,3%	1,7%	0,4%	1,3%	0,9%
Poland	2,9%	4,1%	4,4%	3,5%	4,1%	3,8%
Spain	-1,5%	1,8%	2,1%	0,3%	1,9%	1,2%
United Kingdom	0,6%	2,2%	2,2%	1,5%	1,9%	1,7%
Total EU	0,1%	2,0%	2,3%	1,3%	2,0%	1,7%

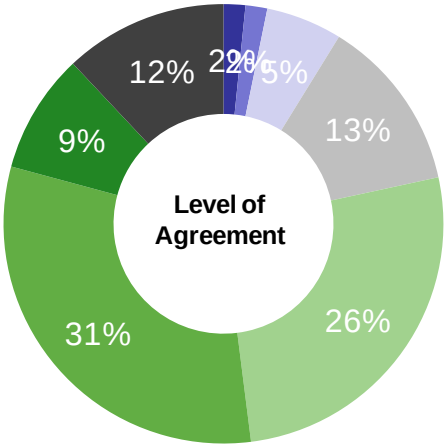
Source: IDC 2012, estimates based on various sources

Likeliness

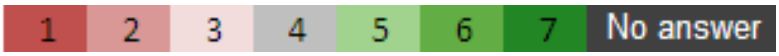
A moderate and slow macroeconomic recovery was the option considered the most plausible by the experts interviewed, as shown in the next figure.

At the time we are writing this report, this sub-scenario of moderate and slow recovery seem to be the most likely one, since it is developed on the forecasts of the main public sources and on conservative assumptions.

Fig. 2: Stakeholders opinion on a moderate macroeconomic sub-scenario



Legenda : 1 – minimum agreement
7 – full agreement



Source: IDC, 2012

9.2.2 Optimistic

The optimistic scenario is based on a moderate recovery in the short term, i.e. in the first forecast period while in the medium term, from 2015 onwards, the European economy will show acceleration in the growth trend.

As already explained, the growth is calculated in this sub-scenario as a positive deviation from the realistic sub-scenario. This positive deviation clearly takes into account the current situation and the barriers to a fast growth of the European area.

This sub-scenario is based on the idea that most of the vulnerable European countries will improve their sovereign debt and that the policy decisions taken since summer 2012 will significantly reduce the risks of a further worsening. The recently announced policy measures at European level may deploy positive effects and improve the euro-area sovereign debt crisis. Businesses and consumers' confidence may improve during the next year and this could have favourable effects on domestic demand and investments so that the overall economic activity may register positive trends by the end of next year. The recovery from the crisis could also be initiated thanks to firm structural reforms in vulnerable Member States rebalancing the euro area and bearing fruit in the general economic activities. Besides, positive impacts could arrive from the US economy and other emerging markets where additional monetary stimulus could support economic activities.

In such a restored economic panorama, the EU GDP will start a moderate positive trend in 2013 and will nearly reach in 2015 a 2% growth rate; the average annual growth in the first forecast period will be nearly 1.3%. In the second part of the forecast period, from 2015 to 2020 the growth trend will be faster but still not at the same level as it was before the financial crisis (2008), with an average annual growth rate around 2%. It worth reminding the reader here that from 2004 to 2007, (which were four years of upward phase) the average annual growth in EU 27 was at +2.6%.

Exhibit 2: Annual GDP growth, in an optimistic macroeconomic sub-scenario

	2012	2015	2020	CAGR 2011-2015	CAGR 2015-2020	CAGR 2011-2020
France	0,7%	1,7%	2,1%	1,3%	1,9%	1,6%
Germany	1,0%	1,8%	2,2%	1,6%	1,9%	1,8%
Italy	-1,3%	1,3%	1,7%	0,4%	1,3%	0,9%
Poland	2,9%	4,1%	4,4%	3,5%	4,1%	3,8%
Spain	-1,5%	1,8%	2,1%	0,3%	1,9%	1,2%
United Kingdom	0,6%	2,2%	2,2%	1,5%	1,9%	1,7%
Total EU	0,1%	2,0%	2,3%	1,3%	2,0%	1,7%

Source: IDC 2012, estimates based on various sources

Such an optimistic macroeconomic sub-scenario, will positively impact the IT spending trend. The IT spending is expected to attain a compound average growth rate of 2.9% during the first forecasting period while in the second forecasting period it will attain 5.4%. The second forecasting period will therefore be characterised by increasing investments addressed both to saving goals and to innovative processes and products.

The optimistic macro-economic sub-scenario will progressively impact the labour market with positive effects on employment since the end of the first forecasting period. Since investments will not be addressed to only saving investment, the demand of e-skills will be positively be affected.

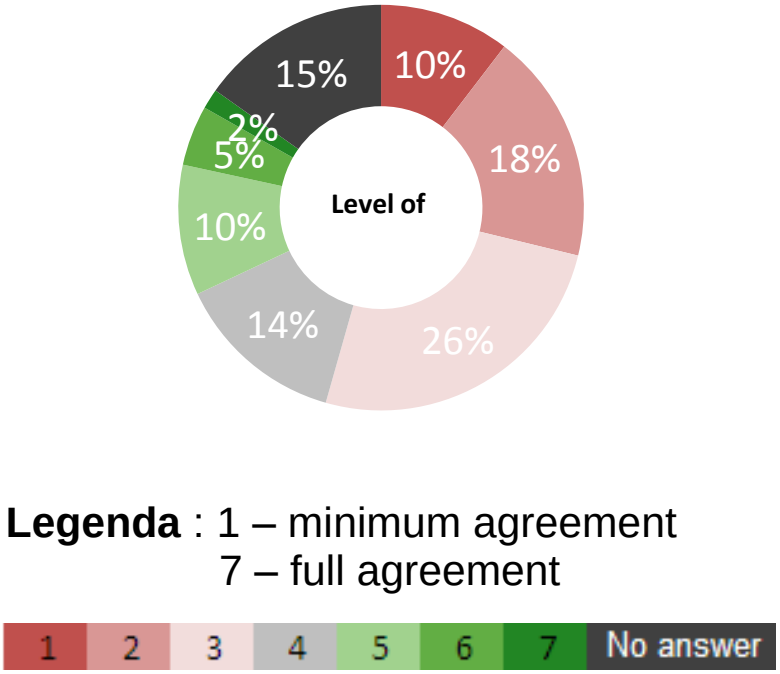
Likeliness

Although the difference between the average annual growth in the realistic and optimistic macro-economic sub-scenario is not dramatic, most of the experts consulted do not agree on an optimistic macro-economic sub-scenario.

This mainly depends on the fact that experts and public sources all agree on the fact that the recovery from the economic crisis will, even with optimistic assumptions, take some time.

Moreover, there are a number of countries where, even in optimistic hypotheses, growth will be slow.

Fig. 3: Stakeholders opinion on an optimistic macroeconomic sub-scenario



Source: IDC, 2012

9.2.3 Pessimistic

At the time we are writing this report, the risks to GDP growth appear less severe than a few months ago, although downside risks still remain relevant.

Financial markets still remain highly vulnerable and their performances are highly dependent on implementation of agreed policy measures. Spreads remain very high and very fluctuating in European Sovereign markets. The banking sector is still exposed to a risk of financial stability both because of the financial stability and because of the permanent weakening of the economy that is reducing their earning and increasing the credit risks.

Furthermore, there are also other additional risks, which relate to the upcoming developments in main partner economies. This is the case of China and other emerging economies where economic activities are recording a decline. At the same time, oil prices increases and fluctuation of the staple foods' prices show a high volatility in commodity markets.

Exhibit 3: Annual GDP growth, in a pessimistic macroeconomic sub-scenario

	2012	2015	2020	CAGR 2011-2015	CAGR 2015-2020	CAGR 2011-2020
France	0.20%	1.10%	1.43%	0.67%	1.18%	0.96%
Germany	0.50%	1.20%	1.50%	0.95%	1.24%	1.11%
Italy	-1.80%	0.70%	0.96%	-0.21%	0.65%	0.27%
Poland	2.40%	3.50%	3.73%	2.85%	3.42%	3.17%
Spain	-2.00%	1.20%	1.43%	-0.36%	1.24%	0.53%
United Kingdom	0.10%	1.60%	1.46%	0.90%	1.19%	1.06%
Total EU	-0.36%	1.38%	1.62%	0.65%	1.35%	1.04%

Source: IDC 2012, estimates based on various sources

The vulnerable economies of the euro-area are undergoing a process of macroeconomic adjustment with structural reforms; the medium term growth perspectives of these economies very much depend on the pace of the correction process of their imbalances. The faster and the more determined the correction process will be, the faster the recovery may start; in case the correction process is going to hesitate and to take a long time, the recovery may slow in showing its effects and the pessimistic scenario could take form in the medium term.

The pessimistic scenario, although not so severe, will show a compound average growth rate of about 0,65% from 2011 to 2015; the second part of the forecasting period will still show a flat trend of the GDP with an average annual growth attaining 1,35%. On the overall, the EU27 area will register a 1% growth.

Such a flat growth trend will negatively impact the productivity of the European economy because of a lack of confidence of consumers and businesses and therefore a lack of investments. Such a pessimistic sub-scenario will negatively impact the labour demand with an increase of unemployment.

The skilled employment will be quickly and negatively affected by such a trend: low investments will at first affect the investments addressed to innovation so that demand for skilled employment will be flat and even decrease.

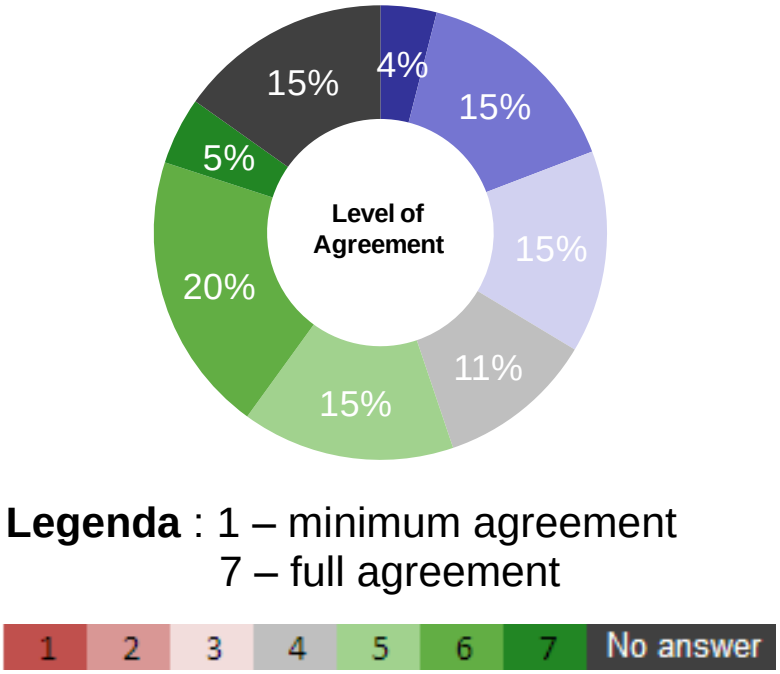
Within a pessimistic macroeconomic sub-scenario, the overall IT spending will be nearly flat during the first forecasting period with (CAGR +0,1%) while in the second forecasting period it will slowly accelerate (CAGR + 1,7%).

The very low level of confidence of both consumers and businesses will very impact the investments trend that will remain flat and be concentrated in investments addressed to savings in the production function with very low levels of innovation and very low investments addressed to new products.

Likeliness

The pessimistic scenario is considered the more likely after the realistic one.

Fig. 4: Stakeholders opinion on a pessimistic macroeconomic sub-scenario



Source: IDC, 2012

9.2.4 Wild card

The very high level and persistence of uncertainty affecting the EU27 area and especially the euro zone, is strongly bringing on the floor a possible sub-scenario where the overall macroeconomic trends are the result of very different trends in the different European countries.

This panorama does not necessarily mean a breakdown of the Euro zone but a continuing divergence of the economic growth in the different European countries.

