MONITORING E-SKILLS DEMAND AND SUPPLY IN EUROPE

eSkillsMonitor

FORESIGHT REPORT

"ANTICIPATING THE DEVELOPMENT OF THE SUPPLY AND DEMAND OF E-SKILLS IN EUROPE 2010-2015"

NOVEMBER 2009

Authors

GABRIELLA CATTANEO
MARIANNE KOLDING
ROSANNA LIFONTI
TOBIAS HÜSING
WERNER B. KORTE

IDC Government Insights
empirica GmbH

Prepared for the European Commission

And the European e-Skills Forum

empirica

IDC Government Insights

Disclaimer

The views expressed in this report are those of the authors and do not necessarily reflect those of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the information provided in this document.

The study team

This study is conducted by:

empirica

Gesellschaft für Kommunikations- und Technologieforschung mbH

Oxfordstr. 2, D-53111 Bonn, Germany

Tel.: +49 (0)228 98 539 0, Fax: +49-(0) 228 98530 12

http://www.empirica.com

Tobias Hüsing, Werner B. Korte

and:

IDC Government Insights

Gabriella Cattaneo, Marianne Kolding, Rosanna Lifonti

Rights restrictions

Milan, Bonn, November 2009

EXECUTIVE SUMMARY

Towards the European Knowledge Economy

Europe's return to economic growth in the next years (2010-2015) may follow very different paths, depending on the role of ICT-based innovation. According to the scenarios developed by this study, possible futures vary from a return to moderate growth (Back to Normal) to the take-off of innovation in the medium term (Investing in the Future) or in the very near future (Turbo Knowledge Economy); but there are also risks of a slow development path with little innovation (Tradition Wins) or flat growth with a struggle to compete with emerging Asian economies (Stagnation). These scenarios highlight the critical role of e-skills availability to enable European competitiveness, but also the substantial risks of e-skills gaps and mismatches whenever ICT-based innovation accelerates its growth. However the factors of change are combined in the scenarios, the lack of human resources with the right skills remains a problem for Europe. There is a need for effective and proactive policies to sustain ICT investments and insure that e-Skills do not become a bottleneck for innovative enterprises and organizations in the private and public sector.

These are the main results of the foresight analysis carried out by the study "Monitoring e-Skills Demand and Supply in Europe 2010-2015" prepared by empirica GmbH and IDC EMEA on behalf of the European Commission DG Enterprise. The main goal of this study is to provide evidence about the main drivers of the evolution of the supply and demand of e-skills in Europe in order to anticipate change and facilitate dialogue between policy makers at the regional, national and EU level and leading stakeholders to reduce e-skills shortages, gaps and mismatches. The definition of e-skills identifies ICT practitioners' skills, including ICT R&D, design and production, marketing and sales, and ICT management skills. This is the final report of the study. The study team developed qualitative scenarios and a quantitative model of the demand-supply balance of e-skills, building on alternative forecasts of EU27 GDP growth, EU27 IT spending and the dynamics of the ICT practitioners labour market. 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 dynamics of IT off-shoring, the impacts of socio-policy trends, ICT education and training trends (resulting in lower or higher attractiveness of ICT careers).

- The global scenarios resulting from this process are: **Back to normal** - a return to "before the crisis" moderate growth development model, with IT-based innovation developing unevenly across Europe. This results in a limited e-skills gap (estimated at 384,000 excess demand in 2015, about 8% of the e-skills workforce);
- **Investing in the future** – a scenario of moderate growth similar to the previous one until 2011, when, thanks to public and private decisions to step up investments in ICT innovation and the Future Internet, there is an acceleration of economic and IT growth, expected to increase after 2015. This leads to higher demand for R&D and ICT technical skills in the period 2012-2015, with an estimated e-skills gap of 580,000 jobs in 2015, about 11% of the ICT workforce.
- **Turbo knowledge economy** – the knowledge economy takes off in Europe, thanks to a virtuous circle of productivity and economic growth driven by widespread diffusion of ICT-based innovation. ICT careers become more attractive and demand of e-skills grows, leading to an e-skills gap of approximately 669,000 jobs in 2015, about 13% of the ICT workforce, even if the attractiveness of ICT jobs increases, leading to a slight increase of e-skills supply.
- **Tradition wins** – after the crisis, an export-driven recovery advantages traditional industries, rather than high-tech and innovative industries, resulting in a combination of moderate economic growth with low ICT growth. The relocation of the ICT industry

outside of Europe accelerates and the demand of e-skills from 2010 to 2015 grows very slowly while the attractiveness of ICT careers declines. A small level of excess demand of e-skills remains, but at the same time there are mismatches between demand and supply across the EU, particularly in the countries where the advanced high intensity IT users remain an important presence.

- **Stagnation** – a very slow recovery, accompanied by domestic protectionism in the most important countries, discourages innovation investments. The European socioeconomic system struggles to keep up with the emerging economies and tends to close itself ("fortress Europe"), with low ICT investments counterbalanced by IT off-shoring growth. Both demand and supply of e-skills are flat, without growth, and the result is a very small e-skills gap accompanied by mismatches in the e-skills labour market across Europe.

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 (Turbo knowledge and Stagnation) appear less likely than the other moderate scenarios, but some of their components are more than likely. Conversely, the "intermediate" scenarios appear more likely, but show clearly that the evolution of present trends may still lead to alternative development models, with different possible impacts on the socio-economic environment. There is not a destiny of innovation for Europe: but a future which must be built, starting now.

Exhibit 1: Overview of Global Demand-Supply of e-skills Scenarios

BACK TO NORMAL	Moderate Economic Growth	Moderate Innovation Growth	Moderate, long-term impact of ICT policies	Medium Offshoring Growth	Moderate attractiveness of ICT careers
INVESTING IN THE FUTURE	Moderate Economic Growth	High Innovation Growth	Strong impact of eskills and ICT stimulus policies	Medium Offshoring Growth	Moderate attractiveness of ICT careers
TURBO KNOWLEDGE ECONOMY	High Economic Growth	High Innovation Growth	Strong impact of eskills and ICT stimulus policies	Medium Offshoring Growth	High attractiveness of ICT
TRADITION WINS	Moderate Economic Growth	Low Innovation Growth	Moderate, long-term impact of ICT policies	Fast Offshoring Growth	Low attractiveness of ICT
STAGNATION	Low Economic Growth	Low Innovation Growth	Low Impact of eskills and ICT Policies	Fast Offshoring Growth	Low attractiveness of ICT

Source: e-Skills Monitor study: Scenarios Model, 2009

Exhibit 2: Main e-skills Trends in Global Scenarios

	e-Skills Demand VAR. 2015/2010	*e-Skills Supply* VAR. 2015/2010	*e-Skills Balance*	*e-Skills Mix*
BACK TO NORMAL	MODERATE INCREASE + 12%	VERY SLIGHT INCREASE +4%	MODERATE e-SKILLS GAP	AS TODAY
INVESTING IN THE FUTURE	INCREASE + 16%	VERY SLIGHT INCREASE +4%	HIGHER e-SKILLS GAP	SHORTAGE OF R&D SKILLS
TURBO KNOWLEDGE ECONOMY	STRONG INCREASE + 21%	INCREASE + 8%	HIGH e-SKILLS GAP	SHORTAGE OF R&D, ICT MANAGEMENT SKILLS
TRADITION WINS	STABLE + 5%	STABLE + 2%	NO GAP BUT MISMATCHES	OVERSUPPLY OF R&D, TECHN. SKILLS
STAGNATION	STABLE + 4%	STABLE + 2%	NO GAP BUT MISMATCHES	OVERSUPPLY OF ICT MANAGEMENT SKILLS

Source: e-Skills Monitor study: Scenarios Model 2009

Building the Scenarios and the Foresight Demand-Supply Model

The study team developed the scenarios and the foresight model in parallel, as shown in the following picture. The main steps of scenario building included the:

- Analysis of the factors affecting the evolution of the e-skills market and the identification of 5 main focal issues, with the support of in-depth interviews with selected opinion leaders;
- Survey of the opinions of 109 e-Skills experts from the IT industry, academia and research, the policy environment, about the likeliness and impacts of the main trends characterising each of the 5 focal issues;
- Development of 5 sub-scenarios around the main focal issues, that is the Macroeconomic, the ICT Innovation, the IT off-shoring, the Socio-policy, the Education and Training sub-scenarios; for each sub-scenario the study team designed alternative development paths for the period 2010-2015, including the estimate of main quantitative variables, namely alternative GDP growth forecasts and alternative IT spending growth forecasts;
- Development of global scenarios building on the interactions between the alternative sub-scenarios.

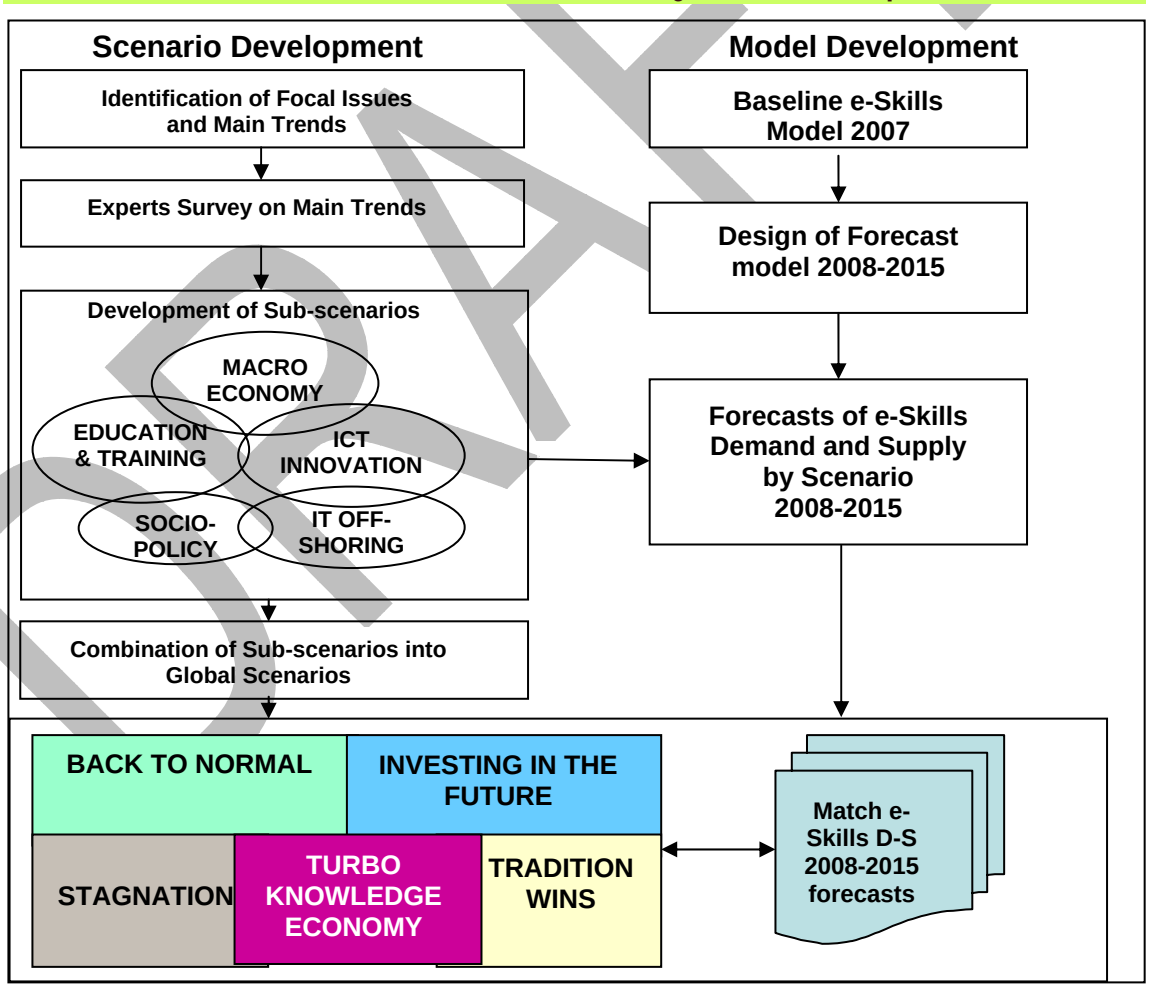
The foresight model was based on the following steps:

- Development of a baseline model for the year 2007, estimating total demand and supply of e-skills (and their resulting balance) for the 6 main EU countries (France, Germany, Italy, Poland, Spain and the United Kingdom), for the other 21 countries and for the EU27; this was based on existing public data.
- Design of the foresight model, estimating the correlation between the demand and supply of e-skills for the period 2008-2015, including the main inflow and outflows parameters (such as the incidence of entries from different education paths, of retirements, of unemployment, and so on);

- Estimating e-skills demand growth for each of the 5 scenarios, building on the quantitative parameters of the Macroeconomic and ICT innovation sub-scenarios, particularly on the variations of the elasticity of IT budgets correlated with GDP growth and the consequent variations of the demand for ICT practitioners by user and supplier industries;
- Estimating e-skills supply growth for each of the 5 scenarios, building on the assumptions of the Education and Training sub-scenarios, particularly on the variations of the attractiveness of ICT careers, leading to increases in the numbers of computing graduates and career changers entering the market;
- Populating the foresight model, with the demand and supply estimates, calculating their balance;
- Validating the foresight model, checking the results with the qualitative assumptions of the 5 scenarios, revising and checking the results by country and for the EU27.

An important remark: the calculation of e-skills demand and supply forecasts in the model is built on several critical assumptions, because necessary data is often missing or incomplete. In a dynamic perspective, the supply side and the demand side obviously change due to inflows and outflows of workers and due to changing skill demands by employers.

Exhibit 3: e-skills Scenarios and Foresight Model Development



The Scenarios Scope

ICT practitioner skills are defined as the capabilities required for researching, developing, designing, strategic planning, managing, producing, consulting, marketing, selling, integrating, installing, administering, maintaining, supporting and servicing ICT systems. ICT practitioners are people whose main responsibility is to take care of an organisations' ICT infrastructure (hardware, software, communications systems).

For the EU27 Member States the empirical status quo (data for statistical measurement) of ICT practitioner jobs is available through the Labour Force Surveys of the EU Member States. This is where the market forces of demand and supply meet. Therefore the stock of ICT practitioners is part of both supply and demand. In hypothetical market equilibrium, supply and demand would match exactly here.

The foresight model was calculated for three different definitions of ICT practitioners: a narrow definition (core) a larger one (broad) and a very broad one, based on main ISCO codes (as indicated in the following table). This was decided to provide a comprehensive basis for comparisons of the study results with related activities in several EU Member States using different definitions. However, the definition most widely used is the "broad ISCO" one, on which we have focused most of our comments.

Exhibit 4: ICT Practitioner Definitions used for Quantification Purposes

Definition Type	ISCO codes included
Core	ISCO 213 and 312
Broad	ISCO 213, 312, 313, 1236
Very broad	ISCO 213, 312, 313, 1236 and 724

The quantification of ICT practitioner jobs in the first three definitions is based on data from the Labour Force Surveys of the European Statistical System.

A Comparison of the 5 Scenarios

A closer comparison of the 5 global scenarios helps to identify the main drivers and impacts of e-skills demand and supply.

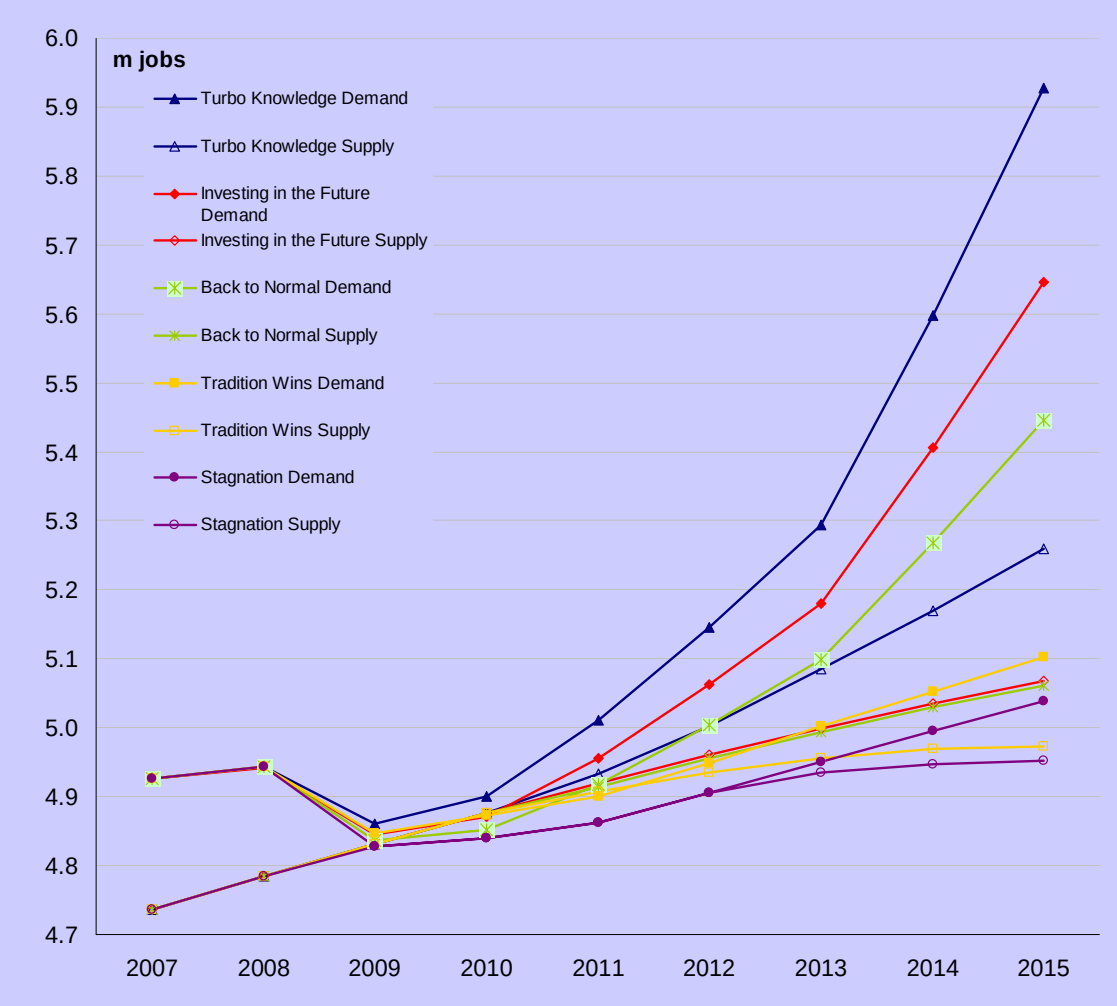
The five scenarios lead to quite different results in terms of the supply demand match for e-skills. At the end of our forecasting period, we estimate a supply-demand match in statistical terms for two of the scenarios (*'Tradition wins' and 'Stagnation'*), an excess demand at a level of about 7% of all jobs for the "Back to Normal" scenario and a shortage of e-skills of respectively 10% and 12% of the workforce for the two positive scenarios *'Investing in the future'* and *'Turbo knowledge economy'*.

Exhibit 5: e-skills Demand and Supply in the EU27 in 2010 and 2015

	2010			2015		
	Demand of e-skills	Supply of e-skills	Demand/ Supply Difference	Demand of e-skills	Supply of e-skills	Demand/ Supply Difference
Back to normal	4,852,700	4,876,200	-23,500	5,445,700	5,061,600	384,100
Investing in the future	4,870,800	4,876,200	-5,400	5,646,700	5,067,200	579,500
Turbo knowledge economy	4,899,900	4,876,200	23,700	5,927,700	5,258,500	669,100
Tradition wins	4,873,200	4,876,200	-3,000	5,102,300	4,973,500	128,900
Stagnation	4,839,500	4,876,200	-36,800	5,038,700	4,952,200	86,500

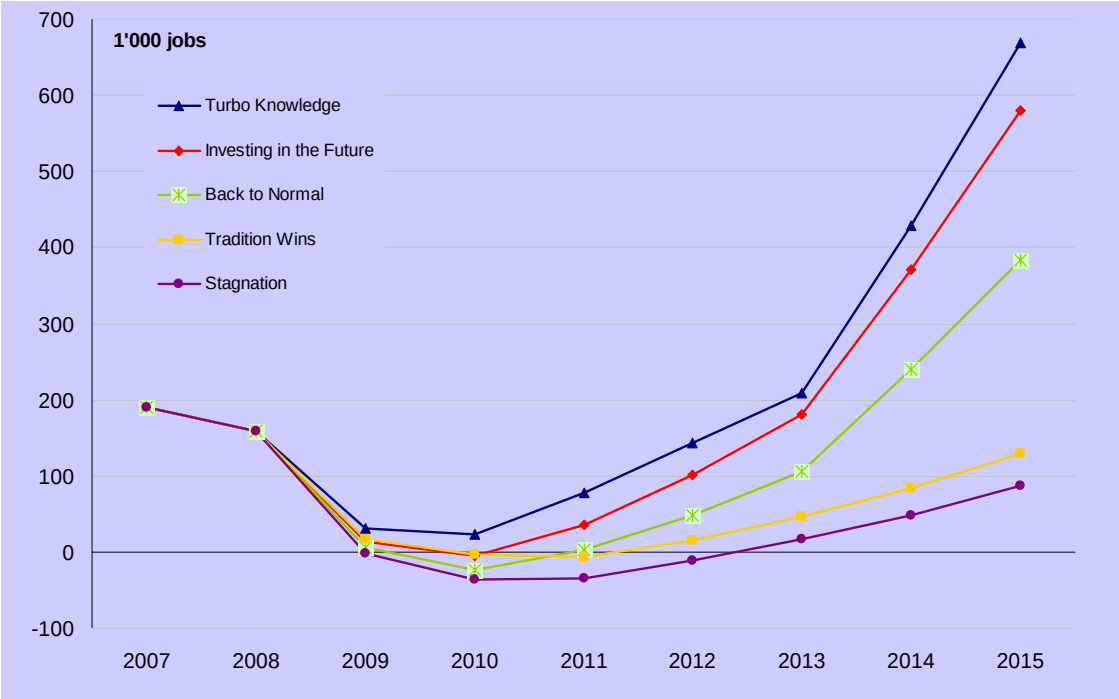
(EU27, broad definition of e-skills) *Source: e-Skills Monitor 2009*

Exhibit 6: e-skills Demand and Supply in the EU27 Forecast until 2015 by Scenario



(EU27, broad definition of e-skills) *Source: e-Skills Monitor 2009*

Exhibit 7: e-skills Demand and Supply Gaps (excess demand) in the EU27 until 2015 by Scenario



(EU27, broad definition of e-skills) *Source: e-Skills Monitor 2009*

On a country by country comparison, one main finding is that there are countries where, given the most negative scenario in economic terms, the crisis may lead to some temporal level of unemployment among ICT practitioners (Spain, France and Poland) while others will still show excess demand (Germany most notably).

Another result that the statistical analysis reveals is that there are structural differences between the countries in terms of the sustainability of their e-skills reproduction. Poland, and probably some other smaller countries are educating an enormous number of ICT graduates compared to their domestic demand, while other countries, especially Italy, "produce" far too few ICT graduates. Intra-European migration may and probably will be one effect of the structural differences.

Towards the end of the forecast period, demand for skills grows much stronger in Spain and Poland than in the other named countries, regardless of the scenario. There are two main reasons for this pattern to emerge in these two countries. First of all, both these countries are slightly less mature form an IT adoption standpoint than for example Germany, France and the United Kingdom. This means that when we come out on the other side of the current economic crisis, IT investments will increase stronger in these two countries than in their more mature neighbours.

However, Spain is a more mature IT nation than Poland with some industries already before the crisis (such as the banking sector for example) often "leap-frogging" in terms of technology adoption. We expect this pattern to re-emerge in Spain when the economy recovers. Poland has a lower IT adoption rate than Spain but is on a strong investment curve, which will result in strong growth for skills as IT penetration spreads also to the many small and mid-sized companies.

Exhibit 8: e-skills Demand and Supply Gaps in 2010 and 2015 by country

(Broad definition of e-skills) *Source: e-Skills Monitor 2009*

The second main factor contributing to strong skills demand in the two countries is the role as a nearshoring location played by both. While the nature of the ICT nearshoring services offered in the two countries varies, this is a proposition that both countries are actively pushing because they are "politically" palatable alternatives to off-shoring to, for example, India due to a number of factors, such as data security and data protection, geographical proximity, cultural affinity, availability of European languages and just the fact that they are inside the EU. Because of these factors, many ICT vendors - including even the India-based offshore companies - are establishing nearshore centres in Spain and Poland and thereby helping drive up the demand for skills.

Learning from the e-Skills Scenarios

The five global scenarios have been developed linking together possible assumptions about the European economy development model in the short-medium term. They are possible futures rather than projections; it is important to draw from their results the learning points

about the consequences of events and of policy actions. To do so, we focus here on the "Broad ISCO" scenarios, as the most representative of the demand-supply dynamics.

Looking more closely at the 2010 scenarios, we notice that the five scenarios are quite similar, because the range of uncertainties in the main quantitative indicators (such as GDP growth) is limited in such a short time horizon. The level of supply is the same for all the scenarios, since the output of the formal education system is rather rigid in the short term, and the uncertainty about the inflows of human resources from other careers or from training-on-the job is quite low. Demand levels instead do change slightly and already show as the starting point for their different trajectories. However, the impact of the economic crisis on IT budgets in 2008-2009 was such that for 4 out of 5 scenarios there is in 2010 a slight oversupply of e-skills (essentially reflecting an increase of unemployment). The only exception is the Turbo knowledge economy scenario, showing a very small excess demand, representing less than 0.5% of the ICT workforce in the year. In other words, the compression of demand caused by the global recession has a very visible impact in the near term.

The divergence in the development paths of the scenarios begins in 2011 and becomes evident in 2015:

- **"Back to normal"** features approximately 384,000 e-skills excess demand, which the supply system cannot satisfy. This is driven by the continuation of "before the crisis" patterns, with IT-based innovation playing an important factor in the development model of the economy, both high intensity user industries and low-intensity user industries increasing their demand in the same proportion as they used to. The result of these trends is that the imbalances of the e-skills market, denounced today by many sources, reappear and become more relevant. In qualitative terms, the main e-skills gaps concern high level technical skills (for the design and development of advanced services) and managerial/customer oriented skills, while the demand for traditional programming skills tends to decline.
- **"Investing in the Future"** develops similarly to the previous scenario until 2011 and then diverges, taking a faster growth path driven by ICT-based innovation and future-oriented investments. The transformational impacts of this innovation begin to be perceived, as advanced users change their relationship with suppliers and evolve their internal business processes. The decrease of costs for run-of-the-mill IT applications and services frees up resources for innovative enterprises to invest in new IT-based projects, without decrease of the quality of services. In this scenario the e-skills gap grows some more to 580,000 in 2015. The mix of demand starts shifting towards management ICT skills, while the gap of R&D skills tends to increase at the end of the forecast period, when ICT research investments start to accelerate.
- **"Turbo knowledge economy":** This scenario envisages a strong acceleration of the knowledge economy in Europe, with a jump ahead of ICT-driven innovation, also helped by effective and proactive ICT policies and the impact of the stimulus package. The turning point in this scenario is the massive adoption of ICT innovation by SMEs, particularly high-tech SMEs and medium-size enterprises (the fast growing "gazelles" described by economic literature as one of the key potential success factors of the European economy). New digital infrastructures (smartgrids, e-health smart networks, intelligent transportation systems and networks) leverage innovation to generate productivity increases in the public sectors and across the economy. , Therefore the excess demand for e-skills almost doubles compared to the first scenario, to 669,000 in 2015. The e-skills more requested are ICT management skills and R&D skills to support the development of innovative products and services.
- **"Tradition wins"** on the contrary features an economic development model driven by traditional industries, with a low profile knowledge economy. ICT policies and the stimulus package are not very effective, and investments in ICT infrastructures are delayed or implemented unevenly. IT spending is focused on maintenance and traditional IT activities, with scarce innovation. The High Intensity IT User sectors grow less than Low Intensity IT User sectors, so that Europe lags behind the rest of the world in the digital environment, running the risk to miss opportunities for the future,

since this development model can sustain only moderate growth rates. Off shoring grows, as user enterprises focus only on cost cutting. The slow development of the advanced services industries, and the relatively lower importance of ICT- based innovation, compresses e-skills demand down and (since supply is relatively rigid) leads to a mere 129,000 of excess demand in 2015,

- Finally, the **"Stagnation"** scenario is based on very low level growth. The ICT industry moves to off-shore not only the simplest operational activities, but also higher-value added ones, such as R&D and product innovation, while in Europe companies focus only on commercial networks and sales. The transformational and productivity impacts expected from IT-based innovation sweeping across the European economy do not materialise in this scenario. Only advanced, sophisticated IT users enjoy some benefits from the reorganisation of their business processes and networking with their closest partners, but this does not affect the largest part of the supply chains. This is essentially a scenario of missed benefits and missed opportunities. By 2015, there is still some excess demand representing only 1.7% of the workforce. Within this picture, there could be demand-supply mismatches in some national markets with some unemployment growth.

This compared analysis shows that the three of the five scenarios characterized by higher economic growth, based on the strengthening of the knowledge economy, all show the potential risk of relevant e-skills gaps. The underlying assumptions of these scenarios are coherent for example with the OECD observations about the current crisis impacts and long-term growth perspectives, which are linked with innovation growth. As the OECD observed[1]:

> "*As policy makers work to stabilise financial markets and strengthen short-term demand, they can leverage the crisis to build the foundations for stronger long-term growth and a transition to a greener economy. (..) Today's world is one in which both OECD countries and non-OECD economies increasingly rely on knowledge and services to drive their performance, where investment in intangible assets is of equal importance as investment in machinery, equipment and buildings. Efforts to stimulate the economy must therefore reflect the current drivers of economic growth, and take advantage of industrial renewal to accelerate the important structural shifts underway*".

In other words, if Europe wishes to get back on the growth path and to sustain its competitiveness with the emerging Asian economies, it is important to invest in the development of the knowledge economy, of which e-skills are a critical factor. According to this study analyses, however the factors of change are shaped, human resources with the right skills are still a problem for Europe. The role of European and national policies are critical, both to sustain innovation investments and to make sure that e-skills do not become a bottleneck for innovative enterprises and organizations in the private and public sector.

Another important assumption underlying our scenarios is the relative rigidity of supply (which is similar across all of the scenarios). This is due to the relatively short time horizon: it is well known that formal education system changes take from 5 to 10 years to materialize. It is very unlikely that the number of ICT graduates in 2015 in Europe will be drastically different from this year's number. On the other hand, there is some flexibility in the training and learning on the job production of ICT practitioners, which might provide additional flexibility to the system by responding to some of the most acute e-skills gaps in the user industries. It will be more difficult to fill these gaps in the ICT producer industries, without considerable effort and investments.

A final element which needs to be discussed is IT off-shoring. This phenomenon is often accused to be the main cause of growing unemployment and jobs destruction in the EU.

[1] OECD 2009: Policy Responses to the Economic Crisis: Investing in Innovation for Long-Term Growth.

Actually, according to IDC estimates and the study team's elaboration, IT services off-shoring is still marginal (compared to overall IT services revenues) and is not likely, in any scenario, to grow explosively, even if it certainly developing. This is due to the complexity of the off-shoring activity, and the fact that its main benefits are for large or medium-large enterprises. In addition, off-shoring does not lead automatically to jobs destruction: in many cases this extreme form of outsourcing frees up resources within European companies, who are then dedicated to other activities. This is likely to happen since there is always potential demand for expert personnel skills, for example for innovative projects. The fact remains that many industry experts continue to point the finger against the risk of delocalization by ICT industries; if developments such as Cloud Computing or Utility computing materialized soon for a majority of user companies, this might have strong impacts on ICT employment. But the real threat for the European ICT employment and knowledge base, rather than IT services off-shoring, is probably linked with the overall globalization trends, which see emerging demand concentrated outside the mature European markets. The ICT industries have already started years ago to open new research and production facilities only nearby new emerging demand, in other markets outside Europe. This is the phenomenon driving ICT jobs loss in the EU.

In conclusion, the five global scenarios underline the risks of imbalances for the e-skills labour market, and they also show the critical role which European and national policies could play to improve the chance of realization of the positive scenarios, avoiding the risks illustrated by the negative scenarios.

Table of Contents

1 Introduction

This report presents the final results of the foresight analysis carried out by the study "Monitoring e-Skills Demand and Supply in Europe 2010-2015" prepared by empirica GmbH and IDC EMEA on behalf of the European Commission DG Enterprise. The main goal of this study is to provide evidence about the main drivers of the evolution of the supply and demand of e-skills in Europe in order to anticipate change and facilitate dialogue between policy makers at the regional, national and EU level and leading stakeholders to reduce e-skills shortages, gaps and mismatches.

The study team developed qualitative scenarios and a quantitative model of the demand-supply balance of e-skills, building on alternative forecasts of EU27 GDP growth, EU27 IT spending and the dynamics of the ICT practitioners labour market. The global e-skills scenarios are based on the complex interaction of five main dimensions (which were developed as sub-scenarios) including macroeconomic growth, the dynamics of ICT-based innovation, the dynamics of IT off-shoring, the impacts of socio-policy trends, ICT education and training trends (resulting in lower or higher attractiveness of ICT careers).

The scope of the study is focused on ICT practitioner skills (not e-Business skills, or e-User skills) including ICT R&D, design and production, marketing and sales, and ICT management skills. Three different definitions of ICT practitioner skills were used based on ISCO codification, a Core e-Skills definition, a Broad e-Skills definition and a Very Broad e-Skills definition. Most of the comments are focused on the Broad e-Skills definition, which, in the opinion of the study team, reflects best the reality of the e-Skills labour market in Europe.

The report is structured as follows:

- The 1st chapter is the Introduction
- The 2nd chapter presents the main sub-scenarios developed as components of the final scenarios;
- The 3rd chapter presents five global demand and supply scenarios and the quantitative model results for the period 2010 - 2015 for each scenario and for different definitions of "ICT practitioners", with a specific focus on Broad e-Skills
- The Annex I presents the main results of the e-skills experts survey implemented on the web in June 2009, providing essential input for the development of the scenarios;
- The Annex II presents the detailed statistics of the expert survey questionnaire answers;
- The Annex III describes in detail the methodology used to develop the scenarios and the Foresight Model;
- Annex IV presents the results of the Global scenarios for the Core e-Skills and the Very Broad e-Skills definitions;
- A bibliography concludes the report.

2 The Sub-scenarios

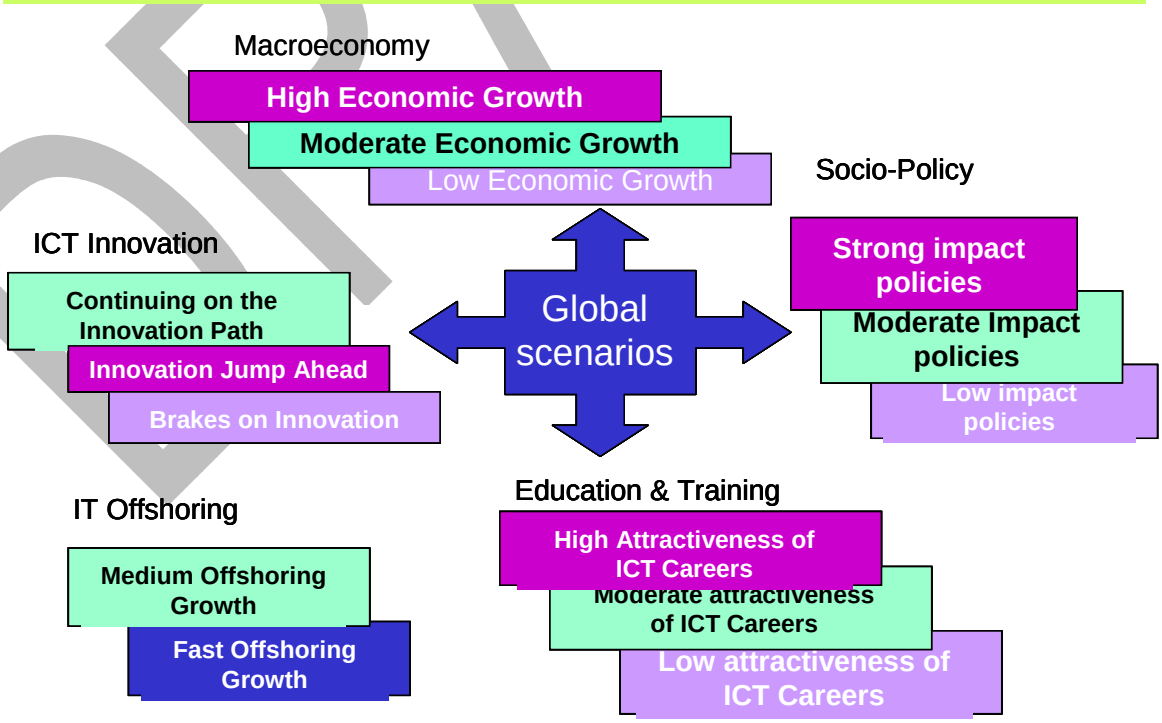
2.1 Overview

The availability of e-skills is an important component of the economic development and competitiveness of the EU, for both the ICT industry and the overall economy. 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. While predicting the future is impossible, exploring the likely or possible interactions between the main trends allows to build 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.

The focal issues affecting the demand and supply of e-skills were identified and investigated through the help of in-depth interviews with 6 leading European experts, brainstorming sessions by the study team, and the 109 experts responding to the experts' survey.

In order to manage the complexity of the socioeconomic environment, we have chosen to identify and investigate the main focal issues through the development of sub-scenarios, which in turn are combined to model the global demand-supply scenarios. Sub-scenarios are shaped by the main trends; trends with a high level of uncertainty will lead to divergent paths and therefore differentiate the sub-scenarios, while trends with an apparently clear future trajectory will be common elements for all sub-scenarios. Therefore sub-scenarios help to clarify the key turning points in the future expecting us.

Exhibit 2-1: Focal Issues and Sub-scenarios



Source: e-Skills Monitor study: Scenarios Model 2009

The five sub-scenarios developed by the study are not only different; they have a different level of relevance in terms of their direct or indirect impact on the evolution of the e-skills market and therefore their influence in the final global scenarios. They are the following:

1) ICT Innovation sub-scenarios = 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. Since we are entering a new wave of IT-based innovation, these sub-scenarios are characterized by a high level of uncertainty and a high influence on the final global scenarios.

2) Macroeconomic sub-scenarios = Alternative hypotheses of economic and employment growth in the EU in 2010-2015, based on the main forecasts of most important public sources, affecting both the demand and supply of e-skills. 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.

3) IT Outsourcing and off-shoring = alternative assumptions about the trend towards sourcing IT skills and activities outside of Europe, and its implications for the IT employment in Europe in the next years, which may (or may not) tend to reduce e-skills demand in the near and long-term future. There are heated discussions about the impact of IT off-shoring on IT employment, and very little evidence so far, also because the volume of off-shoring spending has been marginal until recently (though it seems that the economic crisis is accelerating it). Because of its high level of uncertainty and high potential impact on the e-skills market, this trend has been highlighted and singled out, even if it is not really an independent sub-scenario, rather a component of the overall ICT innovation sub-scenarios, closely following their dynamics.

4) Education and training sub-scenarios = 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.

5) Socio-Policy Sub-scenarios = These sub-scenarios focus on the role and potential impact of the main policies influencing the e-skills environment and the ICT market, within the context of the evolution of social sensitiveness for e-skills and IT-innovation related issues.

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.

2.2 The ICT Innovation Sub-scenarios

2.2.1 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 evolution of these trends in the foresight period is characterised by a high level of uncertainty and high potential impacts on the socioeconomic environment and the demand-supply of e-skills, and therefore they represent the core of the innovation sub-scenarios.

Besides IDC research and industry sources, this chapter borrows from several authoritative reports to frame our sub scenarios, even if our foresight period (2010-2015) is likely to see only the start of this forthcoming transformation, and not yet the most relevant impacts. However, the need to act now is already strongly raised in several "call for actions" (for example "Future Internet 2020, a call for action by a high level visionary panel"; the ISTAG report on "Revising Europe's ICT Strategy"; the EC Communication calling for "A Strategy for ICT R&D and Innovation in Europe"; Europe's Digital Competitiveness Report by DG Information Society; "Toward Global Leadership in the Digital Economy" by Digital Europe, formerly EICTA, and many others). The potential consequences of alternative European choices on the investments and policies for the future Internet and emerging ICT innovation trends are important differentiating elements in our Innovation and Socio-policy sub-scenarios.

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, computer manufacturing. This excludes microelectronics and industrial automation machinery.

IT User industries, divided in:

- High intensity IT user industries = these industries are characterised by IT budgets higher than the rest of the economy, because IT is a key enabler of the core business activities, providing an important contribution to the production/distribution of services to the final users and customers. (As shown in the table below, this includes financial services, business services, media, utilities, healthcare and the public sector);
- Low/Average intensity IT user industries, with low/average IT budgets. In these industries IT and ICT has a minor role in the production and delivery of products/services to customers/citizens (manufacturing, agriculture and other services).

This segmentation is based on IDC classifications and research, including IT spending by sector.

Exhibit 2-2 Segmentation of IT Producer and User Industries

	High Intensity IT User Industries	Low/Normal Intensity IT User Industries	ICT sector
Agriculture, construction, mining		*	
Banking	*		
Insurance	*		
Other finance	*		
Business services (including computer services)		* (84%)	* (24%)
Central government	*		
Local government	*		
Communications	* (16%)		* (84%)
Discrete Manufacturing		* (76%)	*(24%)
Process Manufacturing		*	
Education		*	
Health	*		
Retail		*	
Wholesale		*	
Transport services		*	
Utilities	*		
Other		*	
HOME CONSUMER MARKET SPENDING EXCLUDED			

Source: IDC EMEA, 2009

The main innovation trends, which are already re-shaping the relationship between the ICT industry and the rest of the economy and will fully develop in the next 3 to 5 years, are the following.

- **Innovation in the development of ICT applications, solutions and services**

This includes developments by the ICT industry itself and by the user industries which develop ICT-based services for their customers, in vertical markets such as ebanking, ehealth, egovernment, ecommerce and so on. There is a growing trend towards commoditization of the development of basic IT services and applications, which can be described as follows:

- **Diffusion of advanced tools and interfaces, easier to use technologies** for the development of IT applications. There is an increasing trend towards the diffusion of advanced tools and interfaces more user-friendly, reducing the competence threshold needed to implement and manage a series of basic applications such as websites development. This is part of the overall trend towards the commoditization of basic IT services and applications.
- **Industrialization and automation of IT services**, which means moving from customized solutions development and delivery for each customer engagement, to the creation of re-usable assets, stronger processes and building blocks leading to industrialized development and delivery of ICT solutions. This entails identification of repeating service requirements, standardization of repeatable services into assets, proactive reuse, mass-customization where possible by combining assets into solution services, and continuous improvement at all service levels. While asset-based offerings gives the potential to leverage industry best practices it also allows for

repeatability, and importantly, therefore, continued reduction in planning and implementation time. This can eventually lead to automation of service delivery, thereby transforming strongly labour-based delivery models to asset-based delivery models over time. As such, this trend is strongly intertwined with the trends around off-shoring and outsourcing.

- **Innovation in ICT delivery models, such as Software as a Service (SaaS), Cloud Computing, Utility Computing**

This is a much-discussed trend, essentially the emergence of new business models for the distribution and delivery of IT software and services, which become externalized and commoditized. This includes also the transformation of some of the basic IT applications into services (for example the basic office applications). These models leverage the widespread diffusion of the Internet and IP-based networks as the new common infrastructure for all business users. Their characteristics are still somewhat vague, their definitions vary greatly depending on the source, there is a lot of hype about them in the industry and the offering is not as mature as it could be, as noted for example by the Berkeley university (Above the Clouds: A Berkeley View of Cloud Computing, February 2009) and McKinsey ("Clearing the Clouds", draft paper, 2009). But there is no doubt that this evolution is happening, as indicated also by the experts' survey. Anticipated by controversial gurus such as Nicholas Carr, this trend potentially transforms the value chain of IT services changing the relationship between producers and users and the competitive scenario. Global competitors such as Google and Amazon are exploiting this trend to challenge in their field giants such as Microsoft, SAP and Oracle, not to mention the new competitors who might emerge.

The diffusion of these delivery models is driven by the considerable advantages guaranteed to business users, including greater flexibility, lower capital investments, lower management costs. For the IT industry the main driver is the ability to increase the range of application and services in their offering and widen their market to new user categories. For example, there is consensus that this trend opens new opportunities for small and medium enterprises (SMEs), who will be better able to exploit ICTs for their business strategies.

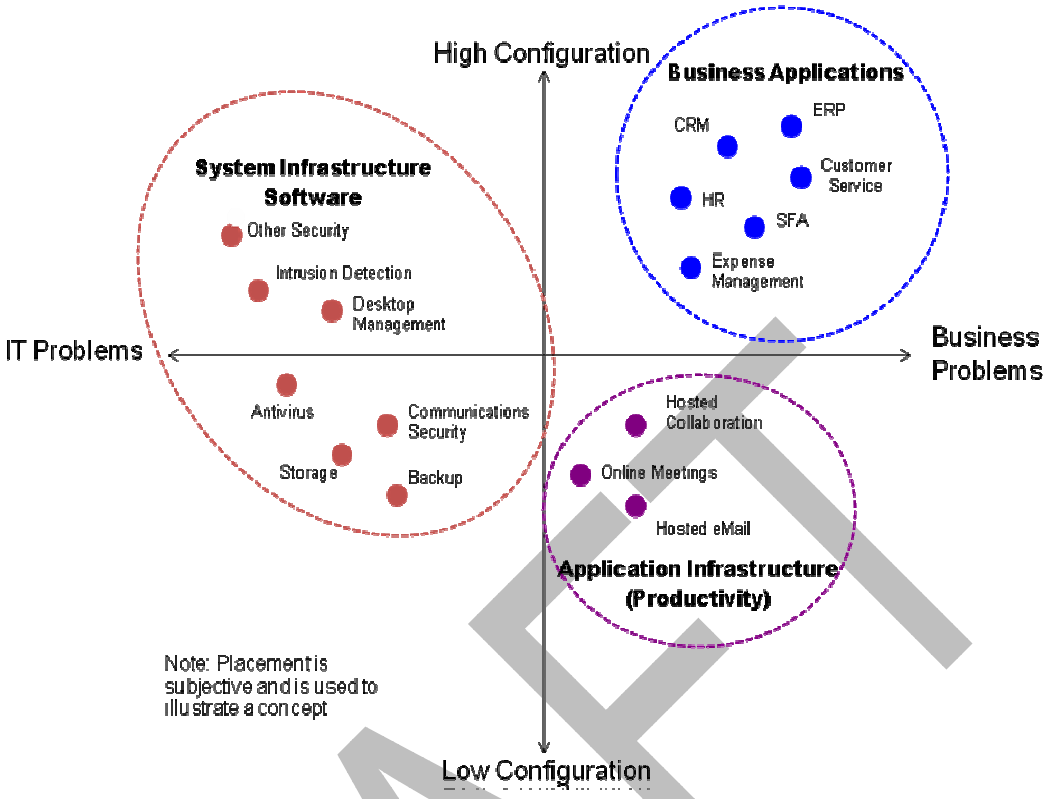
The main barriers slowing this trend concern the complexity of the transformation and the considerable organizational but also technological innovation needed (to update business processes, to improve standardization, interfaces and interoperability, to adapt and update security and accounting processes). There is great uncertainty about the rate and way of development of this trend, which is one of the main differentiations between the scenarios.

Potential impacts of this trend on e-skills are also relevant, as explained by a senior expert in our survey: "Cloud computing could favour the birth of a new IT service and solution industry in Europe, closer to the needs of European SMEs, with potential growth of demand of e-skills. On the other hand it might cause a dramatic disintermediation of the traditional services developed in the last 50 years of IT, creating a need for massive re-training of current staff".

The main delivery models (Software as a service, cloud computing and utility computing) and their differentiations are explained more specifically below.

- **Software as a Service (SaaS)** is an alternative delivery model for business software, whereby the software runs on the vendors systems and the customer accesses the software via a browser-based 'client'. While customer relationship management is the most mature segment in the market, there are many other segments (as shown in the Figure below) all with multiple vendors competing fiercely for customers.

Exhibit 2-3 Conceptualization of Software-as-a-Service Business Application



Source: IDC, 2008

- **Cloud Computing** is effectively the generalization of SaaS to a far broader range of services, and is intimately related to the future Internet and other networked computing activities. IDC distinguishes between Cloud Services and Cloud Computing: Cloud Services are consumer and business products, **services** and solutions that are delivered and consumed in real-time over the Internet. As an emerging IT development, deployment and delivery model, Cloud Computing enabling real-time delivery of products, services and solutions over the Internet (i.e. enabling cloud services). It is also a way to increase or add computing power & capacity but also new applications, without having to invest in new infrastructures or licensing. Cloud Computing is broader than Utility Computing in extending its appeal to individuals, as well as enterprises from SMEs to multinationals. Additionally, cloud computing does not offer the user the ability to keep a 1 to 1 relationship such as the private utility, i.e. the application is running "somewhere in the cloud", where everything is shared.
- **Utility Computing** is the packaging of computing resources, such as computation and storage, as a metered service similar to a **traditional** public utility (such as electricity, water, natural gas, or telephone network). This system has the advantage of a low or no initial cost to acquire hardware; instead, computational resources are essentially rented. Customers with very large computations or a sudden peak in demand can also avoid the delays that would result from physically acquiring and assembling a large number of computers. Conventional Internet hosting services have the capability to quickly arrange for the rental of individual servers, for example to provision a bank of web servers to accommodate a sudden surge in traffic to a web site.
- **IT Outsourcing** Practice of delegating the operations, management and continued development of ICT environments to external providers, as an alternative to maintaining internal staff and resources. The penetration of this service delivery

model has increased strongly in the past years, from large to medium companies, from the private to the public sector. This practice precedes, and/or often accompanies the introduction of the delivery models described above. The perspectives of diffusion of outsourcing vary considerably and are an element of differentiation of the scenarios.

- **The emergence of new ICT-based business models**

While the previous innovation trends are mainly driven by the IT department and the CIO (Chief Information Officer), the business managers of IT user companies (particularly in marketing and sales functions) are paying increasing attention to the new ways of interaction and communication with the customers and sub-suppliers enabled by information infrastructures, falling under the broad label of Enterprise 2.0. Rather than optimising existing processes, these innovations enable the emergence of new business models (for example enabling user-led and open innovation processes, vastly improving business intelligence, improving networked productivity). The adoption of Unified Communications systems in enterprises represents another dimension of this evolution, enabling seamless and continuous communication within and outside company's premises, enriching the Enterprise 2.0 environment.

More specifically, this trend includes:

- **the adoption of Enterprise 2.0 application and services,** that is the use of web-based technologies for networking, collaboration, information sharing and knowledge management within and outside the enterprise. Enterprise 2.0 is the business equivalent of web 2.0, a trend which may mirror the rapid diffusion of social networking applications and services in the business world. The definition may include a system of web-based technologies that provide rapid and agile collaboration, information sharing, emergence and integration capabilities in the extended enterprise. Core functionalities of enterprise 2.0 may include tools such as: hypertext and unstructured search tools; wikis; weblogs for storytelling; social bookmarking for tagging and building organizational folksonomies; RSS for signalling; collaborative planning software for peer-based project planning and management; ideas banks for ideation (idea generation); social networking tools; mashups for visualization etc. Enterprise 2.0 is a set of tools to promote knowledge management, unlock innovation potential, and generate new efficiencies, and may contribute significantly to the growth and competitiveness of the European knowledge economy.

  Finally, Enterprise 2.0 has also a strong cultural dimension, in terms of management. It refers to a less hierarchical, post-Fordist management style, where information sharing is actively cultivated outside hierarchical boundaries, knowledge is shared through flows rather than in structured format, mainly by promoting peer-to-peer contact between individuals. It is also a largely generational trend, with younger workers often pushing for the introduction of such tools in the companies.

  On the other hand, Enterprise 2.0 is vaguely defined and is at permanent risk of oscillating between a narrow, dry technological perspective and a normative and wishful emphasis on collaboration and openness. Data on take-up and market share are contradictory and do not provide a robust perspective on the size and importance. We are at a stage where one could use existing evidence to proof almost every argument. Evidence on Return on Investment at micro level is not only rare, but indeed often deemed impossible because of the intangible nature of the benefits. As Yourdon (2009) puts it, “Web 2.0 typically involves much less emphasis on security, privacy, backup, control, governance, and “business justification”.

- **Convergence of IT and communications technologies in enterprise systems, creating an integrated user experience** (email, web audio and videoconferencing, voice telephony, fax and so on) based on **Unified Communication networks**. Convergence of IT and communications technologies in enterprise systems, creating an integrated user experience for unified messaging (email, fax and voice messaging), online presence, instant messaging (IM), Web audio and videoconferencing, and VoIP calling/IP telephony/call routing, and so on using a variety of PC and wireless devices (also called Unified Communications networks, UC networks). The availability of comprehensive UC solutions from various suppliers and their partner ecosystems intersects with critical masses of UC-related uses in 2008 that include more than half a billion IM users sending 1.5+ trillion instant messages worldwide and more than 75% of information workers in North America having attended an online meeting over the Web by the end of 2008. This evolution is also driven by users' expectations of ubiquitous connectivity to business applications and communications solutions, regardless of the device or location where they are working. At the same time, consumers are expecting their handheld or mobile devices to bring greater and greater functionality for "serious" applications, entertainment and games. Therefore these developments enable the trend towards increasing mobility of workers.

According to the Experts' survey, the transition towards Enterprise 2.0, particularly by the High Intensity IT Users is the most likely innovation trend and the one with the strongest impacts on the e-skills market, as well as the economy. However, there is uncertainty about the rate and ways of development of this trend.

➢ **Future Internet 2020**

The international race to invent the future of the Internet is well under way, and Europe has potentially an important role to play. Today's Internet was designed in the 1970s to support communication between computing systems for communities of technically expert users. The paradigm shift in society and the opportunities enabled by new technological advances in devices, place completely new requirements on the evolution of today's Internet. Future Internet will enable a multitude of new application sectors leading to the development of new markets.

According to the research carried out in the EU in the last years, the key building blocks of the Future Internet will be the Internet of Contents, the Internet of Services and the Internet of Things supported by Network Infrastructures, but an important dimension to insure sustainability and inclusion will be the Internet by and for People. The industry and research communities are already launching "call for actions", worried that the effect of the economic crisis will reduce investments in ICT innovation and downgrade efforts for the Future Internet in the policy agenda. For example, the stakeholders involved in the European Technology Platforms (ETP) have published a Future Internet vision document where it is stated:

> "*European organizations, can if given the right opportunity, significantly contribute to the shaping of the Future Internet, by building notably on the strongholds of Europe as well as on a long tradition in R&D collaboration. Such a collaborative effort can bring about a greater effectiveness on R&D spending while spurring innovation and hence contributing to the Lisbon strategy for growth and jobs. Recent turmoil in the financial markets has changed the context of R&D investment for the coming decade. The potential shortage of investment finance is driving a new level of focus on return for investment. Europe must invest now to simply be at the competition edge in the coming years*".

These recent moves underline the risk that Europe may miss the main opportunities raised by the Future Internet, unless all the stakeholders, private and public, start acting and cooperating to build this future. These alternative options and the risks correlated for the European economy are also part of our sub-scenarios.

- **Wild Cards: key technology breakthroughs**

There is always a high probability that a low-probability event may occur in the future, by definition difficult to anticipate because it deviates from past trends. The "wild card" in these scenarios could be some key technology breakthroughs invented in Europe, which may kick off a virtuous circle of fast development. A possible field for a breakthrough are environmental technologies, or clean fuel technologies (say, a really clean engine triggering a much faster substitution of motor vehicles in the world) or perhaps breakthroughs in the renewable energies field, which would kick off a much faster cycle of implementation of smartgrids to enable distribution. These breakthroughs would affect the whole economy and result in much faster growth of the ICT market and ICT innovation, because any of them would probably kick off acceleration of information infrastructures development.

2.2.2 The three innovation sub-scenarios

The combination of the alternative hypotheses of innovation trends leads to three main sub-scenarios described below.

Exhibit 2-4 Summary of ICT Innovation Sub-Scenarios

	Sub-Scenarios		
Main trends	**Continuing on the Innovation Path**	**Jumping ahead**	**Brakes on IT Innovation**
Innovation in ICT Development	Widespread adoption	Widespread adoption	Adoption continues to cut costs
Innovation in ICT Delivery	Adopted by advanced companies and pioneers	Widespread adoption	Adoption only by pioneers
New ICT-based business models	Adopted by advanced companies and pioneers	Widespread adoption	Adoption only by pioneers
Future Internet 2020	Start of investments at the end of the forecast period	Investments take off from 2011	Low priority, scarce investments for all the forecast period

Source: IDC Government Insights 2009

Quantitative Indicators

The quantitative indicators of these sub-scenarios, feeding into the e-skills demand-supply model, are the level of IT spending (split by group of sectors) and the share of total IT spending on GDP.

Exhibit 2-5 IT spending trends 2008-2015 by Innovation Sub-Scenario

	Continuing on the Innovation Path	Jumping ahead	Brakes on IT Innovation
ICT Industry	Moderate Growth	Rapid growth	Low growth
High Intensity (HI) User Industries	Moderate Growth	Rapid growth	Low Growth
Low Intensity (LI) User Industries	Low Growth	Moderate growth	Low Growth

Source: IDC Government Insights 2009

2.2.3 Continuing on the Innovation Path

Description

This sub-scenario represents an extrapolation of the most likely path of ongoing trends, built on the main expectations of the interactions between innovation drivers and barriers. It assumes that ICT will continue to play a driving role in the economic development model of the European system after the crisis, as it did in the past decade, but also that the evolution towards the knowledge economy will accelerate, as traditional sectors slow down and knowledge-based industries and services gain ground.

In this sub scenario, innovation trends which today are already advanced accelerate to penetrate deeply in the user industries, while more radical innovations (such as enterprise 2.0) begin to spread among pioneer and advanced users, starting to produce real impacts on the economy only at the end of the forecast period. The ICT industry and the High Intensity (HI) User Industries drive ICT innovation, while Low Intensity (LI) User Industries tend to lag behind, with the exception of a few pioneers.

More specifically, industrialization of development and delivery of ICT solutions is widely adopted in the ICT industry and the High Intensity user industries, enabling particularly software and services companies to increase productivity and efficiency in delivering solutions to customers while improving margins. But also enterprises that are heavy users of ICT in order to deliver product and services to their customers (e.g. financial services) implement these innovations to cut service development costs and improve margins.

Cloud computing and other innovative delivery models start being adopted by pioneers and most advanced enterprises (20-30% of the market), with an acceleration at the end of the forecast period (2012-15), but with a limited range of available applications. The diffusion of Enterprise 2.0 applications and services is similar, affecting the high end of the market. There is some diffusion of utility computing in a minority of pioneer LI IT users, with high tech SMEs at the forefront. Unified communications become a common characteristic of enterprise environments, excluding only technology laggards, and this enables a sharp increase of mobile work.

After some delay due to the aftermath of the economic crisis, Europe starts investing in the Future Internet, increasing R&D investments (towards the end of the forecast period) and launching new initiatives, such as public-private partnerships and cooperative research alliances. A new wave of innovative services starts appearing, as the Internet of Services and the Internet of Things begin to materialise.

Main Impacts

These trends lead to efficiency improvements and productivity growth for the innovative enterprises (mainly within the ICT industry and HI User Industries), in parallel with the reorganization of IT supply chains for a sizable part of the market.

The transformational impacts of this innovation begin to be perceived, as advanced users change their relationship with suppliers and evolve their internal business processes. The decrease of costs for run-of-the-mill IT applications and services frees up resources for innovative enterprises to invest in new IT-based projects, without decrease of the quality of services.

The diffusion of Enterprise 2.0 services leads to a transformation of relations with clients; innovative enterprises launch a growing number of virtual communities with customers and introduce practices of co-design of new products and services. These benefits become competitive advantages for pioneer adopters and innovative companies in their respective sectors and geographical regions. This, in turn, leads to an increase of competitiveness of the European HI User industries. The European ICT industry keeps fighting to survive in a global market where Asia-Pacific emerging countries attract most new ICT investments, without losing ground but without winning the battle, either.

Impact on the demand of e-skills

This sub-scenario has mixed impacts on the level and type of demand of e-skills. The industrialization of ICT development leads to a slight decrease of demand of programming and ICT production skills, with a change of mix of skills with more managerial and customer service skills requested. The new business models and new ICT delivery models also lead to a switch in technology skills, rather than an absolute increase/decrease.

At the end of the period, an increase in the demand for R&D skills is likely, driven by the start of investments in the Future Internet, with possible skills shortages.

Overall, the trend of e-skills demand is of slight increase, correlated with overall IT spending increase.

Level of likeliness and potential barriers

This scenario is considered the more likely, even if it remains somewhat optimistic from the point of view of IT growth. Barriers, which may prevent the realization of this scenario, concern the lack of funding for investments and the European markets fragmentation, slowing down the diffusion of innovation and the materialization of innovation demand. There is also a risk that global IT companies may move their investments to emerging Asia-Pacific markets, reducing Europe to a purely commercial market.

2.2.4 Jumping Ahead

Description

This sub-scenario envisages a jump ahead of ICT-driven innovation, a breakthrough with the past with a strong acceleration of the knowledge economy in Europe, thanks to a virtuous circle driven by widespread diffusion of ICT-based innovation across the economy. In this scenario, as soon as the recovery gets underway in 2011, the ICT industry in Europe accelerates its investments in innovation and both the High Intensity and Low Intensity industries invest in ICTs in order to catch the opportunities of the economic recovery and improve their offering with IT-based services. The turning point in this scenario is the massive adoption of ICT innovation by SMEs, particularly high-tech SMEs and medium-size enterprises (the fast growing "gazelles" described by economic literature as one of the key potential success factors of the European economy). This helps Europe to compete successfully with the

emerging Asian economies, or at least to keep pace with them, focusing on sophisticated and value-added activities.

The two main trends driving this scenario are the diffusion of Enterprise 2.0 applications and services and of new ICT delivery solutions (cloud computing, Saas and utility computing). The ICT industry and the majority of mainstream IT users adopt both Enterprise 2.0 accompanied by new delivery solutions by 2015 (reaching 50% of the potential users market). Diffusion in the ICT industry and the HI user industry drives down prices, increases the range of applications available and improves usability, so that also LI User industries enter into the innovation cycle, with a slight delay compared to the other two groups of sectors. Unified communications become the standard environment for all enterprises, save the most laggard ones, enabling mobility and flexibility in communications within and outside the enterprise. The diffusion of easier to use technologies and industrialization of the development of ICTs contribute to reduce costs for basic applications liberating resources for innovative projects.

This environment is naturally strongly favourable for Future Internet investments and research. The ICT industry with the cooperation of advanced, sophisticated IT users and governments launch public-private partnerships who start investing into the development of smartgrids, smart urban transportation systems, smart healthcare systems, as well as the next generation of high-speed internet networks and technologies. This paves the way to achieve widespread productivity and competitiveness benefits. The acceleration of broadband and high-speed networks reduces the digital divide and opens new markets for Internet-based applications and services.

Main Impacts

The acceleration of innovation will enable a relaunch of the European ICT industry, which will be transformed, particularly the software and services industry. A new breed of light "butterfly" companies - no overhead, very little staff, efficient system of partnerships – will arise, cooperating in new value chains to provide cloud services: the new skills will develop inside the cloud. There will be a strong de-verticalisation, leading to the emergence of a few leading “software systems manufacturers” and quite a few “software component developers”. Moreover, the software system of a manufacturer will become a “platform” for the component developers. Hence, in a few years from now, the software market may look very similar to the automotive industry.

One key impact of de-verticalisation will be that, for small and medium-sized ICT market players, not being “big” will no longer mean to be « marginalised ». Thus, a lot of innovative companies will emerge, fostering creativity into the software world, once realised that one can thrive as a Tier-1, Tier-2, Tier-3, etc. “component developer”, providing “spare parts” to the integrator – platform provider who will remain responsible in front of the client to deliver an integrated package. Among these spare parts, whether proprietary or Open Source, there will be the regional / local adapters that will continue to be required for the foreseeable future, especially in Europe as national regulations will survive possibly for ever.

The combination of Enterprise 2.0 and Utility/Cloud Computing will have strong transformational impacts on the business processes of the majority of HI User companies and many LI User companies: IT budgets will increase because of the investments in new projects and IT-based services, rather than maintenance and traditional IT systems. Because of the acceleration of the innovation cycle, user enterprises will start seeing productivity improvements and efficiency-effectiveness benefits already in the forecast period. Overall, the European economy will benefit from an improvement of productivity and competitiveness, getting again on a faster growth path.

Impact on the demand of e-skills

For the ICT industry, this sub-scenario will see a slight decrease of demand of programming and ICT production skills and an acceleration of the evolution of the skills requested, with an

increase of demand for managerial and customer service skills (customer support). There will be an increase of demand for R&D skills in the short-medium term, with possible skills shortages since high-level technical skills are already scarce. At the end of the period, there may be an increase in the net demand of e-skills, but off-shoring and outsourcing may counterbalance this.

For the High Intensity User industry, this sub-scenario foresees a net increase of demand of e-skills, with a specific focus on managerial and customer care skills, due to the diffusion of IT-based services and virtual communities. Sophisticated enterprises and service providers will also increase the demand for high level technical e-skills, when participating in the development of Future Internet networks and services.

For the Low Intensity User industry, there will be a mixed impact, with a decrease of demand of e-skills (due to the diffusion of utility computing, for example, that is outsourcing some of the traditional maintenance of IT) and an increase of business-oriented e-skills, probably with a marginal positive impact.

Likeliness and Main Barriers

This sub-scenario is less likely than the first, but could still happen, especially if the pace of technological innovation remains high, and particularly if some technological breakthroughs occur (see the Wild card trend described above). The main barriers are similar than the previous scenario, but more relevant: the lack of investments in innovation and the Future Internet, inhibiting the virtuous circle between demand and supply, would make it impossible. The lack of high-speed broadband network in the key markets would also be a major obstacle. European markets fragmentation, and European organizations reluctance to embrace organizational innovation are also important barriers. The choice of global IT companies to move abroad their facilities and investments, before the European market has a choice to start growing again after the crisis, would also be a critical problem.

2.2.5 Brakes on IT Innovation

Description

In this sub-scenario a very slow economic recovery from the crisis discourages innovation investments. The ICT industry move to off-shore not only the simplest operational activities, but also higher-value added ones, such as R&D and product innovation, while in Europe companies focus only on commercial networks and sales. Vision, Strategic planning and Product Lines management are more and more concentrated at the headquarter level in the US, Japan, and in the future in India and other Asian Countries.

Main innovative applications and services such as Enterprise 2.0 and Cloud Computing grow very slowly and are adopted only by few pioneer companies, failing to trigger the positive growth cycle. Main ICT industry and user companies still invest in the industrialization of IT solutions development, but only to reduce costs on the most common applications and services. Unified Communications still become widespread, enabling mobility, but lower speed networks reduce the breadth of multimedia and video applications. High Intensity IT User Companies reduce their investments in innovative projects and Low Intensity IT User companies do not innovate at all in ICT, concentrating their efforts in the reduction of IT budgets. Future Internet developments and research are considered low priority, with few investments allocated to building the next generation infrastructures.

Main Impacts

The transformational and productivity impacts expected from IT-based innovation sweeping across the European economy do not materialize in this scenario. Only advanced, sophisticated IT users enjoy some benefits from the reorganization of their business processes

and networking with their closest partners, but this does not affect the largest part of the supply chains. This is essentially a scenario of missed benefits and missed opportunities.

Impacts on the demand of e-skills

The demand of e-skills in this scenario may decrease slightly (as there is no innovation, but also no transformation so traditional IT maintenance needs remain). There could be a reduction of the demand of R&D and high level technology skills (due to lower research investment and strong off-shoring). The demand of ICT management and marketing skills will not increase as much as in the other scenarios.

Likeliness and Barriers

This sub-scenario is less likely than the first, but not at all impossible, if instead of a virtuous circle Europe enters a negative cycle of low growth and lack of courage to innovate (a bit like Japan's "lost decade"). The turning point for this scenario will be the years 2010-2011, when the economic recovery may or may not gain momentum, and enterprises will make their choices on their business strategies and perspectives for the near future. The main factors which may prevent this scenario will be the willingness of European enterprises to bet on growth again, the evidence of the potential benefits to be gained with innovation, the support of proactive policies, the start of new investments. The overall social climate (confidence or lack of confidence) will also play an important role, to favour or prevent choices for innovation. The choices of ICT companies themselves will also be relevant: if they accelerate their plans to move from Europe production and research facilities in the key years of transition, this may create a negative momentum for the industry.

2.3 Outsourcing and Off-shoring

As discussed in the ICT innovation scenarios, outsourcing and off-shoring are critical trends closely connected with the evolution of the ICT industry and of the choices of the IT user industries. Because of its high level of uncertainty and high potential impact on the e-skills market, this trend has been highlighted and singled out, even if it is not really an independent sub-scenario, rather a component of the overall ICT innovation subs-scenarios, closely following their dynamics. These paragraphs provide an overview of the main driving factors of outsourcing and off-shoring growth and their potential impacts on e-skills demand.

Description

While outsourcing and off-shoring are closely connected, the terms cannot be used interchangeably. Outsourcing of IT has grown in importance in the IT industry for the past 40 years. In an outsourcing arrangement, the customer will generally transfer assets to the outsourcer for this vendor to manage and operate on behalf of the customer. These assets typically include computer systems and can also include the transfer of staff as part of the contract. An outsourcing contract, because of the complexity of transferring responsibility for managing and operating the environment as well as the assets, typically runs for five to ten years. The majority of the work in operating and managing the outsourced environment will, at least initially, often take place at the customer site but can then, over time, be transferred to the vendor's facilities to achieve economies of scale.

Over the past two decades, technological developments and improvement in the stability of telecommunications and the associated costs have made it possible to move more and more activities outside the customer's domestic location to a country where it is possible to gain access to skills and resources cheaper than in the customer's country. This phenomenon has been termed off-shoring. However, off-shoring does not necessarily need to be part of an outsourcing arrangement, if we keep to the definition of needing transfer of assets. Increasingly, use of off-shore resources is also becoming part of project engagements, where

there are no asset transfers but where the vendor makes use of labour arbitrage to deliver the project to the customer at a lower price. One further distinction is worth noting. Quite often, the term near-shoring is also used. In reality, all this term covers is off-shoring but in a location that is geographically close to the customer, e.g. in a neighbouring country.

Measuring the e-skills impact

Assessing the e-skills impact of outsourcing and off-shoring is not a simple task since there are several forces working in almost opposite directions.

Quite often, and as witnessed especially in the current economic environment, customers will use outsourcing and off-shoring to take out IT operational and application development costs from their budgets. However, over the several years of observing the dynamics from outsourcing and off-shoring it is clear that there is no direct relationship between number of skills employed with the outsourcer and off-shorer and potential job losses in the customer's IT department. Why is this not the case?

First of all, one of the premises of getting a specialist vendor to take over an IT activity, whether this is running the main IT environment, developing a specialist application, or supporting and maintaining a core enterprise application, is to take advantage of the economy of scale and therefore lower cost that the vendor can bring. This is through being able better to use specialist skills perhaps across several customers, rather than having a specialist that may be idle some of the time (which could be the case for the customer's internal staff), using industrialized and automated approaches to service delivery (which are less likely to be found in all but the largest IT department) – and now increasingly being able to use the best resources from the best country location at the best price.

Secondly, very often IT departments offload some of the non-core activities to achieve the economies of scale described above while freeing up resources to take on burning core activities that had previously been put aside due to lack of resources. In this case, no jobs disappear but because, for example, some of the operational activities can be performed cheaper, the customer can now do extra work using the existing resources.

A further aspect is that even in an off-shore agreement not all tasks are undertaken in an off-shore location. Many will still remain with the customer on-shore (or at the customer premises). There are strong variations for this depending on the scope and content of the agreement but it is very likely that in an off-shore agreement, the off-shorer will still have 20-30% of staff working on the account on-shore. Combining this with the customer using off-shore agreements to free up staff to do other work (rather than making them redundant) it should be clear that assessing the impact of off-shoring is not a straight forward exercise.

For outsourcing overall, it is even more muddled since in traditional outsourcing arrangements, where staff is transferred, they will typically stay in country and over time become part of the outsourcer's employee base that is used to deliver services also to other customers.

Finally, not everything can be off-shored (or indeed outsourced). There are specific tasks where customers have a very strong preference for working with skilled people that understand fully the business culture, the language and the environment. Also, in particular for the public sector in Europe, it is quite clear that off-shoring remains a very difficult subject to tackle – even if the sector would like to save money on the back of economic recovery packages and budget deficits.

However, looking at the ICT industry in itself, it is clear that there is a major push to move both R&D but also service delivery off-shore, where possible. A major driver for this is to protect margins and industrialise service delivery as much as possible – but certainly also to gain access to highly educated skills that may otherwise be in scarce supply within Europe. Having said this, there also seems to be a trend where vendors try to establish centres of

expertise, particularly around specific industry sectors, close to the customers. European customers still prefer to see references that are close to their own environment, and the ICT industry is responding to this – even if some of the centres end up in the newer member states in the European Union, i.e. near-shore, rather than off-shore.

How do we measure the off-shore impact on e-skills? As discussed above, there are several assumptions needed in order to estimate the impact:

- The actual amount spent on activities delivered from off-shore (i.e. from outside the EU). IDC has tracked this market for the past decade and can arrive at an estimated amount and forecast based on analysis of off-shore vendor revenues, discussions with customers and large-scale end-user surveys that include spending intentions.
- A translation of this amount to how many headcounts this spending could cover, taking into account also specific costs in an off-shore engagement for e.g. travel, extra management time, etc.
- Assumptions on the degree to which an off-shore headcount will directly displace an on-shore headcount, i.e. making a call on whether companies use off-shoring to free up the time of their existing staff for more crucial projects or doing straight labour arbitrage.

Because of the complexity of the off-shoring factors, these assumptions will have to be made on a best effort basis.

- **Assumptions of Off-shoring trends in the Innovation scenario "Continuing on the Innovation Path"**

This sub-scenario will to some degree lead to easier outsourcing of non-core activities in the services value chain. The annual growth of IT outsourcing revenues in the EU27 is expected to be in the range of 2 to 5%, slightly higher than the pace of annual GDP growth, in the forecast period.

Off-shoring revenues are driven first by the need to cut costs and then, when economic recovery kicks in, to keep improving operational margins.

As the scenario it refers to, this is the most likely trend according to IDC estimates.

- **Assumptions of Off-shoring trends in the Innovation scenario "Jumping Ahead"**

Enterprises will continue to invest in outsourcing and off-shoring of the non-core IT activities, while keeping in-house at least the control of most critical applications and services. The assumption is that off-shoring will grow at a similar rate as in the previous scenario, but since the economy and the IT spending will grow faster, this will result in a lower relative incidence of off-shoring on total IT spending.

Because of the "jump ahead" of ICT innovation, this level of growth of off-shoring will appear as moderate (compared to overall economic and IT spending growth) and it may have a lower share of overall IT spending.