Although the European countries continue to share some common features, the persistence and the aggravation of the crisis especially in some vulnerable countries is going to bring heterogeneity in GDP growth and in employment performance within the EU area. The vulnerable economies of the euro zone are undergoing macroeconomic adjustment processes. The vulnerable European countries very much differ in terms of adjustments needs: Greece, Spain, Cyprus and Portugal registered very large current-account deficits that raised doubt on their sustainability. Countries such as Ireland, Italy, and Slovenia recorded smaller external deficits but their governments, banks and businesses faced severe funding stress. In order to achieve durable account adjustment it is crucial that reductions in deficits are driven by structural factors, insofar the pre-crisis was driven by excessive credit expansion and inflated consumption growth linked with over-estimates income expectations.

Besides, the health of banking sectors and public finances as well as private debt and external deficits differ considerably across countries in the EU. Countries with relatively balanced public accounts and competitive industries will recover faster and will experience an improvement of business and consumer confidence.

It is easily understandable that the adjustments to imbalances will require very different efforts in the two groups of countries and therefore the strategies and the governance to overcome the crisis will be very different. This state may consolidate two or three different groups of countries, which do not share common features and perspectives within the EU, which might significantly weaken the European Union where considered as a union addressed to create a single market.

9.3 The innovation sub-scenarios

9.3.1 Main trends

The ICT environment is characterised by unrelenting technological progress and incremental innovation. Furthermore, the ICT sector is periodically swept by waves of radical innovation, deeply transforming production, distribution and usage patterns, which have always led to new thresholds of pervasiveness of information infrastructures in the economy and the society. This happened with the advent of personal computers in the 80s, of the Internet and the World Wide Web in the 90s, and is now expected to happen again, in the next decade or so, with the next generation of the Internet (the Future Internet paradigm) characterised by unprecedented, seamless connectivity and mobility. In addition, there are relevant evolutions ongoing affecting the development, distribution and delivery of ICT solutions and services, and emerging ICT-based business models (such as the so-called Enterprise 2.0 environment, transferring the main features of social computing to the business world). Technological innovation plays an important part in these trends but is by no means the only driving factor, actually for most of these developments business and organizational innovation represents the key drivers.

The sub-scenarios are focused on ICTs business demand (excluding the consumer/home market, which is less relevant for the demand-supply of e-skills). The analysis of main innovation trends is differentiated in three main sector groups as follows:

- ICT industry: the definition used in this study includes software, IT services, communication services, and computer manufacturing. This excludes microelectronics and industrial automation machinery
- The user industry: this includes all the manufacturing and service industry using ICTs in their production function; these user industries may have high or low ICT budgets and ICTs may be used for both production or distribution functionalities.

Fig. 5: The main technological innovation trends of the ICT industry

Source: IDC, 2012

The main technological trends

The ICT industry is currently in the midst of a shift to a new technological innovation trajectory built on mobile devices and apps, cloud services, mobile broadband networks, Big Data analytics, and social technologies, as shown in the picture above. Based on the ICT estimates, by 2020, at least 80% of the ICT industry's growth will be driven by these new technologies.

- Mobile devices and Apps

Devices, applications and networks are all going to be dramatically affected by the mobile trajectory. IDC predictions estimate that in 2012, for the first time, the spending from these devices exceeds that for PCs. From 2012 forward, there will be a fast increase in smartphone demand, which will drive in a few years to a mass market. Within the mobile revolution, the mobile apps published will grow very fast as well and users downloading mobile apps will massively increase. The demand trend for the mobile devices and apps will very much depend on the general economic trends, but for sure this is the technology driver of the next years towards the 2020.

Among the most relevant opportunities provided by the mobile devices and apps, there is the connection and integration the social networking services, with cloud application platforms, with analytics offerings or with commerce offerings. Such integrations provide relevant technology trends in both citizens services and business supply chain.

- Cloud services

Over the next several years, cloud services will largely replace client/server as the dominant model for application and solution delivery. For the past two or three years, much of the strategic action around cloud services has been about vendors and users getting their feet wet, most often around cloud infrastructure services. In 2012, the strategic moves in the cloud services world are going to shift to the application platforms and the race to build the largest portfolios and ecosystems around those platforms.

The fastest-growing cloud services segment will be platform as a service (PaaS) and constitutes a strategic beachhead in the cloud.

For the past three years, the largest players in the IT industry have been intensely focused on building cloud infrastructure (IaaS) and app platforms (PaaS). IDC analysis predicts a massive buildout in 2012–2014 of cloud solutions/apps on top of these platforms. The large majority of new apps will be distributed/deployed via the cloud. The traditional model for enterprise application distribution and deployment is quickly being obsolete by the cloud PaaS/app store model, which is far less complex and costly for developers.

Besides, in the upcoming years, organizations will accelerate their movement of legacy enterprise apps to the cloud. Until now, the chief customers for public cloud IaaS have been commercial B2C companies. From now on, because of licensing changes and a desire for deployment flexibility on the part of enterprise IT organizations, more enterprise apps will run on public clouds.

- Big data

Integrated data and analytics technologies are going to move from niche to mainstream adoption, based on the following factors.

A market-wide migration to in-memory technology will rapidly accelerate. Moreover, analytic functionality will migrate into the database. Functionality such as reporting engines, scoring engines, spatial information management extensions, and data transformation will be increasingly embedded within databases. This embedding is being done to speed up the performance of the software because it reduces "overhead" associated with running multiple, layered software products. The ability to take advantage of the performance, scalability, security, and manageability

of the latest databases to perform these functions will decrease the need to purchase separate software for them.

- Social Technologies and Interactive network of things

While social technologies (especially as they're being accelerated by mobile technologies) are from now on a mandatory part of the next technological trajectories, also sensors, tags and “communicating things” in general are going to be part of the Network.

Internet of things refer to the Internet-based embedded solutions capable of linking billions of devices (cameras, sensors, etc.) and objects interacting over a network. Based on IDC predictions, the number of installed intelligent communicating devices on the network will outnumber “traditional computing” devices by almost 2 to 1. This will change the way people think about interacting with each other and with devices on the network.

From now on, there will be an acceleration in the use of microblogging technology — best known for people-to-people communication services like Twitter and Foursquare — for people to follow the "state" of things that are relevant to them. Besides, there will be over 3.5 billion connected industrial products (including cars, planes, and boats), appliances/toys, and entertainment devices connected and communicating over the Internet. These devices will have the ability to share information about their "state" in terms of the need for service, availability for use, time of arrival, and so forth. Microblogging and location/mapping will emerge as ways for consumers to manage their relationship with the devices and objects they deem most relevant to the tasks that they need to undertake on a daily basis. This could include a Twitter-like feed to "follow" the status of a connected appliance in your house to see if it's operating correctly or if it needs service. In addition to appliances, consumers will be able to "follow" objects and services, such as cities for the best location for parking or mass transit for the exact time of arrival for a train or bus. The inverse is true as well, where devices could "follow" people. This could be very useful in the health space, where the ability to track patients' vital signs or medication compliance can be essential to care.

9.3.2 Main drivers of innovation

Innovation is based on technological trajectories on one side, meaning that technology is assumed as being an exogenous variable of the economic system; on the other side, the adoption and diffusion of a technology is instead endogenous since it depends from demand, available budgets to assign to technology and innovation. When an innovation or a new technology is adopted/demanded by businesses and consumers, the adoption/demand is based on priorities that are determined by economic trends and conditions.

As a consequence, in a time of rapid changes and of high economic uncertainties, it is very relevant to consider the main priorities driving the adoption of innovation and what are the main key uncertainties in order to better understand the innovation sub-scenarios.

The main end-user strategic priorities in a time of change:

- Using technologies to cut costs

Some recent IDC surveys on end users priorities clearly confirmed that the cost agenda (IT investment decision driven by a desire to cut organizational and IT costs) is currently more powerful than the growth agenda (IT investment driven by a desire to increase the market share or the revenues). That does not mean, of course, that all or even most IT services buyers are planning to cut their spending. Using IT to cut corporate costs can be a driver of increased, not decreased, IT spending levels. But what is important to realize is that IT investment is often — if not most often — primarily about cutting costs. Using IT to reduce corporate costs is a very different matter from cutting the costs of IT, and indeed the deployment of new technologies that make the organizations

more cost effective can be the stimulus for major IT investment. The cost agenda among corporate buyers is not necessarily antithetical to new IT spending.

Given the uncertain macroeconomic and political environment in much of Western Europe and the consequent low levels of both business and consumer confidence, proposals for net new IT spending have to be framed carefully so that both the ROI and the payback times for the customer are attractive and the implications for the client's cash flow are not harmful.

- Security

Security is a perennial priority for IT services buyers and has been so since networked technology use became more widespread in the client/server evolution in the 1980s/1990s and later in the ongoing Internet/Web revolution of the 1990s onward. Based on the more recent surveys conducted by IDC, it seems that security is now an overwhelming priority. This depends on the fact that from now on it not only a technology issue but a business issue as well. The growing importance of Internet-based supply chains (both business to consumer and business to business) and the invasion of new consumer-oriented technologies (e.g., media tablets), and services (e.g., social Web) into the workplace rise potential threat levels.

The main key uncertainties:

- EU system capacity to adopt innovation: the EU system capacity to adopt innovation will very much depend on the macro-economic trends and on the capability and policy will to invest in innovation and in the IT technologies.
- SMEs level of intensity of innovative IT services and applications: SMEs are still very relevant in the European economy and the innovation capacity of the EU very much depends on the SMEs capacity to innovate. During the crisis the SMEs are more vulnerable than large enterprises because of financial constraints. It is therefore important to develop some policy actions to support SMEs in case the crisis will last more than expected.
- Services sectors accelerating systemic innovation: the current innovation scenario is characterised by increasing relevance of the service industry. Clearly where innovation will be fast and pro-active, the service sector will gain relevance and help in the acceleration of innovation.
- Investments in infrastructures and NGN (overcoming the broadband gap): investments in infrastructures and in NGN are still strategic in the EU in order to reduce the digital divide. These investments will again very much depend on the macroeconomic trends and on the resources the individual countries will be able to address to innovation and the achievement of the Digital Agenda.

9.3.3 The innovation sub-scenarios

The combination of alternative hypotheses about the main technology trends lead to three alternative innovation scenarios.

Table 1: The main technological innovation trends of the ICT industry

	The sub-scenarios		
Main trends	**Struggling on**	**High way to growth**	**Reduced expectations**
Overall IT spending trend	Moderate growth	High growth	Low growth
Mobile devices and apps	Slow diffusion	High investment and fast diffusion	Low diffusion
Cloud services and	Widespread adoption,	Widespread adoption,	Patchwork adoption

technology delivery models	medium investments	high investments	
Big data	Low priority, investments only by large companies	High priority, investments by large and medium companies	Low priority, investments only by multinationals
Social technologies and interactive network of things	Medium priority, slow diffusion	High priority, high investments, diffusion in both large companies and SMEs	Low priority and very scarce investments for all the time period 2012-2020

Source: IDC, 2012

These different technology sub-scenarios correspond to different macroeconomic assumptions and IT spending propensity (i.e. the total IT spending on GDP) that feed into the e-skills demand model.

In the following paragraphs we present the main characteristics of the three innovation sub-scenarios.

9.3.4 Struggling on

This sub-scenario is based on the assumption of a moderate IT spending trend. After a difficult 2011 and 2012, IT investments will progress at a moderate pace throughout the forecast period. Businesses' and consumers' confidence will very moderately improve, so that innovation adoption will be mainly addressed to implementing savings and increasing productivity. Innovation will mainly be implemented by large enterprises while for SMEs the innovation will remain at a low/medium level.

Within such a sub-scenario, cloud services and new technology delivery models will follow a widespread adoption since this innovation trend very much allows savings and a productivity improvement at enterprises' level. Cloud services will be adopted by both large enterprises and by SMEs since the cloud contributes to cost savings and provide SMEs with services that otherwise may be too expensive.

For the past three years, the largest players in the IT industry have been intensively focused on building cloud infrastructure (IaaS) and app platforms (PaaS). From now on cloud platforms (PaaS/app stores) will be one of the most valuable areas for innovation. Organisations, both large and small, will accelerate their movement of *legacy* enterprise apps to the cloud.

In the short term (2012-2013), investments in PCs, servers and storage show a flat growth or a decline, depending on country, as companies demonstrate a cautious approach to capital spending. In the longer term, new/enhanced mobile devices, replacement cycles of traditional hardware and infrastructure demand from both private and public cloud players drive positive demand towards 2020. By then, the centre of gravity for IT will have increasingly shifted from the PC to the mobile device.