- **Assumptions of Off-shoring trends in the Innovation scenario "Brakes on innovation"**

Since user enterprises focus on traditional uses of IT and cutting costs, without much innovation, outsourcing (which accompanies some of the advanced delivery models such as utility computing) does not actually grow much faster, even if the industrialization of applications development does lay the basis for some outsourcing and concentration of development in specialised companies. Overall, outsourcing revenues are expected to grow about 5-7% annually in this period.

Off-shoring by the ICT industry instead is expected to grow strongly, as IT companies and some of the HI User companies relocate production and research elsewhere. The annual

growth rate of off-shoring revenues in the EU27 is expected to be two to three times the rate of annual GDP growth, higher in countries as the UK, with a strong propensity to it.

2.4 The Macroeconomic Sub-scenarios

The macroeconomic sub-scenarios are based on alternative hypotheses of economic growth of the main European Union economies in the period 2010-2015. 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.

The crisis hit the ICT industry hard, but less than the Internet bubble burst. Overall, hardware sectors such as semiconductors and communications equipment are declining less than in 2001-2002, and in comparison some ICT services are performing worse than in 2001-2002. Longer-term prospects and trends for the ICT sector remain good with cyclical and structural growth continuing across many segments, as ICTs become embedded in all economic, social and cultural activities (*see OECD, The Seoul Declaration on the future of the Internet economy, 17-18 June 2008*).

There is a general consensus by most public sources that the next two years (2010-2011) will see the end of the economic crisis (some say this will already happen at the end of 2009) and the start of the recovery, with a return to higher growth rates only from 2012 onwards. Given the magnitude of the crisis, it will take several years to get back to the absolute levels of wealth (and global trade) of 2007.

There is still uncertainty on the precise level of the GDP downfall in 2009 (even if it is now accepted that the decline for the first time hit all the world economies, none excluded), while the forecasts for 2010 still vary but in a limited range, as almost no economist foresee a strong rebound in the immediate future.

The macro-economic sub-scenarios are based on a comparative assessment of the assumptions and forecasts of the OECD, the IMF, the EIU and IDC for the IT spending estimates.

At the time this report is written, there is still a very high level of uncertainty about the future trends of macro-economics so that forecasts at 2015 are not available yet.

In order to build the following scenarios, we had been using the available forecasts of OECD, IMF, EIU (Economist Intelligence Unit) to 2009-2010 and data series from the early 1990s. The IDC forecasts at 2015 are based on the available data series and on a number of assumptions developed under each sub-scenario.

2.4.1 The Moderate Growth sub-scenario

Description

This sub-scenario foresees a return to the historical development trajectory experienced before the crisis, in terms of growth rates and IT innovation. According to this hypothesis, in the next two years the main EU economies will be on their way back to where they were, to a sustainable growth path and sustainable levels of employment. During this first sub-period, GDP will gradually recover from negative to positive figures and will then eventually be back to a sustainable rate of growth approximately in 2011-2012. Given that unemployment reacts with a delay to GDP developments, unemployment rates will first go up and then gradually down.

In the second part of the forecast period, average growth rates are estimated to return to the level achieved on average over the period 2000-2007. Sustainable growth should occur in

2012-15, except for the UK and Spain, where the comparatively more adverse labour market consequences of the crisis will slow down the recovery until 2013. The actual outcome and timing of the exit from the crisis will much depend on what happens to the labour market, namely on the extent to which the crisis results in seriously negative second-round effects from increasing unemployment onto consumption and investment and thus GDP growth. This is why we expect the UK and Spain to pay a higher toll in terms of growth in the near future.

In this scenario the incidence of IT spending on GDP goes from 2.58% in the EU27 in the year 2009, to 2.95% in 2015. In other words, global IT spending grows faster than GDP, but not by much, similarly to the historical trends of the industry.

Exhibit 2-6 Moderate Macroeconomic Growth (GDP % growth)

	2009	2010	2015
France	-2.5	0.2	2.0
Germany	-6.1	0.2	1.1
Italy	-5.0	0.4	1.1
Spain	-4.2	-0.9	3.4
UK	-4.3	0.0	1.9
Poland	-0.4	0.6	4.0
EU21	-4.8	0.0	2.1
EU27	-4.3	0.2	2.4

Source: IDC 2009, forecast based on various sources, OECD, EIU, IMF

Main Impacts

The baseline scenario for GDP growth embodies the idea that the growth process in Europe "after the deluge" will evolve somewhat in line with the developments in place "before the deluge". In other words, if the crisis does not bring about major structural changes:

(1) the gradual introduction and adoption of ICT of the past ten years will continue;

(2) the policies that have made European labour markets more flexible than twenty years ago (and contributed to generate an impressive pace of job creation in European countries) will not be discontinued.

Both (1) and (2) will imply the continuation of the past trends of skill-biased technical change and increased wage differentiation between the skilled and the unskilled, observed in the last twenty years or so.

Based on these hypotheses, we expect labour productivity to fall considerably in 2009 (and the number of hours worked to fall less) but not as much as GDP, due to the process of labour hoarding. We also expect this to go up somewhat in 2010 due to the process of labour shedding (originating from the GDP crisis in 2009) and then further up in 2011, before reaching its long-run growth rate in 2012-13.

This implies negative employment growth in 2009 and 2010, becoming roughly zero in 2011. Employment growth will then gradually become more positive, reaching +0.8% in 2014-15. If the future resembles the past, the bulk of job creation in Europe will take place in Spain, the UK and, to a lower extent, in Italy.

Likeliness and barriers

As discussed above, this is considered as the most likely scenario.

2.4.2 The High Growth sub-scenario

Description

This scenario envisages a strong acceleration of economic growth in Europe, with an even stronger acceleration of IT spending, both driven by the transition towards a different, more dynamic development model (what we called a jump ahead towards the knowledge economy). The GDP growth rates may seem not too different from the previous scenario, but on the macroeconomic scale this variation is not small. In any case, European structural problems will not disappear in a day, and even if we assume a radical change in the development model, the most important impacts on the growth potential of the economy would still appear after 2015 rather than before.

This best case scenario might be the one in which Asian countries successfully decouple their growth rates from the West still plagued by low growth from 2011 onwards, the US economy goes back to intermediate growth rates (well above zero, albeit lower in 2000-07) and no major bad news from the banking sector in the EU come about. This means China going up to average growth rates of 10% per year. This would mostly benefit countries for which China exhibits a relatively high share of their exports, such as Germany. This is less so for Italy and Spain for example. But if Germany exports more, it would also import more from Italy and Spain.

Exhibit 2-7 High Macroeconomic Growth (GDP % growth)

	2009	2010	2015
France	-2.5	0.2	2.2
Germany	-6.1	0.2	2.7
Italy	-5.0	0.4	1.6
Spain	-4.2	-0.9	3.5
UK	-4.3	0.0	2.2
Poland	-0.4	0.6	6.6
EU21	-4.8	0.0	2.5
EU27	-4.3	0.5	3.2

Source: IDC 2009, forecast based on various sources, OECD, EIU, IMF

Main Impacts

The first impact of this scenario will be faster productivity growth in Europe (thanks to the "jump ahead" of innovation); there will also be positive impacts on the overall competitiveness of the European economy and European industries. There will be positive impacts on employment as well, but they will take time to materialize, even if employment will return positive since 2012.

In this scenario the incidence of IT spending on GDP goes from 2.58% in the EU27 in the year 2009, to 3.33% in 2015. In other words, global IT spending grows rather faster than GDP, as it did in the best years of the period before the crisis.

Likeliness and barriers

This sub-scenario is relatively unlikely, but not impossible, since it is driven by the twin engines of fast recovery of global trade and fast innovation. A minority of economists are actually arguing in favour of a fast and strong recovery, based on the rationale that when the downturn is particularly steep and deep (as it happened in 2008-2009) the bounce back tends to be as fast. The likeliness of this scenario depends on private and public initiative, as well as some luck (for example some technological breakthroughs) as discussed in the other sub-scenarios.

2.4.3 The Low Growth sub-scenario

Description

This scenario is based on the assumption of a very slow economic recovery from the crisis. Europe enters a stagnation cycle where neither innovation, nor export, seems able to trigger a return to growth. This could be caused by protectionist measures (slowing down the return of global trade to the levels reached before the crisis) and/or by a reversal in the labour and product market reforms implemented in the last fifteen years. The dramatic effects of the crisis could drive governments to re-introduce tighter labour and product market restrictions, to fight the rise of unemployment. In addition, a resurgence of banking problems not yet completely solved might also lead to a similar scenario.

Main Impacts

This scenario may impede the continuation of the process of innovation in European economies. If this materializes, this would mostly depress potential GDP growth in the period 2012-15. Or, it may simply redistribute a given amount of GDP growth away from growth of total hours into higher labour productivity growth for the induced substitution of cheap capital for expensive (or inflexible) labour. This will depress job creation and raise unemployment among the unskilled upfront and over a longer run. The payoff of this would probably a lessening of the process of increasing wage differentiation. This would result in lower growth of total hours and, in parallel, higher growth of labour productivity (from capital deepening, though, not from faster total factors productivity growth).

In this scenario the incidence of IT spending on GDP goes from 2.58% in the EU27 in the year 2009, to 2.65% in 2015 that is essentially stable. This means that the historical growth rates of IT spending actually decline, even if the level of IT spending in absolute terms does not go down. Since much of IT spending is stable (being related with the maintenance and support of ICT systems used for daily business and communications) this means that basically no IT innovation is implemented.

Likeliness and Barriers

The level of likeliness of this scenario depends on a reversal of the economic and trade policies implemented in Europe in the last 20 years, so it would appear rather unlikely in its entirety. Some of these developments (for example, the slow recovery of global trade) however are not so unlikely, as it the possibility that some countries may suffer more than others from an insufficient recovery.

Wild card

This negative scenario might also be caused by a major negative socio-political event affecting global stability and, again, restraining international trade and economic growth. This could be a major terrorist action, as it could be the murder of President Barak Obama; or the bombing of Iran by Israel; or a new war erupting between Pakistan and India, perhaps caused by the fall out of events in Afghanistan.

Exhibit 2-8 Low Macroeconomic Growth (GDP % growth)

	2009	2010	2015
France	-3.0	0.1	1.7
Germany	-6.1	0.0	0.9
Italy	-5.5	0.3	0.8
Spain	-4.2	-1.0	3.0
UK	-4.3	0.0	1.5
Poland	-0.4	0.5	3.5
EU21	-4.8	-0.2	1.5
EU27	-4.6	0.0	1.6

Source: IDC 2009, forecast based on various sources, OECD, EIU, IMF

2.5 The Education Sub-scenarios

2.5.1 Main Trends

Computer science graduates are the first and most relevant "inflow" contributor to e-skills supply. There are as well computer graduates from non-tertiary courses that might enter the workforce as ICT professionals; these graduates might contribute a significant share to the total degree holders in computer courses. As a conclusion, the annual number of computing graduates is a proxy of the pool of ICT skilled persons that might enter the workforce.

Besides computing graduates, graduates from other fields might enter the ICT professional's labour force, especially for students in the field of "science, mathematics or engineering".

Education is, as a consequence, one of the major factors influencing e-skills supply. The take up of computing courses is highly influenced by the perceived job satisfaction and security, by likely levels of remuneration in future years, especially where compared with the remuneration in other industries. Finally, the overall image of the ICT industry may significantly influence the take up of computing courses.

Education, especially the formal one is in our model a variable that may be considered difficult to be modified within the timeframe we analyse. The skills required by the society development evolve in the long term and within our five years timeframe, professional profiles, competencies, and skills required are not expected to change dramatically. That's the reason why we expect that the trends in the formal education will not change dramatically, but they can slightly change because of the attractiveness of the sector. The attractiveness of the sector depends on the general economy trends and on the ICT industry competitiveness and trends. When socio-economic change accelerates, formal education systems prove comparatively slow to react and to adapt. Changes made in the tertiary education will make their effect evident at least three to five years later.

What we expect to change in a significant way within the general scenarios is the attractiveness of the ICT sector. The attractiveness of the sector as defined above will determine a different percentage of ICT skilled people entering into the ICT labour market. When attractiveness of the sector increases it may happen that the number of graduates/professionals entering the ICT sector will increase; when the attractiveness of the

sector decreases, the number of graduates/professionals entering the ICT sector will decrease.

Exhibit 2-9 Summary of Education Sub-Scenarios

Main trends	Moderate attractiveness of ICT careers	High attractiveness of ICT careers	Low attractiveness of ICT careers
General economic and ICT scenario	*Moderate growth of macro economy and moderate growth of ICT industry*	*Rapid recovery from the economic crisis and high growth of ICT industry*	*Very slow recovery from the crisis and low growth in the ICT industry*
ICT formal Education			
Impacts on e-skills supply	Slowing down of the decline of ICT graduates and stabilization of their number at the end of the forecast period	Increase of ICT graduates	Decrease in ICT graduates
Evolution of supply by type of e-skills	The mix of skills supplied by formal education remain unchanged	Growing relevance of R&D skills	Growing relevance of marketing skills
ICT training (non formal education)			
Impacts on e-skills supply	Enterprises' training budgets will slowly get back to pre-crisis levels	Increase of the training budget	Decrease in the training budget
Evolution of supply by type of e-skills	Similar to the one offered before the crisis	Marketing skills and management skills	Marketing skills

Source: IDC 2009

Beside the formal education, there is an ICT workforce that has not taken a formal education computer or scientific degree, but that might have acquired ICT professional skills informally through training on the job or private interest or that might have taken IT practitioner training courses offered by different vendors. The non-formal education, being managed by the enterprises, is a tool that industry might use in case of shortage of e-skills, providing effects in the short to medium term.

When the attractiveness of the sector increases, demand of ICT skilled people will increase, and supply may be insufficient: enterprises may face a shortage of ICT skilled people. In this case, enterprises might use training as a tool to help them to face the shortage of skilled people.

Combining both formal higher education trends and non-formal education (training) trends, based on the level of attractiveness of the ICT industry, we identify three different scenarios for the overall education of ICT skills. Another relevant aspect of the education sub-scenarios that we expect to change is the evolution of supply by type of e-skills. The consequence of

the three sub-scenarios is a variation of the supply of e-Skills in the EU, measured in terms of the annual numbers of ICT graduates and ICT career changers (that is the number of individuals with non-ICT degrees entering the ICT labour market every year). These indicators feed in turn into the foresight model (see Methodology Annex for more details).

Exhibit 2-10 e-Skills Supply trends by Education and Training Sub-scenario 2008-2015

Indicators	Moderate attractiveness of ICT careers	High attractiveness of ICT careers	Low attractiveness of ICT careers
Number of ICT graduates	Extrapolation of present trends	Boost due to enhanced attractiveness	Lower growth than present trends
Number of ICT Career Changers	Extrapolation of present trends	Boost due to enhanced attractiveness	Lower number of entries than present trends

Source: IDC Government Insights 2009

2.5.2 Moderate attractiveness of ICT careers

Description

This education scenario envisages a macroeconomic moderate recovery from the crisis and at the same time a moderate path of the innovation in ICT. This means that recovery from the crisis will be slow during the upcoming years and competitiveness of European economy will remain stable at the same level it was before the crisis. ICT pervasiveness will be as it was before the crisis so that the European productivity will be stable and the contribution of ICT to productivity is not foreseen to increase significantly. Based on these backgrounds, the ICT infrastructures are improving very slowly.

As a consequence, the overall image of the ICT sector is going to be satisfactory and the ICT careers are going to be perceived as moderately secure with levels of remuneration relatively competitive with other sectors. Therefore, the attractiveness of the ICT careers is going to be moderate with a moderate level of computer graduates and science graduates moving in the sector.

The decline of new graduates is going to slow down with their stabilisation at the end of the forecast period.

Main Impacts

The skills required by the economy are not expected to change dramatically, so that the skills supplied by formal education are going to remain unchanged and similar to the pre-crisis period. Moreover, skills addressed to increase innovation are going to be stable.

Enterprises' training budgets will slowly get back to pre-crisis levels. The recovery from the crisis being slow, enterprises prefer to hire employees already available on the labour market instead of investing on training on the job.

The mix of skills provided by enterprises' training is similar to the one they offered before the crisis. On the job training mainly provides skills addressed to marketing and sales, while for the research skills and for the management skills they usually prefer to attend to the supply available on the labour market and supplied by the formal education.

Likeliness

This is the most probable sub-scenario, since the macroeconomic scenario is based on a slow recovery from the crisis that is expected as the most likely scenario for the upcoming years, with an innovation path similar to the one we had before the crisis.

2.5.3 High attractiveness of ICT careers

Description

In this sub-scenario, a rapid recovery from the economic crisis is expected accompanied by an important innovation path and high growth of ICT industry with an increasing pervasiveness within all the sectors. This process will favour an increase in the general productivity and an increase in the European competitiveness.

The perceived image of the sector is going to improve and the average remuneration is going to increase where compared with the other sectors, and the security in being employed as an ICT professional, both in the ICT or in the user sectors, is very strong.

Main Impacts

As a consequence, the attractiveness of the ICT careers is very high and the share of computer science students and other science students entering the ICT sector and ICT careers will be very high. Also, the number of graduates from other branches starting ICT careers will increase.

The decline of the number of ICT graduates will stop and will start increasing at the end of the forecast period. Since ICT industry is expected to grow and its innovation capacity is expected to improve, R&D skills are expected to be more important than they were in the past. R&D skills are going to be developed within formal education system. At the end of the forecast period, university will probably start providing management skills and marketing skills to complete ICT education

Within this high growth scenario, the industry may face a shortage of the e-skills. Enterprises may face this shortage by increasing their training budgets getting them higher than they were before the economic crisis. The training will especially focus on developing and providing marketing skills and management skills, while for the R&D skills enterprises will hire people already available on the labour market and supplied by the formal education.

Likeliness

This scenario is not expected to be very likely; currently, in fact the fast recovery from the crisis is not expected to be a very likely scenario.

2.5.4 Low attractiveness of ICT careers

Description

In this scenario, a slow recovery from the economic crisis is expected, with a slow diffusion of ICTs into the user industries. European productivity is not going to improve and competitiveness is going to slow down while unemployment is expected to grow across Europe. Information infrastructures are going be steady. The perceived image of the ICT sector is not improving because the average remuneration of the ICT practitioners is slowly declining, where compared with other sectors. At the same time, the security of the ICT careers is low, especially where compared with other mature and traditional sectors.

Main Impacts

ICT career paths are not getting attractive. There is gradually a diminishing interest in maths and science computing in European higher education. ICT graduates decline continues in the beginning of the forecast period and it stabilises at the end of the forecast period since enrolment trend is stable or slowly decreasing.

The innovation path in the ICT sector is not improving so that the relevance of the R&D skills toughed by formal education is expected to decrease. On the overall, skills addressed to generate innovation and to manage cross-cultural environment are less relevant than it was in the past. In the meanwhile there is an increasing relevance of marketing and sales skills: at the end of the forecasting period, university may focus on sales and marketing skills more than it was in the past. Supply from basic education (secondary school) is stable.

Overall, from the beginning of the forecast timeframe, the share of graduates from computer sciences and from other science courses starting ICT careers will decrease.

Enterprises are reducing the employment, including e-skills. Enterprises are expected to reduce their training budgets and where possible, will hire licensed people from secondary school.

Training provided and developed from enterprises is expected to be mainly sector specific skills, as well as marketing and sales skills. On the opposite, R&D skills and management skills are going to be relatively less relevant. An increasing part of the e-skills required by companies are acquired on the job.

Likeliness

This is the most pessimistic education sub-scenario. It is not at all likely, since it is based on the assumption that European economy will stop to increase its innovation capacity, getting a mature and traditional economy with stability in productivity.

2.6 The Socio-Policy Sub-scenarios

2.6.1 Main Trends

These sub scenarios focus on the main trends of European Commission and EU governments' policies that affect the evolution of the global e-skills scenarios. While all information society and innovation policies influence the socioeconomic environment and therefore e-skills dynamics, the study team identified the following policy strands as those with the most direct impacts on the e-skills demand-supply balance in the period 2010-2015. They have been selected for the following reasons:

- Policies for the development of e-skills, for obvious reasons;
- ICT measures within the Economic Stimulus Package: policies launched by the EC and many EU governments to fight the effects of the economic crisis, because they play a role in the rate of economic recovery and the role of ICT in the European development model in the near future;
- ICT Research and Innovation policies, particularly those focused on the development of the Future Internet and the related new wave of applications and services, because they play a role in the timing and level of European investments in the Future Internet, one of the main differentiators between the scenarios.

The following paragraphs describe these main policy trends and their main characteristics and potential impacts.

Policies for the development of e-skills

The main driver for these policies is the e-skills gap always declared by ICT companies as a competitive disadvantage, particularly for specific kinds of e-skills. The main problems actually are the mismatches in the European labour market, which lead to IT unemployment and at the same time scarcity of e-skills, depending on the industry segment and the country (as discussed in our 1st deliverable). Several policy strategies to solve these problems have been developed or suggested at the EC and national level.

The main policy framework for the development of e-skills is the EC Communication "*E-Skills For The 21st Century: Fostering Competitiveness, Growth and Jobs*" and the related Action Plan 2007-2010, whose main action lines are the following:

- Promoting long-term cooperation and monitoring progress;
- Developing supporting actions and tools;
- Raising awareness;
- Fostering employability and social inclusion;
- Promoting better and greater use of e-learning for e-skills.

The policy measures promoted in this framework by the EU and some Member States include promoting e-skills careers, providing incentives for life-long learning and training for e-skills, raising the awareness of the young, particularly girls, to enter ICT careers, supporting the exchange of information and good practice for the promotion of science, maths, ICT and e-Skills, and in general sustain the development of the formal education system for science, maths and ICT.

This has led for example to the launch of the Code of Best Practices for Women in ICT (March 2009) to encourage young women to study and follow careers in the ICT sector. Since the launch of the Code in March 2009, 28 organisations including large corporations, Small and Medium sized Enterprises (SMEs), consultancies, academic institutions, NGOs and telecoms regulators have signed on.

On a similar vein, a recent INSEAD report (*Who cares? Who dares? Providing the skills for an innovative and sustainable Europe, 2009*) called for a European Skills Path to solve the European long-standing skills problem, particularly for high level scientific and technical skills, including e-skills. The actions suggested by INSEAD are a call for action to involve all main stakeholders in order to take strong measures affecting the education and training scenario in Europe, as follows:

1. Launch a Europe-wide public-private alliance to ensure the re-skilling of excess labour in times of crisis.
2. Re-focus the European Structural Funds earmarked for training and re-training in 2007-2013 towards the sectors most likely to contribute to Europe's competitiveness in post-crisis times.
3. Identify and scale-up successful public-private initiatives and partnership (such as JetNet), aiming at stimulating young people's interest for mathematics, science and careers in engineering, information and communications technologies and protection of the environment.
4. Enhance and develop high-level business universities partnerships to generate the 'Global Knowledge Economy' skills which Europe needs to realize the benefits of its Lisbon strategy and be a leader in innovation.
5. Encourage skills mobility within Europe, as well as between Europe and other parts of the world.

6. Foster innovative approaches to education, including through e-learning and distance learning.

There is also a growing perception of the relevance of the problem at the national level. The UK Government asked for a specific addition to its "Digital Britain" strategy, a report called " Creating the Skills for the Digital Economy: A summary of recommendations for action" which listed the following specific actions to be taken:

Ensure a healthy pipeline of talent into the workforce (for example promoting 'Digital Careers')

- Support the growth of entry level employment (for example launching specific Apprenticeship and Internship programmes for graduates entering Digital Professional careers, with flexible training contents)
- Accelerate the development of the existing workforce, launching a Digital Professional Skills Development Fund to be managed by the new Skills Funding Agency.

This last initiative by the UK government is particularly interesting, because it underlines that current skill policies tend to focus on the low-end of the market and that there is a lack of funding for training in the digital sectors. The UK Digital Fund should also provide funding for learning and learning credits by professionals. Since this is a sector with decreasing training investments by the industry and a growing number of professionals who will need to invest in their own employability (to compete with the workforce of Asian countries), the availability of funding to professionals fills an important gap.

This brief excursus does not of course summarize all existing e-skills policies but shows that there is a growing consensus about the need for proactive policies, and about the action lines of these policies.

The experts, according to our survey, agree that the EC and the Member State Governments will launch proactive policy measures to increase life-long-learning and training for ICT skills, particularly to increase the amount of training in this area by SMEs. They also agree that this could have a strong positive potential impact on the supply of e-skills for the next years. Some of the experts, however, profess a degree of scepticism about the willingness of policy makers and private stakeholders to back up these policies with substantial resources and effective actions, so that to make them successful.

ICT measures within the Economic Stimulus Package policies

The EC and many national governments have set up economic stimulus packages to address the economic crisis. The aim of these packages is to stimulate demand in the short term, i.e. refinancing banks, injecting cash into the economy and protecting existing jobs. However, most governments also plan to foster growth through smart investments, which have repercussions on the supply-side, helping to restore favourable conditions for innovation and long-term growth. In most cases these plans are directly relevant to the ICT sector and technology diffusion, and many include ICT-related elements, which should prove a positive stimulus to the ICT sector[2].

Many of the existing stimulus packages put some emphasis on deploying ICT infrastructure and a 'networked recovery' – i.e. the notion that ICT infrastructure and its use are a tool to revive the economy through new innovative services and offer solutions to pressing social challenges. Existing references to communications infrastructure in stimulus plans cover two key areas: extending broadband to areas without connectivity and upgrading existing networks to support very high-speed communications. The focus of many plans is on closing

[2] OECD – Working Party on the Information Economy (2009): The Impact of the Crisis on ICTs and their Role in the Recovery; Policy Responses to the Economic Crisis: Investing in Innovation for Long-Term Growth (June 2009) Paris, at www.oecd.org/dataoecd/59/45/42983414.pdf.

the broadband gap by providing universal broadband coverage throughout the country, but mostly in rural and remote areas. Some plans also devote resources to building out new, very high-speed networks (next-generation networks). In most cases, the exact meaning of 'broadband' and 'unserved' or 'underserved' is mostly not yet defined in terms of geography, speeds or technology. In all cases, the deployment of broadband is to ensure connectivity of most if not all businesses and households.

Besides direct investment in broadband, stimulus packages often have a more indirect but larger impact on ICT deployment and use, for example investment in "intelligent" transport systems, greener cars with more electronics and embedded software, smart buildings and electricity grids, smart health systems and modernising public services. Planned investments in these areas tend to be much bigger in monetary terms than those for broadband.

There is always an element of uncertainty about the level and effectiveness of implementation of these plans. The EC recovery package for example includes funding to extend and upgrade high-speed internet in rural communities. This support is targeted at the 23% of the population in rural areas who do not have broadband access. But, according to Commissioner's Vivian Reding recent declarations "*The latest returns show that only €315 million of the €1.02 billion made available for broadband and CAP Health Check has been taken up in Rural Development Plans. I am disappointed that some Member States have not yet decided to take advantage of these new funds in the Rural Development Plans they have submitted to the Commission. But I will continue to work and convince them. In addition, a series of regulatory measures and guidelines to support very high speed broadband roll-out are under way*".

ICT Research and Innovation Policies

Stakeholders' expectations of a new wave of ICT innovation centred around the Future Internet paradigm are leading to requests for a substantial increase of ICT R&D investments and for a mobilisation of European industries and governments, intensifying cooperation through public-private partnerships, for Europe to lead the way in the design and development of the new infrastructures and services. The urgency felt by the proponents of these initiatives is evident in their "call for actions" (see also par.2.2.1). It is often underlined that, although private and public sector investment in digital research exceeds €40 billion a year in the EU, this is only half the amount being invested by major global competitors such as the US. In addition, the weak points of the European innovation system (markets fragmentation, difficulty to translate research into innovation and so on) are well known.

Many of the ideas and suggestions brought forward by the "call for action" documents are being incorporated into the new round of national and European ICT policy strategies which is being prepared in 2009-2010, establishing new targets for the post-2010 period. These plans include for example not only the forthcoming post i2010 strategy by the EC, but also UK's Digital Britain, Spain's Avanza, France's Numerique 2012.

The EC's Communication "A Strategy for ICT R&D and Innovation in Europe: Raising the Game" of last March 2009, which was also based on a broad stakeholders' consultation, analysed the situation and proposed three main action lines as follows:

1. Raise both public and private investments in ICT R&D&I in Europe and increase their efficiency
2. Prioritise ICT R&D in Europe into key areas and reduce the fragmentation of efforts
3. Facilitate the emergence of new public and private markets for ICT-based innovative solutions.

We will borrow for our positive scenarios the goalposts indicated by this Communication for a new European landscape in 2020, if Europe actually stepped up its investments, pooled its resources, and ensured competitive and innovation-friendly markets. In this new landscape:

- Europe has doubled its private and public investments in ICT R&D, doubled venture capital investments in high-growth ICT SMEs and tripled its use of pre-commercial procurement in ICT;
- Europe has nurtured an additional five ICT poles of world-class excellence, measured by private and public investments in the pole;
- Europe has grown new innovative businesses in ICT so that one third of all business expenditure in ICT R&D is invested by companies created within the last two decades;
- Europe's ICT sector supplies at least the equivalent of its share of the global ICT market.

2.6.2 The Policy Impact Sub-scenarios

The focus of these sub-scenarios is on the level of implementation and effectiveness of the policy trends in the forecast period. Based on the current policy environment, the main directions of policy strategies in this field for the next years are rather clear, but there is uncertainty about the political willingness to act, the actual level of investments, ability to implement them effectively and successfully. In other words, the question is whether these policies will rank high in the political agenda, and whether main stakeholders will join in to make them a success. No policy can be successful without the active engagement and full cooperation of the people involved and the consensus of public opinion.

Exhibit 2-10 Summary of Socio-Policy Sub-Scenarios

	Sub-Scenarios		
Main trends	**Moderate Policy Impact**	**High Policy Impact**	**Low Policy Impact**
E-skills Policies	Present policies continue with mixed success and moderate impact	Higher policy priority and investments for e-skills proactive policies, resulting in high impacts	Bland, ineffective e-skills proactive policies resulting in low or no impact
ICT Stimulus Package Policies	Medium to long term impact of stimulus package policies for ICT	Effective implementation with high impacts in the forecast period and beyond	Few initiatives and scarce investments, low or no impact in the forecast period
ICT Research and Innovation Policies	Medium level of policy priority for future internet initiatives and some increase of ICT R&D, mainly public	High policy priority for future internet initiatives and increase of ICT public and private R&D investments	Low policy priority for future internet initiatives and ICT R&D, governments focus on welfare rather than innovation

Source: IDC Government Insights 2009

The sub-scenarios develop alternative hypotheses of how these policy trends might achieve a high, medium or low level of impact on the global environment and the e-skills demand-supply balance. This includes an estimate of the typologies of their potential impacts, which are clearly different. For example, e-skills policies are designed to have medium and long-

term structural impacts on the labour market, while the economic stimulus package is an emergency intervention with effects ranging from the short to the medium-long term.

These sub-scenarios feed into the global demand-supply e-skills model as semantic indicators (low, medium, high level impacts) and enabling factors for the main qualitative conditions of the main global scenarios.

2.6.3 The Moderate Policy Impact Sub-scenario

Description

In this sub-scenario, current e-skills policies continue to be developed along the present guidelines, with mixed success. Member States with a strong ICT industry and a tradition of support of higher education achieve better results than Southern European countries, historically less able to implement this kind of initiatives.

Measures to prevent loss of IT jobs due to off-shoring are discussed, but never really decided because of the start of the recovery. However governments provide some incentives for ICT enterprises to keep using local human resources, for example linking incentives with the maintenance of production or research facilities in the EU.

Stimulus package initiatives for ICT (direct and indirect) are implemented only partially: for example new infrastructures investments are launched during the forecast period but not in all the Member States, and focus on reducing the digital divide rather than on launching new high-speed infrastructures. The lack of momentum and the moderate level of investments tend to dilute in time the impact on the economy.

Overall, the EU governments recognize only a medium-level priority to ICT research and innovation policies. There is not a major public effort on the Future Internet, but there is a moderate increase of public ICT R&D investments and several initiatives to develop and pilot new infrastructures and services, without coordination across Europe, with some success but failing to achieve economies of scale. For example, the use of public demand to help innovative products and services take-off is implemented here and there, depending on the countries and the markets.

Main Impacts

In this scenario policies have a weak impact on the e-skills labour market problems across the EU, supporting some increase of training and easing some imbalances, but without solving e-skills gaps. The stimulus package measures have a moderate positive impact on the ICT industry revenues and employment in the forecast period, and contribute to fuel the diffusion of innovation in key sectors, such as healthcare, government, energy, transport (with a slow but constant growth of ICT-related investments and diffusion of smartgrids, intelligent transport systems, eGovernment networks and services).

The infrastructure investments and the increase of R&D investments start producing positive impacts in the second half of the forecast period, when the building blocks for the new infrastructures and services begin to be laid down. However, with this level of moderate engagement of resources, it is unlikely that Europe will be among the leaders of the new innovation wave, and the industry will not gain strong competitive advantages.

This scenario leads to a moderate increase of the demand for R&D ICT skills and ICT management skills, particularly at the end of the forecast period, and helps improving the attractiveness of ICT careers.

Likeliness and Barriers

This sub-scenario is rather likely as it extrapolates current trends.

2.6.4 The High Policy Impact Sub-scenario

Description

In this sub-scenario, the combination of robust stimulus package policies focused on ICT with an acceleration of ICT research and development investments preparing the ground for the Future Internet, have a high impact on the ICT industry and the market.

The EU and Member State governments intensify their investments and support for life-long learning and training for e-skills, providing effective support and incentives particularly for SMEs. These measures help enterprises to manage the transition to innovative IT services delivery and IT-based business models.

Stimulus package initiatives for ICT (direct and indirect) are implemented well and fast across Europe, accelerating the transition towards high-speed infrastructures and filling the broadband gap, preparing the ground for the Future Internet and supporting the evolution towards a single digital market. The development of key digital infrastructures in the private and public sector (ehealth networks, smartgrids and so on) is accelerated. This increases the potential demand for new applications and services, contributing to the virtuous circle of the high innovation sub-scenario.

In this context, The EU governments and the EC naturally give a high priority to new ICT research and innovation policies focused on the Future Internet, increasing public R&D investments: this encourages the investments by the private sector as well.

Main Impacts

Effective e-skills policies improve the functioning of the e-skills labour market, increasing training and learning-on-the-job activities, and filling gaps, helping enterprises to find the highly qualified resources needed to keep up with market growth.

The stimulus package policies have a positive impact on the ICT industry revenues and employment in the forecast period; indirect stimulus measures show early benefits so investments are accelerated, creating a positive virtuous circle triggering the launch and adoption of a wave of new IT based services and applications. These proactive policies will enable a jump ahead of the European Internet industry and market, creating positive impacts for the socioeconomic system, particularly for enterprises

The coming into place of this sub-scenario leads to an increase of the demand of e-skills with increasing relevance of ICT management skills and R&D skills.

Likeliness and Barriers

This sub-scenario is not as likely as the first, because it implies a high level of effectiveness, coherence and engagement for all the policy strands examined, for most of the European Union. On the other hand, these policies are backed by important groups of stakeholders who have a vested interest in their success and in cooperation across Europe. Furthermore, these policies already exist and respond to a strong rationale and important European needs, so that their success is not so unlikely either.

2.6.5 The Low Policy Impact Sub-scenario

Description

In this sub-scenario, a jobless recovery with low growth rates forces governments to focus on welfare, rather than innovation policies and investments.

Bland, ineffective policies pay lip service to life-long learning, but have little practical effect, failing to counteract the trend towards a decrease of private training investments in e-skills.

Individuals are forced to rely mostly on their own resources to pay their training and maintain their skills at the level requested by the market. Public investments focus on retraining of the low-skills unemployed.

Stimulus package initiatives for ICT (direct and indirect) are implemented only partially or slowly with limited infrastructures investments. Governments decrease ICT budgets and cut innovative projects, with the partial exception of the healthcare sector, but mainly using technologies to reduce costs. Investments in green technologies and environmental services slow down drastically.

In this context, ICT research and innovation policies end up at a low level in the European political agenda. The Future Internet investments are postponed to the future and not even broadband gap investments are fully implemented. The digital development plans launched by some governments remain mainly on paper.

Main Impacts

In a context of low economic growth or stagnation, the lack of effective policies fails to help the functioning of the e-skills labour market across the EU. This results in an aggravation of the demand-supply mismatches, with gaps and shortages, but also areas of oversupply with an increase of ICT unemployment.

The stimulus package measures have very little impact on ICT industry revenues and employment. The missing ICT infrastructures investments result in an increase of the digital divide across Europe, and a general slow down of IT-related innovation demand and diffusion, particularly in the European regions with less developed IT markets.

In this scenario, the European industry and market will risk accumulating a delay, compared to the rest of the world, for the development and deployment of ICT-related innovation and the Future Internet. There is also a risk that Europe becomes even more only a commercial market for ICTs, with all the major decisions taken elsewhere in the US or the emerging Asian economies.

This scenario may see a decrease of the demand of e-skills, particularly high level e-skills (since traditional maintenance and management activities of ICT systems and networks will remain necessary). The decrease of attractiveness of ICT careers and the reduction of training investments may also have negative impacts on the supply, with a risk for the European knowledge base.

Likeliness and Barriers

The likeliness of this sub-scenario depends on several factors, first of all the level of the economic recovery, since the driving factor is the economic climate rather than specific policy choices. Then the level of uncertainty may change depending on the policies considered.

The likelihood that e-skills policies may only have a marginal impact on the e-skills labour market is not so remote. The threshold of effectiveness for this kind of policies is very high, since influencing the labour market is very difficult. It requires very determined and focused initiatives backed with substantial resources. Their success chances would be enhanced, if they were enacted in the context of more general education and innovation policies.

Concerning the stimulus package policies, lack of action and therefore of impact seems less likely, even if the data quoted by Commissioner Reding about the Member States not taking advantage of the opportunities offered by the EC package is worrying. The main barrier is likely to be the scarcity of funding, if the recovery is weak and public investments are deviated to more pressing emergencies. Similar considerations are valid also for ICT research and innovation policies, which may suffer from lack of funds and a negative economic

climate, and are more likely to be postponed than the initiatives envisaged by the stimulus package.

3 The Global e-skills Demand-Supply Scenarios and Forecasts

3.1 Scenarios Overview

The global e-skills demand-supply scenarios have been designed combining the main sub-scenarios described above, eliminating illogical combinations and selecting the global scenario logics corresponding to coherent and believable paths of the European socio-economic system.

The main scenarios resulting from this process are briefly described below and in the following figures:

- **Back to normal -** a return to the historical development trajectory experienced before the crisis, in terms of growth rates and IT innovation**;**
- **Investing in the future –** a return to moderate growth, accompanied by an acceleration of ICT investments and innovation which will yield their main benefits after 2015, but provide hope for the future;
- **Turbo knowledge economy –** the knowledge economy takes off in Europe, thanks to a virtuous circle of productivity and economic growth driven by widespread diffusion of ICT-based innovation. ICT careers become more attractive and demand of e-skills grows;
- **Tradition wins –** after the crisis, an export-driven recovery advantages traditional industries, rather than high-tech and innovative industries**,** resulting in a combination of moderate economic growth with low ICT growth. The relocation of the ICT industry outside of Europe accelerates, with a possible slight decrease of the demand of e-skills;
- **Stagnation –** a very slow recovery, accompanied by domestic protectionism in the most important countries, discourages innovation investments. The European socioeconomic system struggles to keep up with the emerging economies and tends to close itself ("fortress Europe"). Low ICT investments and IT off-shoring growth lead to a reduction of the demand of e-skills and potential over-supply problems.

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 (Turbo knowledge and Stagnation) appear less likely than the other moderate scenarios, but some of their components are more than likely. Conversely, the "intermediate" scenarios appear more likely, but show clearly that the evolution of present trends may still lead to alternative development models, with different possible impacts on the socio-economic environment. There is not a destiny of innovation for Europe: but a future which must be built, starting now.

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 I). Also, the expert survey helped in selecting the most relevant and likely qualitative and quantitative trends of the years to come.

Exhibit 3-1: Overview of Global Demand-Supply of e-skills scenarios

BACK TO NORMAL	Moderate Economic Growth	Moderate Innovation Growth	Moderate, long-term impact of ICT policies	Medium Offshoring Growth	Moderate attractiveness of ICT careers
INVESTING IN THE FUTURE	Moderate Economic Growth	High Innovation Growth	Strong impact of eskills and ICT stimulus policies	Medium Offshoring Growth	Moderate attractiveness of ICT careers
TURBO KNOWLEDGE ECONOMY	High Economic Growth	High Innovation Growth	Strong impact of eskills and ICT stimulus policies	Medium Offshoring Growth	High attractiveness of ICT careers
TRADITION WINS	Moderate Economic Growth	Low Innovation Growth	Moderate, long-term impact of ICT policies	Fast Offshoring Growth	Low attractiveness of ICT careers
STAGNATION	Low Economic Growth	Low Innovation Growth	Low Impact of eskills and ICT Policies	Fast Offshoring Growth	Low attractiveness of ICT careers

Source: e-Skills Monitor 2009

Exhibit 3-2: Main e-skills Trends in Global Scenarios

	E-Skills Demand VAR. 2015/2010	E-Skills Supply VAR. 2015/2010	E-Skills Balance	E-Skills Mix
BACK TO NORMAL	MODERATE INCREASE + 12%	VERY SLIGHT INCREASE +4%	MODERATE E SKILLS GAP	AS TODAY
INVESTING IN THE FUTURE	INCREASE + 16%	VERY SLIGHT INCREASE +4%	HIGHER E SKILLS GAP	SHORTAGE OF R&D SKILLS
TURBO KNOWLEDGE ECONOMY	STRONG INCREASE + 21%	INCREASE + 8%	HIGH E SKILLS GAP	SHORTAGE OF R&D, ICT MANAGEMENT SKILLS
TRADITION WINS	STABLE + 5%	STABLE + 2%	NO GAP BUT MISMATCHES	OVERSUPPLY OF R&D, TECHNICAL SKILLS
STAGNATION	STABLE + 4%	STABLE + 2%	NO GAP BUT MISMATCHES	OVERSUPPLY OF ICT MANAGEMENT SKILLS

Source: e-Skills Monitor 2009

3.2 Forecasting overview

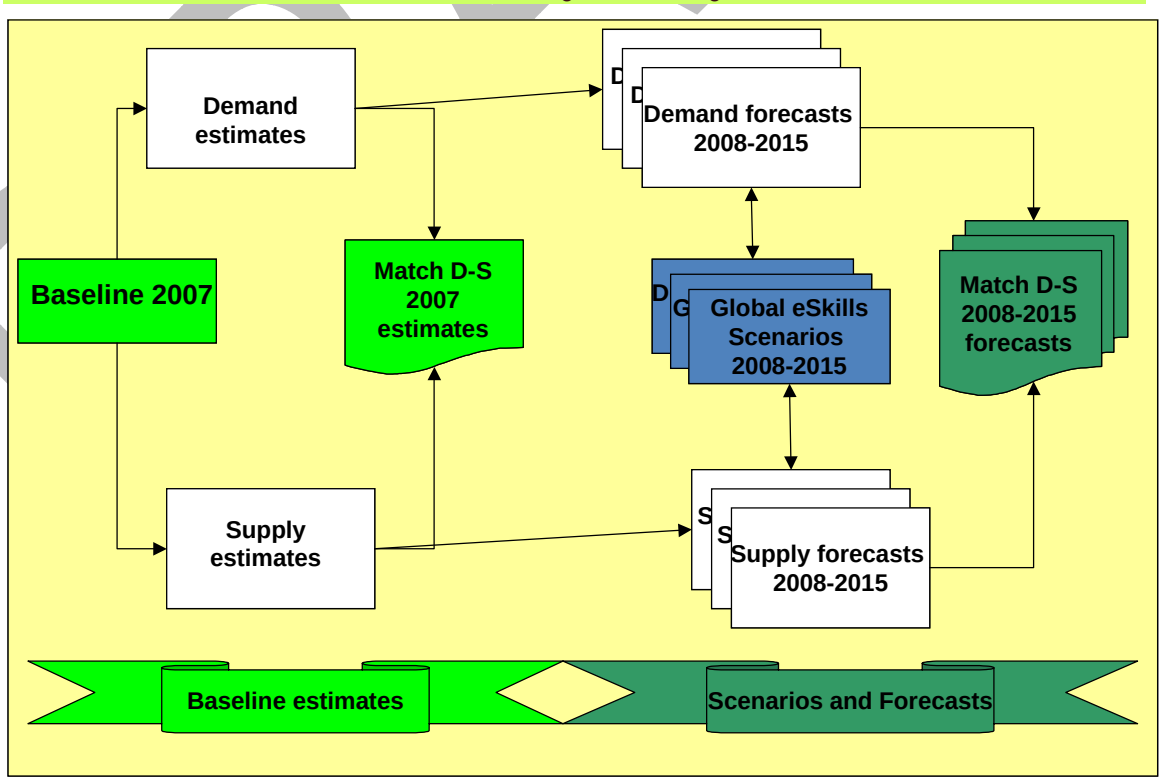
The scenarios and the foresight model were developed in parallel, starting from a baseline model for the year 2007 based on published sources, as indicated in the following figure.

The foresight model was based on the following steps:

- Development of a baseline model for the year 2007, estimating total demand and supply of e-skills (and their resulting balance) for the six main EU countries (France, Germany, Italy, Poland, Spain and the United Kingdom), for the other 21 countries and for the EU27;
- Design of the foresight model, estimating the correlation between the demand and supply of e-skills for the period 2008-2015, including the main inflow and outflow parameters;
- Estimate of e-skills demand growth for each of the five scenarios, building on the quantitative parameters of the Macroeconomic and ICT innovation sub-scenarios;
- Estimate of e-skills supply growth for each of the five scenarios, building on the assumptions of the Education and Training sub-scenarios;
- Population of the foresight model with the demand and supply estimates, calculating their balance for each of the five scenarios;
- Validation of the foresight model, checking the results with the qualitative assumptions of the five scenarios, revising and checking the results by country and for the EU27.

An important remark: the calculation of e-skills demand and supply forecasts in the model is built on several critical assumptions, because necessary data is often missing or incomplete.

Exhibit 3-3: Building the Foresight Model



Source: e-Skills Monitor 2009

To measure supply and demand for ICT practitioner skills (occupations with advanced IT tasks that require IT skills) needs to rely on sensible definitions and available data matching these definitions.

ICT practitioner skills are defined as the capabilities required for researching, developing, designing, strategic planning, managing, producing, consulting, marketing, selling, integrating, installing, administering, maintaining, supporting and servicing ICT systems. ICT practitioners are people whose main responsibility is to take care of the company's ICT infrastructure (hardware, software, communications systems).

For the EU27 Member States the empirical status quo (data for statistical measurement) of ICT practitioner jobs is available through the Labour Force Surveys of the EU Member States. This is where the market forces of demand and supply meet. Therefore the stock of ICT practitioners is part of both supply and demand. In hypothetical market equilibrium, supply and demand would match exactly here[3].

It was decided to use different definitions of ICT practitioners to provide a comprehensive basis for comparisons of the study results with related activities in several EU Member States using different definitions depicted in the following overview.

Exhibit 3-4: ICT practitioner definitions used for quantification purposes

Definition Type	ISCO codes included
Core e-Skills	ISCO 213 and 312
Broad e-Skills	ISCO 213, 312, 313, 1236
Very broad e-Skills	ISCO 213, 312, 313, 1236 and 724

The quantification of ICT practitioner jobs is based on data from the Labour Force Surveys of the European Statistical System. More details are provided in Annex III.

The table overleaf presents the sum of all employed or self-employed ICT practitioners (active e-skills workforce) according to the respective definitions in the year 2007, for the EU27, the EU 21 and the six main countries, which is the baseline model e-Skills workforce, and the starting point for the foresight analysis.

The Foresight Model developed the e-Skills demand and supply forecasts for the period 2008-2015 for the five global scenarios and the three e-Skills definitions, and then calculated the demand-supply match, that is the net difference between realised demand and effective supply.

The demand and supply trajectories for each scenario were estimated separately, on the basis of the main scenarios assumptions, and then fed into the model, as described in Annex III.

In a dynamic perspective, the supply side and the demand side obviously change due to inflows and outflows of workers and due to changing skill demands by employers.

On the supply side, new market entrants come from computer science graduates entering the labour market as well as other graduates who possess the IT skills demanded. Also, career changers originally coming from a non-IT background may enter but also re-entrants who had

[3] We refrain from any attempt to model classical supply and demand curves where aggregate demand and supply are a function of the price (wage) and elasticities could be discerned.

been out of the labour market previously. Finally, immigrants may be a source of additional supply in the market.

Exhibit 3-5: Baseline e-Skills Workforce by skills definition, 2007

	CORE ISCO	BROAD ISCO	VERY BROAD ISCO
EU27	3,793,000	4,736,000	6,929,000
DE	737,000	823,000	1,203,000
ES	328,000	395,000	617,000
FR	367,000	417,000	613,000
IT	346,000	452,000	647,000
PL	195,000	228,000	427,000
UK	643,000	1,028,000	1,229,000
EU21	1,177,000	1,394,000	2,193,000

Source: e-Skills Monitor 2009

Exhibit 3-6: Baseline e-Skills Demand-Supply match, EU 27, 2007

	CORE ISCO	BROAD ISCO	VERY BROAD ISCO
e-Skills Demand	3,945,000	4,926,000	7,206,000
e-Skills Workforce	3,793,000	4,736,000	6,929,000
Graduate entries	112,000	143,000	213,000
Retirement exits	76,000	95,000	139,000
Excess demand	152,000	189,000	277,000

Source: e-Skills Monitor 2009

Supply side exits may be due to retirement, temporary leave and emigration of IT workers as well as promotion or other career change to non-IT jobs.

The dynamics on the demand side can create new demand for IT skills through structural change as well as through locational change. Structural change that causes market growth, either within existing or in newly emerging employer companies is normally the result of the emergence of new services or other innovation. Apart from the creation of new jobs, also in-shoring of previously imported services creates new IT jobs in the domestic market.

Structural and locational change can also be observed to create redundancies through market decline, productivity gains through innovation and new services, off-shoring and market exits.

These complex interactions between demand and supply were reflected in the model through correction factors of the demand and supply values (market entries and market exits). The model is flexible, because it allows to vary the correction parameters and to test different assumptions. The methodology and the structure of the model are described in Annex III.

3.3 Global Scenarios Results

The five scenarios lead to quite different results in terms of the supply demand match for e-skills. At the end of our forecasting period, we estimate a supply-demand match in statistical terms for two of the scenarios ('*Tradition wins*' and '*Stagnation', with a very small level of 3% excess demand*), a moderate shortage of about 7% of all jobs for the "*Back to Normal*" scenario and a shortage of e-skills of respectively 10% and 11% of the workforce for the two positive scenarios '*Investing in the future*' and '*Turbo knowledge economy*'.

Exhibit 3-7: Broad e-Skills Demand and Supply in 2010 and 2015

	2010			2015		
EU27, broad definition of e-skills	**Demand of e-skills**	**Supply of e-skills**	**Demand/ Supply Difference**	**Demand of e-skills**	**Supply of e-skills**	**Demand/ Supply Difference**
Back to normal	4,852,700	4,876,200	-23,500	5,445,700	5,061,600	384,100
Investing in the future	4,870,800	4,876,200	-5,400	5,646,700	5,067,200	579,500
Turbo knowledge economy	4,899,900	4,876,200	23,700	5,927,700	5,258,500	669,100
Tradition wins	4,873,200	4,876,200	-3,000	5,102,300	4,973,500	128,900
Stagnation	4,839,500	4,876,200	-36,800	5,038,700	4,952,200	86,500

Source: e-Skills Monitor 2009

These figures are based on the broad definition of ICT skills. If one wants to use the narrower core definition, the shortages follow the same trend, however not perfectly proportional because of differing significance of the individual occupations in the different countries.

Exhibit 3-8: Core e-Skills demand and supply in 2010 and 2015

	2010			2015		
EU27, core definition of e-skills	**Demand of e-skills**	**Supply of e-skills**	**Demand/ Supply Difference**	**Demand of e-skills**	**Supply of e-skills**	**Demand/ Supply Difference**
Back to normal	3,880,400	3,899,200	-18,700	4,038,300	4,352,500	314,200
Investing in the future	3,894,900	3,899,200	-4,300	4,043,200	4,513,500	470,300
Turbo knowledge economy	3,918,200	3,899,200	19,100	4,194,800	4,738,500	543,700
Tradition wins	3,896,900	3,899,200	-2,300	3,969,900	4,076,700	106,800
Stagnation	3,869,800	3,898,300	-28,500	3,952,500	4,025,700	73,200

Source: e-Skills Monitor 2009

On a country by country comparison, one main finding is that there are countries where, given the most negative scenario in economic terms, the crisis may lead to some temporal level of unemployment among ICT practitioners (Spain, France and Poland) while others will still show excess demand (Germany most notably).

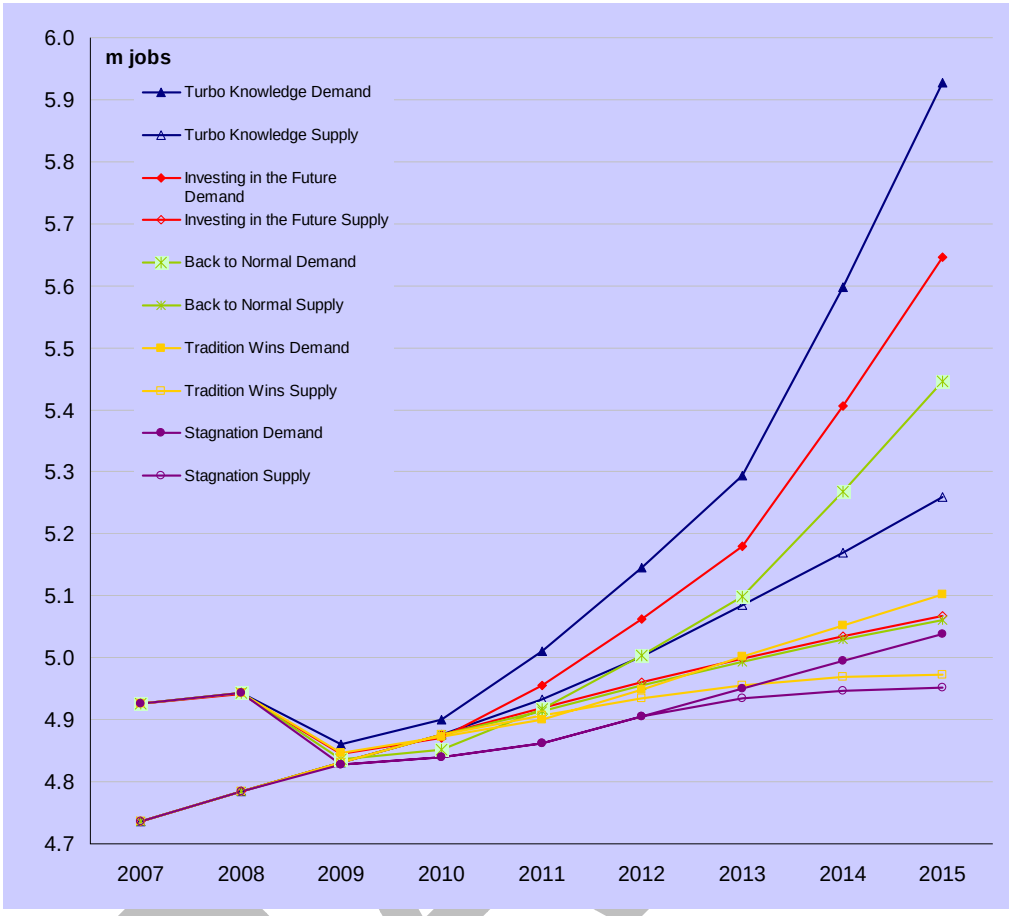
Another result that the statistical analysis reveals is that there are structural differences between the countries in terms of the sustainability of their e-skills reproduction. Poland, and probably some other smaller countries are educating an enormous number of ICT graduates compared to their domestic demand, while other countries, especially Italy, "produce" far too few ICT graduates. Although it is true that Italy "produces" an insufficient number of ICT graduates, it is also true that the Italian supply of ICT graduates is significantly underestimated because of classification issues in the official education statistics; for more details, please see the note in the Methodological Annex III. Intra-European migration may and probably will be one effect of the structural differences.

Towards the end of the forecast period, demand for skills grows much stronger in Spain and Poland than in the other named countries, regardless of the scenario. There are two main reasons for this pattern to emerge in these two countries. First of all, both these countries are slightly less mature form an IT adoption standpoint than for example Germany, France and the United Kingdom. This means that when we come out on the other side of the current economic crisis, IT investments will increase stronger in these two countries than in their more mature neighbours.

However, Spain is a more mature IT nation than Poland with some industries already before the crisis (such as the banking sector for example) often "leap-frogging" in terms of technology adoption. We expect this pattern to re-emerge in Spain when the economy recovers. Poland has a lower IT adoption rate than Spain but is on a strong investment curve, which will result in strong growth for skills as IT penetration spreads also to the many small and mid-sized companies.

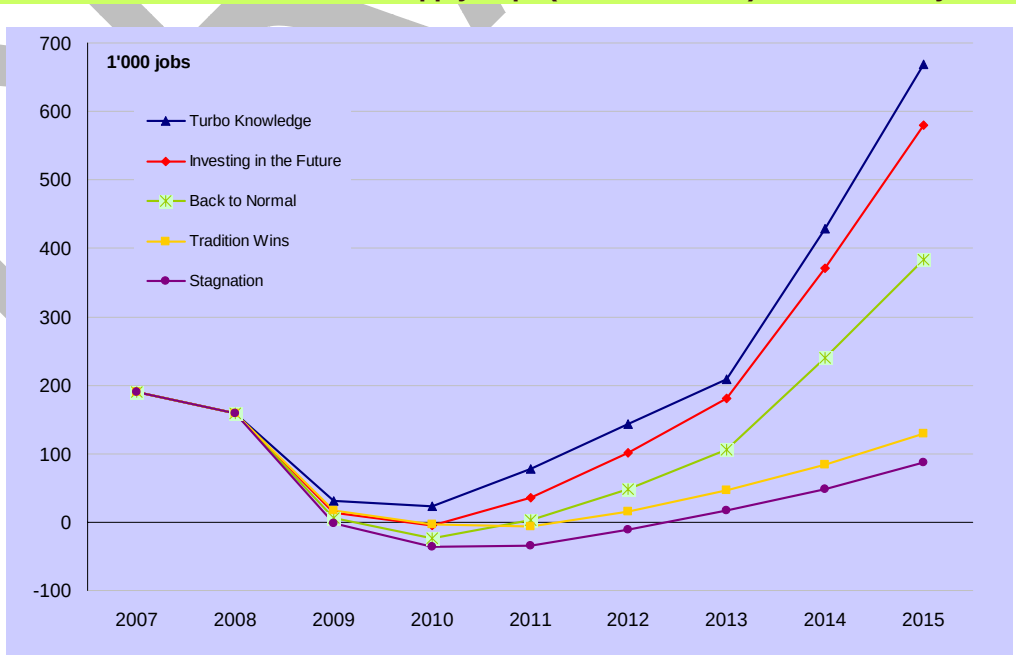
Again in the broad definition, we find for the two optimistic scenarios *"Turbo Knowledge Economy* and *"Investing in the future'* shortages at about 12% until 2015, while *'Back to normal"* results in a 384.000 shortage or 8% of all filled posts.

Exhibit 3-9: e-skills Demand and Supply in the EU27 Forecast by Scenario



(EU27, broad definition of e-skills) *Source: e-Skills Monitor 2009*

Exhibit 3-10: e-skills Demand and Supply Gaps (Excess Demand) in the EU27 by Scenario



(EU27, broad definition of e-skills) *Source: e-Skills Monitor 2009*

3.4 Detailed Scenarios and Forecasts

Each scenario is subsequently described under the heading "Scenario" followed by a description of its "main impacts" and presentations of the forecasting results using one of the three definitions of ICT practitioners described above, namely the 'broad' definition.

3.4.1 Back to normal

Scenario

This scenario is based on the assumption of a return to the historical development trajectory experienced before the crisis, in terms of growth rates. This means also a scenario where IT innovation grows faster than GDP, with a gradual evolution of the European system towards the knowledge economy, as it was the case before 2008.

In this scenario, ICT will continue to play a driving role in the economic development model of the European system after the crisis, as it did in the past decade, but the evolution towards the knowledge economy will gradually accelerate, as traditional sectors slow down and knowledge-based industries and services gain ground. The ICT industry and the High Intensity (HI) User Industries will drive ICT innovation, while Low Intensity (LI) User Industries will tend to lag behind, with the exception of a few pioneers. These trends will lead to efficiency improvements and productivity growth for the innovative enterprises (mainly within the ICT industry and HI User Industries), in parallel with the reorganization of IT supply chains for a sizable part of the market.

This scenario will to some degree lead to easier outsourcing of non-core activities in the services value chain. The annual growth of IT outsourcing revenues in the EU27 is expected to be in the range of 2 to 5%, slightly higher than the pace of annual GDP growth, in the forecast period. Off-shoring revenues will be driven first by the need to cut costs and then, when economic recovery kicks in, to keep improving operational margins.

Current e-skills policies will continue to be developed along the present guidelines, with mixed success. Member States with a strong ICT industry and a tradition of support of higher education will achieve better results than Southern European countries, historically less able to implement this kind of initiatives. The attractiveness of ICT professions will remain moderate. Stimulus package initiatives for ICT (direct and indirect) will be implemented only partially: for example new infrastructures investments will be launched during the forecast period but not in all the Member States, and will focus on reducing the digital divide rather than on launching new high-speed infrastructures. The lack of momentum and the moderate level of investments will tend to dilute in time the impact on the economy. Overall, the EU governments will recognize only a medium-level priority to ICT research and innovation policies. There will not be a major public effort on the Future Internet, but a moderate increase of public ICT R&D investments and several initiatives to develop and pilot new infrastructures and services, without coordination across Europe, with some success but failing to achieve economies of scale.

Main Impacts

The path of ICT-based innovation will be similar to the one Europe had before the crisis. As a consequence, the demand of e-skills required by the economy will follow the same trend as before the crisis.

This scenario will have mixed impacts on the level and type of demand of e-skills. The industrialization of ICT development will lead to a slight decrease of demand of programming

and ICT production skills, with a change of mix of skills with more managerial and customer service skills requested. The new business models and new ICT delivery models will also lead to a switch in technology skills, rather than an absolute increase/decrease. The innovation path towards a new delivery model and a new business model will moderately increase demand of development skills. The diffusion and pervasiveness of the new ICT based business models will also lead to an increase in the demand of management skills. This path will lead to diffusion within all the industries so that demand of sales and marketing skills will increase significantly by the end of the forecasting period. As a result, the main e-skills demand trends will continue as before the crisis, as well as the supply trends; the result will be a continuing relatively small gap of e-skills, particularly concerning R&D and technical ICT skills, which has been a constant trend in the past years.

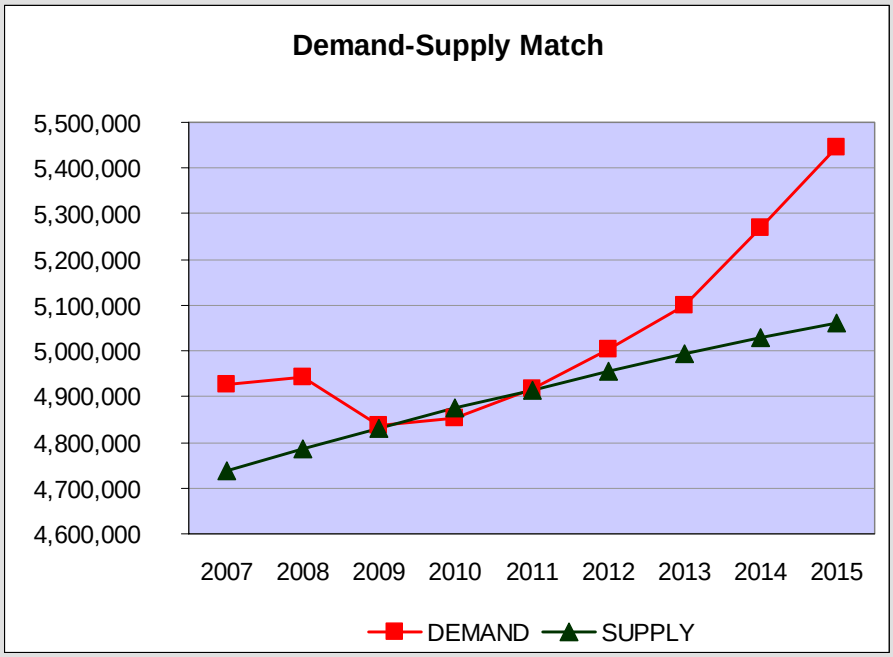
R&D skills and management skills will be mainly provided by the formal education as it was before the crisis, although this may also depend on some country-specific characteristics of the ICT labour market..Overall, e-skills demand will increase, from 2010 to 2015 by about 12% while supply will register during the same period a +4% growth.

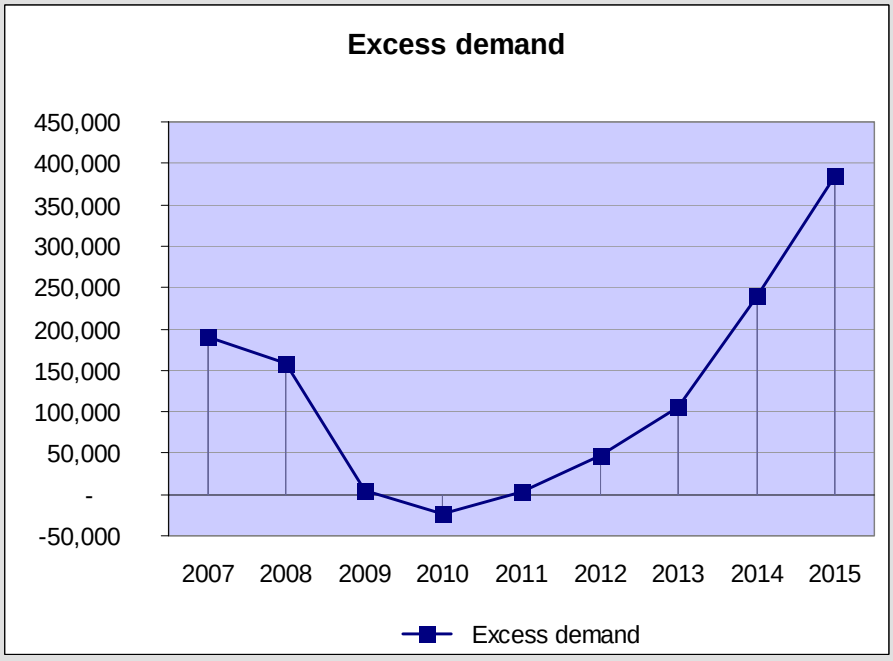
Forecasts

In the baseline year 2007 demand for ICT practitioners exceeds the supply by an absolute number of around 190,000. The supply figures are supposed to increase continuously over the coming years, as will the demand figures after the slump of 2009. Supply will increase from 4.74 million in 2007 to 5.13 million in 2015 while demand will develop from 4.93 million in 2008 to around 5.06 million in 2015. The excess demand for ICT practitioners will turn into an excess supply of 23,500 in 2011 with unemployment rates among IT professionals slightly increasing. Demand will rise again and reach about the demand level of 2007 – the baseline year –in 2011. It will continue to increase and reach a high excess demand of 384,000 ICT practitioners in 2015.

Exhibit 3-11: Forecast EU27 – Back to normal scenario, broad e-skills

European Union (EU27) – 'Back to normal' scenario BROAD definition of ICT practitioners



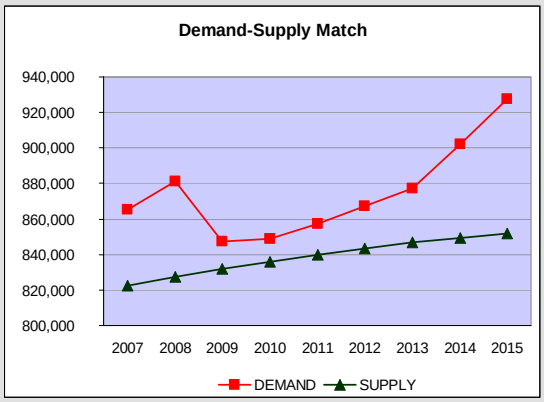


Source: e-Skills Monitor 2009

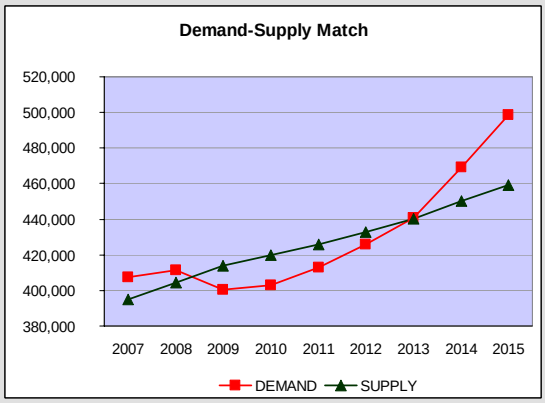
At a country level the developments in the 'Back to normal' scenario are very different, reflecting the different national economic conditions and development models. While at the European level we forecast almost a demand and supply match between 2009 and 2012, at the country level we find a significant level of excess supply and hence unemployment in four of the six largest countries, namely in Poland (20,500 in 2010), Spain (16,900), the United Kingdom (16,600) and France (8,100), while demand will still exceed supply in Germany and Italy throughout the crisis years. In all countries the trend will be towards an excess demand at least after 2013 with most severe shortages in Italy and Poland.

Exhibit 3-12: Forecast countries – Back to normal scenario, core definition of e-skills

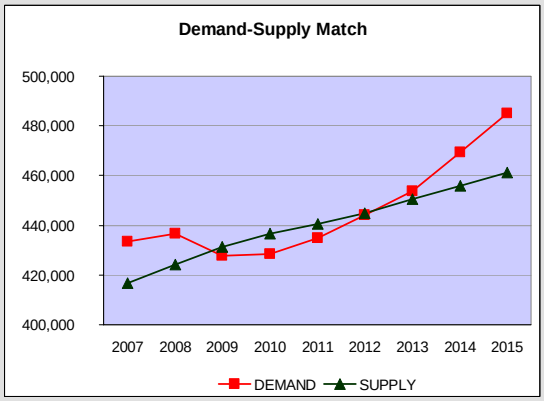
GERMANY (DE) – 'Back to normal' BROAD definition of ICT practitioners



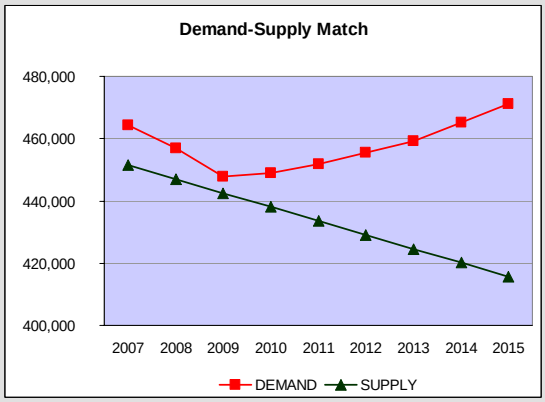
SPAIN (ES) – 'Back to normal' BROAD definition of ICT practitioners



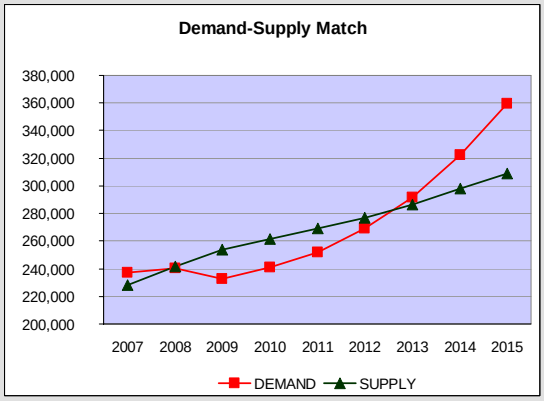
FRANCE (FR) – 'Back to normal' BROAD definition of ICT practitioners



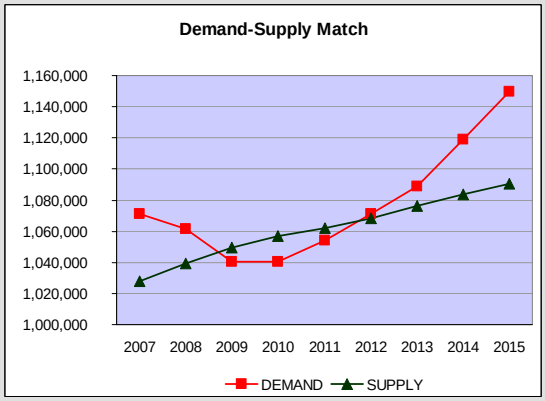
ITALY (IT) – 'Back to normal' BROAD definition of ICT practitioners



POLAND (PL) – 'Back to normal' BROAD definition of ICT practitioners



UNITED KINGDOM (UK) – 'Back to normal' BROAD definition of ICT practitioners



Source: e-Skills Monitor 2009

3.4.2 Investing in the future

Scenario

This scenario is also based on the assumption of a return to the historical development trajectory experienced before the crisis, in terms of growth rates. But this will be

accompanied by faster innovation growth, thanks to a strong impact of proactive ICT policies. This will lead to an increase of ICT investments, particularly in broadband infrastructures. Consequently, ICT innovation growth will take off in the second part of the forecast period (2012-2015). Because of this, the main benefits and impacts of the acceleration of innovation will be expected after 2015, even if advanced enterprises will start reaping productivity and efficiency benefits before that.

Innovation trends which today are already advanced will accelerate to penetrate deeply in the user industries, while more radical innovations (such as enterprise 2.0) will begin to spread among pioneer and advanced users, starting to produce real impacts on the economy only at the end of the forecast period. The ICT industry and the High Intensity (HI) User Industries will drive ICT innovation, while Low Intensity (LI) User Industries will tend to lag behind, with the exception of a few pioneers.

After some delay due to the aftermath of the economic crisis, Europe will start investing in the Future Internet, increasing R&D investments (towards the end of the forecast period) and launching new initiatives, such as public-private partnerships and cooperative research alliances. A new wave of innovative services will start appearing, as the Internet of Services and the Internet of Things will begin to materialise.

Main Impacts

These trends will lead at first to efficiency improvements and productivity growth for the innovative enterprises (mainly within the ICT industry and HI User Industries), in parallel with the reorganization of IT supply chains for a sizable part of the market.

The transformational impacts of this innovation will begin to be perceived, as advanced users change their relationship with suppliers and evolve their internal business processes. The decrease of costs for run-of-the-mill IT applications and services will free up resources for innovative enterprises to invest in new IT-based projects, without decrease of the quality of services.

The start of the diffusion of Enterprise 2.0 services will lead to a transformation of relations with clients; innovative enterprises will launch a growing number of virtual communities with customers and introduce practices of co-design of new products and services. These benefits will become competitive advantages for pioneer adopters and innovative companies in their respective sectors and geographical regions. This, in turn, will lead to an increase of competitiveness of the European HI User industries. The European ICT industry will keep fighting to survive in a global market where Asia-Pacific emerging countries attract most new ICT investments, without losing ground but without winning the battle, either.