The software industry is going through a major transformation, from basic architecture (service-oriented architecture [SOA]) and the way software is written (composite applications) to the way software is delivered (public cloud) and even funded (advertising based). IDC assumes that this transformation will take a decade. By 2020, many of these developments will have already made a strong impact on the software industry, which is therefore expected to show positive growth along the forecast period.

The IT services industry is also transforming. This is a long, slow process involving the rise of offshore IT services, the increased integration of IT services inside business services, and the advent of new service delivery models. Most firms have developed a multishoring capability and blended pricing model and are now working on ways to standardize on technologies and methodologies, deliver services online or in new form factors, invest in datacentres, and expand into business

services. Despite the race to automate service creation and delivery, there is a looming talent shortage, which IDC expects to keep on affecting the market also in the long run. Overall, IDC anticipates IT services will grow at a moderate pace across the forecast period (less compared to the software market).

In the short-term, with difficulty in accessing credit, European small companies will put on hold new investments, to focus on facing the economic contingency. Hardware investments (which represent a higher than average share of IT spending in this company size band) will be easily postponed until better times. In the longer term, SMEs will increase their IT spending, but IT penetration will remain limited compared to large companies.

In the short term, all vertical markets will feel the pressure of the strong uncertainty in the economy and the concerns over the sovereign risk in some EU countries. However some verticals are more impacted (government, finance, automotive, air transport), others are more resilient (utilities, telecom). In the longer term, a moderate economic recovery will accelerate investments across all vertical markets, in particular those which have already a good IT sophistication (utilities, finance, telecom, large companies in manufacturing and distribution). With strong focus on cutting inefficiencies, centralizing procurement and reducing costs, growth in the government sector (especially central government) will remain subdued along the forecast period.

Impact on the demand of e-skills

The high uncertainty in the economy will lead to a non-homogeneous increase in the e-skills demand. Specifically, the growth rates are going to vary strongly depending on the varied maturity of the ICT industry and penetration in the verticals across countries.

Since the innovation path will be driven by saving objectives and new ways to do and organise production services, management skills will on the overall grow more than score skills.

Core skills will be flat also because off-shoring is increasingly adopted in the IT service delivery.

Level of likeliness

Based on the opinion expressed by the experts in the online survey conducted, the Struggling on sub-scenario is the more likely one. Moreover, most of the experts, also expressed the opinion that the innovation path of the Struggling on sub-scenario may positively affect the demand of e-skills, especially where management skills are concerned.

9.3.5 High way to growth / turning point

The High way to growth sub-scenario is based on the assumption that a substantial economic recovery drives strong business and consumer confidence, creating a favourable environment for IT investments. While European debt issues will dominate downside risks, especially during the first time period (2012-2015), this sub-scenario will be demand driven thanks to the progressive recovery from the crisis. Innovation drivers will be addressed to both implementation of savings through productivity increases and to the adoption of new products.

Mobile devices demand and their impact on the market will progressively grow in the European market, while the emerging markets will drive mobile device price towards a decreasing trend, which will lay the foundation for a global mass market. At the same time, the publication of mobile apps will continuously increase as well as the mobile apps downloads.

Besides, the launch of new devices, availability of innovative services and high replacement rates are going to drive a second-round of booming spending in smart devices. Deployment of complex IT projects will spur demand also for traditional enterprise hardware (servers, storage and datacom).

The economy recovery will accelerates the ongoing software industry transformation process, through a virtuous cycle. New offerings are going to be available (especially in the areas of public

cloud, enterprise mobility, analytics and big data), and companies' demand increases. Cloud computing, mobility and Web 2.0 become integral part of EU companies' strategies. Cloud computing and Web 2.0 will facilitate SMEs businesses in the global economy so that the innovation process will spread among SMEs as well as among large enterprises.

SMEs may start catching up with large companies. IT spending growth rates in this segment may progressively outpace the ones of large companies, with a strong push coming from public cloud services, and mobile computing.

Complex IT projects drive renewed demand for IT services. IT spending growth strengthens across all vertical markets, and in particular in those verticals with a stronger penetration of SMEs (such as business services, distribution, manufacturing and construction).

This dynamic innovation process will start already in the second half of 2013 with a moderate path until 2015 and then from 2015 onwards the IT spending and the innovation path will accelerate. The main characteristic of this sub-scenario is that the innovation process is very pervasive and it involves all potential users of ICTs.

Such a sub-scenario will drive to the breakthrough towards a new technology platform based on mobile devices and apps, cloud services, mobile broadband networks, Big Data analytics, and social technologies.

Impact on the demand of e-skills

The High way to growth sub-scenario is the one with the major potential impact on the demand of e-skills. Demand for devices and for IT services being so pervasive, the demand for e-skills will impact both the management component and the core skills. Within this sub-scenario, clouds and innovative apps and services will spread in all user industry, so that the demand of e-skills will not be limited to the main IT users but to all the industries, both traditional and high tech.

One of the main impacts of such pervasiveness will be new waves of innovations with new products and services in traditional industries.

Level of likeliness

This scenario is nowadays the less likely since the European debt issues are remaining the main and concrete downside risks. Nevertheless, the technological trajectories and breakthrough driven by the mobile devices and cloud computing are quite realistic. Very much will depend on the capacity of the European enterprises to adopt innovations. If high-speed broadband will reduce the digital divide in the European regions and if enterprises, especially SMEs will look for innovations addressed to improve their productivity and competitiveness in the global market, this sub-scenario could become reality.

9.3.6 Reduced expectations

The reduced expectations sub-scenario is based on the assumption that the EU recovery from the crisis will take more time. The 2013 GDP growth is going to be very limited (nearly 0.5%); growth strengthens in the following years, but remains below realistic levels. This pessimistic scenario doesn't foresee a collapse of the Euro, but very slow path to growth. Innovation adoption will only be addressed to reduce costs, and only where unavoidable. Companies are going to postpone investments in IT projects and will focus on maintenance/ optimization of the existing IT infrastructure.

Investments in traditional hardware (servers, PCS, storage, in particular) are further pushed back, as companies seek to save capital spending. Replacement cycles are going to elongate. Despite outpacing the rest of the market, investments in smart devices will also be affected by declining business and consumer confidence. As a consequence very little effort will be addressed to

innovate in the business organisation and therefore productivity will remain on steady-state level so that the European economy will lose competitiveness in the global market.

The uncertain economic environment will slow down the major transformation process the software industry is undertaking. Despite growing much higher than average and being somewhat "anticyclical", adoption of public cloud services will also slow down. Cloud would replace or complement existing solutions, but it wouldn't be leveraged for first time adoption of solutions, with a negative impact on EU SMEs, which traditionally lag behind large companies in the adoption of complex IT solutions (CRM for example).

Large IT projects as well are postponed with a negative demand for innovative IT services. Length of contracts is reduced and so are the fees.

Companies with less than 250 employees are strongly impacted across the forecast period. Issues around liquidity and access to credit keep on affecting SMEs' IT demand. The short-term tactical approach of most of SMEs limits also their ability to innovate the products and services they offer and/or leverage in their business operations. Their ability to operate in the global market may be seriously damaged so that an increasing mortality of the European SMEs could occur. Since SMEs are a relevant part of the European economy, this may reduce the production capacity of Europe.

All vertical industries will be impacted by the prolonged downturn in the economy. The government sector will need to cut further public expenditure. This will negatively impact IT spending as well, which will be therefore smaller than in the realistic scenario (where we already predict small growth). Cuts in public expenditure have a similar negative impact on education and healthcare. Utilities keep on growing above average but there is a delay in the implementation of smart meters' projects in some countries and on the launch of smart services that could be enabled through smart grids. All in all, these cuts and delays will in turn negatively affect the productivity of the EU.

Impact on the demand of e-skills

The demand of e-skills will be negatively affected by such a scenario; at the same time, the negative approach to innovation and to IT spending will also reduce significantly the attractiveness of the IT sector as a promising area for a career path. The manager skills as well as the core skills will be negatively affected. The demand of e-skills will decline in both the ICT industry and the user industry. The decline in the user industry nevertheless will be very severe since replacement cycles and innovation in the business organisation will be avoided as much as possible.

Level of likeliness

This sub-scenario is not at all impossible, at the moment, although it is less likely than the Struggling on one. The turning point for this scenario as well as for the others will be the second half of 2013 when it will be clear whether the economic recovery is going to gain momentum or not. At this point, the enterprises will make their choices on their business strategies and perspectives for the near future that will determine their contribution to the innovation path. The main factors which may prevent this scenario are the solution of the debt issues and constraints as well as the policies the countries are going to adopt in order to counterbalance a hard and laboured recovery from the crisis.

9.4 The education and training sub-scenarios

9.4.1 Main trends

The major source of ICT workforce comes from the ICT graduates from universities. The trend of the ICT graduates in Europe is showing, since 2006, a continuous decrease, excepted in Germany. The attractiveness of the ICT careers seems to be slowing down. Based on Eurostat data, the

number of ICT graduates from University is decreasing faster than expected. As a consequence, when the European economy will start recovering from the current economic crisis, Europe may face an increasing excess demand for e-skilled work.

Education is one of the major factors influencing the supply of e-skills. The take-up of computer science courses depends a lot on the attractiveness of the ICT careers and in general of the careers dealing with the ICT industry. The careers' attractiveness depends more specifically on a number of factors such as:

- the average wages of the ICT professions
- the general reputation of the ICT industry,
- the ICT industry perspectives and the careers paths that can be developed
- opportunities for mobility across enterprises and industries

Changes in the formal education system deploy effects only in the long term: whatever change in the tertiary education will take at least from 5 to 8 years to produce effects on the labour market. Also, changes in the demand for specific skills usually take a while to bring about a change in the formal education. First of all, because the skills required by a high-tech labour market evolve in the medium term and second because the education offer being a complex institutional apparatus, it takes some time to change the education offer.

This is the reason why professional training and mobility of human resources are both important factors to face changes in the demand of skills. Professional training is provided by enterprises and usually matches the specific needs of the enterprises, it usually needs a shorter time than education to deploy its effects and also to be developed and implemented. Human mobility as well might counterbalance in the short time mismatch of demand and supply of e-skills.

Beside the formal education, there is a workforce that has acquired ICT professional skills through training on the job or through training courses delivered by different vendors. Young people entering the labour market during the last 5 to 10 years are digital natives and they might have developed ICT skills informally through private interests. Nevertheless, although young people may have taken advantage from being digital natives, competitive and performing enterprises are going to ask for advanced and specific skills that need to be developed through an education or specific training path.

The labour market is balanced when the demand for employees matches the supply in terms of quantity and of quality. This very much depends on whether the education system has provided the students with the skills needed by the enterprises. Often enterprises complain about young people skills and about their ability to be immediately productive; from the enterprises point of view the education system is not sufficiently appropriate to the industry needs. Nevertheless, it is important to bear in mind that the education system has to meet the needs of the enterprises as well as the students demand for education. In a very fast and high-tech changing industry, the enterprises needs do not always correspond to the students' demand for education characteristics. In a fast changing market in fact, young people demand for education and training is influenced by their very long time horizon (more than 40 years), whereas prospective employers' time horizon coincides with average job duration, which has shortened during the last 10-20 years and is now considerably shorter than youth's time horizon. Enterprises' training budgets are getting tighter than they were in the past because of the difficult economic time as well as because shorter job duration discourages enterprises from investments addressed to training. Finally, average wages in Europe are lower than in the USA and the gap with emerging countries is narrowing. As a consequence, mobility to and from Europe might be difficult.

9.4.2 The education sub-scenarios

The combination of the main trends of the education and training system is going to draw three different sub-scenarios as illustrated in the table below.