In the second part of this period, innovation diffusion will accelerate and the ICT industry will invest more for innovation. Efficiency improvements and productivity growth will gradually involve SMEs as well as low intensity IT user industries, increasing their pervasiveness in all sectors at the end of the forecasting period..

Effective e-skills policies will improve the functioning of the e-skills labour market, increasing training and learning-on-the-job activities, and filling gaps, helping enterprises to find the highly qualified resources needed to keep up with market growth.

The infrastructure investments and the increase of R&D investments will start producing positive impacts in the second half of the forecast period, when the building blocks for the new infrastructures and services will begin to be laid down. However, with moderate engagement of resources only, it is unlikely that Europe will be among the leaders of the new innovation wave, and the industry will not gain strong competitive advantages.

At the end of the forecast period, R&D skills are expected to be more relevant than they were before the economic crisis.

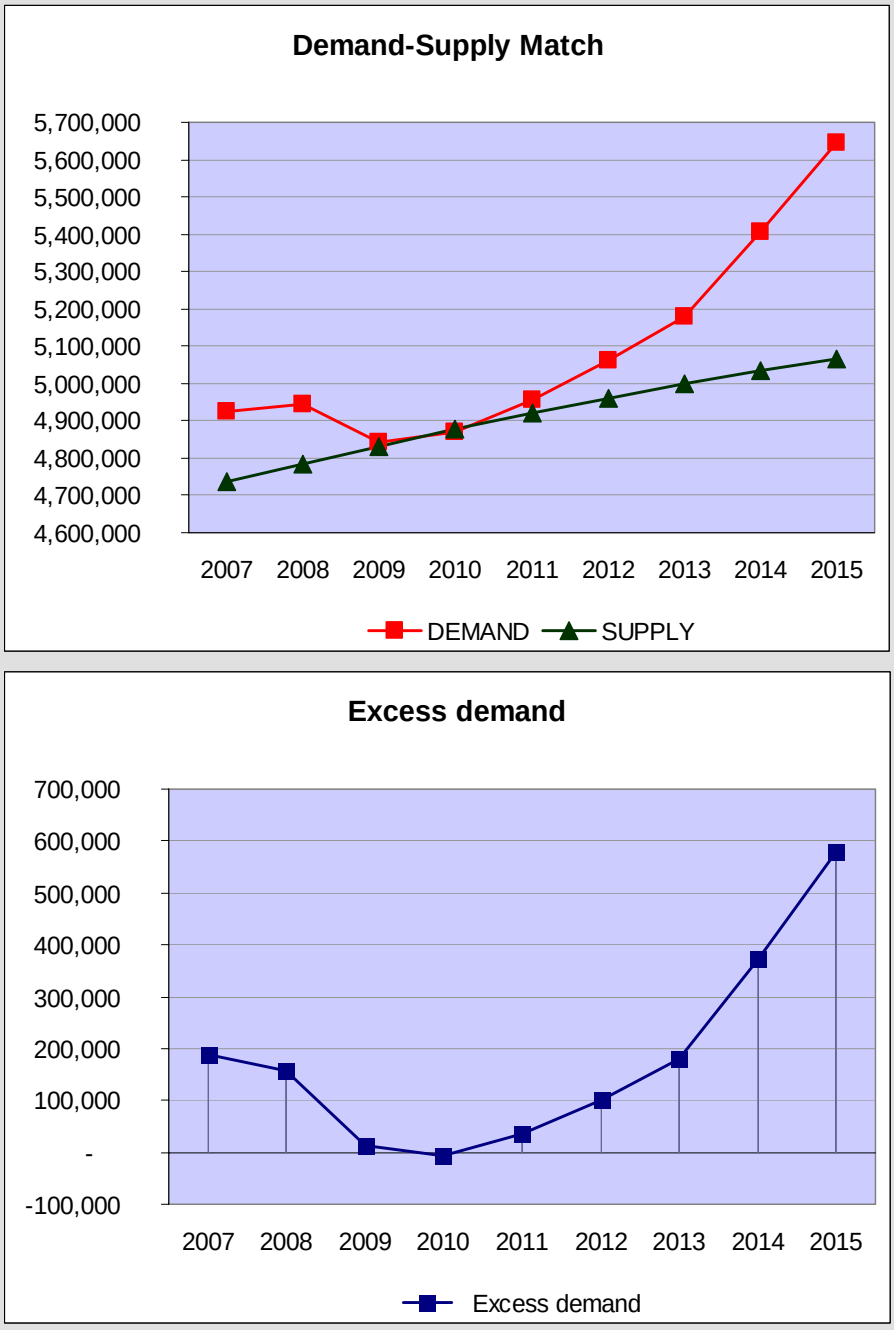
As a result, the demand of e-skills will tend to grow faster than supply (which will grow at a constant rate, since the attractiveness of ICT professions will remain stable) and therefore the e-skills gap will tend to increase strongly compared to the previous scenario. The mix of demand will start shifting towards management ICT skills, while the gap of R&D skills will tend to increase at the end of the forecast period, when ICT research investments start to accelerate.

On the supply side, the decline of ICT graduates will disappear during the forecasting period. Universities will continue providing R&D skills and at the end of the period will also start providing more management skills to respond to the enterprises demand.

Forecasts

Exhibit 3-13: Forecast EU27 – Investing in the future scenario, broad e-skills

European Union (EU27) – 'Investing in the future' BROAD definition of ICT practitioners



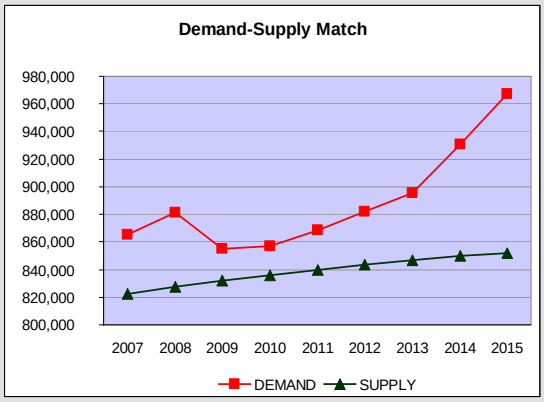
Source: e-Skills Monitor 2009

In the baseline year 2007 demand for ICT practitioners exceeds the supply by an absolute number of around 190,000. The supply figures are supposed to increase continuously over the coming years as will the demand figures after the 2009 slump. Supply will increase from 4.74 million in 2007 to 5.07 million in 2015 while demand will develop from 4.94 million in 2008 to around 5.65 million in 2015. The excess demand for ICT practitioners will vanish in 2010 but then start to increase again and reach the demand level of 2007 in numbers again in 2013. It

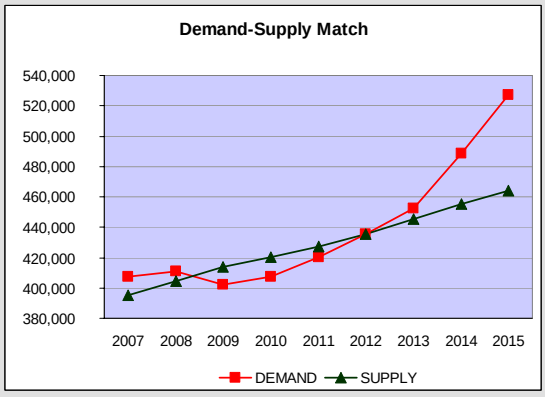
will continue to increase and reach a very high excess demand of 580,000 ICT practitioners in 2015.

Exhibit 3-14: Forecast countries – Investing in the future scenario, broad e-skills

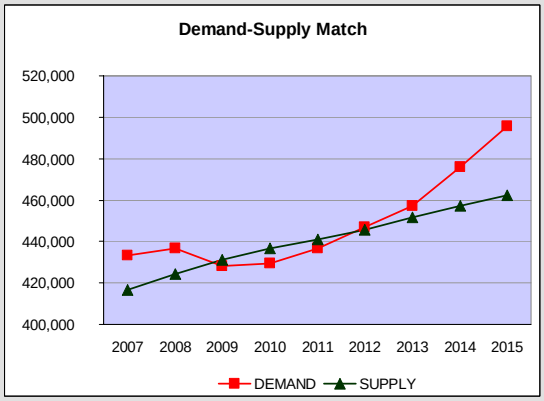
GERMANY (DE) – 'Investing in the future' BROAD definition of ICT practitioners



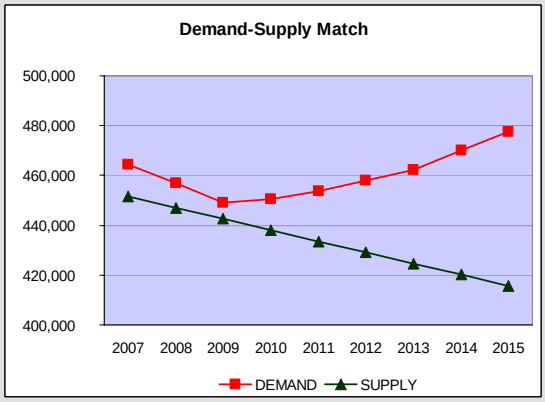
SPAIN (ES) – 'Investing in the future' BROAD definition of ICT practitioners



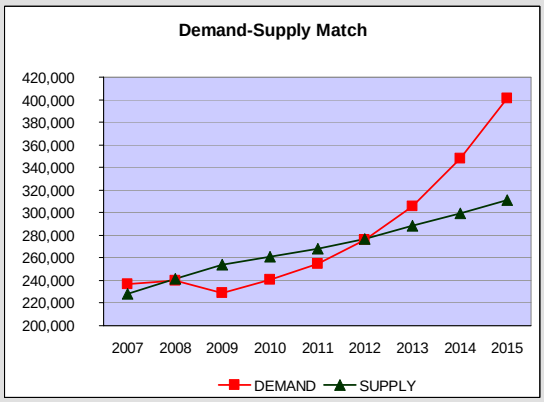
FRANCE (FR) – 'Investing in the future' BROAD definition of ICT practitioners



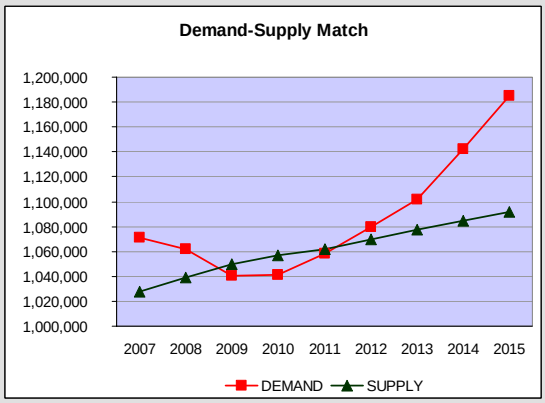
ITALY (IT) – 'Investing in the future' BROAD definition of ICT practitioners



POLAND (PL) – 'Investing in the future' BROAD definition of ICT practitioners



UNITED KINGDOM (UK) – 'Investing in the future' BROAD definition of ICT practitioners



Source: e-Skills Monitor 2009

However, there are huge differences between the countries. In two of the largest six countries, Germany and Italy, the demand for ICT practitioners will never drop below the supply line and demand for ICT practitioners will continue to outreach supply. In terms of quantitative figures for Germany the excess demand figures will drop from 54,000 in 2008 to

21,000 in 2010 but then constantly increase to a high 115,000 in 2015 despite an increasing supply of ICT practitioners. The data for Italy seem to show a decline in the supply of ICT practitioners from 2008 to 2015, but there maybe a data problem (see Annex III). If these data are correct, then Italy would see an excess demand figure reaching 62,000 in 2015.

The situation is somewhat different in the United Kingdom, France and Spain where supply will exceed demand in the years of the economic crisis (2009-2010) but like in Germany and Italy fall below demand levels later on in the forecasting period. For the United Kingdom the excess demand figures will increase from around 10,000 in 2012 to 93,000 in 2015. In France excess demand will only start to emerge again in 2012/13 and reach 33,000 in 2015, whereas in Spain the corresponding figures are a match in 2012 and an excess demand of 63,000 in 2015.

In Poland we are going to face an over demand of 90,000 ICT practitioners despite very high graduates figures.

3.4.3 Turbo knowledge economy

Scenario

This scenario envisages a strong acceleration of the knowledge economy in Europe, with a jump ahead of ICT-driven innovation, also helped by effective and proactive ICT policies and the impact of the stimulus package. The turning point in this scenario is the massive adoption of ICT innovation by SMEs, particularly high-tech SMEs and medium-size enterprises (the fast growing "gazelles" described by economic literature as one of the key potential success factors of the European economy). New digital infrastructures (smartgrids, ehealth smart networks, intelligent transportation systems and networks) will leverage innovation to generate productivity increases in the public sector and across the economy. Technology breakthroughs might help this acceleration. For example, if smartgrids enabled the diffusion of electric cars in Europe ahead than in the rest of the world, the fall-out for the automotive sector would have a huge impact on the economy.

These developments will help Europe to compete successfully with the emerging Asian economies, or at least to keep pace with them, focusing on sophisticated and value-added activities. This will constitute a break with past trends, thanks to a virtuous circle of productivity and economic growth driven by widespread diffusion of ICT-based innovation across the economy. IT spending will grow much faster than GDP, so that ICT careers will become more attractive.

Enterprises will continue to invest in outsourcing and off-shoring of the non-core IT activities, while keeping in-house at least the control of most critical applications and services. The assumption is that off-shoring will grow at a similar rate as in the previous scenario, but since the economy and the IT spending will grow faster, this will result in a lower relative incidence of off-shoring on total IT spending.

Main Impacts

The acceleration of innovation will enable a relaunch of the European ICT industry, which will be transformed, particularly the software and services industry. A new breed of light "butterfly" companies - no overhead, very little staff, efficient system of partnerships – will arise, cooperating in new value chains to provide cloud services: the new skills will develop inside the cloud. There will be a strong de-verticalisation, leading to the emergence of a few leading “software systems manufacturers” and quite a few “software component developers”. Moreover, the software system of a manufacturer will become a “platform” for

the component developers. Hence, in a few years from now, the software market may look very similar to the automotive industry.

The combination of Enterprise 2.0 and Utility/Cloud Computing will have strong transformational impacts on the business processes of the majority of HI User companies and many LI User companies: IT budgets will increase because of the investments in new projects and IT-based services, rather than maintenance and traditional IT systems. Because of the acceleration of the innovation cycle, user enterprises will start seeing productivity improvements and efficiency-effectiveness benefits already in the forecast period. Overall, the European economy will benefit from an improvement of productivity and competitiveness, getting again on a faster growth path.

The acceleration of innovation and the new business model will involve both high ICT users as well as low ICT users, so that ICT pervasiveness will rapidly increase. This will lead to efficiency and competitiveness improvements for both large enterprises and SMEs so that the attractiveness of the ICT sector will rapidly improve.

The demand of e-skills will grow quickly, so that the gap between demand and supply will increase, even if supply will increase too because of the greater attractiveness of ICT careers. The e-skills more requested will be ICT management skills and R&D skills to support the development of innovative products and services. Demand of ICT management skills will increase especially within industries and enterprises where ICT had low diffusion before the crisis. This process will increase the average wage of the ICT professionals. As a consequence, there may be a number of professionals from other markets entering the e-skills market. Off-shoring will grow in this scenario too, as low level tasks will be outsourced outside of Europe to reduce costs, but the overall growth of the ICT industry and of the economy will be such that the relative weight of off-shoring will be lower than in the previous scenarios.

In such a scenario, the ICT industry may face a shortage of e-skills wider than it was before the crisis; as a consequence enterprises may increase their training budgets at a higher level than before 2007. Enterprise training will especially focus on management and marketing know-how, while for R&D skills enterprises will hire people available on the market and provided by the formal education.

Wild Cards: key technology breakthroughs

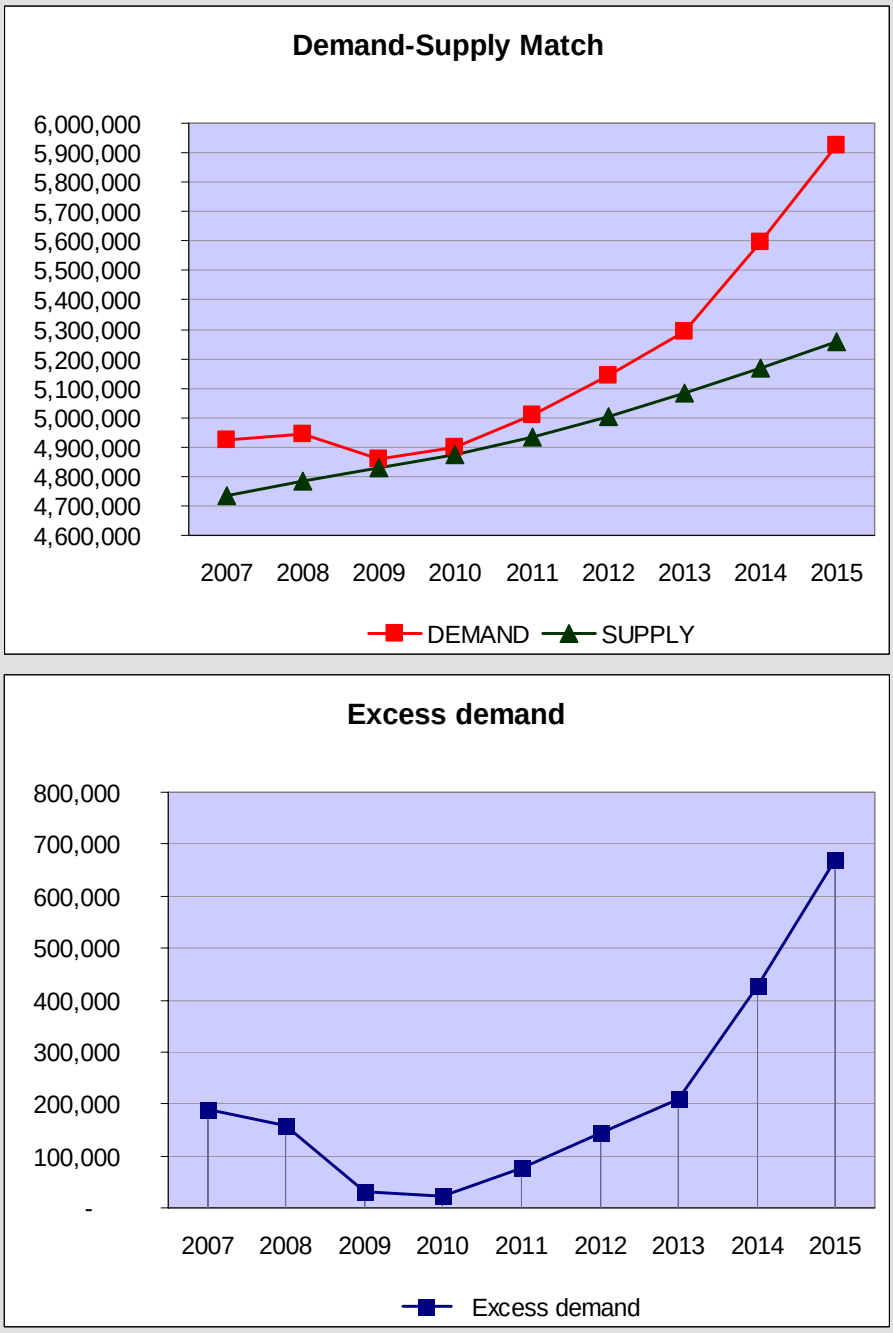
The "wild card" in this scenario could be some key technology breakthroughs invented in Europe, which may kick off a virtuous circle of fast development. A possible field for a breakthrough are environmental technologies, or clean fuel technologies (say, a really clean engine triggering a much faster substitution of motor vehicles in the world) or perhaps breakthroughs in the renewable energies field, which would kick off a much faster cycle of implementation of smartgrids to enable distribution. These breakthroughs would affect the whole economy and result in much faster growth of the ICT market and ICT innovation, because any of them would probably kick off acceleration of information infrastructures development.

Forecasts

In the ‘turbo knowledge economy’ scenario Europe will always experience an excess demand of ICT practitioners. Even in the period 2008-2010, still during the economic crisis, excess demand is estimated to never fall below 24,000 (in 2010). There will be a positive supply side development leading to 266,000 additional inflows to the labour market, but the increase in supply wil not suffice to cope with the surge in demand. From 2010 onwards e-skills shortages will rapidly increase to an extremely high level of 669,000 in 2015

Exhibit 3-15: Forecast EU27 – Turbo knowledge economy scenario, broad e-skills

European Union (EU27) – 'Turbo knowledge economy scenario' BROAD definition of ICT practitioners

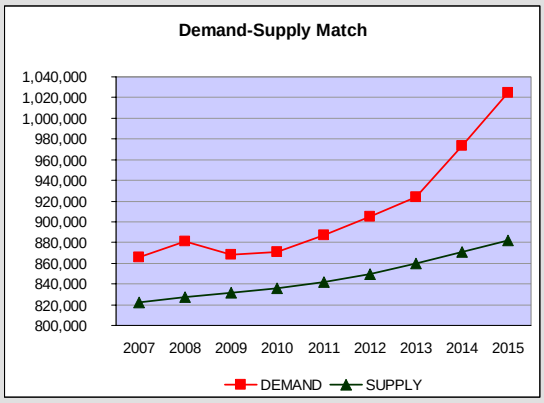


Source: e-Skills Monitor 2009

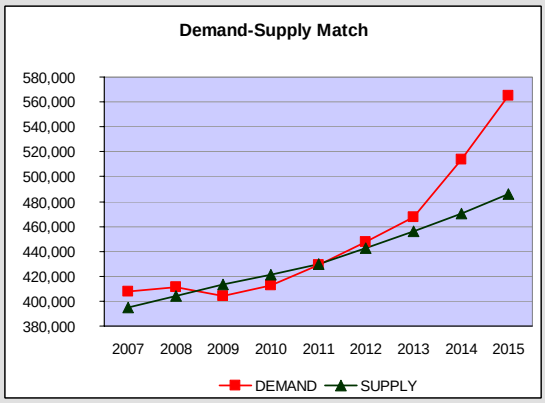
At country level is becomes apparent that in the 'turbo knowledge economy' and using the broad e-skills definition supply of ICT practitioners will be slightly above demand in the years of the economic crisis (2009 – 2011) in Spain, France, Poland and the United Kingdom. This will reach its peak in 2010 with an oversupply of ICT practitioners in Spain of around 8,200, France 6,700, the United Kingdom of 14,700 and Poland of 15,200 (where the peak is however already in 2009, with 23,400). Poland can be seen as an exceptional case with oversupply due to very high graduate figures, which nevertheless result in an excess demand due to domestic growth and nearshoring from other European countries.

Exhibit 3-16: Forecast countries – Turbo knowledge economy scenario, broad e-skills

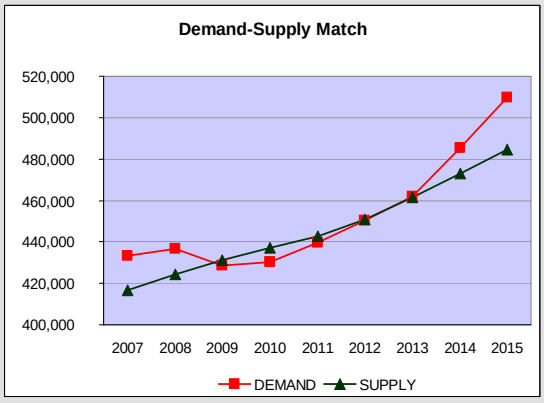
GERMANY (DE) – 'Turbo knowledge economy' BROAD definition of ICT practitioners



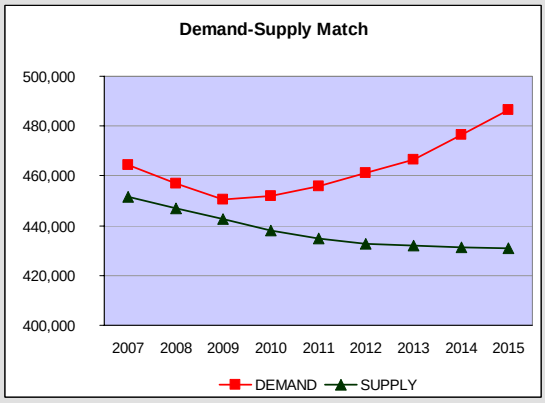
SPAIN (ES) – 'Turbo knowledge economy' BROAD definition of ICT practitioners



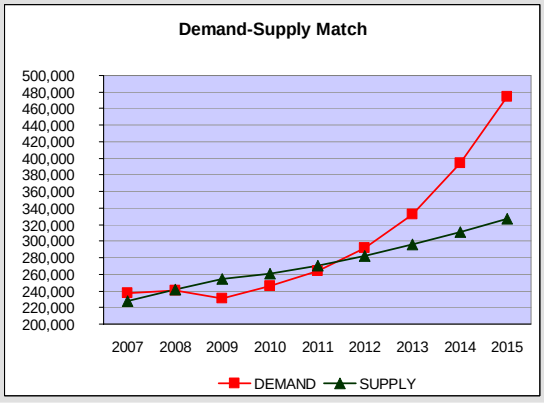
FRANCE (FR) – 'Turbo knowledge economy' BROAD definition of ICT practitioners



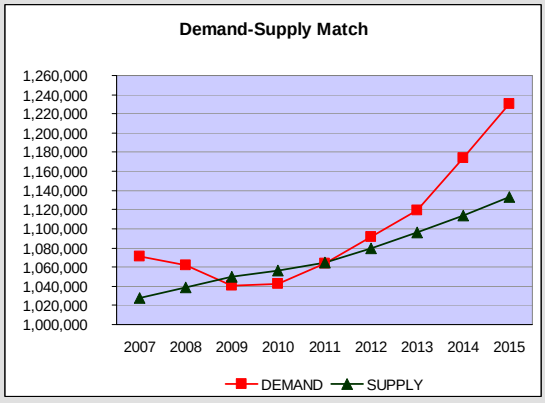
ITALY (IT) – 'Turbo knowledge economy' BROAD definition of ICT practitioners



POLAND (PL) – 'Turbo knowledge economy' BROAD definition of ICT practitioners



UNITED KINGDOM (UK) – 'Turbo knowledge economy' BROAD definition of ICT practitioners



Source: e-Skills Monitor 2009

Germany and Italy show the same pattern as in the other scenarios with both experiencing a strong lack of sufficient numbers of ICT practitioners to satisfy the demand. Again, in Italy this may depend on a low supply of graduates (see Annex III). In Germany the supply of ICT practitioners will still grow, although only very moderately. With an excess demand of 143,000 in 2015, Germany will reach an excess demand more than three times as high as before the current economic crisis.

3.4.4 Tradition wins

Scenario

This scenario is based on the assumption of a return to the historical development trajectory experienced before the crisis, in terms of growth rates, but the recovery is driven by traditional sectors (thanks for example to exports to Asia Pacific countries).

ICT policies and the stimulus package will not be very effective, and investments in ICT infrastructures will be delayed or implemented unevenly. IT spending will be focused on maintenance and traditional IT activities, with scarce innovation. The High Intensity IT User sectors will grow less than Low Intensity IT User sectors, so that Europe will lag behind the rest of the world in the digital environment, running the risk to miss opportunities for the future, since this development model can sustain only moderate growth rates. Off shoring will grow, as IT user enterprises will focus only on cost cutting.

Main Impacts

In this scenario policies will have a weak impact on the e-skills labour market problems across the EU, supporting some increase of training and easing some imbalances, but without solving e-skills gaps. The stimulus package measures will have a moderate positive impact on the ICT industry revenues and employment in the forecast period, and will contribute to fuel the diffusion of innovation in key sectors, such as healthcare, government, energy, transport (with a slow but constant growth of ICT-related investments and diffusion of smartgrids, intelligent transport systems, eGovernment networks and services).

Overall, this model is characterised by a slow diffusion of ICT into user industries and into SMEs. As a consequence, there will be few IT-based productivity improvements, especially for industries with a traditional low IT intensity. This will impact moderately the competitiveness of high intensity ICT users. The mix of the ICT professional skills will remain very similar to the ones we had before the ongoing crisis. R&d skills will be moderately requested by the ICT industries. Also, this development model will not need additional skills to generate innovation and to manage cross-industry business development.

The attractiveness of the ICT industry will not improve and the share of graduates from computer sciences and from other science courses starting ICT careers will remain stable. Supply from university and secondary schools will mainly remain stable, with a moderate increase in providing marketing and sales skills, because institutions may perceive that it is necessary to support the ICT adoption into the more traditional industries and enterprises.

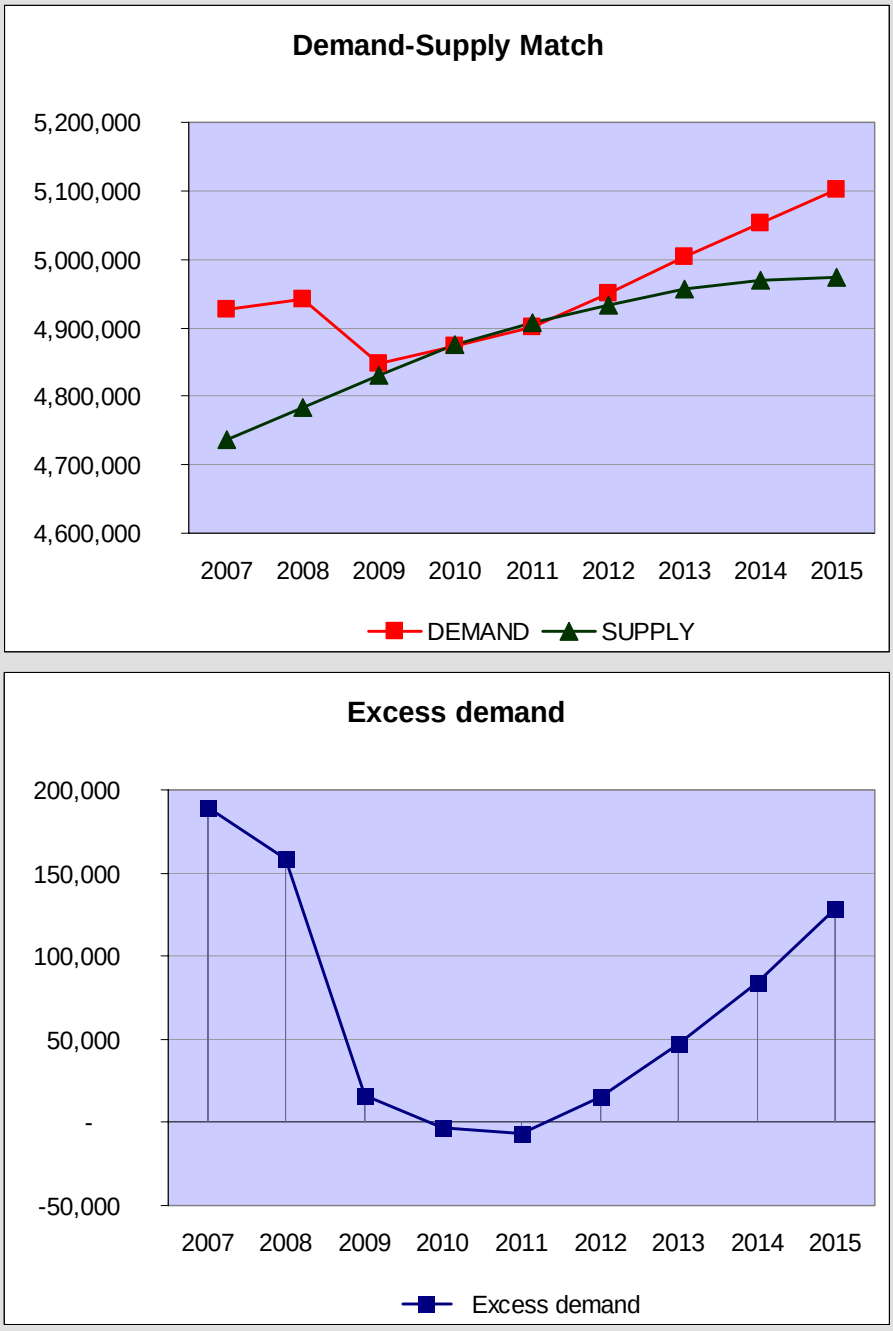
The average wages of ICT practitioners will slightly decrease. Overall, the e-skills gap will be substantially reduced in the forecast period, reaching a statistical balance of e-skills demand and supply in 2015, hiding mismatches between demand and supply in national markets. For example, High Intensity IT User Industries in some countries may have problems to recruit the appropriate e-skills, since the attractiveness of ICT careers will decline.

Forecasts

In the 'tradition wins' scenario a substantial balance of supply and demand of ICT practitioners can be expected at European level. This will happen because of a decline of e-skills demand, from a pre-crisis excess demand figure of 190,000 at EU27 level to -3,000 (over supply) in 2010. There will be a balance at least until 2012, with a slight oversupply in 2011 at 6,700 (0.1%) and 15,000 excess demand in 2012 (0.3%). According to the forecasts excess demand is likely to occur again after 2015, with a 2015 figure of 128,900, or 2.6% of the ICT practitioner workforce.

Exhibit 3-17: Forecast EU27 – Tradition wins scenario, broad e-skills

European Union (EU27) – 'Tradition wins' BROAD definition of ICT practitioners



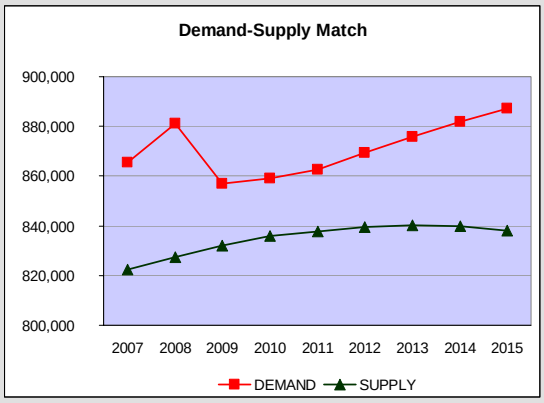
Source: e-Skills Monitor 2009

In the 'tradition wins' scenario and based on the broad definition of ICT practitioners we will observe a continuous excess demand in Germany and Italy for the reasons already stated in the forecasts for the other scenarios.

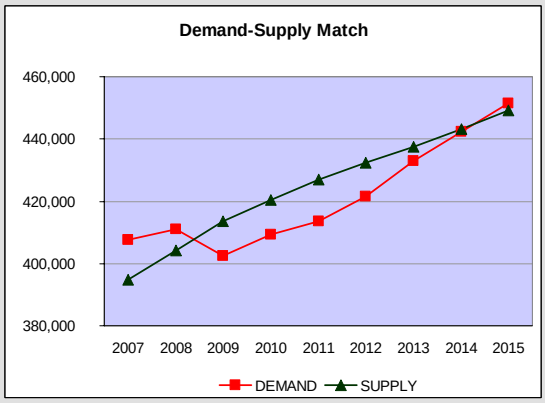
All other countries will experience an oversupply of ICT practitioners in the coming years in this scenario. In France, Poland, UK and Spain gap is about to close in 2014/2015 or slightly later. In Poland the oversupply is very slowly closing year by year starting from 22,000 in 2009 and reaching 11,000 in 2015. In the United Kingdom it will change from a 15,500 oversupply to 17,000 excess demand in 2015.

Exhibit 3-18: Forecast countries – Tradition wins scenario, broad definition of e-skills

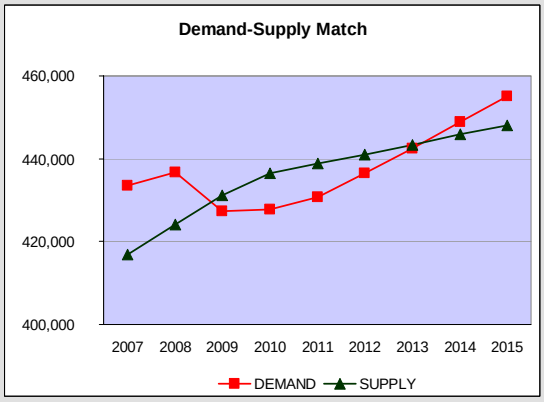
GERMANY (DE) – 'Tradition wins' BROAD definition of ICT practitioners



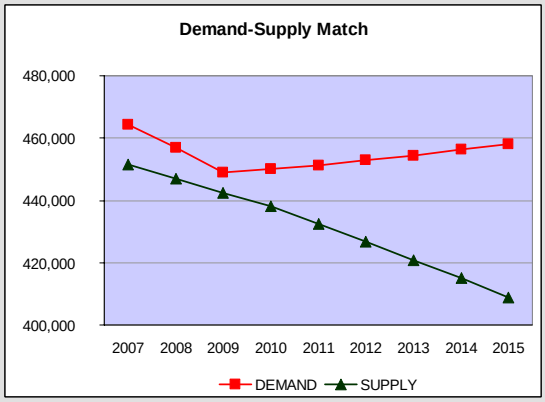
SPAIN (ES) – 'Tradition wins' BROAD definition of ICT practitioners



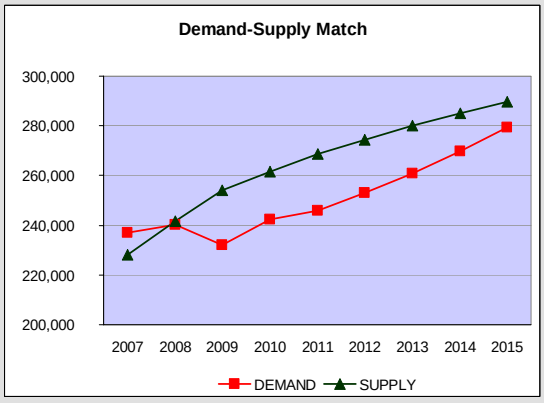
FRANCE (FR) – 'Tradition wins' BROAD definition of ICT practitioners



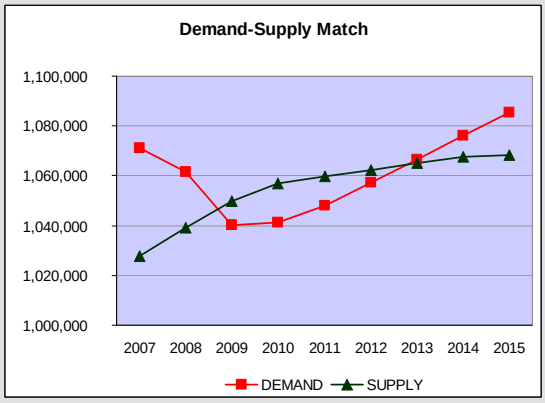
ITALY (IT) – 'Tradition wins' BROAD definition of ICT practitioners



POLAND (PL) – 'Tradition wins' BROAD definition of ICT practitioners



UNITED KINGDOM (UK) – 'Tradition wins' BROAD definition of ICT practitioners



Source: e-Skills Monitor 2009

3.4.5 Stagnation

Scenario

This scenario is based on the assumption of a very slow economic recovery from the crisis. Europe will enter a stagnation cycle where neither innovation, nor export, seems able to trigger a return to growth. This could be caused by protectionist measures (slowing down the return of global trade to the levels reached before the crisis) and/or by a reversal in the labour and product market reforms implemented in the last fifteen years. The dramatic effects of the crisis could drive governments to re-introduce tighter labour and product market restrictions, to fight the rise of unemployment. In addition, a resurgence of banking problems not yet completely solved might also lead to a similar scenario.