Table 2: The main education trends in the ICT industry

Main trends	The sub-scenarios		
	Meeting the training challenge	**Labour mobility/private funding**	**Supply gap**
Decrease of ICT graduates and risk of ICT practitioner shortage	Education system substantially stable, no relevant changes. Slow decrease of ICT graduates	Decline of ICT graduates	Low attractiveness of ICT careers and decline of ICT graduates.
Increase of digital natives into the labour market	Increase of "digital natives" into the labour market helps the training and education of "dual thinkers".	Digital natives increases the number of young people entering into the labour market without graduation in ICT	Increase of digital natives without ICT graduation entering the labour market
Demographic trends increase the demand for life-long learning and e-learning	Increase of “digital natives” without ICT graduation enhances the demand for life-long learning and e-learning	Increasing need for training on the job and life-long-learning	High need for training and life-long- learning
Increasing relevance of private funding private organisations to substitute the traditional and public education providers	Private funding addressed to the training becomes more important	Increasing need for private funding addressed to training but	Enterprises do not return to pre-crisis spending level for training

Source: IDC, 2012

9.4.3 Meeting the training challenge

This education sub-scenario is envisaged with an optimistic macro-economic trend, which supports an increasing demand for ICT products and innovation. The ICT pervasiveness will strengthen the attractiveness of ICT careers to young people and will support the demand for e-skills. The contribution of ICT to productivity will support the wages level so that the ICT careers will be perceived as relatively secure with levels of remuneration relatively competitive where compared with other sectors. Nevertheless, at international level, the wages in Europe may remain relatively lower than in the USA at least until the end of the second forecasting period.

The education system will make efforts in order to provide enterprises with updated young people, immediately productive after the graduation and able to compete in the global market. The supply of ICT graduates will stop declining and during the first forecasting period it will remain stable. In case the macro-economic trends will be confirmed, the ICT graduates may start increasing at the end of the second forecasting period.

Because of demographic reasons, the young people starting university or entering the labour market without a graduation are going to be digital natives. As a consequence the computer based courses will have to face students with needs for high and competitive skills. Enterprises providing training and e-learning as well will need to change and update the training projects and programs to the more advanced needs of the “digital natives”.

Impacts

The economic system will require skills addressed to a new organisation of labour and production since mobility and cloud computing will be pervasive in the European economy. There will be an increase in the demand of e-leadership skills and in the demand of "dual thinkers". The gap of the remuneration between e- leadership skills and practitioners may increase since dual thinkers and the management skills will be increasingly strategic.

The enterprises will address some effort in the training activities and at the end of the first forecasting period the training budgets will get back to the pre-crisis levels. Since the number of digital natives will increase in the labour market, there will be an increase in the use and diffusion of e-learning.

Likeliness

This sub-scenario is based on an optimistic macroeconomic trend, which, in the overall, is not yet considered very likely. A fast recovery from the crisis and a proactive innovation policy is not considered at the moment very probable.

9.4.4 Labour mobility/private funding

This education sub-scenario is the one we might have with a realistic IT sending growth. A realistic IT spending growth in the next years means a moderate level of innovation in the ICTs with a moderate diffusion of innovation mainly addressed to increase productivity and to achieve savings. As a consequence the innovation sub-scenario will be mainly addressed to high diffusion of new delivery models.

Within such a macroeconomic and innovation panorama, the ICT professions will be very moderately attractive with wages stable during all the forecasting period. As a consequence, the ICT graduates from the traditional education system will decrease and there may be a risk of ICT practitioner skills shortage. The mismatch of demand-supply may be met with labour mobility within the EU.

Because of demographic reasons the number of digital natives is going to increase and the number of digital natives entering the labour market without a graduation in computer sciences will increase.

Impacts

The skills required by the EU economy will not change dramatically, both in the ICT industry and in the user industry. The skills supplied by the education system are going to remain basically unchanged and there will be small room for innovation in the education system and for the education of skills addressed to innovate.

The increasing number of digital natives entering the labour market without a graduation will definitely increase the need for training on the job and for life-long-learning. Although the macroeconomic system will recover slowly from the crisis, the enterprises hiring young digital natives will have to return to pre-crisis level of training budget in order to partially compensate the lack of formal education and to enable at least some professional growth.

The ICT average wages will be stable and relatively lower than the other sectors' wages: this trend depends on the fact that people without a graduation accept lower salaries and also because the training is considered by the enterprises as a benefit compensating a lower salary.

Beside, during the second forecasting period there will be a number of new private organisations providing job training and addressing their services directly to the workers instead of addressing their services to the enterprises.

Likeliness

This is a very likely sub-scenario since it is based on a realistic innovation and IT spending trend, both improving with a moderate and slow path that is expected as very likely in the upcoming years.

9.4.5 Supply gap

The so called Supply gap education sub-scenario is the one foreseen with a pessimistic macro-economic sub-scenario accompanied with a pessimistic IT spending as well. In this case, the EU economy will face a very flat trend of the GDP growth during the forecasting period and a pessimistic IT spending that is not going to return to the pre-crisis levels.

The innovation strategies will be very conservative and innovation will be only addressed to savings and implemented only where necessary. As a consequence, there will be a very low diffusion of innovation in the user industry, European productivity will not improve and the European competitiveness is going to slow down and unemployment is going to grow all over EU. Within such a scenario, the ICT infrastructures are not going to improve.

As a consequence, the image of the ICT sector will get worse because the security of ICT jobs and because the average remuneration will be relatively low where compared with other industries.

Impacts

There will be very low interest for maths and computer science university courses. ICT graduates will decline since the beginning of the forecasting period and it will stabilise at the end of the period.

Since innovation will be mainly addressed to savings, the demand for management skills may decrease less than demand for practitioners.

While the ICT graduates from computer science and other science courses will decrease, the number of young digital natives without a graduation will relatively increase. Although these digital natives without graduation will need and ask for training on the job, the enterprises will not get back to the pre-crisis training budgets. The remuneration of the ICT jobs will remain flat and career opportunities will be very limited. Job training and life-long-learning will not compensate the insufficiency of the formal education. Adult ICT workers will be at risk because of the lack of training and updating opportunities.

Likeliness

Currently, such a pessimistic scenario does not seem to be very likely, at least where the EU in general is considered. Such a sub-scenario may happen in the more vulnerable countries where very low resources may be spent for innovation.

9.5 The social sub-scenarios

The social attitude of individuals, the way they live and the way they work are very much related with the technological environment. The Internet is shaping a new way of keeping contacts, of participating in political debates and also of studying as well as of the working life.

The Internet users will continue to increase as technological innovations become available (and cheaper) to a wider audience. The Internet is definitely part of the day to day life of the digital natives.

Furthermore, the Internet services are leading Europe to change its approach to working life since it changed the way people do business. The economic crisis is affecting the market labour with

increasing job losses and an increasing demand for flexible work. Job losses are stimulating entrepreneurship and a new flexible way of conducting business.

At the same time, the Internet is changing the way people purchase products and services. The Internet and the social networks may, as a consequence, take an increasingly commercial flavour and become marketplaces for commercial advertising and business.

Besides, the Internet and the social networks also facilitate mass democracy and participation of a vast audience of people to political and social life and opinion.

In addition, issues such as privacy and consumer protection, cross-border data transferability, trust and confidence, are particularly sensitive in these sectors and are reflected in regulatory barriers to Internet

adoption. The need for security and data protection arise as a huge amount of personal information is socially available to friends but to commercial partners likewise: the risk for the individual user is to lose the control over the availability of personal information to third party entities which may use them for commercial concerns and control.

The increasing relevance of the Internet in the social and economic life will be very much supported and accelerated by the diffusion of the mobile devices and apps.

9.5.1 Eventually big brother

This sub-scenario is dominated by the commercial side of the Internet, driven by multinationals and authoritarian governments. It is centred on the commercial nature that Internet can adopt through the personal information collected over the Social Network: within this theoretical framework, Internet serves as a capturing net in which individuals become potential customers subject to targeted advertisement by commercial entities.

Digital divide problem remains with low income/uneducated population, which are excluded from value added services. Individualism is the key characteristic ruling inter-personal relationships: within this context, innovation and entrepreneurship may find a positive environment to run their business.

The government assistance level is low as individual competition and the entrepreneurial attitude is stimulated: the freelancer working profile find an ideal environment characterized by low bureaucracy level and high possibility to manage working life thanks to the high level of services provided by the Internet.

Based on the stakeholder's survey, it seems the commercial side of Internet will prevail with respect to the possibility for commercial entities to access personal information through the most famous social networks. Social networks will serve as collectors of personal information used for commercial purposes in order to target consumer behaviour.

Impacts

This sub-scenario shall lead to the creation of employment, especially for commercial and marketing jobs, management of big data.

Likeliness

A very high percentage of respondents to the survey believe that businesses and commercial entities will target social network users in order to understand the evolution and profiles of consumer behavior and in order to better design their marketing policy. This is very likely especially with recovery from the crisis and diffusion of mobile devices.

9.5.2 Everybody needs somebody

This sub-scenario is the most social oriented one and it stimulates the soft side of the Internet. It is based on a collaborative nature of personal and business relationships: it balances the profit nature of the social networks but it also protects individual privacy and enriches the power of Internet services through the collaboration and co-production of individuals. Individual privacy and control over private information is strong enough to face the rising commercial nature of social networks and of the Internet in general.

While the Internet will facilitate social interactions among different people grouping them according to their interests, passions and job, individual mobility and a faster diffusion of mobile devices will positively affect use, access and co-production of the Internet services. This will lead to high level of participation and transparency of all the services delivered on the Internet, accompanied with a high level of knowledge sharing among the citizens.

This sub-scenario may be favoured by a high level of individual mobility and a fast diffusion of mobile devices: mobility may keep people more connected one with the other although physical distance between them increases.

Governments are involved in individual privacy protection and individuals feel comfortable in sharing opinions and personal information through the social networks. The digital divide is not particularly affecting the use of mobile technologies and social cohesion is driven by social networks which can group together individuals according to their own interests.

Impacts

The impact on the demand for e-skills is positive, although not addressed to marketing and commercial jobs but to security and data protection, as well as to the management and production of advanced online services. This social sub-scenario may also stimulate innovation based on individual contribution and initiatives. The rich eco-system of enterprises and public sector providing products and services on the net is likely to produce high quality employment.

Likeliness

Based on the stakeholder interviews, this sub-scenario seems to be less likely than the previous one. It may take place with a recovery path from the crisis accompanied by a pro-active innovation policy.

9.5.3 Extreme fragmentation

This third possible sub-scenario is based on a combination of the previous sub-scenarios. It is based on a patchwork EU society where a number of countries or European regions are characterised by the commercial domination of the Internet and other countries are dominated by a no-profit knowledge sharing of the Internet.

Such a sub-scenario is characterized by a high level of uncertainty with mixed levels of mass democracy and participation. The digital divide is going to be high especially in some geographical areas so that the social interaction will still be limited to some specific ages and social groups. In the areas with high levels of digital divides and limited diffusion of mobile devices, the social technologies will not support social interaction among ages and social groups. The multinationals exploiting the commercial opportunities of the social networks will be limited while where the digital divide will be lower, the participation of the citizens to the Internet for mass democracy and cooperation may be more higher. Sensitivity to privacy and data protection will be relevant only where the digital divide is low and the population is aware of the potential power of the network as a common space of knowledge sharing.

Impacts

This fragmentation will contribute to a limited diffusion of knowledge and innovation through the Internet. The use of the networks for the development of entrepreneurship will be limited to some specific areas. In most of the European countries, there will be a fragmentation of the Internet into some proprietary segments dominated by leading global companies while the Internet as a common space for knowledge will emerge only in few areas.

Likeliness

This sub-scenario may take place in case Europe will be characterised by different recovery and development speed so that this may be likely in the first forecasting period. The second forecasting period should be characterised by more convergent growth path so that the social sub-scenario should as well converge to a similar model.

9.6 The policy sub-scenario

The severe economic crisis is highlighting how the economic policy of the EU may have more or less effective impacts on the recovery path. One of the major issues the EU is facing during the crisis relates to the level of the sovereignty of the States with reference to the growth strategy of the economy and to the implementation of the IT strategy. Each country has been affected by the crisis to a different extent and needs to implement more or less severe structural reforms and policy actions. The budget constraints and the different structural and trend issues the different countries are facing are also weakening the initial commitment around the policy strategies designed by the EU.

Currently the EU has set two main strategies affecting the e-skills scenarios. These policy strategies are:

- The Europe 2020: this is the current EU strategy addressed to the achievement of a smart, sustainable and inclusive economy. The EU has set five ambitious objectives, specifically on employment, innovation, education, social inclusion and climate/energy to be reached by 2020. Each Member State has adopted its own national targets in each of the mentioned areas.
- The digital Agenda is the first of seven flagships initiatives under Europe 2020, aiming at delivering sustainable economic and social benefits from a digital single market based on fast and ultra fast internet and interoperable applications.

The more the EU will be able to keep the lead of the policy strategies the more the development and growth of the EU countries will follow a common path and will produce synergies. Conversely, in case the EU will lose the lead of this strategy, the countries' growth and recovery from the crisis will significantly differ. In the following paragraphs we are not going to present the contents of the policy strategies of the EU but rather attitude of the MSs towards common strategies and policy objectives.

9.6.1 Endless negotiation

This sub-scenario foresees that the negotiations about the policy strategies and objectives are re-discussed by the EU because of the prolonged crisis. Nevertheless, the EU institutions will partially fail in the governance and will need to work hard to agree on the strategies and on the policy objectives. This negotiation period will take too long time so that the next years will be addressed to endless negotiations instead of implementing policies.

The development of the main objectives of Europe 2020, especially for the labour market will last and the development and implementation of the Digital Agenda will be very weak. The implementation of collaborative policies between EU institutions, MS governments, business and Academia to address the most urgent e-skills gaps will be very uncertain.

The first forecasting period will be addressed to the negotiations and then in the second forecasting period, the EU will need to restart and re-build its governance and lead of the policy strategies.

Impacts

In the first forecasting period, there will be a lack of governance so that the crisis will be counter-balanced in a very limited way. The effects on of the policy governance on the e-skills demand and supply will be very limited, at least during the first forecasting period.

Likeliness

This is a likely scenario at least for the first two years of the forecasting period.

9.6.2 Federal Europe

The assumption of this sub-scenario is that, despite the difficult and lasting economic crisis, the EU will continue leading the growth strategy of the MSs, with a high level of coordination and a strong governance of the main policy objectives.

The implementation of the Digital Agenda will be achieved by most of the countries as well as the main policies supporting employment.

The EU will keep a high level of governance and will implement collaborative policies between EU institutions, MS governments, business and Academia to address the most urgent e-skills mismatch and market needs.

During the first forecasting period, i.e. before 2015 and especially in 2013, the governance of the policy strategy at EU level will face hard time. Nevertheless, EU will address a lot of efforts to the crisis recovery and will take into account the difficulties of the most vulnerable countries. Most of the countries will try to stick as much as possible to the main EU strategies and where necessary the EU will revise the objectives of its strategies keeping into account the impacts of the crisis.

Impacts

In this scenario, the growth strategies and the employment strategies for e-skills and education are going to deploy their effects and positively support demand and supply of e-skills. The policy strategies will not impact as much as expected before the crisis but they will rather help to limit the negative effects of the crisis in most countries. Where the Federal Europe will actively govern the crisis, the negative effects will be limited especially in the most vulnerable countries.

Likeliness

This scenario is not very likely since the main countries may face some difficulties in the agreement of policy strategies during the crisis.

9.6.3 Nationalism return

Within the policy sub-scenarios, this is the most pessimistic one. The assumption of this sub-scenario is that the MSs will be concentrated on their individual and domestic issues and that all the resources and policy efforts will be addressed to the emergency of the crisis. With this assumption, there will not be room for policy development and growth strategy. The overall European objectives will be considered without relevance and the federal governance at federal level will be totally absent.

The development of policies supporting the ICT education system, including e-business skills will be managed at national level. As well the development and implementation of the Digital Agenda will have very weak coordination and only some nations will on their own develop a Digital Agenda. The implementation of collaborative policies between EU institutions, MS governments, business and Academia to address the most urgent e-skills gaps will be definitely absent in the next years.

Impacts

Each country will manage at the policy strategies on its own without any synergy. The funds for the European initiatives will be devoted to other objectives. The e-skills demand and supply will depend on the national policies exclusively.

Likeliness

This is not a very likely scenario since it is based on the assumption that the policy strategies at EU level addressed to growth and to the development of the information society, of the ICT education and training will be in some way stopped and the efforts of the last decade cancelled.

10 Annex 2: Global e-Skills Scenarios

Authors: Rosanna Lifonti, Gabriella Cattaneo, Marianne Kolding, IDC Europe

10.1 Scenarios overview

The scenario methodology is built on possible futures rather than a projection and is based on the combination of known or possible facts of the future with plausible alternative trends, which we define as the key factors.

The global e-skills demand scenarios have been designed combining the main sub-scenarios described above. To do so, we combined the possible assumptions of the sub-scenarios, we cut out the illogical combinations and we finally selected the global scenarios corresponding to coherent, believable and possible paths of the European socio-economic system.

The global e-skills scenarios are based on the complex interaction of 5 main dimensions, which were developed as sub-scenarios, including

- the macroeconomic growth,
- the dynamics of ICT-based innovation,
- the impacts of ICT education and training trends (resulting in lower or higher attractiveness of ICT careers),
- the impacts of the policy trends
- the impacts of the social trends.

The five global scenarios have been developed linking together possible assumptions about the European economy development model in the short-medium term. The time period considered is from now until the year 2020. The high level of uncertainty due to the economic crisis sometimes makes the adoption of assumptions and the selection of the possible features very uncertain and difficult to draw.

Among the five key factors analysed, the macroeconomic sub-scenarios are particularly important for the forecasts of e-skills demand, based on the assumption that GDP and IT spending growth are the most relevant drivers of e-skills demand. The macroeconomic growth and the IT spending, together with the innovation policy and trends determine in fact the quantity and quality of new products placed on the market, the pervasiveness of the IT in the user industry and therefore the e-skills demanded by both the ICT industry and the user industry.

The main scenarios resulting from this process are named as follows:

1. Two speed Europe: this is probably the most controversial scenario but also the most likely one. It is based on the assumption that individual countries will face the evolution of the crisis in very different ways and that different options are nowadays possible. What is sure is that a Federal approach will be weak. Within this scenario, there will be two groups of

countries: the first one with a good recovery and increasing IT spending trends; the second one with a low capacity of innovation and different possible strategies to face the very slow recovery from the crisis.

2. Struggling on: a slow return to historical trajectory accompanied by a moderate innovation policy and IT spending.
3. Defying the odds: a recovery from the crisis faster than expected will support a positive trend of IT spending. An improved level of confidence for both businesses and consumers will support a fast diffusion of innovation and a positive trend of the demand of e-skills. In the first forecasting period (2012-2015) the recovery will be moderate and then faster from 2015 onwards.
4. Troubled waters: a very slow and above all uncertain recovery will discourage innovation investments and favour domestic protectionism with low mobility of labour and of other factors of production, which reduces the innovative capacity.
5. Social innovation wins: this global scenario is based on a realistic macro-economic sub-scenario that means a very slow return to historical trajectories but accompanied by a proactive innovation policy. This innovation policy will be activate by a public policy providing more resources addressed to innovation, and especially focused on the ICT development.

The likeliness of the various scenarios may vary: they should be considered as possible futures, which test the range of impacts on the demand-supply of e-skills of the main economic, industry and social factors affecting the e-skills market. Certainly the "extreme" scenarios (Social Innovation Wins and Troubled Waters) appear less likely than the other moderate scenarios, but some of their components are more than likely. Moreover, it is very important to note that within a very uncertain context, there are not scenarios definitely more likely than others. Conversely, the "intermediate" scenario such as the Two Speed Europe and the Struggling on appears more likely, although within a very deteriorate context, it means that the economic and innovation system does not have enough reaction capability, which may lead to stagnation and in the long term to very negative trends.

What is really new into this crisis and what makes difficult building future scenarios and forecasts is that the crisis is lasting much longer than expected and much longer than it did in the past. Since forecasts and expectations are, among other things, built on the past trends, it is very difficult to understand how the economic system is going to react and to face this prolonged crisis.

An outcome of the crisis started in mid-2007 shall be that all European countries must balance their public accounts and keep public debt under strict control; nevertheless individual countries have widely different abilities and strategies to achieve this goal. A number of countries do not have severe budget constraints and others do. Moreover, among those having budget constraints there are more or less vulnerable countries. In such a scenario, the EU is managing the economic policy but the strategies adopted by the individual countries are neither always similar nor converging. The following global scenarios will depend, among other things, on the level of convergence of the strategies adopted by the different countries to overcome the crisis.

The features of the scenarios and the impacts on demand-supply of e-skills are based on our analysis and on the results of the expert survey (see Annex). Also, the expert survey helped in selecting the most relevant and likely qualitative and quantitative trends of the years to come.

GLOBAL SCENARIOS 2012-2020

Global scenario	Economic growth	Innovation	Education / labour	Social trends	Policy trends
STRUGGLING ON	Realistic economic growth	Moderate Innovation Growth	Labour mobility/private funding	Eventually big brother	Endless negotiation
SOCIAL INNOVATION WINS	Realistic economic growth	High way to innovation	Labour mobility/private funding	Every body needs somebody	Federal Europe
DEFYING THE ODDS	High Economic Growth	High way to Innovation	Meeting the training challenge	Eventually big brothers	Federal Europe
TROUBLED WATERS	Pessimistic economic growth	Reduced expectations	Supply Gap of e-skills	Extreme fragmentation	Nationalism return
TWO SPEED EUROPE	Pessimistic economic growth	Moderate innovation growth	Labour mobility / private funding	Extreme fragmentation	Nationalism return

Each scenario is subsequently described, with the synthetic presentation of the main impacts.

10.2 Two speed Europe

Scenario

In this scenario, the current crisis is going to impact in a very different way in the different European countries. Some countries will recover before 2015; others will experience a very pessimistic macroeconomic scenario.

This does not necessarily mean an official breakdown of the Euro zone, but a continuing divergence between north and south Europe growth rates. On the overall, the balance between this divergence and the consequently difficult governance of Europe will provide a macroeconomic pessimistic scenario and the partial failure of EU policies addressed to recovery and structural reforms.

A number of countries, especially those with competitive industries and with balanced public accounts, will recover fast and will show strong business and consumer confidence so that IT investments may increase. In these countries, a high diffusion of innovation will be addressed both to savings and to introduction of new products.

In southern Europe and countries with high budget constraints and very slow recovery, innovation will not be a priority of the enterprises, except where it will be addressed to achieve savings.

An outcome of the crisis started in mid-2007, in fact, shall be that all European countries must balance their public accounts and keep public debt under strict control; nevertheless individual countries have widely different abilities to achieve this goal.

Therefore, whereas governments in some countries shall be able to devote to innovation and ICT investments all the resources required by political will, other countries shall have to make difficult choices.

Within this second group of countries, some will forgo public investment and current expenditure in innovative activities in order to defend current levels of traditional service provision and of public employment. Other countries might be willing (or forced) to do the opposite, especially for cost saving innovation. In sum, for countries' strict budget constraints, three alternative strategies can be envisaged:

1. **A conservative strategy**: this strategy defends the service provision and public employment as is. This strategy minimises investments in IT infrastructures and new technologies and consequently will lead to an increase in the international digital divide;
2. **A cost saving strategy**: this strategy is addressed to investments able to produce savings and to increase productivity. As a consequence, it leads to a short-term reduction in the digital divide which however may not last in the long run (this seems for example to be the option currently adopted by the Italian government);
3. **A growth inducing strategy**: the strategy is oriented to all investments able to induce economic growth. This will ensure a long run reduction in the international digital divide which however may take time to materialize.

Which of these strategies will be pursued shall depend on the national (and regional) political will. It is also clear that the fate of the labour market and the education system will very much depend on which of the above strategies will be pursued by most of the countries that currently have to balance their public accounts.

In the Two Speed Europe scenario we make two important assumptions. The first assumption is that most of the countries having budget constraints will adopt a conservative or a cost saving strategy. The second assumption is that the EU will partially fail in the governance of the economic crisis so that the vulnerable countries will only be slightly supported by EU policy and infrastructures and by competitive countries.

Besides, the countries with low budget constraints will only slightly support the countries with strong budget constraints so that they will be able to recover as already said by 2015, so that this group of countries will show macroeconomic and IT optimistic trends.

Impacts

This two speed economy will produce a labour market characterised by a high level of labour mobility at least within the European area. Northern Europe will probably absorb part of the workers of Southern Europe, while Southern Europe may be affected by a risk of brain drain. The labour single market may be very useful in such a situation, since it may help compensating local mismatch of demand-supply of e-skills.