The ICT industry will move to off-shore not only the simplest operational activities, but also higher-value added ones, such as R&D and product innovation, while in Europe companies will focus only on commercial networks and sales. Vision, Strategic planning and Product Lines management will be more and more concentrated at the headquarter level in the US, Japan, and in the future in India and other Asian Countries.

Main innovative applications and services such as Enterprise 2.0 and Cloud Computing will grow very slowly and be adopted only by few pioneer companies, failing to trigger the positive growth cycle. High Intensity IT User Companies will reduce their investments in innovative projects and Low Intensity IT User companies will not innovate at all in ICT, concentrating their efforts in the reduction of IT budgets. Future Internet developments and research will be considered low priority, with few investments allocated to building the next generation infrastructures.

The transformational and productivity impacts expected from IT-based innovation sweeping across the European economy will not materialize in this scenario. Only advanced, sophisticated IT users will enjoy some benefits from the reorganization of their business processes and networking with their closest partners, but this will not affect the largest part of the supply chains. This is essentially a scenario of missed benefits and missed opportunities.

Impacts

The demand of e-skills in this scenario may decrease slightly (as there is no innovation, but also no transformation so traditional IT maintenance needs remain). There could be a reduction of the demand of R&D and high level technology skills (due to lower research investment and strong off-shoring). The demand of ICT management and marketing skills will not increase as much as in the other scenarios.

The demand decrease of R&D skills also will depend on the fact that the ICT activities will become standardised and very little innovation will be introduced into the system. As a consequence the demand of graduates from university will decrease, while the demand of graduates from secondary schools will be stable or even increase a bit since there may be a trade off between demand of graduates from university and graduates from secondary schools.

Demand for e-skills within industries with ICT high intensity will remain stable especially for R&D skills and management; these industries will look for highly qualified people. In the industries with low ICT intensity, the demand for R&D skills and management skills will decrease and these industries will hire graduates from secondary schools.

The attractiveness of the ICT careers will slow down as well as the average wages. Enterprises will reduce their ICT training budgets and will hire people available on the market especially

for R&D jobs. The management skills will be more developed on the job training than by formal education. A relevant part of the necessary skills will be acquired on the job.

Overall, when the recovery from the economic crisis will come, the e-skills gap will decrease, reaching a statistical balance of demand and supply in 2015.

Wild card

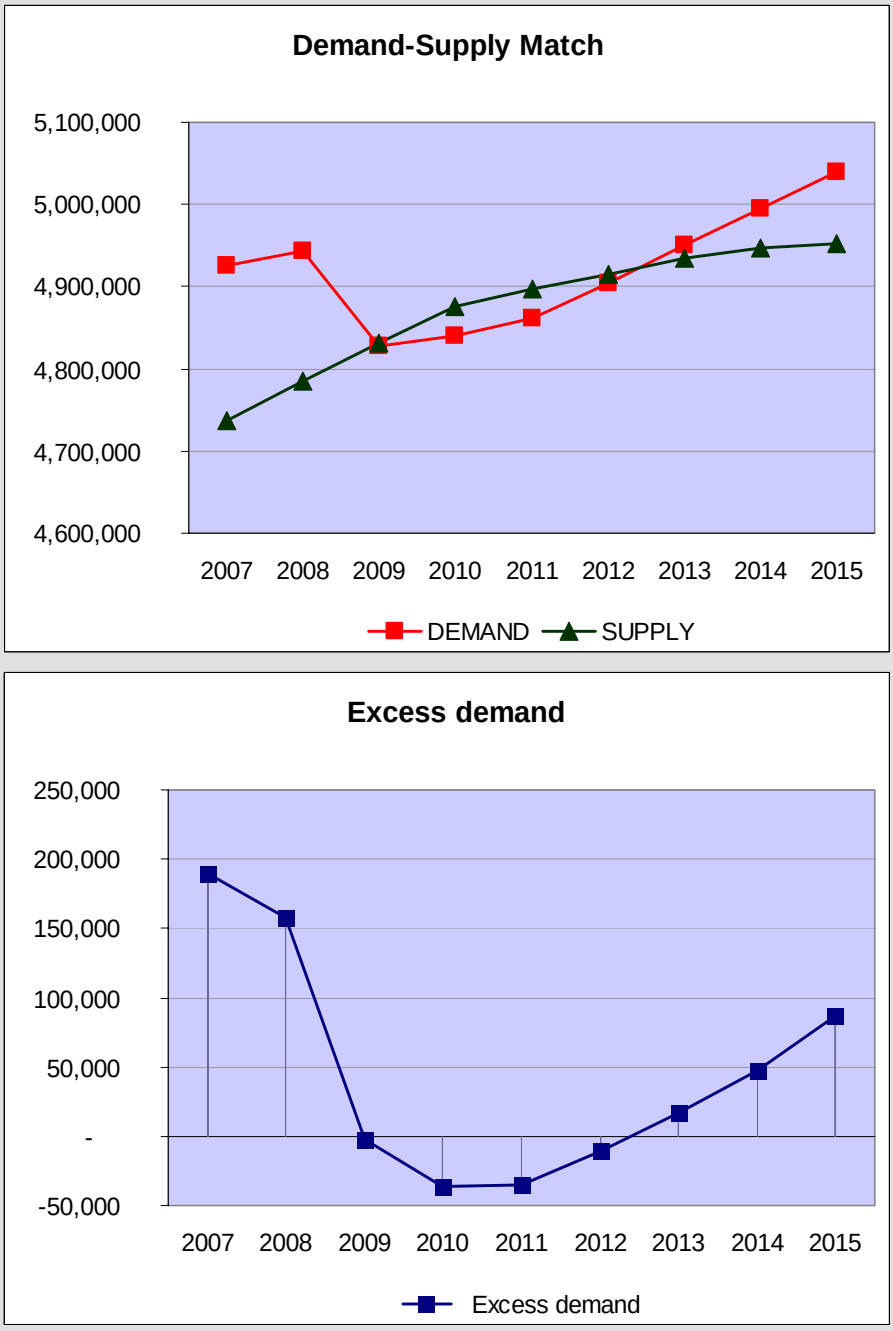
This negative scenario might also be caused by a major negative socio-political event affecting global stability and, again, restraining international trade and economic growth. This could be a major terrorist action, as it could be the murder of President Barak Obama; or the bombing of Iran by Israel; or a new war erupting between Pakistan and India, perhaps caused by the fall out of events in Afghanistan.

Forecasts

In the "stagnation" scenario and at European level supply and demand are going to match in the years to come.

Exhibit 3-19: Forecast EU27 – Stagnation scenario, broad e-skills

European Union (EU27) – 'Stagnation' BROAD definition of ICT practitioners

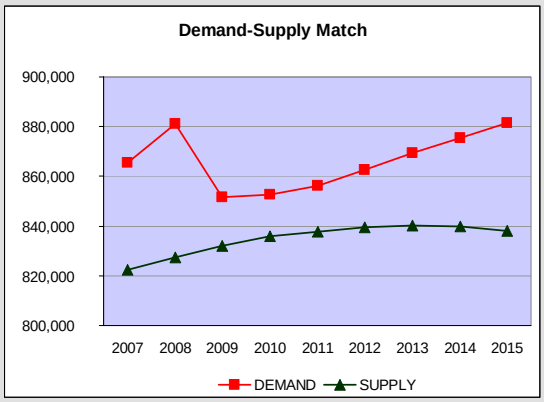


Source: e-Skills Monitor 2009

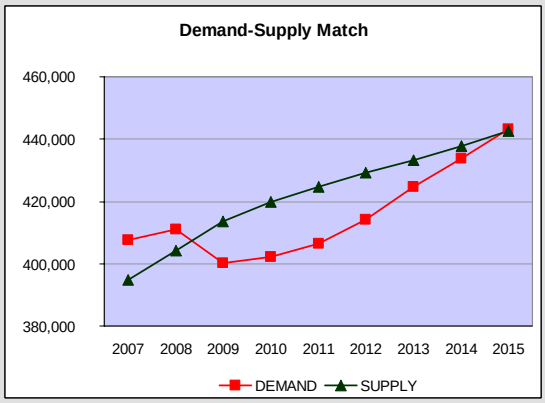
At a country level, the developments of supply and demand in the 'stagnation' scenario will almost match in France, Spain, UK and Poland, whereas there will be an excess demand in Germany and Italy as already in the other scenarios. This is likely to increase from 17,000 in 2010 to 43,000 in 2015 in Germany. With the latter figure Germany would be back to the situation in 2007 and before the economic crisis. The opposite is likely to happen in Poland, experiencing an oversupply of ICT practitioners in the years to come in the 'stagnation' scenario. The oversupply will be at a level between 28,800 and 16,600 throughout the reporting period. In the UK a 20,000 oversupply will develop into a match of demand and supply, statistically, in 2015

Exhibit 3-20: Forecast countries – Stagnation scenario, broad e-skills

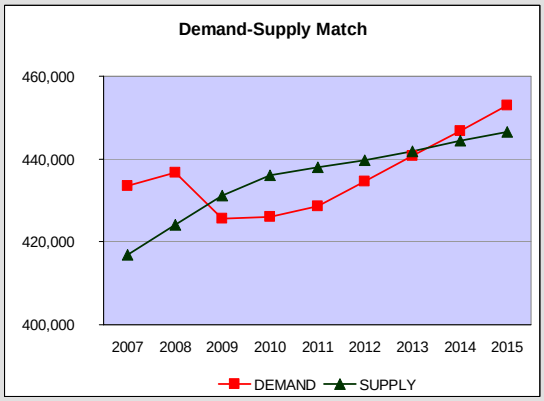
GERMANY (DE) – 'Stagnation' BROAD definition of ICT practitioners



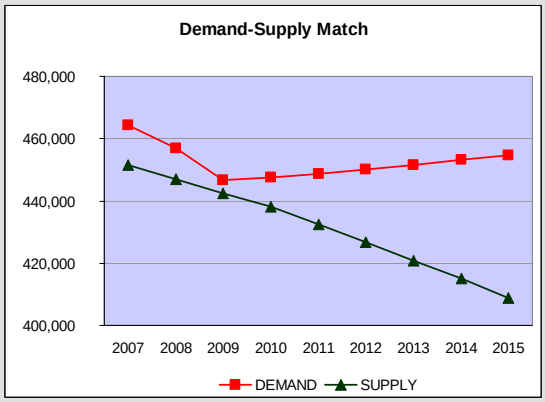
SPAIN (ES) – 'Stagnation' BROAD definition of ICT practitioners



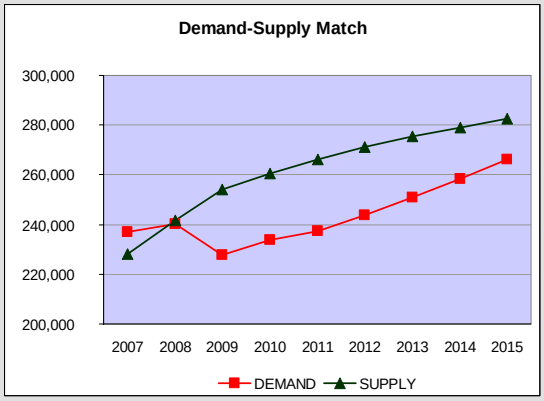
FRANCE (FR) – 'Stagnation' BROAD definition of ICT practitioners



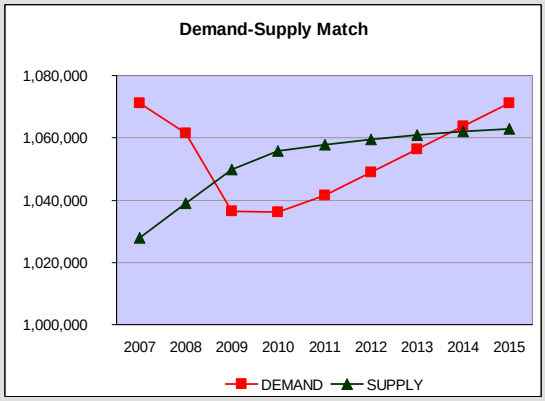
ITALY (IT) – 'Stagnation' BROAD definition of ICT practitioners



POLAND (PL) – 'Stagnation' BROAD definition of ICT practitioners



UNITED KINGDOM (UK) – 'Stagnation' BROAD definition of ICT practitioners



Source: e-Skills Monitor 2009

3.5 Conclusions

The five global e-skills demand-supply scenarios, which have been developed by this study point to rather different outcomes for 2010 and 2015[4]. For the next year, the scenarios do not differ markedly, but they show how the impact of the economic crisis has substantially reduced the e-skills gap lamented by the ICT industry, resulting in a demand-supply balance in quantitative terms for the EU27. But this general picture still hides mismatches by country and by type of skills. By the year 2015, however, the risk of a relevant e-skills gap resurfaces again and is relevant for 3 out of 5 scenarios, reaching up to 11% of the total ICT employment in the most positive scenario and 10% and 7% excess demand levels in the next two scenarios. In the other two scenarios there is only a slight excess demand compared to supply, actually there is clearly a potential risk of e-skills oversupply in some areas, given that the statistical model does not allow to analyse the potential mismatches for the specialisations demanded by employers.

The five scenarios have been developed linking together possible assumptions about the European economy development model in the short-to-medium term. They are possible futures rather than projections; it is important to draw from their results the learning points about the consequences of events and of policy actions.

Looking more closely at the 2010 scenarios, we notice that next year represents a starting point for their different trajectories. The five scenarios are quite similar, because the range of uncertainties in the main quantitative indicators (such as GDP growth) is limited, given the five scenarios, and differences between scenarios which are bound to still feel the impact of the crisis and the other scenarios which are bound to the first signs of the rebound are not yet surfacing due to a rather slow reaction speed in the model (which is certainly not unlikely to reflect the reality in this regard). The level of supply is the same for all the scenarios, since the output of the formal education system is rather rigid in the short term, as well as the inflows of human resources from other careers or from training. The net result is that by 2010 for all five scenarios demand and supply of e-skills should be essentially balanced, and the range between an excess demand of 23,800 in the "Turbo knowledge Economy" Scenario and an oversupply of 36,000 in the "Stagnation" scenario equals a margin varying from 0.5% to -0.7% of the demand, which should not be overemphasized.

The divergence in the scenarios becomes much more evident in 2015:

- **"Back to normal"** features approximately 384,000 e-skills excess demand, which the supply system cannot satisfy. This is driven by the continuation of "before the crisis" patterns, with IT-based innovation playing an important factor in the development model of the economy, both high intensity user industries and low-intensity user industries increasing their demand in the same proportion as they used to. The result of these trends is that the imbalances of the e-skills market, denounced today by many sources, reappear and become more relevant. In qualitative terms, the main e-skills gaps concern high level technical skills (for the design and development of advanced services) and managerial/customer oriented skills, while the demand for traditional programming skills tends to decline.
- **"Investing in the Future"** develops similarly to the previous scenario until 2011 and then diverges, taking a faster growth path driven by ICT-based innovation and future-oriented investments. The transformational impacts of this innovation begin to be perceived, as advanced users change their relationship with suppliers and evolve their internal business processes. The decrease of costs for run-of-the-mill IT applications

[4] In the present chapter the scenarios and forecasts are presented in a summary overview. In this overview we have selected the results from using the broad definition of ICT practitioners as opposed to the other three definitions for which forecasts have also been developed. During the expert discussions in the course of our work it appears that this definition captures the current situation best.

and services frees up resources for innovative enterprises to invest in new IT-based projects, without decrease of the quality of services. In this scenario the e-skills gap grows some more to 580,000 in 2015. The mix of demand starts shifting towards management ICT skills, while the gap of R&D skills tends to increase at the end of the forecast period, when ICT research investments start to accelerate.

- **"Turbo knowledge economy":** This scenario envisages a strong acceleration of the knowledge economy in Europe, with a jump ahead of ICT-driven innovation, also helped by effective and proactive ICT policies and the impact of the stimulus package. The turning point in this scenario is the massive adoption of ICT innovation by SMEs, particularly high-tech SMEs and medium-size enterprises (the fast growing "gazelles" described by economic literature as one of the key potential success factors of the European economy). New digital infrastructures (smartgrids, e-health smart networks, intelligent transportation systems and networks) leverage innovation to generate productivity increases in the public sectors and across the economy. , Therefore the excess demand for e-skills almost doubles compared to the first scenario, to 669,000 in 2015. The e-skills more requested are ICT management skills and R&D skills to support the development of innovative products and services.
- **"Tradition wins"** on the contrary features an economic development model driven by traditional industries, with a low profile knowledge economy. ICT policies and the stimulus package are not very effective, and investments in ICT infrastructures are delayed or implemented unevenly. IT spending is focused on maintenance and traditional IT activities, with scarce innovation. The High Intensity IT User sectors grow less than Low Intensity IT User sectors, so that Europe lags behind the rest of the world in the digital environment, running the risk to miss opportunities for the future, since this development model can sustain only moderate growth rates. Off shoring grows, as user enterprises focus only on cost cutting. The slow development of the advanced services industries, and the relatively lower importance of ICT- based innovation, compresses e-skills demand down and (since supply is relatively rigid) leads to a mere 129,000 of excess demand in 2015,
- Finally, the **"Stagnation"** scenario is based on very low level growth. The ICT industry moves to off-shore not only the simplest operational activities, but also higher-value added ones, such as R&D and product innovation, while in Europe companies focus only on commercial networks and sales. The transformational and productivity impacts expected from IT-based innovation sweeping across the European economy do not materialise in this scenario. Only advanced, sophisticated IT users enjoy some benefits from the reorganisation of their business processes and networking with their closest partners, but this does not affect the largest part of the supply chains. This is essentially a scenario of missed benefits and missed opportunities. By 2015, there is still some excess demand of 86,000, representing only 2% of the workforce. Within this picture, there could be demand-supply mismatches in some national markets with some unemployment growth.

The table below - reproduced from chapter 3.3 – provides an overview of the e-skills demand and supply situation in 2010 and 2015 and compares these according to the different scenarios developed.

This comparative analysis shows that the three of the five scenarios characterized by higher economic growth, based on the strengthening of the knowledge economy, all show the potential risk of relevant e-skills gaps. The underlying assumptions of these scenarios are coherent for example with the OECD observations about the current crisis impacts and long-term growth perspectives, which are linked with innovation growth. As the OECD observed[5]:

"As policy makers work to stabilise financial markets and strengthen short-term demand, they can leverage the crisis to build the foundations for stronger long-term growth and a transition to a greener economy. (..) Today's world is one in which both

[5] OECD 2009: Policy Responses to the Economic Crisis: Investing in Innovation for Long-Term Growth.

OECD countries and non-OECD economies increasingly rely on knowledge and services to drive their performance, where investment in intangible assets is of equal importance as investment in machinery, equipment and buildings. Efforts to stimulate the economy must therefore reflect the current drivers of economic growth, and take advantage of industrial renewal to accelerate the important structural shifts underway".

Exhibit 3-21: e-Skills demand and supply in 2010 and 2015 (broad definition of e-Skills)

	2010			2015		
	Demand of e-skills	Supply of e-skills	Demand/ Supply Difference	Demand of e-skills	Supply of e-skills	Demand/ Supply Difference
Back to normal	4,852,700	4,876,200	-23,500	5,445,700	5,061,600	384,100
Investing in the future	4,870,800	4,876,200	-5,400	5,646,700	5,067,200	579,500
Turbo knowledge economy	4,899,900	4,876,200	23,700	5,927,700	5,258,500	669,100
Tradition wins	4,873,200	4,876,200	-3,000	5,102,300	4,973,500	128,900
Stagnation	4,839,500	4,876,200	-36,800	5,038,700	4,952,200	86,500

Source: e-Skills Monitor 2009

In other words, if Europe wishes to get back on the growth path and to sustain its competitiveness with the emerging Asian economies, it is important to invest in the development of the knowledge economy, of which e-skills are a critical factor. According to this study analyses, however the factors of change are shaped, human resources with the right skills are still a problem for Europe. The role of European and national policies are critical, both to sustain innovation investments and to make sure that e-skills do not become a bottleneck for innovative enterprises and organizations in the private and public sector.

Another important assumption underlying our scenarios is the relative rigidity of supply (which is similar across all of the scenarios). This is due to the relatively short time horizon: it is well known that formal education system changes take from 5 to 10 years to materialize. It is very unlikely that the number of ICT graduates in 2015 in Europe will be drastically different from this year's number. On the other hand, there is some flexibility in the training and learning on the job production of ICT practitioners, which might provide additional flexibility to the system by responding to some of the most acute e-skills gaps in the user industries. It will be more difficult to fill these gaps in the ICT producer industries, without considerable effort and investments

A final element which needs to be discussed is IT off-shoring. This phenomenon is often accused to be the main cause of growing unemployment and jobs destruction in the EU. Actually, according to IDC estimates and the study team's elaboration, IT services off-shoring is still marginal (compared to overall IT services revenues) and is not likely, in any scenario, to grow explosively, even if it certainly developing. This is due to the complexity of the off-shoring activity, and the fact that its main benefits are for large or medium-large enterprises. In addition, off-shoring does not lead automatically to jobs destruction: in many cases this extreme form of outsourcing frees up resources within European companies, who are then dedicated to other activities. This is likely to happen since there is always potential demand

for expert personnel skills, for example for innovative projects. The fact remains that many industry experts continue to point the finger against the risk of delocalization by ICT industries; if developments such as Cloud Computing or Utility computing materialized soon for a majority of user companies, this might have strong impacts on ICT employment. But the real threat for the European ICT employment and knowledge base, rather than IT services off-shoring, is probably linked with the overall globalization trends, which see emerging demand concentrated outside the mature European markets. The ICT industries have already started years ago to open new research and production facilities only nearby new emerging demand, in other markets outside Europe. This is the phenomenon driving ICT jobs loss in the EU.

In conclusion, the five global scenarios underline the risks of imbalances for the e-skills labour market, and they also show the critical role which European and national policies could play to improve the chance of realization of the positive scenarios, avoiding the risks illustrated by the negative scenarios.

BIBLIOGRAPHY

"Digital Britain Report", June 2009, by the UK Department for Culture, Media and Sport and thye Department for Business, Innovation and Skills

"Digital Britain - Creating the Skills for the Digital Economy: A summary of recommendations for action" by e-skills UK, SSC for Business and Information Technology, and Skillset, SSC for Creative Media, 2009

Final ReportFuture Internet 2020, call for action by a high level visionary panel, may 2009, http://ec.europa.eu/information_society/activities/foi/library/epr.pdf

Visions and scenarios developed by the seven working groups of the Future Internet Assembly (FIA), http://www.future-internet.eu/

The European Future Internet Initiative "Enabling the future - Networked Society starts today" by the ICT industry core group, http://www.fi-prague.eu/program/p/kennedy.pdf

Draft Report of the Task Force on Interdisciplinary Research Activities applicable to the Future Internet, July 2009, Report open for consultation and comments at:http://forum.future-internet.eu

Playing To Win In The New Software Market - Software 2.0: Winning For Europe Report Of An Industry Expert Group on A European Software Strategy, May 2009

EC Communication, Europe's Digital Competitiveness Report - Main achievements of the i2010 strategy 2005-2009 - Brussels, 04.08.2009 COM(2009) 390

EC Communication, "A Strategy for ICT R&D and Innovation in Europe: Raising the Game", COM(2009)116

CEPIS, Council of European Professional Informatics Societies, Thinking Ahead On E-Skills For The Ict Industry In Europe, December 2006

Richard Peynot, Major European Economies' IT Graduate Deficit, for Strategy Professionals, October 15, 2007

INSEAD, E-Skills, Competitiveness and Employability, Knowledge Societies' Next Frontier, September 2008.

INSEAD (2009): Who cares? Who dares? Providing the skills for an innovative and sustainable Europe. Background report for the European Business Summit 2009, http://www.insead.edu/ discover_insead/docs/WhocaresWhodares.pdf

ISTAG, Information Society Technology Advisory Group, "Revising Europe's ICT Strategy" final Report, February 2009, ftp://ftp.cordis.europa.eu/pub/ist/docs/istag-revising-europesict-strategy-final-version_en.pdf

World Economic Forum, Building E-skills for the Information Age, Bruno Lanvin, INSEAD, eLab, and Pamela S. Passman, Microsoft Corporation, The Global Information Technology Report 2007-2008

OECD – Working Party on the Information Economy (2009a): The Impact pf the Economic Crisis on ICT and ICT-Related Employment

OECD – Working Party on the Information Economy (2009b): The Impact of the Crisis on ICTs and their Role in the Recovery.

OECD - Policy Responses to the Economic Crisis: Investing in Innovation for Long-Term Growth (June 2009) Paris, at www.oecd.org/dataoecd/59/45/42983414.pdf.

OECD Working Party on the Information Economy (2005): Potential off-shoring of ICT-Intensive using occupations.

OECD (2008): Information Technology Outlook 2008.

IDC (2004): 40 Years of IT. An IDC Special Edition Executive White Paper.

IDC Insight (March 2009): Enterprise Investment Reality Check 2009: European Customers Switch Out Vendors with Inadequate Skills

Van der Zee, F: et al. (2009): Investing in the Future of Jobs and Skills. Scenarios, implications and options in anticipation of future skills and knowledge needs. Sector Report Computer, Electronic and Optical Products. http://ec.europa.eu/social/main.jsp?langId=en&catId=89&newsId=566&furtherNews=yes

ITU Confronting the crisis - Its Impact on the ICT Industry – February 2009

4 ANNEX I – The Experts Survey

4.1 Overview

E-skills demand and supply are both related with a number of socio-economic factors; it is nowadays very difficult to foresee what will be the trend of these factors that in some cases are qualitative factors that we cannot even measure.

This is the reason why we launched an online survey. Its objective was to gain a better understanding of the future trends of these factors, based on the opinion of e-skills experts , in order to be able to take the socio-economic factors into account within the future scenarios.

The expert survey was web based and it was launched in early June 2009 and de-activated in early July 2009.

The expert survey was sent to 355 experts selected by empirica and by IDC. The valid responses were 109, meaning that 31% of the experts contacted answered with a valid questionnaire. During the month of June, empirica made a follow-up and the research team personally contacted a number of experts in order to ask them to participate to the survey.

Exhibit 4-1: The e-Skills Monitor experts' survey data

Total number of experts	355	
Of which:		
Selected list of experts, prepared by empirica and IDC	184	
List of experts within industry, selected by IDC	71	
Number of respondents	138	39% of the total experts
Number of valid questionnaires	109	31% of the total experts
Questionnaires with all the 5 sub-sections completed	24	22% of the valid questionnaires
Questionnaires with at least one sub-section fully completed	85	78% of the valid questionnaires

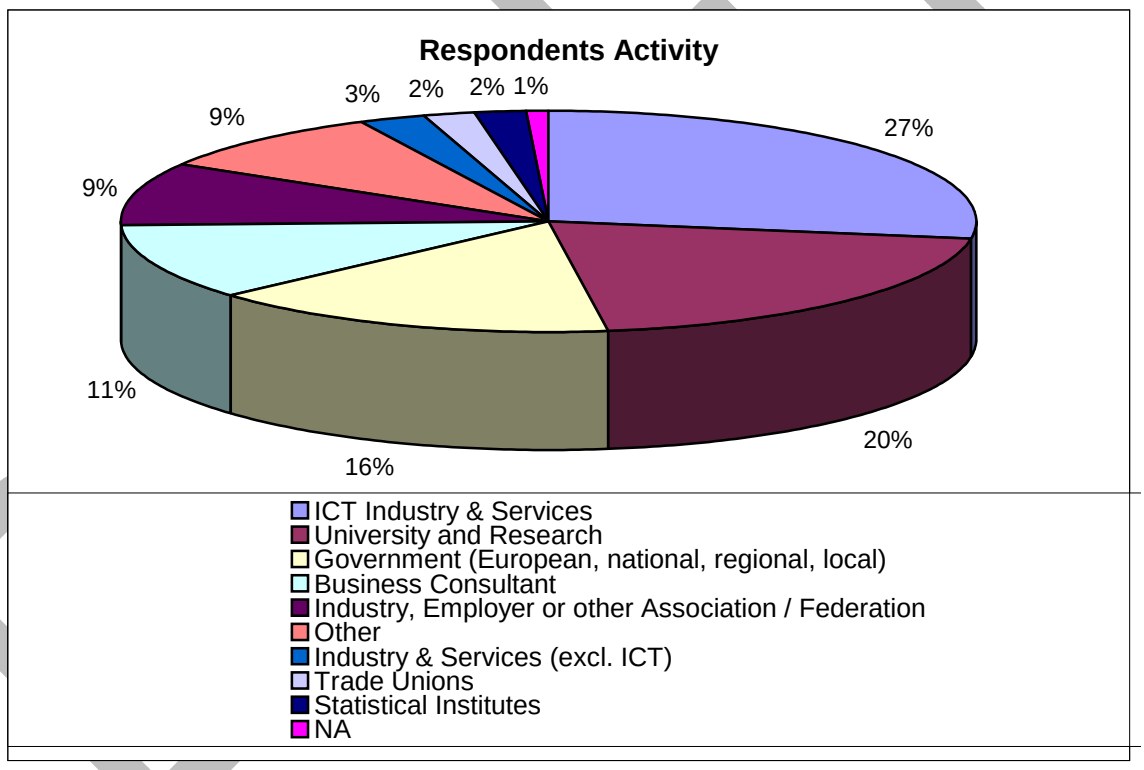
The survey was subdivided into five main sections, corresponding to the five sub-scenarios. The experts could fill in all the sections or select only some of them.

22% of the valid questionnaires were fully completed, while the other 78% were not fully completed. In the following table, we show the number of responses by sub-scenarios. The number of valid questionnaire by sub-scenario is big enough to allow elaboration within each single sub-scenario.

Exhibit 4-2: Number of respondents by sub-scenario

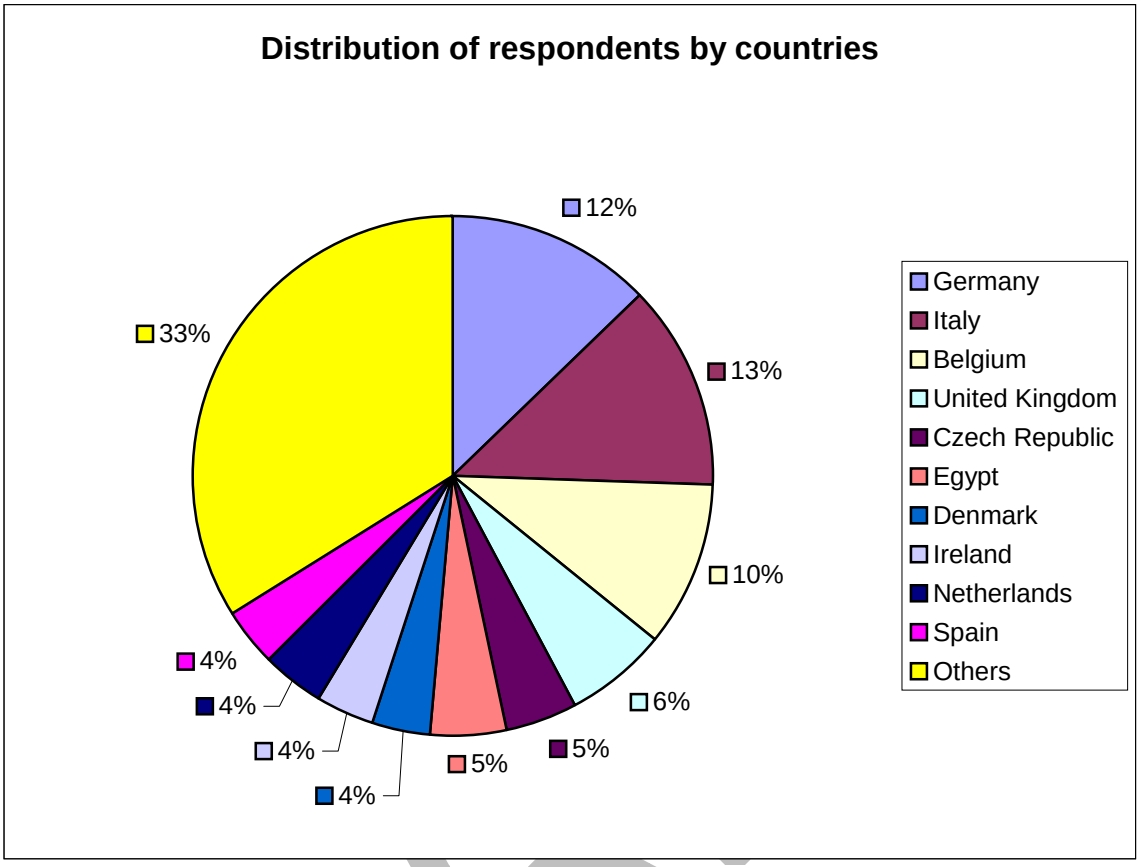
Sub-scenario	As a % of total valid questionnaires	Number
Innovation	74	81
Off-shoring	62	68
Education	62	68
Macroeconomic	59	64
Socio-policy	55	60

Respondents' activity is equally distributed between industry, and research and consultancy. As shown in the flowing pie, nearly one respondent out of three is working in the IT industry; 20% of respondents work in university and research and 11% of respondents are business consultants, meaning that again one respondent out of three works in research and services. Another relevant respondents' activity is the one in the government area (16%), including the European, national, regional and local ones.



The survey respondents are mainly based in EU: in fact 95 respondents, meaning 87% of them are located in EU countries. 14 respondents, i.e.13%, are located in non-EU countries. Four countries, i.e. Belgium, Germany, Italy, the United Kingdom represent 42% of the respondents. The experts also include a significant sample of answers from Eastern Europe: in fact 13% of them are located in Eastern Europe.

Exhibit 4-3: Distribution of Respondents by Country



4.2 The structure of the questionnaire

The questionnaire is sub-divided into five sub-sections corresponding to five sub-scenarios (for the complete questionnaire, see the annex).

The five sub-scenarios are the following.

1. ICT Innovation sub-scenarios = 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.
2. ICT Off-shoring sub-scenarios = alternative developments of the trend towards sourcing ICT skills and activities outside of Europe, and its main drivers and impacts.
3. Macroeconomic/ Labour Market sub-scenarios = Alternative hypotheses of economic and employment growth in the EU in 2010-2015, based on possible scenarios of a quick economic recovery from the crisis or a slow one.
4. Education sub-scenarios = the main trends affecting the production of e-skills by the education and training system in the examined period.
5. Socio-Policy sub-scenarios = alternative policy strategies and social trends which may affect the demand-supply of e-skills.

In each sub-scenario, we asked the experts to evaluate a series of statements, stating their level of agreement and their opinion on the potential impact on demand/supply of e-skills in Europe on the basis of a scoring scale ranging from 1 to 7.

To state their level of agreement, the experts had the possibility to evaluate each statement on the basis of a scoring scale from 1 to 7:

Exhibit 4-4: Scoring scale of the experts' survey statements

1	2	3	4	5	6	7
Completely disagree						Completely agree

Neutral opinion

Disagreement area **Agreement area**

As we will show in the following paragraphs, one of the main results of the expert survey is that the experts' opinions are concentrated into the agreement area. In average, in fact the level of agreement of the experts to the statements presented in the survey always has average values over 4. This means that, on the overall, the experts agreed with the sub-scenarios proposed into the statements (details will be presented in the following paragraphs).

Moreover, there is also a good level of consensus among experts, based on the standard deviation of the level of agreement expressed by the experts: the standard deviation around the average level of agreement is on average lower than 1.5 (see the following paragraphs, referring to the single sub-scenarios).

For each statement, we also asked the experts' opinion about the impact on e-skills demand and/or, where this is consistent, on e-skills supply.

Exhibit 4-5: Scoring scale of impact on e-skills demand or supply, into the experts'survey

1	2	3	4	5	6	7
Relevant decrease of demand/ supply						Relevant increase of demand/ supply

e-skills demand/supply stable

Decrease of e-skills demand/supply **Increase of e-skills demand/supply**

There is not a linear relation between the level of agreement and the experts' consensus, but it may be interesting to highlight that the statements with the lowest level of agreement are as well those with the lowest level of consensus.

The statements with lower experts' agreement are in some cases also those where consensus is lower. For these statements, where relevant, we will provide an analysis by group of experts, in order to better understand the reasons of the different opinions.