As explained, it is currently difficult to know what strategies the single countries are going to adopt and, as a consequence, it is difficult to foresee the impacts of such a scenario. Nevertheless, we can say that on the overall, the European area will be characterized by a moderate innovation dynamic, driven by large companies. Innovation diffusion will be fast in Northern Europe and in countries with low budget constraints and it will be very patchwork in the rest of Europe.

Northern Europe will experience steady competitive levels of its industry, while countries with high budget constraints will lose competitiveness and productivity. The gap between vulnerable countries and the other countries will widen so that it will be more and more difficult to establish and agree within EU common policy objectives and agenda especially where innovation and investments are required. The will be clearly Digital Agenda disregard.

Forecasts

E-skills demand will on the overall stand on a medium/low level. Countries with low budget constraints will show a high demand of e-skills demand, especially for management skills. In the

vulnerable countries it will very much depend on which strategy they will adopt. In any case e- skills demand will be at medium/low levels in the countries with high budget constraints. Because of this high uncertainty level, internal mobility of workers will compensate the mismatch of demand and supply.

Practitioner skills will experience positive although smooth trends in the European competitive countries while in the vulnerable countries they are going to experience decreasing trends.

10.3 Struggling on

Scenario

This scenario is based on the assumption of a very slow return to historical trajectory of the GDP growth experienced before the crisis. What is nowadays definitely getting clear is that the return to the past trends may not be as easy as we thought just a few months ago and for sure it will take more time than it took after the crisis of the last 20 years. This is due on one side to the length of the crisis and on the other on the fact that the crisis has been particularly dramatic in some countries.

The macroeconomic scenario foresees that after a difficult 2012, the EU27 economy will start recovering with definitely slow recovery rates until 2015 (lower than before the crisis) and with more positive growth, although smooth, from 2015 to 2020.

In this scenario the ICT will play a relevant role in the economic recovery since ICTs are an important tool for cost savings. The ICTs investments will therefore mainly be addressed to cost savings and to achieve productivity gains. As a consequence the investments achieved by the private industry will be mainly short to medium term investments. The investments achieved by the public sector will also be addressed to cost savings and rationalization of the public spending. Where possible, some countries may address investments to infrastructures in order to reduce the digital divide.

After a difficult time period (2011 -2012), IT spending will progress at a moderate pace throughout the forecast period. The IT spending will grow faster than GDP, with a gradual evolution of the IT spending; from 2015 to 2020 the IT spending growth will attend the 2007-2008 trend.

In the short term, all vertical markets will feel the pressure of the strong uncertainty in the economy and the concerns over the sovereign risk in some EU countries. However some verticals are more impacted (government, finance, automotive, air transport), others are more resilient (utilities, telecom). In the longer term, the moderate economic recovery will accelerate investments across all vertical markets, in particular those which have already a good IT sophistication (utilities, finance, telecom, large companies in manufacturing and distribution). With strong focus on cutting inefficiencies, centralizing procurement and reducing costs, growth in the government sector (especially central government) will remain subdued along the forecast period.

Within such a scenario there will be different IT spending growth and innovation diffusion by countries. As a consequence, e-skills demand will show different trends in the different countries. The attractiveness of the ICT careers will be steady and it may also slowdown since there is no room for significant wages' increase. Moreover, some of the Member States that are going through a severe economic crisis are also countries with a weak ICT industry and historically not supporting higher education in the ICTs. Because of the prolonged crisis there is a concrete risk that the EU governments will only recognize a low medium level of priority to research and innovation policies and to education development. There will be an increase of digital natives entering the labour market without ICT graduation, especially in the countries with low ICT education. As a consequence there will be an increasing need for lifelong learning and for training on the job. Nevertheless, because of the economic crisis, the industry training budgets will not go back to the pre-crisis level.

Impacts

During the first forecasting period (2012-2015), the demand for e-skills will slowdown because of the economic and IT trends. During this time period, digital natives without graduation will enter the labour market as ICT practitioners, taking advantage of the crisis. The young digital natives will in fact compete with the young graduates by working for lower wages.

The demand for Management skills will experience positive growth rate during the overall forecasting period. In fact IT investments will mainly be addressed to cost savings and productivity gains, which will require some re-organization of the production processes both in industry and in services sectors.

During the second forecasting period replacement cycles of infrastructures and the emergence of the cloud computing will increase the demand of both management skills and practitioners.

The EU will face a moderate decline of ICT graduates due to the low level of the careers' attractiveness. The low level of the industry training budgets will limit the professional growth of digital natives who entered the labour market some years before.

Forecasts

All in all, the demand of e-skills will remain at a medium level during the complete forecasting period, driven in the long term by the demand of management skills.

The demand for ICT practitioners will increase with a smooth trend.

10.4 Defying the odds

Scenario

The second scenario, 'Defying the Odds', is based on the assumption of a recovery from the crisis faster than it was in the previous scenario. This scenario is based on the assumption that most of the EU countries will face in 2013 a noticeable economic recovery because of an improvement of the sovereign debt crisis and because the policy actions taken against the crisis will quickly become effective. GDP growth strengthens along the forecast period. It is an optimistic scenario and it shows a positive deviation from growth rates of the realistic scenario. Nevertheless, the growth does no rapidly become higher than it was before the crisis. This is due to the shared opinion that a full recovery will definitely take a long time period.

After such a long and severe economic crisis, the economic recovery will lead strong business and consumer confidence, creating a favourable environment for IT investments. The effects of the economic recovery on the ICT dynamics will start since 2014 but will become evident in the second forecasting period, from 2015 onwards.

ICT investments will aim at productivity gains so that the EU economy could compete at global level.

Cloud computing, mobility and Web 2.0 will become integral part of EU companies' strategies. Internet economy and Internet of things is possibly going to modify production processes and increase services contribution to the economic systems. The public sector concentrates resources on research and development and on new services addressed to rationalise the public spending and to improve the quality of services delivered.

IT spending growth strengthens across all vertical markets, including those verticals with a strong penetration of SMEs (such as business services, distribution, manufacturing and construction).

Such a recovery will help the education system capacity to change making ICT courses more attractive for young people in a long time perspective. ICT graduates will nearly remain stable, stopping the decreasing trend of ICT graduates. At the same time, enterprises will need for a

trained and up-to-date labour force, so that industry will come back to the pre-crisis training budgets. The increase of "digital natives" entering the labour market will help the training on the job of "dual thinkers".

The fast recovery will contribute avoiding the sovereignty risk and will consolidate the project and perspectives of a Federal Europe. The EU will carry on strong governance and will achieve the Digital Agenda and the digital single market. In such a context, implementation of collaborative policies between EU institutions, MS governments, business and Academia will take place in order to address the most urgent e-skills gaps.

The Internet will be divided between commercial domination of the multinationals and of governments. Social networks will assume an increasingly commercial flavour and there will also be an increasing use of the Internet for mass democracy and participation.

Impacts

The positive economic trend emerging since 2013 and the increasing level of innovation inherent in this scenario addressed to both savings and to new products will bring adoption of innovation in both large companies and SMEs. Cloud computing, mobile devices and apps and the social technologies will require re-organisation and innovation in relationships with suppliers and with customers as well as into internal business processes. As a consequence, management skills will be a relevant component of the overall demand of e-skills. The demand for practitioners will be smoother.

The ICT graduates will remain stable. Beside the ICT graduates, the digital natives without graduation may enter the labour market because of the increasing demand. The latter will take advantage from the positive innovation climate and from the training supplied by the enterprises. At the end of the first forecasting period the training budgets of the enterprises will increase and get slowly back to the pre-crisis level.

Because of the spread of ICT innovation in all the vertical markets, the demand for management skills will combine e-skills and other industry-specific skills. Such combination is not currently delivered by the formal education so that the training on the job will be very important for the management skills as well as for the practitioners.

Such a combination of skills will favour the spread of innovation in vertical industries where ICT in not an intensive production factor and could revitalise the innovation and productivity of traditional sectors or of low ICT intensive industries.

Forecasts

The e-skills' demand trend will be positive in the long term (2012-2020) with a CAGR over 3%. The leadership skills will definitely drive this growth (average annual growth almost 6%) while the practitioner skills demand trend will be positive but with an average annual growth below 2%.

10.5 Troubled waters

Scenario

The third global scenario is named 'Troubled Waters' and is based on pessimistic macroeconomic trends. Such trends could be the result of the failure of the vulnerable countries in undertaking a correction process of their imbalances and in undergoing an adjustment process with structural reforms. In this scenario the recovery from the economic crisis fails to take off: the EU will not recover from the crisis within the forecasting period. 2013 GDP growth is limited to some 0.5%; growth strengthens in the following years, but remains definitely below the levels of the Struggling on scenario. Nevertheless, this pessimistic scenario doesn't foresee a collapse of the Euro.

As a consequence, companies postpone investments in IT projects and focus on maintenance/ optimization of the existing IT infrastructure. IT investments remain subdued. Innovation and replacement of devices, infrastructures and IT systems are far away from being a priority of the European industry. Despite outpacing the rest of the market, investments in smart devices will also be affected by declining business and consumer confidence.

The uncertain economic environment will slow down the major transformation process the software industry is undertaking. Despite growing much higher than average and being somewhat "anticyclical", adoption of public cloud services will also slow down. Large IT projects are postponed with a negative demand for IT services. Length of contracts is reduced, so are fees.

Companies with less than 250 employees are strongly impacted across the forecast period. Issues around liquidity and access to credit keep on affecting SMEs' IT demand. The short-term tactical approach of most SMEs limits also their ability to innovate the products and services they offer and/or leverage in their business operations. Only large enterprises may start investments; nevertheless, they will only start limited and short-term investments.

All vertical industries are impacted by the prolonged downturn in the economy. The government sector needs to cut further public expenditure. This will negatively impact IT spending as well, which will be therefore weaker than in the realistic scenario (where we already predict small growth). Cuts in public expenditure have a similar negative impact on education and healthcare. Utilities keep on growing above average but there is a delay in the implementation of smart meters' projects in some countries. The launch of smart services that could be enabled through smart grids is also delayed.

The EU industry and services sectors will suffer from permanent declines in non-price competitiveness in both high tech and traditional sectors. Consequently, productivity of the European productivity will continue slowing down. Such a negative trend in economics and in IT investments will consolidate the decrease in ICT graduates. The education system will fail in the long term in making ICT courses and careers more attractive, which will provide less management skills to the labour market. In the meanwhile, companies will not get back to the pre-crisis training budgets and training projects will be pushed back by most of the enterprises. Enterprises will count on “digital natives”, who may have some basic IT practitioner skills, but there will be a shortage of management skills. Demographic trends will definitely increase the demand of life-long-learning and e-learning but, because of the decrease of training budgets, private funding will not compensate the insufficiency of public education.

This lack of recovery from the crisis will weaken the European and federal governance, so that innovation and growth policy will be mainly driven at national levels; the coordination among nations will require relevant efforts. Most of the countries’ policy agenda will need to focus on socio-economic issues due to anaemic labour markets. Innovation as well as the development and implementation of the Digital Agenda will be postpone, which makes it difficult to start a virtuous circle.

Impacts

Innovation adoption both in private and public sectors will be addressed to reduce costs and only when unavoidable. Technology delivery models will be characterised by a patchwork adoption while all the other technology investments (mobility, Internet economy, big data) will have very low priority. Most of the efforts will be addressed to the delivery of basic services and traditional products.

Such a negative trend in economics and IT investments will consolidate the decrease in ICT graduates. The education system will fail in the long term in making ICT courses and careers more attractive, which will provide less management skills to the labour market. In the meanwhile, companies will not get back to the pre-crisis training budgets and training projects will be pushed

back by most of the enterprises. Enterprises will count on "digital natives", who may have some basic IT practitioner skills, but there will be a shortage of management skills. The shortage of the management skills may be supplied by foreigners professional from countries with low wages. Demographic trends will definitely increase the demand of life-long-learning and e-learning but, because of the decrease of training budgets, private funding will not compensate the insufficiency of public education. All in all, EU will experience an impoverishment of the professional skills.

The impact on the skills demand will show a decrease of the core skills demand while the leadership skills will be characterised by a medium/low demand accompanied by a shortage of such skills.