In the Annex of this report we will present the detailed results of the survey. The annex includes, for each sub-scenario, a table with the corresponding statements. For each statement of the sub-scenario, we provide, into the table:

- The level of agreement (mean of the scoring scale from 1 to 7) for each statement of the sub-scenario, and the corresponding standard deviation that shows the level of consensus of the experts about each statement
- The expected level of the impact on demand (mean), for each statement, and the corresponding standard deviation, showing the level of consensus from the experts about the impact the above statement may have on the e-skills demand

The agreement in average has also been analysed with a paired T-test in order to evaluate what are the most significant results.

A descriptive synthesis of the results will be provided for each sub-scenario in the following paragraphs.

4.3 Opinions on ICT innovation Trends

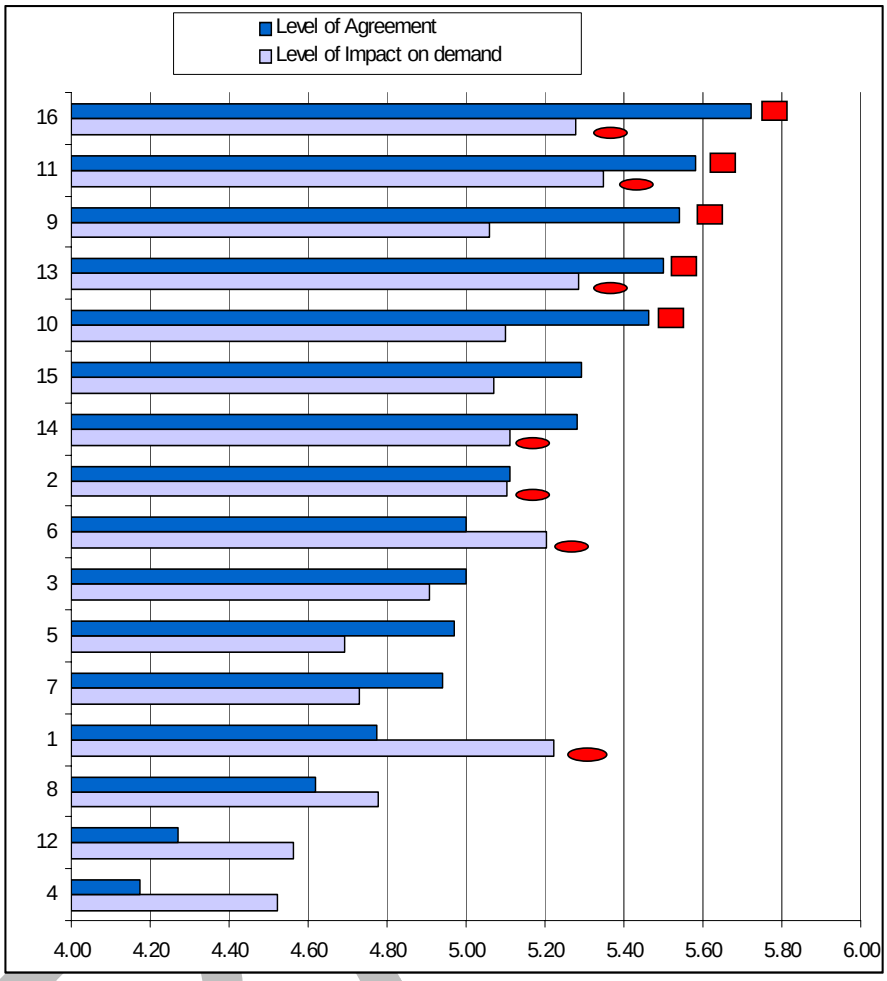
The ICT innovation sub-scenario is focused on alternative visions of the main trends of ICT innovation, their diffusion in the EU, the evolution of ICT delivery and business models, and the changes of the interactions between ICT producer and user industries in the examined period.

The main ICT innovation technology trends for the examined period are the following:

1. **Industrialization & automation of IT Services**
2. Emergence of **new technology delivery models** (Software as a Service, Cloud Computing, Utility Computing)
3. **Outsourcing** of ICT services
4. **Diffusion of advanced tools and interfaces**, making it easier to develop simple IT applications (e.g. programming a web site)
5. **Enterprise 2.0**, that is the use of web-based technologies for networking, collaboration, information sharing and knowledge management within and outside the enterprise.
6. **Convergence of IT and communications technologies** in enterprise systems, creating an integrated user experience (email, web audio and videoconferencing, voice telephony, fax and so on) based on Unified Communication networks

The main innovation technology trends presented above were detailed with sixteen statements.

Exhibit 4-6: Ranking of Innovation Trends based on Experts Opinions



16	Change of the mix of ICT skills required in Europe - ICT management skills
11	Adoption of enterprise 2.0 applications and services by the majority of high intensity ICT user industries
9	Widespread diffusion of easier to use technologies for the development of IT applications by ICT industry and ICT user industry
13	Unified user experience (IT+communications) in the majority of ICT industry and ICT user industry companies
10	Adoption of enterprise 2.0 applications and services by the majority of ICT industries
15	Change of the mix of ICT skills required in Europe - ICT marketing and sales skills
14	Change of the mix of ICT skills required in Europe - ICT R&D skills
2	Industrialization of development and delivery of IT solutions and services by high intensity ICT user industries
3	Rapid adoption of new technology delivery models by the majority of the high intensity ICT user industries
6	New technology delivery models stimulating creation of new innovative enterprises in Europe
5	Adoption of new technology delivery models by SMEs
7	Diffusion of IT outsourcing by high intensity ICT user industries
1	Industrialization of development and delivery of IT solutions and services by ICT industries
8	Diffusion of IT outsourcing by low intensity ICT user industries
12	Adoption of enterprise 2.0 applications and services by the majority of low intensity ICT user industries
4	Adoption of new technology delivery models by the majority of low intensity ICT user industries

Legenda: *statements statistically significant*

Source: IDC for e-Skills Monitor (2009)

The main conclusions from the innovation sub-scenario survey may be summarised as follows:

- Main innovation trends are common to ICT industry and to high intensity ICT users
- Experts believe that main technology innovation trends won't have an important diffusion in the low intensity ICT users
- Innovation trends that will have the most relevant impact on e-skills demand are the enterprise 2.0 applications, the convergence of the IT and communication technology for a unified user experience between telephony and the Web, and the new delivery models.
- The two most important innovation trends - increase in the management activity and skills and the adoption of enterprise 2.0 applications - will also be the trends with the most relevant impact on demand.

4.4 Opinions on Off-shoring Trends

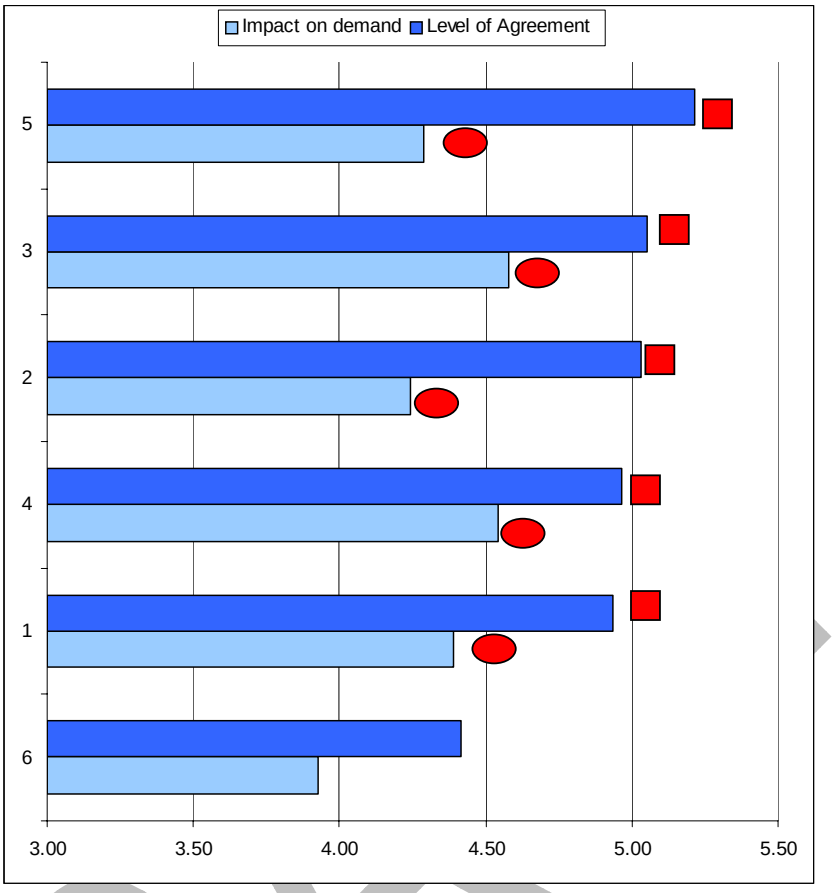
These sub-scenarios are focused on alternative developments of the trend towards ICT off-shoring, which is the sourcing of ICT skills and activities outside of Europe, and/or near-shoring, which is the sourcing of skills in countries within Europe but with lower average costs.

The main hypotheses for the period 2010-2015 are:

- ICT Off-shoring grows fast across all IT-related sectors, such as software development, application management and managed services, as well as IT-supported activities, such as Business Process Outsourcing.
- ICT Off-shoring remains stable or grows slowly, due to little or no labour cost advantages or the inability of potential suppliers to provide the required service quality and skills, and possible EU policy measures promoting local skills or restraining off-shoring

The off-shoring sub-scenario included 6 hypotheses, as detailed in the following table.

Exhibit 4-7: Ranking of Off-shoring Trends based on Experts Opinions



5	The gap of ICT practitioner labour costs between EU and off-shoring countries will be the main reason for off-shoring IT skills.
3	European ICT industry companies will increase their use of near-shored skills faster than the use of off-shored skills.
2	Increase of the use of off-shored skills by high intensity ICT user companies
4	High intensity ICT user companies will increase their use of near-shored skills faster than the use of off-shored skills.
1	Increase in the use of off-shored skills by European ICT industry
6	Negative impact of off shoring on the innovative capacity and the knowledge base of the European economy.

Legenda: *statements statistically significant*

Source: IDC for e-Skills Monitor (2009)

The survey shows that experts do not believe that off shoring may have a negative impact on the innovative capacity and the European economy; nevertheless, there is not, among the experts, a high level of consensus on this aspect. Looking more in depth to the results of the survey, we can see that the experts that are more concerned about the negative impact of off shoring on innovative capacity are the experts from the ICT industry.

We'd rather notice that also among ICT industry experts, there is not a high consensus about that issue. This in our view means that there is a high level of uncertainty about the future off-shoring effects.

4.5 Opinions on IT Education and Training Trends

These sub-scenarios focus on the main trends affecting the production of e-skills by the education and training system in the examined period. The main trends affecting the education sub-scenarios are the following:

- Risk of decrease of enrollment to computer science and IT-related education courses
- Risk of ICT practitioners skills shortage and skills gap
- Decrease, in the short/medium term, of private investments in life-long learning and training, due to the economic crisis
- In the long term, increase of relevance of life-long learning and training for IT skills

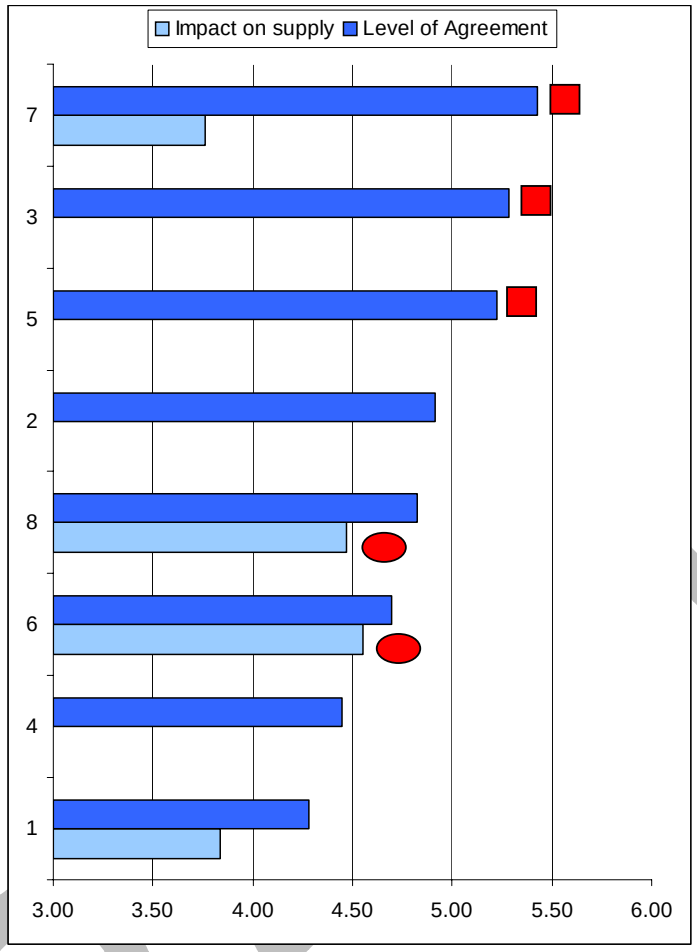
To illustrate the education sub-scenarios, we presented eight statements.

Education can only have an impact on the e-skills supply: for a number of statements, we in fact asked for the corresponding impact on e-skills supply. Moreover, the impact of the education trends on the e-skills supply will need at least five years to occur.

Based on the experts' opinion, we may summaries the expert education sub-scenario as follows:

- Due to the economic crisis, the IT training budgets are going to decrease until 2011 but this will not have relevant impacts on e-skills supply.
- At the end of the economic crisis, the companies' IT training budgets may not quickly return to pre-crisis level.
- From 2010 to 2015, increasing skills gaps will involve mainly R&D skills and management skills
- In average, the experts do not believe that from 2010 to 2015 the number of students choosing computer science and IT related courses will decrease. Nevertheless, on this item, there is not a high level of consensus among experts.
- Enterprises will solve their problems of e-skill gaps with on-the-job learning

Exhibit 4-8: Ranking of Education Trends based on Experts Opinions



7	Decrease in the number of students choosing computer science and IT-related university degrees in the European Union.
3	Increasing skills gaps for ICT R&D skills in the EU
5	Increasing skills gaps for ICT management skills in the EU
2	Increasing e-skills shortage in the EU
8	At the end of the economic crisis, companies' IT training budgets will quickly return to pre-crisis level and more
6	Enterprises will solve ICT skills gap problems mainly through re-training or on the job learning
4	Increasing skills gaps for ICT marketing and sales skills in the EU
1	Decrease of companies' training budgets until 2011 due to the economic crisis

Legenda: *statements statistically significante*

Source: IDC for e-Skills Monitor (2009)

Looking at this sub-scenario by experts' activity, we may observe that government experts believe that there will be a decrease in the number of students choosing computer sciences, while the industry experts don't believe that such a decrease may occur.

Finally, we should notice that industry experts (including both ICT industry and other industry experts) believe, more than other experts do, that in the next years there will be an increasing gap for ICT R&D skills in Europe.

4.6 Opinions on Macroeconomic Trends

The main trends examined here are based on alternative hypotheses of economic and employment growth in the period 2010-2015

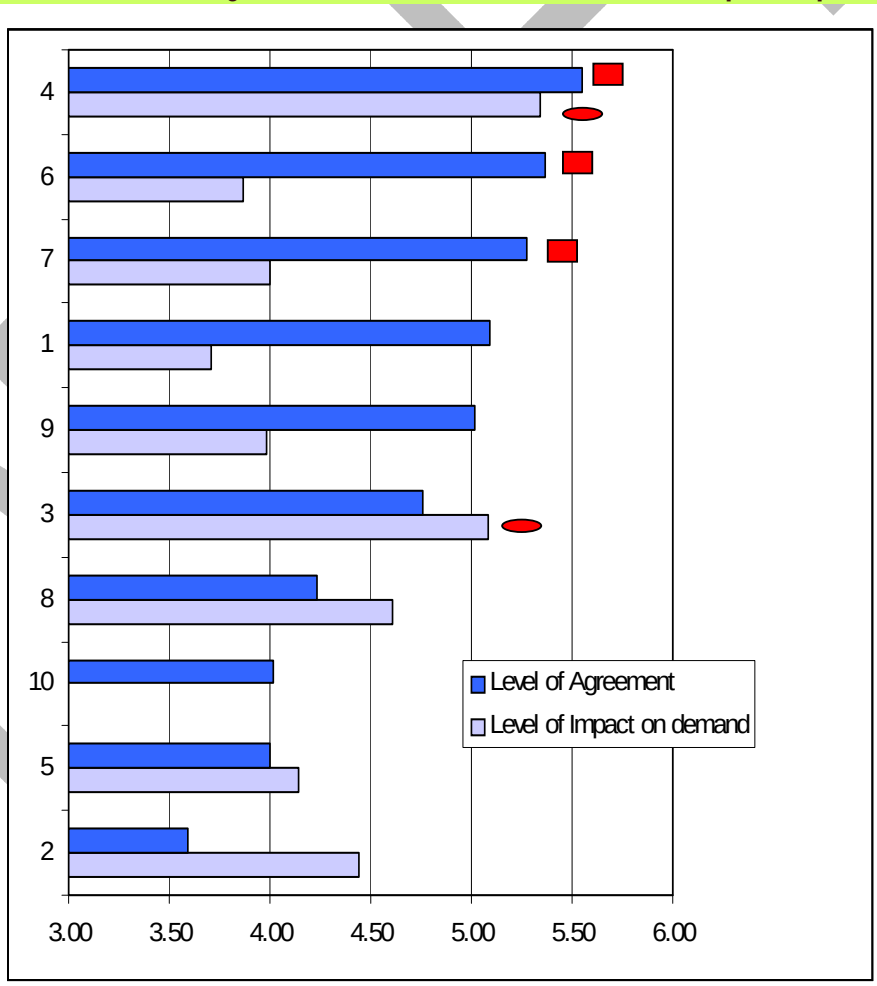
Baseline: currently, a very slow recovery is expected to take place in 2010, with stagnation of the economy for the EU zone (GDP +0-0.5%) and unemployment not decreasing until the end of the year.

The sub-scenario hypotheses for the examined period:

- The European Union economy will recover very slowly from the current crisis, with low growth rates (0-1,5% per year) increasing from 2012 onwards
- The European Union economy will recover rapidly from the current crisis, with growth rates increasing from 2011 to 2014 (over 1,5% per year) and possibly starting to slow again in 2015

The macroeconomic sub-scenarios include a set of ten questions.

Exhibit 4-9: Ranking of Macroeconomic Trends based on Experts Opinions



4	When the recovery comes, ICT investments will pick up again strongly in high intensity ICT user industries
6	Because of the economic crisis, the majority of ICT industry companies will reduce their employment in the EU at least until 2011.
7	Because of the economic crisis, the majority of ICT user companies will reduce their IT employment in the EU at least until 2011.

1	The recovery of the EU economy will be slow, with low GDP growth in the period 2010-2015.
9	In the year 2015, the majority of ICT user companies will employ less ICT practitioners in the EU than they did before the crisis in 2007.
3	After the crisis, the ICT industry will grow rapidly and play a more important role in the EU economy.
8	In the year 2015, the majority of ICT industry companies will employ less ICT practitioners in the EU than they did before the crisis in 2007.
10	The level of wages for ICT practitioners in Europe will remain stable or decrease compared to the average wages of other professionals
5	When the recovery comes, ICT investments will pick up again strongly in low intensity ICT user industries (at least at pre-crisis levels).
2	The recovery of the EU economy will be fast, with GDP growth over 1,5% per year in the period 2011-2015

Legenda:  *statements statistically significant*

Source: IDC for e-Skills Monitor (2009)

Main results from the expert survey may be summarised as follows, for the macroeconomic sub-scenarios:

- The economic crisis is having an impact on ICT investments and on IT employment for both ICT companies and high intensity ICT users. This will slightly decrease the e-skills demand
- Recovery from the crisis will be slow and this will have a negative impact on e-skills demand. There is not a strong agreement about an hypothesis of decrease of ICT practitioners in the ICT industry and in the ICT user sectors.
- The recovery from the crisis is expected to have a positive impact on the e-skills demand thanks to an increase in the ICT investments

For a number of statements, we also checked the possible impacts on the e-skills supply, but, based on the opinion of the experts, most of the statements presented are expected to have a neutral impact on e-skills supply.

When we analysed responses based on different experts' activity, we noticed that the ICT industry experts believe that ICT industry will employ in the 2015 less practitioners than they did before the crisis. This statement shows that the ICT industry is more cautious, where compared with other experts, on the recovery effects on e-skills. ICT experts believe, as the other experts, that when recovery will come, the ICT investments will pick up again, especially in the high intensity ICT industries but they also believe that ICT industry companies will reduce their employment.

4.7 Opinions on Socio-policy Trends

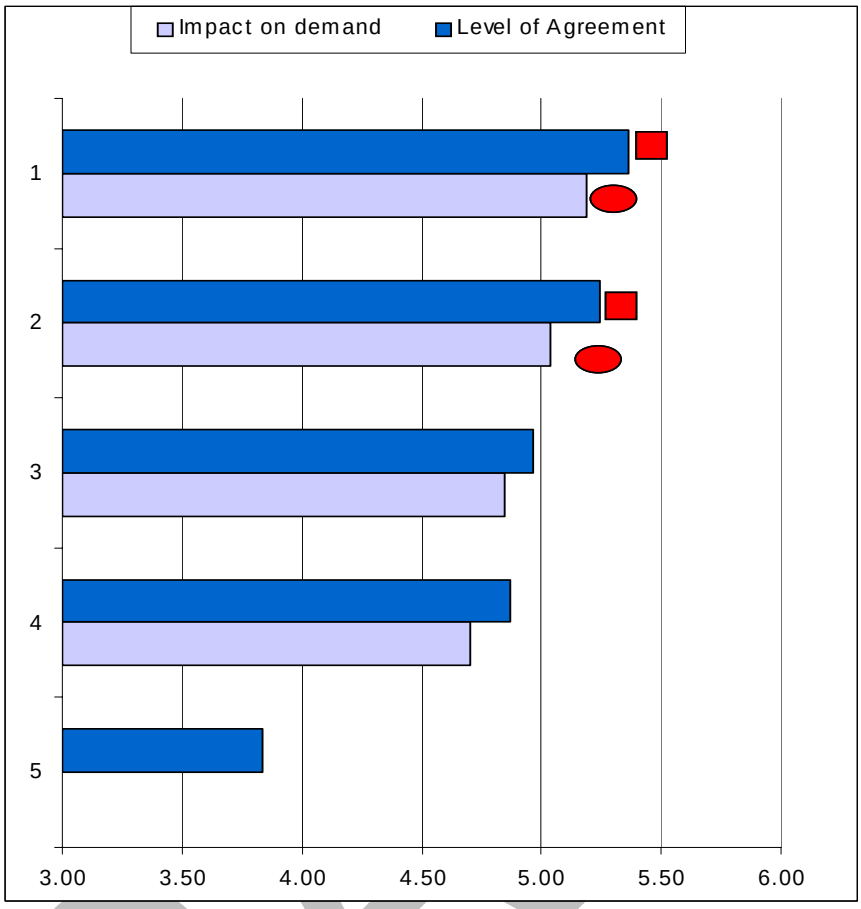
These sub scenarios focus on the main trends of European Commission policies, European Union governments' policies, and the main social trends, which may affect the demand-supply of e-skills. This includes:

- Policy measures supporting life-long learning and training for e-skills
- Policy measures to encourage women to enter ICT professions
- Policy measures against off-shoring of ICT skills and incentives for the use of EU local skills (including near-shoring)

Policy measures supporting the development of the ICT education system

The socio-policy sub-scenario includes five statements.

Exhibit 4-10: Ranking of Socio-Policy Trends based on Experts Opinions



1	The EC and MS Governments will launch proactive policies to increase life-long-learning and training for ICT skills.
2	The EC and MS Governments will launch proactive policies to increase the amount of training in ICT skills by SMEs
3	The EC and MS Governments will launch proactive policies to avoid e-skills shortages in Europe.
4	The EC and MS Governments will launch proactive policies to stimulate women to study ICT and enter into related professions
5	The EC and MS Governments will launch proactive policies to prevent ICT off-shoring from Europe.

Legenda: *statements statistically significant*

Source: IDC for e-Skills Monitor (2009)

The experts believe that socio-policy actions will mainly focus on life-long-learning and on training.

4.8 General Considerations

The experts have by and large confirmed the study team vision: very rarely there is disagreement and many key statements have been confirmed with statistical significance

There aren't significant variations in the answers by category. We analysed the survey results by category of experts' activity, i.e. and we did not find substantial differentiation in the survey results by activity

One of the most relevant differences is that ICT industry experts seem to be more pessimistic than the research and consultancy experts or the other industry experts. A reason for this vision may be related to the fact that ICT industry is still influenced by the negative feeling of the 2001 crisis.

The results of the expert survey have been included into the scenario building. The survey gave a substantial contribution to the selection of the more relevant factors affecting alternative scenarios and to the understanding of the most likely trends of the forecasting period.

5 ANNEX II – Experts Survey Detailed Data

5.1 Innovation Trends Answers

Exhibit 5-1: Opinions on Innovation Trends: Mean and Standard Deviation

Statement	Level of agreement Mean	St. dev.	Impact on demand Mean	St. dev.
16- From 2010 to 2015, main ICT innovation trends will change the mix of ICT skills required, particularly the demand of ICT management skills in Europe	5.72	1.14	5.28	1.15
11- From 2010 to 2015, the majority of high intensity ICT user industries will adopt enterprise 2.0 applications and services, establishing intensive web-based interactions with their customers and partners	5.58	1.21	5.35	1.10
9- From 2010 to 2015, the diffusion of easier to use technologies for the development of IT applications will grow rapidly in the majority of ICT industry and ICT user industry companies	5.54	1.12	5.06	1.38
13- From 2010 to 2015, the majority of ICT industry and ICT user industry companies will converge their IT and communications technology, creating an unified user experience between telephony and the Web.	5.50	1.37	5.29	1.29
10- From 2010 to 2015, the majority of ICT industries will adopt enterprise 2.0 applications and services, establishing intensive web-based interactions with their customers and partners.	5.46	1.23	5.10	1.24
15- From 2010 to 2015, main ICT innovation trends will change the mix of ICT skills required, particularly the demand of ICT marketing and sales skills in Europe	5.29	1.47	5.07	1.31
14- From 2010 to 2015, main ICT innovation trends will change the mix of ICT skills required, particularly the demand of ICT R&D skills in Europe	5.28	1.28	5.11	1.25
2- From 2010 to 2015, the majority of high intensity ICT user industries (the main services industries) will industrialize the development and delivery of IT solutions and IT-based services for their customers.	5.11	1.29	5.10	1.24

6- From 2010 to 2015 the rapid diffusion of new technology delivery models (Software as a Service, Cloud Computing, Utility Computing) will create a multitude of new innovative enterprises offering these services in Europe	5.00	1.46	5.20	1.36
3- From 2010 to 2015 the new technology delivery models (Software as a Service, Cloud Computing, Utility Computing) will be adopted by the majority of the high intensity ICT user industries (the main services industries)	5.00	1.28	4.91	1.37
5- From 2010 to 2015 the new technology delivery models (Software as a Service, Cloud Computing, Utility Computing) will become convenient for and be adopted by many small and medium enterprises (between 10 and 250 employees)	4.97	1.42	4.69	1.30
7- From 2010 to 2015, the practice of outsourcing the management and development of ICT environments will increase rapidly among high intensity ICT user industries (the main services industries	4.94	1.36	4.73	1.37
1- From 2010 to 2015 the majority of ICT industry companies will industrialize completely the development and delivery of IT solutions and IT-based services for their customers.	4.77	1.30	5.22	1.28
8- From 2010 to 2015, the practice of outsourcing the management and development of ICT environments will increase rapidly among low intensity ICT user industries (the main manufacturing industries)	4.62	1.45	4.78	1.21
12- From 2010 to 2015, the majority of low intensity ICT user industries will adopt enterprise 2.0 applications and services, establishing intensive web-based interactions with their customers and partners.	4.27	1.57	4.56	1.22
4- From 2010 to 2015 the new technology delivery models (Software as a Service, Cloud Computing, Utility Computing) will be adopted by the majority of the low intensity ICT user industries (generally the main manufacturing industries)	4.17	1.58	4.52	1.41

Source: IDC for e-Skills Monitor (2009)

5.2 Off-shoring Trends Answers

Exhibit 5-2: Opinions on Off-shoring Trends: Mean and Standard Deviation

Statement	Mean	Standard deviation	Impact on demand Mean	St. dev.
5- From 2010 to 2015 the gap of ICT practitioner labour costs between EU and off-shoring countries will be the main reason for off-shoring IT skills	5.22	1.52	4.29	1.36
3- From 2010 to 2015, the majority of European ICT industry companies will increase their use of near-shored skills faster than the use of off-shored skills.	5.05	1.16	4.58	1.16
2- From 2010 to 2015, the majority of high intensity ICT user companies will increase their use of off-shored skills faster than the local European skills.	5.03	1.24	4.24	1.45
4- From 2010 to 2015, the majority of high intensity ICT user companies will increase their use of near-shored skills faster than the use of off-shored skills.	4.97	1.59	4.54	1.26
1- From 2010 to 2015, the majority of European ICT industry companies will increase their use of off-shored skills faster than the local European skills.	4.94	1.50	4.39	1.50
6- In the period 2010-2015 the off-shoring of ICT skills will have a negative impact on the innovative capacity and the knowledge base of the European economy.	4.42	2.04	3.93	1.61

Source: IDC for e-Skills Monitor (2009)

5.3 Education Trends Answers

Exhibit 5-3: Opinions on Education Trends: Mean and Standard Deviation

Statement	Level of Agreement - Mean	St. dev.	Impact on supply - Mean	St. dev.
7- Due to the economic crisis, companies' IT training budgets are going to decrease, in the short/medium term (2009-2011).	5.42	1.28	3.76	1.33
3- From 2010 to 2015 there will be increasing skills gaps for ICT R&D skills in the European Union.	5.28	1.24	-	-
5- From 2010 to 2015 there will be increasing skills gaps for ICT management skills in the European Union	5.22	1.33	-	-
2- From 2010 to 2015 there will be an increasing e-skills shortage problem in the European Union.	4.92	1.51	-	-
8- At the end of the economic crisis, companies' IT training budgets will quickly return to pre-crisis level and more	4.82	1.45	4.47	1.30
6- From 2010 to 2015, enterprises will solve ICT skills gap problems mainly through re-training or on the job learning.	4.70	1.39	4.55	1.31
4- From 2010 to 2015 there will be increasing skills gaps for ICT marketing and sales skills in the European Union.	4.45	1.56	-	-
1- From 2010 to 2015 there will be a decrease in the number of students choosing computer science and IT-related university degrees in the European Union.	4.28	1.72	3.84	1.61

Source: IDC for e-Skills Monitor (2009)

5.4 Macroeconomic Trends Answers

Exhibit 5-4: Opinions on Macroeconomic Trends: Mean and Standard Deviation

Statement	Level of Agreement - Mean	St. dev.	Impact on supply - Mean	St. dev.
4- When the recovery comes, ICT investments will pick up again strongly in high intensity ICT user industries	5.55	1.17	5.34	1.00
6- Because of the economic crisis, the majority of ICT industry companies will reduce their employment in the EU at least until 2011.	5.37	1.07	3.87	1.48
7- Because of the economic crisis, the majority of ICT user companies will reduce their IT employment in the EU at least until 2011.	5.28	1.37	4.00	1.56
1- The recovery of the EU economy will be slow, with low GDP growth in the period 2010-2015.	5.09	1.39	3.71	1.50
9- In the year 2015, the majority of ICT user companies will employ less ICT practitioners in the European Union than they did before the crisis in 2007.	5.02	1.36	3.98	1.55
3- After the crisis, the ICT industry will grow rapidly and play a more important role in the EU economy.	4.75	1.44	5.09	1.27
8- In the year 2015, the majority of ICT industry companies will employ less ICT practitioners in the European Union than they did before the crisis in 2007.	4.23	1.83	4.61	1.28
10- In the period 2010-2015, the level of wages for ICT practitioners in Europe will remain stable or decrease compared to the average wages of other professionals, at similar qualification levels.	4.02	1.59	-	-
5- When the recovery comes, ICT investments will pick up again strongly in low intensity ICT user industries (at least at pre-crisis levels).	4.00	1.78	4.14	1.23
2- The recovery of the EU economy will be fast, with GDP growth over 1,5% per year in the period 2011-2015	3.59	1.52	4.44	1.18

Source: IDC for e-Skills Monitor (2009)

5.5 Socio-policy Trends Answers

Exhibit 5-5: Opinions on Socio-policy Trends: Mean and Standard Deviation

Statement	Level of Agreement - Mean	St. dev.	Impact on supply - Mean	St. dev.
1- In the period 2010-2015 the EU Commission and Member States Governments will launch proactive policies to increase life-long-learning and training for ICT skills.	5.36	1.43	5.19	1.36
2- In the period 2010-2015 the EU Commission and Member States Governments will launch proactive policies to increase the amount of training in ICT skills by SMEs (companies with 10-250 employees) or for SME employees.	5.24	1.37	5.04	1.27
3- In the period 2010-2015 the EU Commission and Member States Governments will launch proactive policies to avoid e-skills shortages in Europe.	4.96	1.41	4.84	1.30
4- In the period 2010-2015 the EU Commission and Member States Governments will launch proactive policies to stimulate women to study ICT and enter into related professions to avoid e-skills shortages in Europe	4.87	1.57	4.70	1.34
5- In the period 2010-2015 the EU Commission and Member States Governments will launch proactive policies to prevent ICT off-shoring from Europe.	3.83	1.69		

Source: IDC for e-Skills Monitor (2009)

6 ANNEX III – Scenario and Forecasting Methodology

6.1 Methodological Approach

The study team developed the scenarios and the foresight model in parallel, as shown in the following picture.

The main steps of scenario building included the following:

- Analysis of the factors affecting the evolution of the e-skills market and the identification of main focal issues, with the support of in-depth interviews with selected opinion leaders;
- Survey of the opinions of 109 e-Skills experts from the IT industry, academia and research and the policy environment, about the likeliness and impacts of the main trends characterising each of the five focal issues (the detailed results of the experts survey are presented in Annex I);
- Development of five sub-scenarios around the main focal issues;
- Development of global scenarios building on the interactions between the alternative sub-scenarios.

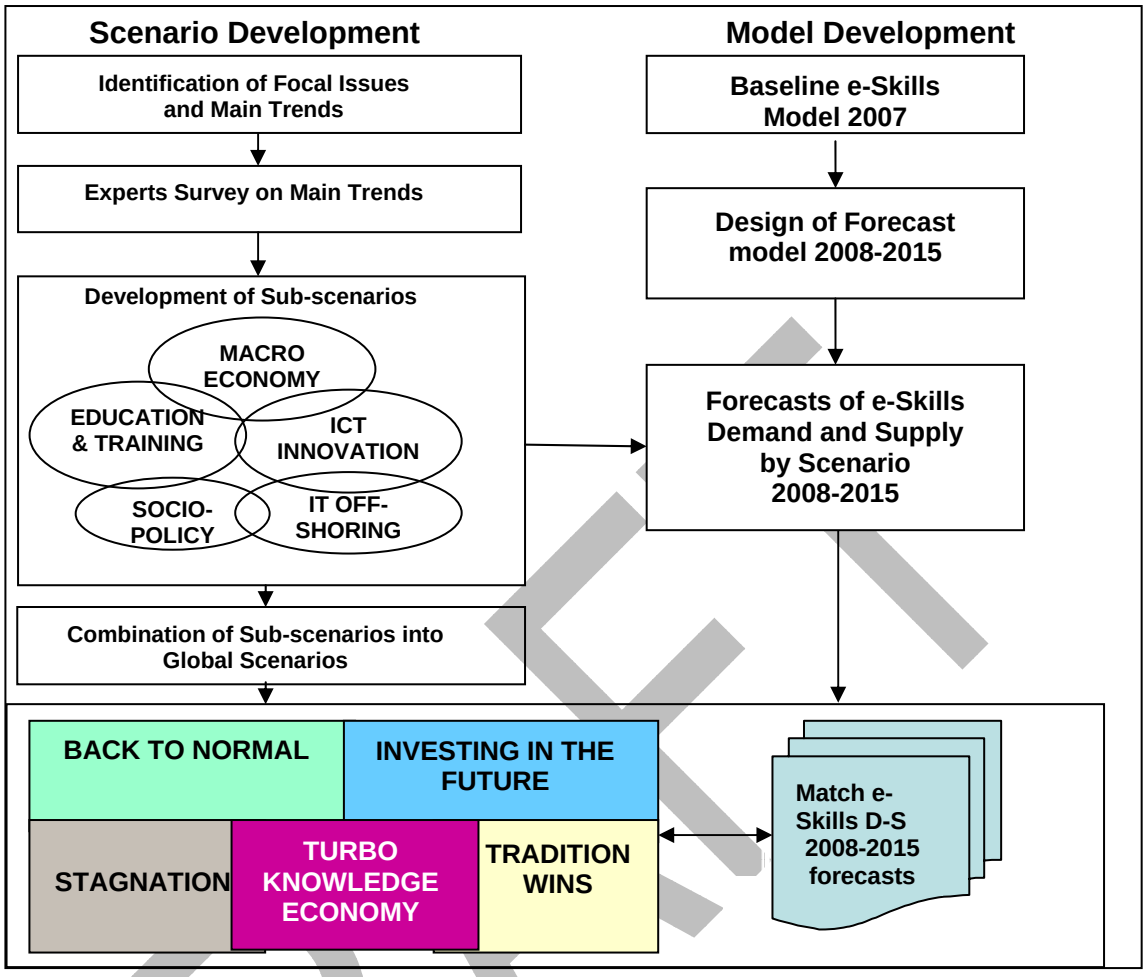
The foresight model was based on the following steps:

- Development of a baseline model for the year 2007, estimating total demand and supply of e-skills (and their resulting balance) for the six main EU countries (France, Germany, Italy, Poland, Spain and the United Kingdom), for the other 21 countries and for the EU27;
- Design of the foresight model, estimating the correlation between the demand and supply of e-skills for the period 2008-2015, including the main inflow and outflows parameters;
- Estimate of e-skills demand growth for each of the five scenarios, building on the quantitative parameters of the Macroeconomic and ICT innovation sub-scenarios;
- Estimate of e-skills supply growth for each of the five scenarios, building on the assumptions of the Education and Training sub-scenarios;
- Population of the foresight model with the demand and supply estimates, calculating their balance for each of the five scenarios;
- Validation of the foresight model, checking the results with the qualitative assumptions of the five scenarios, revising and checking the results by country and for the EU27.