Forecasts

The demand for e-skills will experience a decreasing trend for at least all the first forecasting period and probably until 2017, while in the following years the trend will be positive and nearly flat. The demand for ICT practitioners will decrease all over the period while management skills will smoothly increase.

10.6 Social innovation wins

Scenario

The last scenario, 'Social Innovation Win' is based on the assumption of a realistic GDP growth after the crisis and on an optimistic IT spending policy. This is mainly based on the idea that most of the European governments, supported by the EU, will adopt a growth inducing policy where the ICTs will play a relevant role. All the European countries, supported by the EU, will orient their efforts to investments able to induce the growth thanks. The countries with severe budget constraints will at least adopt a cost saving strategy and will start with growth strategy as soon as this will be possible.

After a difficult 2012, the economy starts recovering, with definitely slow recovery rates until 2015 (lower than before the crisis) and with more positive growth expected from 2015 to 2020. In the meanwhile, the majority of the European governments adopt an optimistic innovation policy with high propensity to invest in the ICT (investment/GDP). Most of the countries show a strong political will addressed to fast recover from the crisis. This is, among other things, based on a proactive ICT policy. This will lead to an increase in ICT investments addressed to telecommunication infrastructures and to fast diffusion of the new ITs.

The EU growth will be driven by the most competitive countries, although the countries with budget constraints will follow closely.

ICT innovation will accelerate after 2015: widespread benefits and impacts of such an innovation policy will be expected after 2015 even if some countries and the most advanced enterprises will start reaping efficiency benefits before that. The digital divide among countries and between the Northern and Southern countries will decrease, from 2015 to 2020. At the same time, the diffusion of ICT innovations in the user industry will be fast.

Innovation, in both ICT industry and user industry, will be addressed at first to achieve relevant cost savings and to permanent gain of productivity and competitiveness at global level. In a second phase, innovation will be addressed to the introduction of new products and services supported by careful strategies focusing on developing competitive advantages and leadership in specific industries or technologies.

This innovation policy will need strong coordination and governance at European level. This will consolidate the Federal Europe and the achievement of the current Digital Agenda. The ICTs innovation will spread in the vertical industries lead to important waves of cost savings and innovation in all industries.

The growth inducing strategy will accelerate the recovery and EU economy will return to pre-crisis levels of growth. The relevant result of such a scenario is that the innovation policy will provide to Europe permanent productivity gain and the decrease of structural gaps with the most innovative economies at international level. Inside the EU as well, the digital divide among regions will be reduced.

Impacts

The fast innovation policy and the acceleration of innovations after 2015 will increase the demand for e-skills, for both leadership skills and core skills. The mismatch of demand-supply of e-skills will be met through internal movement within the European Union. After 2015, the entry of non European workers may be necessary.

Bearing in mind that the effects of an education policy takes time to show its effects, private funding for training will be necessary to balance e-skills demand in the short term. In the meanwhile, the attractiveness of the ICT careers will improve and EU will need to start new policy education campaign.

Enterprises will have to come back to pre-crisis levels of training budgets.

Forecasts

The demand for e-skills will experience a positive trend initially driven by the most competitive countries.

The demand for management skills will be very relevant since such the strong innovation policy will start with investments addressed to cost savings. During the second forecasting period the practitioner skills will increase as well thanks to the widespread diffusion of innovation.

11 Annex 3: Definitions, statistics and survey questionnaire details

Author: Tobias Hüsing, empirica GmbH

Mapping of ISCO-08, e-CF, ICT profiles

ICT Profile titles A-Z **e-Competences**	Enterprise Architect	ICT Consultant	Systems Architect	Business Analyst	Business Information Manager	Chief Information Officer	Project Manager	ICT Security Manager	ICT Operations Manager	Quality Assurance Manager	Test Specialist	Digital Media Specialist	Developer	Network Specialist	Systems Administrator	Database Administrator	Systems Analyst	Technical Specialist	Service Manager	ICT Security Specialist	ICT Trainer	Service Desk Agent
A.1 IS and Business Strategy alignment	4.5			4	4	5																
A.2 Service Level Management																			4			
A.3 Business Plan Development	3.5	4		4	4	5																
A.4 Product or Project Planning		3					4															
A.5 Architecture Design	4		4														3					
A.6 Application design												2				1						
A.7 Technology Watching	5	5	4.5					4														
B.1 Design and development			4.5								3.5	3	3	2.5		3	3.5					
B.2 System integration			4								2.5		2	2.5	2	2.5						
B.3 Testing											2.5	2	2		2							
B.4 Solution Deployment											3	3		2.5	2							
B.5 Documentation Production												3	3									
C.1 User support															2.5							2
C.2 Change Support																		3		3		
C.3 Service delivery																		2	3	3		1

ICT Profile titles A-Z	Enterprise Architect	ICT Consultant	Systems Architect	Business Analyst	Business Information Manager	Chief Information Officer	Project Manager	ICT Security Manager	ICT Operations Manager	Quality Assurance Manager	Test Specialist	Digital Media Specialist	Developer	Network Specialist	Systems Administrator	Database Administrator	Systems Analyst	Technical Specialist	Service Manager	ICT Security Specialist	ICT Trainer	Service Desk Agent
C.4 Problem management											2.5		3	2.5	2.5	3		3	4			2
D.1 Information Security Strategy Development								5														
D.2 ICT quality strategy development										4.5												
D.3 Education and Training Provision																					2.5	
D.8 Contract Management																			4			
D.9 Personnel Development									4										3	3	2	
D.10 Information and Knowledge Management					5											3				3		
E.2 Project and portfolio management					4	5	4															
E.3 Risk management		3					3	3	3	3												
E.4 Relationship Management						4	3															
E.5 Process improvement				4						3							3.5					
E.6 ICT quality management									3	4												
E.7 Business Change Management	4.5	4.5			4		3		4													
E.8 Information Security Management								4	3					2	2					3.5		
E.9 IT Governance						5		4														
PLAN	17	12	8.5	8	8	10	4	4	0	0	0	2	0	0	0	1	3	0	4	0	0	0
BUILD	0	0	8.5	0	0	0	0	0	0	0	11.5	11	10	7.5	6	5.5	3.5	0	0	0	0	0
RUN	0	0	0	0	0	0	0	0	0	0	2.5	0	3	2.5	5	3	0	8	7	6	0	5

ICT Profile titles A-Z	Enterprise Architect	ICT Consultant	Systems Architect	Business Analyst	Business Information Manager	Chief Information Officer	Project Manager	ICT Security Manager	ICT Operations Manager	Quality Assurance Manager	Test Specialist	Digital Media Specialist	Developer	Network Specialist	Systems Administrator	Database Administrator	Systems Analyst	Technical Specialist	Service Manager	ICT Security Specialist	ICT Trainer	Service Desk Agent
ENABLE	0	0	0	0	5	0	0	5	4	4,5	0	0	0	0	0	3	0	0	7	6	4,5	0
MANAGE	4,5	7,5	0	4	8	14	13	11	13	10	0	0	0	2	2	0	3,5	0	0	3,5	0	0
ISCO-08																						
1330 - Information and communications technology service managers	x		x		x	x	x	x	x	x									(x)			
2511 - Systems analysts	x		x	x							x						(x)					
2421 - Management and organization analysts		x		x																		
2512 - Software developers											x		x									
2513 - Web and multimedia developers											x	x										
2514 - Applications programmers											x		x									
2519 - Software and applications developers and analysts not elsewhere classified											x		x									
2521 - Database designers and administrators			x													x						
2522 - Systems administrators															x							
2523 - Computer network professionals														x								
2529 - Database and network professionals not elsewhere classified																				x		
3511 - Information and communications technology operations technicians																		x				
3512 - Information and communications technology user support technicians																						x
3513 - Computer network and systems technicians														x								

ICT Profile titles A-Z	Enterprise Architect	ICT Consultant	Systems Architect	Business Analyst	Business Information Manager	Chief Information Officer	Project Manager	ICT Security Manager	ICT Operations Manager	Quality Assurance Manager	Test Specialist	Digital Media Specialist	Developer	Network Specialist	Systems Administrator	Database Administrator	Systems Analyst	Technical Specialist	Service Manager	ICT Security Specialist	ICT Trainer	Service Desk Agent
3514 - Web technicians												**x**						**x**				
2152 - Electronics engineers																						
2153 - Telecommunications engineers																						
2356 - Information technology trainers																					x	
3114 - Electronics engineering technicians																		x				
3139 - Process control technicians not elsewhere classified																		x				
3155 - Air traffic safety electronics technicians																		x				
3211 - Medical imaging and therapeutic equipment technicians												x						x				
3252 - Medical records and health information technicians												x										
3521 - Broadcasting and audio-visual technicians												x										
3522 - Telecommunications engineering technicians																		x				
7421 - Electronics mechanics and servicers																						
7422 - Information and communications technology installers and servicers																						
8212 - Electrical and electronic equipment assemblers																						

Sector definitions

Survey sector definitions
1. Manufacturing, mining, utilities
2. Construction
3. Retail & Wholesale
4. Transport logistics, publishing and broadcasting
5. Financial industry
6. ICT including telecommunication
7. Public sector
8. Other Services such as hotel and restaurant, real estate, business services and social services industries

	NACE1.1	Survey Sector			NACE 2	Survey Sector
Code	Description			Code		
0		9		0		9
1	Agriculture, hunting and related service activities	9		1	Crop and animal production, hunting and related service activities	9
2	Forestry, logging and related service activities	9		2	Forestry and logging	9
5	Fishing, fish farming and related service activities	9		3	Fishing and aquaculture	9
10	Mining of coal and lignite; extraction of peat	1		5	Mining of coal and lignite	1
11	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying	1		6	Extraction of crude petroleum and natural gas	1
12	Mining of uranium and thorium ores	1		7	Mining of metal ores	1
13	Mining of metal ores	1		8	Other mining and quarrying	1
14	Other mining and quarrying	1		9	Mining support service activities	1
15	Manufacture of food products and beverages	1		10	Manufacture of food products	1
16	Manufacture of tobacco products	1		11	Manufacture of beverages	1
17	Manufacture of textiles	1		12	Manufacture of tobacco products	1
18	Manufacture of wearing apparel; dressing and dyeing of fur	1		13	Manufacture of textiles	1
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	1		14	Manufacture of wearing apparel	1
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	1		15	Manufacture of leather and related products	1
21	Manufacture of pulp, paper and paper products	1		16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	1

	NACE1.1	Survey Sector			NACE 2	Survey Sector
Code	**Description**			**Code**		
22	Publishing, printing and reproduction of recorded media	1		17	Manufacture of paper and paper products	1
23	Manufacture of coke, refined petroleum products and nuclear fuel	1		18	Printing and reproduction of recorded media	1
24	Manufacture of chemicals and chemical products	1		19	Manufacture of coke and refined petroleum products	1
25	Manufacture of rubber and plastic products	1		20	Manufacture of chemicals and chemical products	1
26	Manufacture of other non-metallic mineral products	1		21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	1
27	Manufacture of basic metals	1		22	Manufacture of rubber and plastic products	1
28	Manufacture of fabricated metal products, except machinery and equipment	1		23	Manufacture of other non-metallic mineral products	1
29	Manufacture of machinery and equipment n.e.c.	1		24	Manufacture of basic metals	1
30	Manufacture of office machinery and computers	6		25	Manufacture of fabricated metal products, except machinery and equipment	1
31	Manufacture of electrical machinery and apparatus n.e.c.	1		26	Manufacture of computer, electronic and optical products	6
32	Manufacture of radio, television and communication equipment and apparatus	1		27	Manufacture of electrical equipment	1
33	Manufacture of medical, precision and optical instruments, watches and clocks	1		28	Manufacture of machinery and equipment n.e.c.	1
34	Manufacture of motor vehicles, trailers and semi-trailers	1		29	Manufacture of motor vehicles, trailers and semi-trailers	1
35	Manufacture of other transport equipment	1		30	Manufacture of other transport equipment	1
36	Manufacture of furniture; manufacturing n.e.c.	1		31	Manufacture of furniture	1
37	Recycling	1		32	Other manufacturing	1
40	Electricity, gas, steam and hot water supply	1		33	Repair and installation of machinery and equipment	1
41	Collection, purification and distribution of water	1		35	Electricity, gas, steam and air conditioning supply	1
45	Construction	2		36	Water collection, treatment and supply	1
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	3		37	Sewerage	1
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	3		38	Waste collection, treatment and disposal activities; materials recovery	1

	NACE1.1	Survey Sector			NACE 2	Survey Sector
Code	**Description**			**Code**		
52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	3		39	Remediation activities and other waste management services	1
55	Hotels and restaurants	8		41	Construction of buildings	2
60	Land transport; transport via pipelines	4		42	Civil engineering	2
61	Water transport	4		43	Specialised construction activities	2
62	Air transport	4		45	Wholesale and retail trade and repair of motor vehicles and motorcycles	3
63	Supporting and auxiliary transport activities; activities of travel agencies	4		46	Wholesale trade, except of motor vehicles and motorcycles	3
64	Post and telecommunications	6		47	Retail trade, except of motor vehicles and motorcycles	3
65	Financial intermediation, except insurance and pension funding	5		49	Land transport and transport via pipelines	4
66	Insurance and pension funding, except compulsory social security	5		50	Water transport	4
67	Activities auxiliary to financial intermediation	5		51	Air transport	4
70	Real estate activities	8		52	Warehousing and support activities for transportation	4
71	Renting of machinery and equipment without operator and of personal and household goods	8		53	Postal and courier activities	4
72	Computer and related activities	6		55	Accommodation	8
73	Research and development	8		56	Food and beverage service activities	8
74	Other business activities	8		58	Publishing activities	4
75	Public administration and defence; compulsory social security	7		59	Motion picture, video and television programme production, sound recording and music publishing activities	4
80	Education	7		60	Programming and broadcasting activities	4
85	Health and social work	7		61	Telecommunications	6
90	Sewage and refuse disposal, sanitation and similar activities	1		62	Computer programming, consultancy and related activities	6
91	Activities of membership organizations n.e.c.	8		63	Information service activities	6
92	Recreational, cultural and sporting activities	8		64	Financial service activities, except insurance and pension funding	5
93	Other service activities	8		65	Insurance, reinsurance and pension funding, except compulsory social security	5
95	Activities of households as employers of domestic staff	8		66	Activities auxiliary to financial services and insurance activities	5
96	Undifferentiated goods producing	9		68	Real estate activities	8

	NACE1.1	Survey Sector			NACE 2	Survey Sector
Code	**Description**			**Code**		
	activities of private households for own use					
97	Undifferentiated services producing activities of private households for own use	9		69	Legal and accounting activities	8
99	Extra-territorial organizations and bodies	7		70	Activities of head offices; management consultancy activities	8
				71	Architectural and engineering activities; technical testing and analysis	8
				72	Scientific research and development	8
				73	Advertising and market research	8
				74	Other professional, scientific and technical activities	8
				75	Veterinary activities	8
				77	Rental and leasing activities	8
				78	Employment activities	8
				79	Travel agency, tour operator and other reservation service and related activities	8
				80	Security and investigation activities	8
				81	Services to buildings and landscape activities	8
				82	Office administrative, office support and other business support activities	8
				84	Public administration and defence; compulsory social security	7
				85	Education	7
				86	Human health activities	7
				87	Residential care activities	7
				88	Social work activities without accommodation	7
				90	Creative, arts and entertainment activities	8
				91	Libraries, archives, museums and other cultural activities	7
				92	Gambling and betting activities	8
				93	Sports activities and amusement and recreation activities	8
				94	Activities of membership organisations	8
				95	Repair of computers and personal and household goods	1
				96	Other personal service activities	8

	NACE1.1	Survey Sector			NACE 2	Survey Sector
Code	**Description**			**Code**		
				97	Activities of households as employers of domestic personnel	8
				98	Undifferentiated goods- and services-producing activities of private households for own use	9
				99	Activities of extraterritorial organisations and bodies	7

Vacancies calculations

We interviewed 2408 ICT employing firms in eight countries: DE, FR, ES, IT, PL, RO, SE, UK.

SMEs are 10-249 employees, LEs 250+. We excluded micro enterprises.

The screening question was:

How many ICT professionals are employed by your enterprise?

On answer "0" the interview was abandoned. The answers were recorded however to calculate the incidence rates.

The question on vacancies was (the time of the interviews being May/June 2012):

Do you currently or persistently have any vacancies for ICT professionals? By this we mean whether you would shortly hire any ICT professionals given the appropriate candidates applied.

PROMPT: at common wage levels and given common skills and qualification levels within their certified credentials

If yes:

How many vacancies do you have for professionals in the following domains

PROMPT: in Full Time Equivalents

Management, such as CIO, ICT operations managers, project managers etc.
Planning and Strategy, such as enterprise architects, systems analysts, and ICT consultants
Design, development, and integration
... such as software, web and multimedia developers and test specialists
… such as database designers and administrators
… such as hardware and network specialists and systems administrators
… such as security specialists
Office user support
Service delivery and operation, such as operations, control or equipment technicians etc.
Any other ICT professionals

Let me just check, this means that your organisation has [SUM] vacancies for ICT practitioners. Is this about right? [Correct replies to items if needed]

These are mapped onto the ISCO-08 codes and CEN WS ICT profiles respectively as follows:

ISCO-08	CEN WS ICT-Profiles	Questionnaire items
1330 - Information and communications technology service managers	Business Information Manager Chief Information Officer Project Manager ICT Security Manager ICT Operations Manager Quality Assurance Manager Service Manager	**Management, such as CIO, ICT operations managers, project managers etc.**
2511 - Systems analysts	Enterprise Architect Systems Architect Business Analyst Systems Analyst	**Planning and Strategy, such as enterprise architects, systems analysts, and ICT consultants**
2421 - Management and organization analysts	ICT Consultant	
2512 - Software developers	Test Specialist Developer	**Design, development, and integration ... such as software, web and multimedia developers and test specialists**
2513 - Web and multimedia developers	Digital Media Specialist	
2514 - Applications programmers	Developer?	
2519 - Software and applications developers and analysts not elsewhere classified	Developer?	
2521 - Database designers and	Database Administrator	**Design, development, and integration… such as database designers and**

administrators		**administrators**
2522 - Systems administrators	Systems Administrator	**Design, development, and integration… such as hardware and network specialists and systems Administrators**
2523 - Computer network professionals	Network Specialist	**Design, development, and integration… such as hardware and network specialists and systems Administrators**
2529 - Database and network professionals not elsewhere classified	ICT Security Specialist	**Design, development, and integration … such as security specialists**
3511 - Information and communications technology operations technicians	Technical Specialist	**Service delivery and operation, such as operations, control or equipment technicians etc.**
3512 - Information and communications technology user support technicians	Service Desk Agent	**Office user support**
3513 - Computer network and systems technicians	Technical Specialist?	**Service delivery and operation, such as operations, control or equipment technicians etc.**
3514 - Web technicians	Technical Specialist?	**Service delivery and operation, such as operations, control or equipment technicians etc.**
2152 - Electronics engineers	?	**Any other ICT professionals**
2153 - Telecommunications engineers	?	**Any other ICT professionals**
2356 - Information technology trainers	ICT Trainer	**Any other ICT professionals**
2434 - Information and communications technology sales professionals	Account Manager	**Any other ICT professionals**
3114 - Electronics engineering technicians	Technical Specialist?	**Service delivery and operation, such as operations, control or equipment technicians etc.**
3139 - Process control technicians not elsewhere classified	Technical Specialist?	**Service delivery and operation, such as operations, control or equipment technicians etc.**
3155 - Air traffic safety electronics technicians	Technical Specialist?	**Service delivery and operation, such as operations, control or equipment technicians etc.**
3211 - Medical imaging and therapeutic equipment technicians	Technical Specialist?	**Service delivery and operation, such as operations, control or equipment technicians etc.**

3252 - Medical records and health information technicians	Technical Specialist?	**Service delivery and operation, such as operations, control or equipment technicians etc.**
3521 - Broadcasting and audio-visual technicians	Technical Specialist?	**Service delivery and operation, such as operations, control or equipment technicians etc.**
3522 - Telecommunications engineering technicians	Technical Specialist?	**Service delivery and operation, such as operations, control or equipment technicians etc.**

There is of course some uncertainty in this mapping and so at what breakdown this allows us to publish data is not yet decided.

Weighting was applied by ICT employment, where we had cells for industries (the 9 sectors as described above) crossed with SMEs and Large Enterprises per country. We have a 2008 sectoral distribution of ICT employment from Eurostat and 2011 totals (but no distribution) per the ISCO-08 codes as above. So, we applied the 2008 distribution proportionally to the 2011 total. We merged sectors down to 5, becausse of the limited number of interviews, which gave us more cases to each cell.

For survey results, we calculated per cell (country/sector/size class) average ICT staff and vacancies. These quota were applied to the known distribution of ICT staff (which is of course also an estimation based on 2008 and 2011 figures as described).

Other actors in the field, such as e-Skills UK, use definitions of ICT jobs which include all workers in the ICT industry. This is not the approach we follow; we have a strictly functional and not sectoral definition of ICT jobs. This may explain a narrower figure base, and thus fewer vacancies.

Definition of management and business architecture, core, broad and very broad ICT skills in terms of ISCO-08

ISCO-08		Management and Business Architecture level skills	Core ICT practitioners	Other ICT technicians	ICT mechanics and manual
1330	Information and communications technology service managers	1			
2421	Management and organization analysts (ICT: 50%)[60]	1			
2511	Systems analysts	1			
2152	Electronics engineers		1		
2153	Telecommunications engineers		1		
2356	Information technology trainers		1		
2434	Information and communications technology sales professionals		1		
2512	Software developers		1		
2513	Web and multimedia developers		1		
2514	Applications programmers		1		

[60] We had to implement an estimation as to the percentage of consultants (Management and organization analysts) who are predominantly working as ICT consultants. A source for Germany (http://luenendonk-shop.de/out/pictures/0/lue_itb_2011_f300511%281%29_fl.pdf, http://luenendonk-shop.de/out/pictures/0/lue_mb_2011_f300511_fl.pdf) lists at least the employment figures of the IT top 25 and non-IT top 25 consultancies. These are for IT: 47,958, and for Non-IT: 17,367. In these fifty 50 firms thus 65,325 employees work. While the ISCO-08 total for Germany is Management and organization analysts is 190,014. An assumption of 50% thus seems conservative enough to at least not overestimate the number of ICT consultants.

ISCO-08		Management and Business Architecture level skills	Core ICT practitioners	Other ICT technicians	ICT mechanics and manual
2519	Software and applications developers and analysts not elsewhere classified		1		
2521	Database designers and administrators		1		
2522	Systems administrators		1		
2523	Computer network professionals		1		
2529	Database and network professionals not elsewhere classified		1		
3511	Information and communications technology operations technicians		1		
3512	Information and communications technology user support technicians		1		
3513	Computer network and systems technicians		1		
3514	Web technicians		1		
3114	Electronics engineering technicians			1	
3139	Process control technicians not elsewhere classified			1	
3252	Medical records and health information technicians			1	
3155	Air traffic safety electronics technicians			1	
3211	Medical imaging and therapeutic equipment technicians			1	
3521	Broadcasting and audio-visual technicians			1	
3522	Telecommunications engineering technicians			1	
7421	Electronics mechanics and servicers				1
7422	Information and communications technology installers and servicers				1
8212	Electrical and electronic equipment assemblers				1

Source: empirica, 2012

Definition and questionnaire wording used by empirica to allocate reported vacancies to skills categories

	Total	**Management and Business Architecture level skills**	**Core ICT practitioners & Other ICT technicians**
Q3a Management, such as CIO, ICT operations managers, project managers etc.	X	X	
Q3b Planning and Strategy, such as enterprise architects, systems analysts, and ICT consultants	X	X	
Design, development, and integration Q3c ... such as software, web and multimedia developers and test specialists	X		X
Q3d … such as database designers and administrators	X		X
Q3e … such as hardware and network specialists and systems administrators	X		X
Q3f … such as security specialists	X		X
Q3g Office user support	X		X
Q3h Service delivery and operation, such as operations, control or equipment technicians etc.	X		X
Q3i Any other ICT professionals	X		X