An important remark: the calculation of e-skills demand and supply forecasts in the model is built on several critical assumptions, because necessary data is often missing or incomplete.

The following paragraphs present the methodology for each of the main steps.

Exhibit 6-1: e-Skills Scenarios and Foresight Model Methodology



Source: eSkills Monitor 2009

6.1.1 The Sub-scenarios/Scenarios Interaction with the Foresight Model

The five sub-scenarios were developed selecting the focal issues with the highest impacts on e-Skills labour market. The sub-scenarios develop alternative assumptions about the evolution of the focal issues in the period 2010-2015 and their direct/indirect impacts on:

- The evolution of the demand of e-Skills
- The evolution of the supply of e-Skills
- The mix of e-Skills requested/supplied, segmented as follows:
  - ICT R&D skills = capabilities required for researching, developing and designing, and producing of ICT systems
  - ICT Marketing and sales skills = capabilities required for consulting, marketing and selling, integrating and installing of ICT systems
  - ICT management skills = capabilities required for managing, installing and administrating, maintaining, supporting and servicing of ICT systems
- The possible mismatches between demand and supply, that is e-Skills shortages (insufficient availability of skilled individuals) or e-Skill gaps (competence shortfalls

between the current and needed competence levels of individual staff within organizations).

The sub-scenarios (described more in detail in chapter 2) were the following:

1) ICT Innovation sub-scenarios = three alternative visions of the main trends of ICT-based innovation in the EU: Continuing on the Innovation Path, Jumping ahead and Brakes on Innovation;

2) Macroeconomic sub-scenarios = three alternative hypotheses of economic and employment growth in the EU in 2010-2015: Moderate Growth, High Growth, Low Growth.

3) IT Outsourcing and off-shoring = two alternative assumptions about the trend towards sourcing IT skills and activities outside of Europe: Medium Off-shoring Growth and High Off-shoring Growth.

4) Education and training sub-scenarios = three alternative visions of the evolution of e-Skills supply, by the formal education system and the training system; Moderate attractiveness of ICT Careers, High Attractiveness of ICT Careers, Low Attractiveness of ICT Careers.

5) Socio-Policy Sub-scenarios = three alternative visions of the evolution of main e-Skills policies, ICT Stimulus Package Policies, ICT RTD policies, and their impacts on the socio-economic environment and the e-Skills labour market: Strong Impact Policies, Moderate Impact Policies, Low Impact Policies.

The sub-scenarios were combined in order to develop the global scenarios, excluding the illogical and unlikely combination and selecting the global scenario logic corresponding to possible development paths of the European socio-economic system, at least in the assessment of the study team. The combination of sub-scenarios in the global scenarios is presented in Exhibit 3-1.

The development of the sub-scenarios included the estimate of quantitative indicators, differentiated by sub-scenario, which feed into the Foresight model as summarised in the following table. The development of qualitative indicators supported the elaboration of the key global scenarios logics and to shape the key parameters of the model. During the elaboration of the model, the quantitative indicators were revised and controlled for coherence with the global scenario logics, between themselves, and with the e-Skills impacts. Therefore the link between the scenario development and the foresight model development was interactive.

Exhibit 6-2: Sub-scenarios Inputs to the Foresight Model

Sub-scenarios	Input to the Foresight Model	Feeding into
ICT Innovation	Balance of IT spending between the ICT industry, the High It-intensity User Industries and the Low IT-Intensity User industries for each sub-scenario	e-Skills demand forecasts
Macroeconomic Growth	Estimates of GDP spending and IT spending by sub-scenario	e-Skills demand forecasts
IT off-shoring	Estimates of off-shoring spending by sub-scenario	e-Skills demand forecasts
Education and Training	Estimates of supply of ICT graduates and ICT career changers by sub-scenario	e-Skills supply forecasts
Socio-Policy sub-scenarios	No quantitative indicator – Semantic scale of main policies impacts (High, medium, low) by sub-scenario	e-skills IT spending growth assumptions

Source: e-Skills Monitor 2009

More specifically, 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 important drivers of demand.

The GDP and IT spending forecasts were developed as follows with a bottom-up process, starting from the estimates of the EU27 growth data and assessing the total EU27 as a result.

1. The first step was the forecast of macroeconomic trends for the period 2008-2015 for the three main sub-scenarios. The calculation of GDP growth rates was done as follows:
   - **a moderate scenario** based on the same average growth rates as before the crisis, considered as the more likely one. This was developed as a balanced average of the forecasts of the main public sources (EIU, OECD, IMF, EC);
   - **a pessimistic growth scenario**, based on the average growth rates of the last crisis period;
   - **an optimistic growth scenario**, which was based on the projection of the average highest growth rates registered before the current crisis;

   The calculation of GDP values for the period 2008 - 2015 for the three scenarios was done by applying the estimated growth rates to Eurostat GDP values for the year 2007.
2. The second step was to calculate the value and growth rate of IT spending for the three scenarios above for the period 2008 - 2015. This was done by applying different elasticity rates of IT spending growth compared to GDP growth for the three scenarios. The IT spending elasticity was calculated as follows.
   - Calculation of the **elasticity of IT spending** on GDP for the period 1996 - 2007, for each of the countries analysed, based on IDC databases of IT and GDP growth;
   - Application of the **average IT spending elasticity** rates of this period to the period 2008 - 2015: this was defined as the Moderate Growth or likely scenario.
   - Application of the **highest IT spending elasticity** rates of this period to the period 2008 - 2015: this was defined as the High growth or optimistic scenario;

- Application of the **lowest IT spending elasticity** rates of this period to the period 2008 - 2015: this was defined as the Low Growth or pessimistic scenario.

The calculation of IT spending values for the period 2008 - 2015 for the Moderate scenario was based on the IDC Blackbook forecast, which is IDC corporations' worldwide IT model. The IDC Blackbook data is gathered and developed by IDC analysts based on a constant assessment of the conditions, trends and developments in the markets that they cover through integrating numerous data sources to develop market size estimates, five-year spending forecasts, and regional and country trends for more than 45 years now. The estimates of IT spending values for the Optimistic and Pessimistic scenarios were calculated applying the different elasticity growth rates to the Moderate scenario values.

3. The third step was to break down the IT spending estimates for each of the three scenarios by macro sector, i.e. for the ICT industry, the High Intensity IT User industries and the Low Intensity IT User industries. This was done based on the estimates of the IDC Blackbook forecasts which includes spending by sector and qualitative assumptions about the IT spending dynamics for each macro sector developed in the ICT innovation sub-scenarios. These estimates rely on confidential IDC data and cannot be published as such, even if they were used for the validation of the e-skills demand estimates in the global scenarios (see also following paragraphs).

6.2 The Baseline Model

The baseline model is the starting point for the foresight model. It is based on existing, consolidated data (as much as possible, as discussed in the following paragraphs) and presents the demand and supply of e-skills (and their resulting balance) for the year 2007 for the six main EU countries (France, Germany, Italy, Poland, Spain, United Kingdom), for the other 21 countries and for the EU27.

The baseline model structure is based on the following equations:

Demand = realised demand + excess demand.

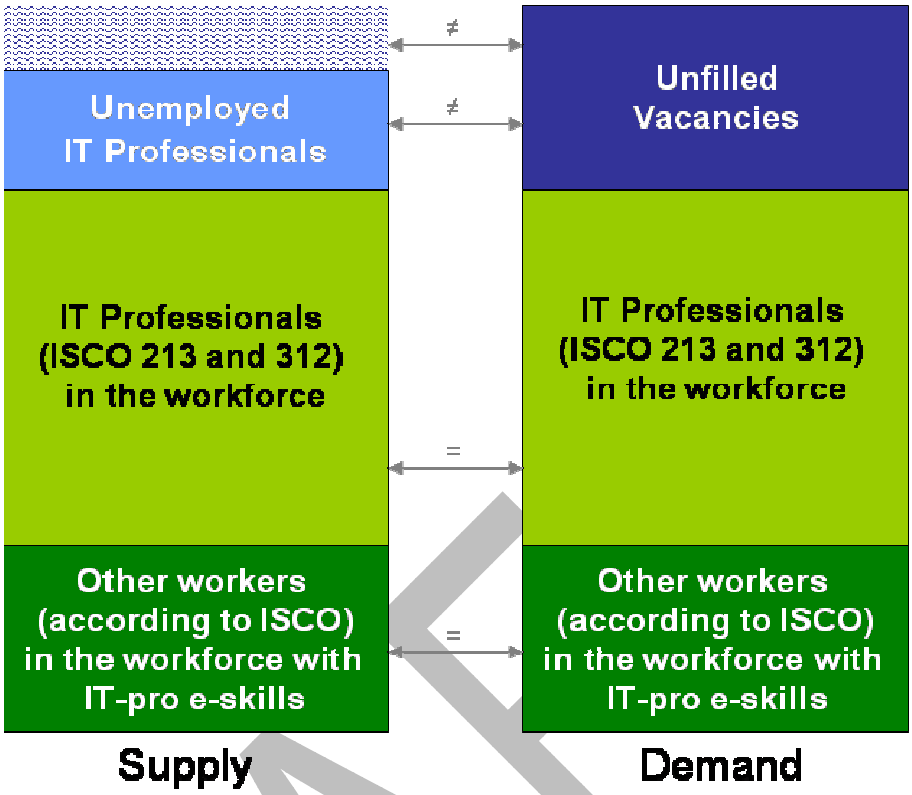
Supply = realised supply + excess supply.

Further, it should be obvious, that realised demand must be met realised supply, so that:

Realised demand = realised supply.

The following figure shows the main components of the demand and supply definitions.

Exhibit 6-3: Simplified e-skills supply and demand baseline model



Source: e-Skills Monitor (2009)

In this model the short term supply side of the IT labour market consists of IT workers (whether they are classified as ISCO 213 and 312 or according to the other definitions mentioned above) plus the excess supply of unemployed IT professionals while the demand side consists of employed IT workers plus excess demand, i.e. unfilled vacancies.

6.2.1 The Definition of ICT Practitioners

We identified three definitions of the ICT practitioner jobs, based on ISCO codes of the Labour Force Surveys of the European Statistical System and presented in the following table.

Exhibit 6-4: Definitions of ICT occupations

Definition	Codes according to ISCO-88
Core e-Skills:	ISCO 213 and 312
Broad e-Skills	ISCO 213, 312, 313, 1236
Very broad e-Skills:	ISCO 213, 312, 313, 1236 and 724

The respective ISCO codes are from ISCO-88 ("88" standing for 1988), which is a little outdated today, but for data availability reasons it is necessary to use this instead of the new ISCO-08 (of 2008).

The following table presents the reference to today's occupations.

Exhibit 6-5: Definitions of ICT occupations according to ISCO-88 and ISCO-08

	ISCO-88	ISCO-08
Core	213 COMPUTING PROFESSIONALS 2131 Computer systems designers and analysts 2132 Computer programmers 2139 Computing professionals not elsewhere classified	2511 Systems analysts 2512 Software developers 2513 Web and multimedia developers 2514 Applications programmers 2519 Software and applications developers and analysts not elsewhere classified 2521 Database designers and administrators 2522 Systems administrators 2523 Computer network professionals 2529 Database and network professionals not elsewhere classified 3513 Computer network and systems technicians
Core	312 COMPUTER ASSOCIATE PROFESSIONALS 3121 Computer assistants 3122 Computer equipment operators 3123 Industrial robot controllers	3511 Information and communications technology operations technicians 3512 Information and communications technology user support technicians 3513 Computer network and systems technicians 3514 Web technicians 3139 Process control technicians not elsewhere classified
Broad	1236 Computing services department managers	1330 Information and communications technology service managers
Broad	313 OPTICAL AND ELECTRONIC EQUIPMENT OPERATORS 3131 Photographers and image and sound recording equipment operators 3132 Broadcasting and telecommunications equipment operators 3133 Medical equipment operators 3139 Optical and electronic equipment operators not elsewhere classified	3431 Photographers 3521 Broadcasting and audio-visual technicians 3522 Telecommunications engineering technicians 3211 Medical imaging and therapeutic equipment technicians
Very broad	724 ELECTRICAL AND ELECTRONIC EQUIPMENT MECHANICS AND FITTERS 7241 Electrical mechanics and fitters 7242 Electronics fitters 7243 Electronics mechanics and servicers 7244 Telegraph and telephone installers and servicers 7245 Electrical line installers, repairers and cable jointers	7412 Electrical mechanics and fitters 7413 Electrical line installers and repairers 7421 Electronics mechanics and servicers 7422 Information and communications technology installers and servicers

Data is available through the Labour Force Surveys of the EU Member States.

6.2.2 Unemployment (Excess Supply) in the Baseline Model

There are little reliably comparable data about unemployment among IT practitioners across countries. When estimating the e-Skills supply potential coming from the unemployed IT professionals we use an unemployment figure that amounts to 50% of the total unemployment in the EU27 of 2.65% for the baseline year of 2007. Given that we see excess demand in every country covered by the Eurostat ICT enterprise surveys, it appears justified to assume only such a level of natural unemployment (due to searches and job changes) in Europe for the year 2007. This level is maintained as a minimum level of unemployment in the forecast model.

As for the dynamic forecasting of supply, future unemployment rates will be endogenous of the model (we will base the calculation on the assumption that a certain percentage (80%) of unemployed IT professionals will remain in the labour market in a one-year period, whether unemployed or employed).

6.2.3 Unfilled Vacancies (Excess Demand) in the Baseline Model

The unfilled demand for e-skills manifests in hard-to-fill vacancies on the side of employers, i.e. enterprises and organisations. According to the ICT enterprise surveys of Eurostat, generally, 18 percent of the European enterprises employ ICT specialists (among private sector enterprises of 10 and more employees of 2007). Among large enterprises (250+) a majority employs ICT specialists, compared to 12% and 39% of small (10-49) and medium sized (50-249) enterprises. Knowledge intensive services such as computer related activities, banking or telecommunications have the highest share of IT specialist employing enterprises.

As a conclusion for the excess demand to be estimated, we want to establish a baseline excess demand for the year 2007 at least 150,000 positions in EU27 or of about 4% of the filled vacancies.

As variance across countries, it is estimated that the excess demand variations follow the variation of the open positions in the Eurostat ICT enterprise surveys, replacing a standard deviation of hard-to-fill vacancies by a 1-percentage point variation in excess demand. This results in an excess demand variation between 2.8 percent in Italy (where 1.8 percent of enterprises had hard to fill vacancies) and 5.2 in Germany (5.1 percent of enterprises with hard-to-fill vacancies).

In absence of any better estimation, it is assumed that the excess demand is a constant percentage irrespective of the occupational definition used.

Exhibit 6-6: Baseline e-skills excess demand in 2007

	% of filled positions
EU27	4.0%
DE	5.2%
ES	3.2%
FR	4.0%
IT	2.8%
PL	3.8%
UK	4.2%
EU21	4.0%

Source: e-Skills Monitor 2009

6.3 The Foresight Model

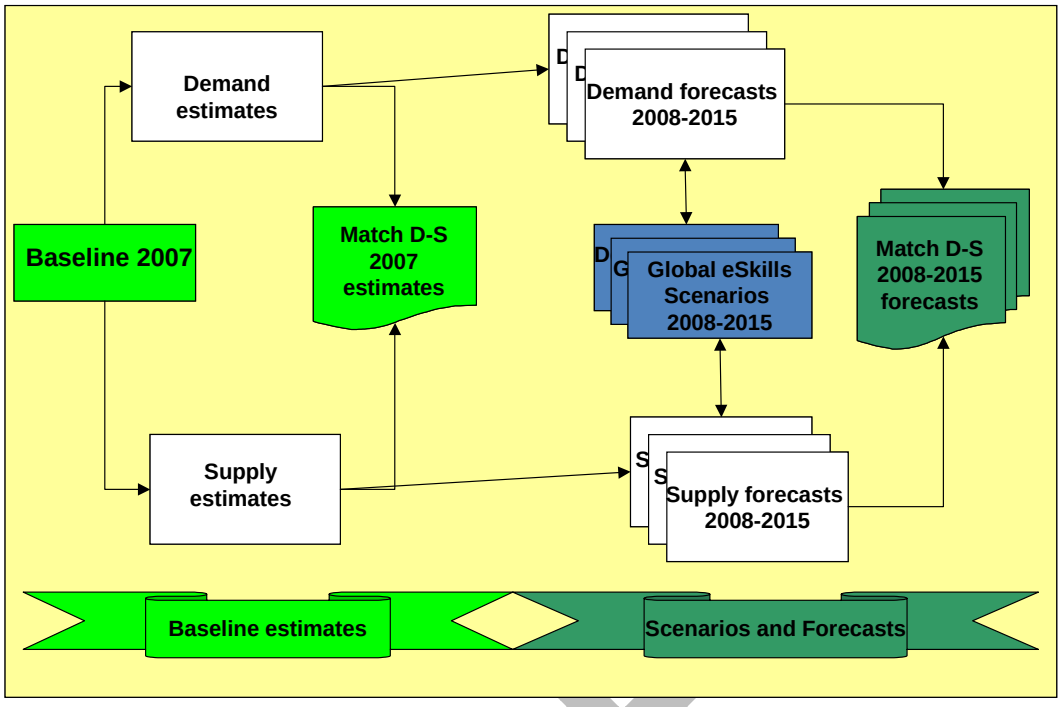
The Foresight model builds on the structure of the baseline model and is based on the following core elements, as described in the following figure;

- The baseline model, with the e-skills demand and supply data for the year 2007, for the three definitions of e-Skills (Core, Broad, and Very Broad);
- The e-Skills Demand forecasts for the five global scenarios and the three e-Skills definitions, with correction factors (off-shoring impacts)
- The e-Skills Supply forecasts for the five global scenarios and the three e-Skills definitions, with correction factors (market entries and exits)
- The Demand-Supply match, i.e. the net difference between realised demand and effective supply, for the five global scenarios and the three e-Skills definitions, which is the final result of the model.

The demand and supply estimates by scenario are developed separately, as described in the following paragraphs, using the baseline estimates as a starting point.

The model is flexible, because it allows to vary the correction parameters and to test different assumptions. The exact structure of the model is described in the final paragraph of this Annex.

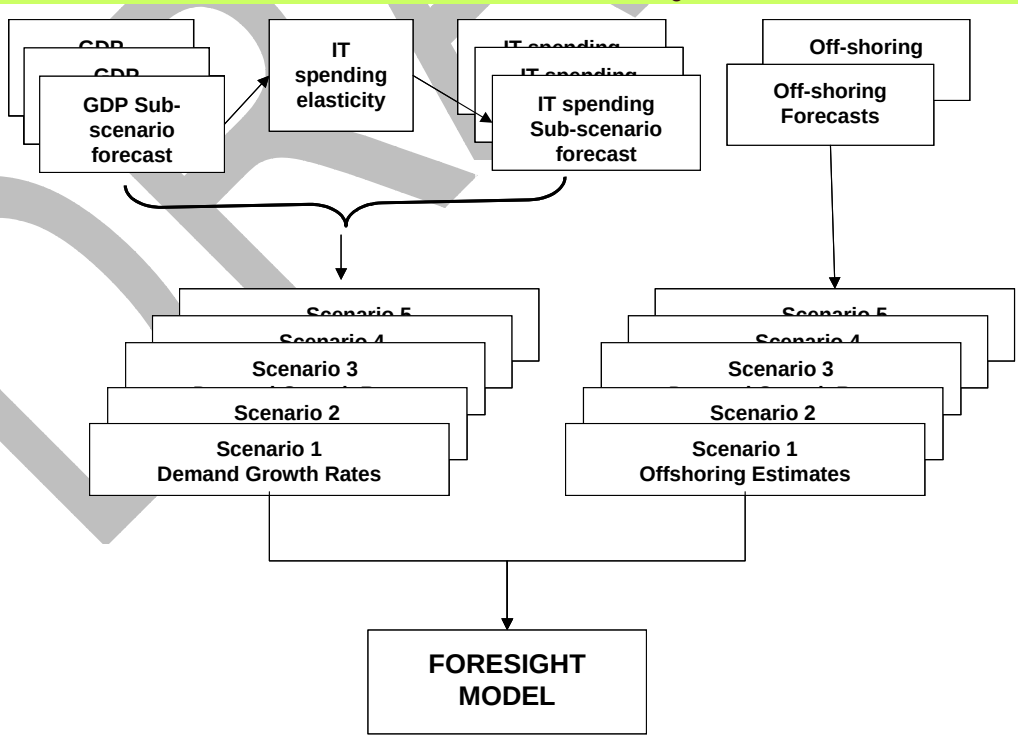
Exhibit 6-7: Building the Foresight Model



Source: e-Skills Monitor 2009

6.3.1 The Forecast of e-Skills Demand

Exhibit 6-8: e-Skills Demand Foresight Model



Source: e-Skills Monitor 2009

This was done according to the following steps, illustrated in the figure:

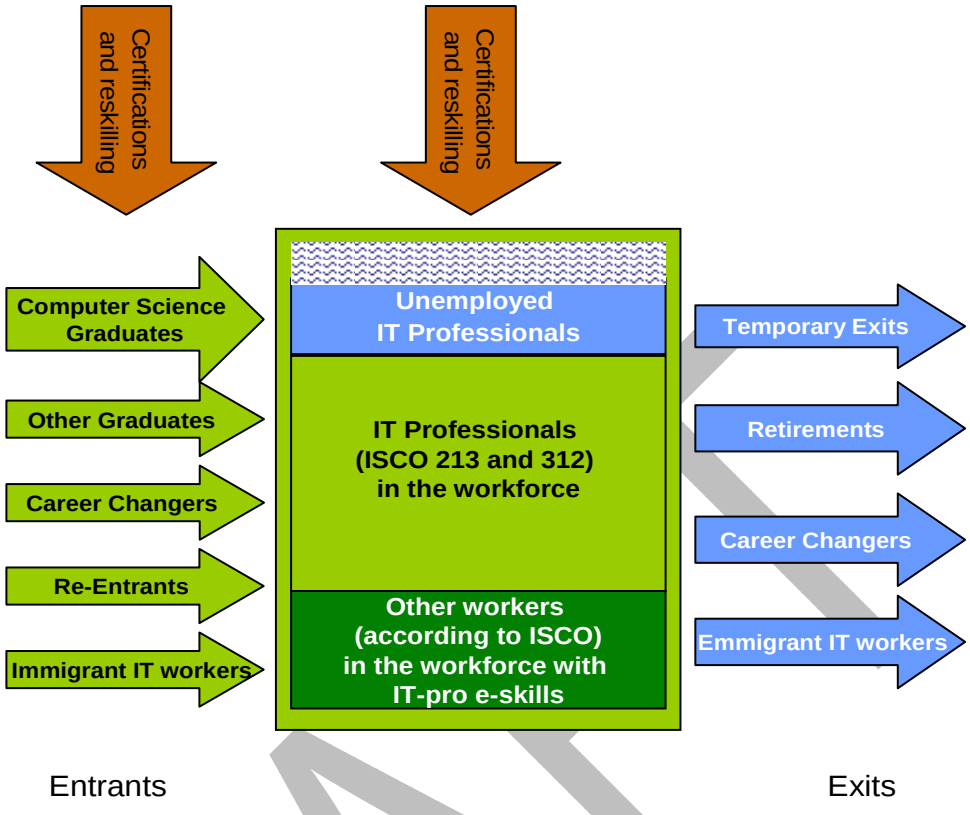
1. Macroeconomic sub-scenarios estimates of GDP growth and IT spending growth, based on different IT spending elasticity assumptions (already described in par. 6.1.1);
2. Estimates of IT spending breakdown for the three main macro sectors (ICT industry, High Intensity IT User Industries, Low Intensity IT User Industries) for each of the three sub-scenarios (already described in par. 6.1.1);
3. Calculation of e-Skills Demand growth rates for each of the five scenarios, based on a weighted combination of GDP growth and IT spending growth rates differentiated by scenario, and on the variations of the macro sector spending by scenario;
4. In parallel, Calculation of off-shoring spending by sub-scenario;
5. Estimate of a coefficient of off-shoring impact on jobs (25%); that is, 25% of the off-shoring spending is translated into a number of e-skills jobs eliminated (using an average wage level for IT professional);
6. The results of these two calculations (demand growth rates and off-shoring impacts on jobs) were fed into the e-Skills Foresight Model and applied to the 2007 baseline data; this resulted in the net total e-Skills demand estimates for the five scenarios and the three e-skills definitions.

6.4 The Forecast of e-Skills Supply

In a dynamic perspective, the supply side and the demand side obviously change due to inflows and outflows of workers and due to changing skill demands by employers.

On the supply side, new market entrants come from computer science graduates entering the labour market as well as other graduates who possess the IT skills demanded. Also, career changers originally coming from a non-IT background may enter but also re-entrants who had been out of the labour market previously. Finally, immigrants may be a source of additional supply in the market.

Exhibit 6-9: Dynamic supply side measurement model



Source: e-Skills Monitor (2009)

Certifications and re-skilling programmes play a crucial role in adapting the workforce skills to the demand side requirements. Statistically, if the task is summing up the supply side, the number of certifications and re-skilling programme graduates is ambivalent, for a lot of these further education measures will be undertaken by the existing workforce as well as by market entrants. If the shares of these two groups are not known, the extent of these qualification measures, e.g. the number of (vendor based) e-Skills certifications, can not simply be added to the supply side dynamics for the risk of double counting.

Supply side exits may be due to retirement, temporary leave and emigration of IT workers as well as promotion or other career change to non-IT jobs.

The dynamics on the demand side can create new demand for IT skills through structural change as well as through locational change. Structural change that causes market growth, either within existing or in newly emerging employer companies is normally the result of the emergence of new services or other innovation. Apart from the creation of new jobs, also in-shoring of previously imported services creates new IT jobs in the domestic market.

Structural and locational change can also be observed to create redundancies through market decline, productivity gains through innovation and new services, off-shoring and market exits.

Computer sciences graduates

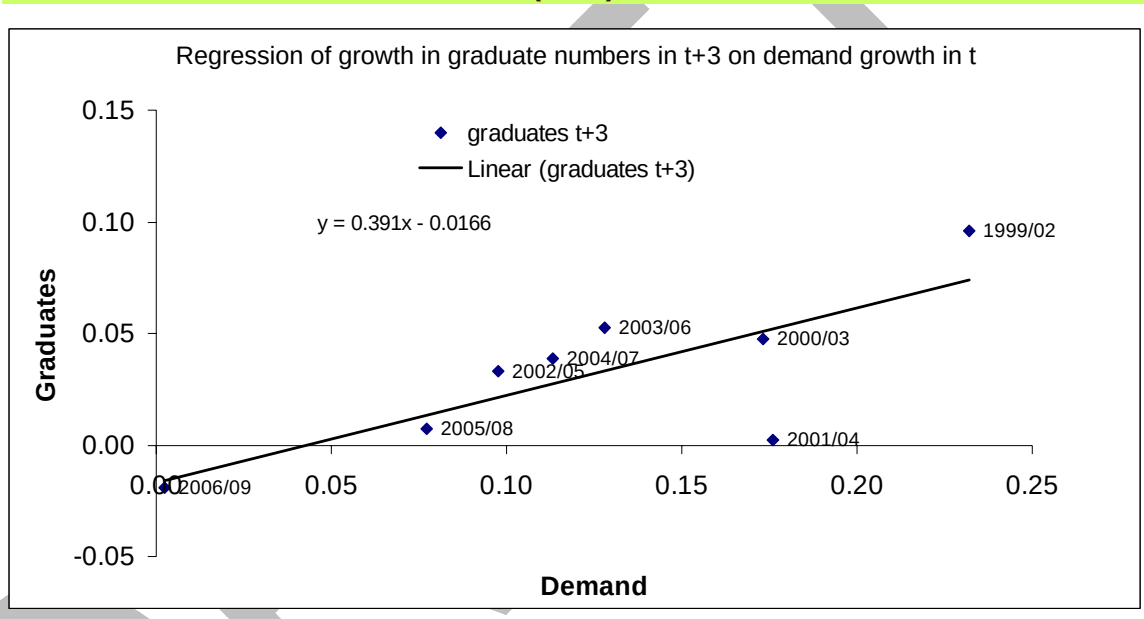
Computer science graduates are the first, most relevant and important "inflow" contributors, the so called "core" supply of IT practitioners. Graduates from other study fields like mathematics, science (part of EF4), engineering, construction, architecture and manufacturing (EF5) may as well enter the labour force of IT practitioners.

The basic hypothesis is that in times of high demand, more students decide to take up computer sciences studies. The very simple micro level logic behind this can be expected to be based on signals such as remuneration levels and vacancies which transpire into an enhanced individual propensity to take up studies in a given field. Given the time lag between entering computer science studies and graduation, we expect therefore a time lag between high demand and graduate figures.

Another factor influencing the supply of computer science graduates is the general trend towards tertiary education across all fields. The shares of young people with university degrees have been increasing over decades and with it the numbers of ICT graduates would have risen even if their share in all graduates would have remained stable.

Looking at empirical data we find at the European level a linear trend when modelling the number of graduates only depending on the demand growth.

Exhibit 6-10: Relation between growth in demand and growth in graduate numbers (EU27)



Source: e-Skills Monitor 2009

The calculation is based on the numbers of first degrees from tertiary programmes obtained in one year. While of course graduates holding a first degree do not enter the labour market immediately, the total number of all degrees delivered in one year would be misleading because of double counts. The baseline of computer science graduates is displayed in the following table.

Exhibit 6-11: Baseline figures: Computer Science Graduates in 2007 (first degrees)

	2007
United Kingdom	25,027
France	19,403
Germany	13,932
Italy	4,649[6]
Poland	14,253
Spain	17,374
EU21	28,782
EU27	122,289

Source: e-Skills Monitor 2009

Supply Forecasts by Scenario

As described in chapter 2 we base our foresight endeavour on three Education and training sub-scenarios (moderate, high and low attractiveness of ICT Careers), leading to three different estimates of the total number of e-skills supply, which are then used in the five global scenarios as indicated in the following table.

Exhibit 6-12: Match between Education sub-scenarios and Global Scenarios

Global Scenarios	Matching Education and Training Sub-Scenarios
Back to Normal	Moderate ICT careers Attractiveness
Investing In the Future	Moderate ICT careers Attractiveness
Turbo Knowledge Economy	High ICT Careers Attractiveness
Tradition Wins	Low ICT Careers Attractiveness
Stagnation	Low ICT Careers Attractiveness

Source: e-Skills Monitor 2009

In the case of the Moderate scenario, the number of graduates is forecasted as described above, the growth in number of graduates being a function of the growth in demand in t-3 (three years earlier). To this result, several weights are applied for non-Computer Science graduates, non-tertiary graduates etc. and depending on the definition of ICT practitioner chosen.

In the high attractiveness sub-scenario, i.e. the Turbo Knowledge Economy main scenario, we assume a boost in the attractiveness of ICT careers, which translates in a slight increase in the number of graduates as would be received following the Moderate sub-scenario. Because

[6] The Figure published by Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/portal/education/data/database) is 3,530, however, some corrections apply, see box "Computer Science Graduate Fgures for Italy".

it takes time for the increased attractiveness to translate into actual labour market entries, we assume a 2% plus in 2011, followed by a 4% plus in 2012 and 5% in 2013 - 2015. Other things the same, this assumption results in a cumulative plus of 72,990 graduates in the broad definition and Turbo Knowledge scenario.

Apart from an effect on students enrolling in university studies, there is also an effect of the image or attractiveness on the existing workforce, both on outsiders who might enter ICT jobs and on career changers who turn away from ICT. It appears justified to assume that there is always a pool of outsiders with an orientation towards IT and some existing skills who, potentially after taking part in vendor training, might easily become IT professionals as well as there are IT professionals who can change into management, science, or other service jobs. For the Moderate sub-scenario we have assumed that the balance between these two inflows and outflows is 0. An assumption now is that as attractiveness rises or sags, this balance will move accordingly. For the High Attractiveness sub-scenario, i.e. the Turbo Knowledge Economy main scenario, we therefore assume that the boost in the attractiveness of ICT careers translates in a surplus of about 12,500 career changers in the EU27 in 2010, about 25,000 in 2011 and 37,500 in the following years, which sums up to a total 187,000 extra entrants until 2015.

In the Low Attractiveness sub-scenario the opposite development takes places, a curbed development of graduate figures and a net loss with regard to the career changer balance. For the graduate figures, we assume in 2011 a -1% from the forecast as under a) -3% in 2012 and -5% in the three subsequent years. For the Tradition Wins scenario, all other things equal, this means a cumulative loss of 54,500 graduates entering ICT occupations in the broad definition at EU27 level.

For career changers, it is assumed that from 2010 on in every year a net loss of 12,500 career changers happens in the lost attractiveness sub-scenario for the broad definition, resulting in a cumulative loss of 74,600.

Box: Italy's few Computing Graduates: a classification problem

Based on statistical data, the supply of IT professionals seems to be significantly lower in Italy than in the other main European countries. These statistical data, published by Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/portal/education/data/database), need some specification for a correct interpretation.

Data on graduates in the Education Field of "computing" fall into the two digit code 48 in the 97 ISCED classification (International Standard Classification for Education). According to these data, Italy has 3 to 6 time less computing graduates than the other main European countries.

There is however a classification problem leading to a severe underestimation of Italian Computing graduates. Eurostat statistics include the Maths, Science and Technology Schools/faculties (corresponding to 46, 44 48 ISCED classification) but do not include the Engineering, Manufacturing and Constructions Schools/faculties (corresponding to 58 and 52 ISCED classification). Within the 52 code there is a sub-specialization "engineering of IT" which is grouped with the other engineering courses and cannot be measured separately. But for historical and cultural reasons, Engineering in Italy has a very high prestige; many young Italians interested in computing tend to choose it rather than Information Technologies courses, and this does not show in Eurostat data. Furthermore, computing science masters and specialisation courses in Italy are not classified under the computing Education Field 48, because they appear in the faculty they belong to, which may fall under different classifications (often again Engineering).

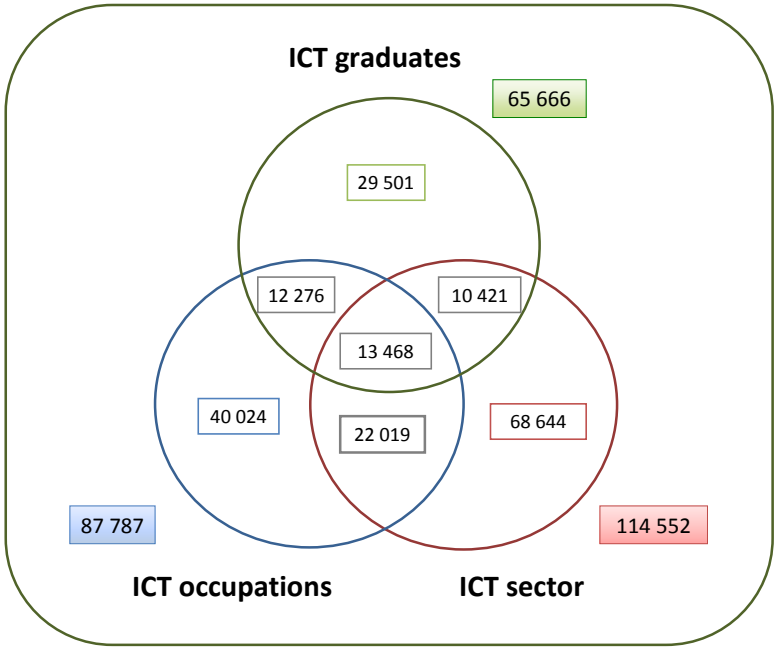
Finally, Eurostat data on Italian graduates of sub-tertiary education also reveal a classification problem. The Italian statistics show zero students in the Education Field 48, because of the Italian classification system which includes Computing diplomas within a larger group of technical and professional tertiary schools. Considering that Italian firms employ generally a higher number of sub-tertiary graduates than university graduates, this lack of data about computing sub-tertiary graduates becomes even more troubling.

In conclusion, because of this weakness of the e-skills supply data for Italy there is a legitimate doubt about our scenarios' results in terms of the e-skills demand-supply balance. It would be useful if the Italian industry and academia community made an effort to improve the availability and comparability of Italian data.

Share of computer science graduates entering IT

Little data is available as to what share of ICT graduates enter the ICT sector or ICT occupations. According to data from Statistics Denmark for Denmark, 45% (30,000 out of 66,000) of ICT graduates work outside of ICT occupations and outside of the ICT sector. Only 40% work in ICT occupations.

Exhibit 6-13 The Danish ICT labour market in 2002



Data: Danmarks Statistik(2003) p.2114, own representation

This share appears to unnaturally high. Also, these figures deal with the workforce in total, while we are only interested in graduates. It is reasonable to assume, that a good share of the ICT graduates not working in ICT occupations nevertheless started their career as an ICT professional and dropped out only later. We therefore assume that a share of 50% of ICT graduates enter ICT occupations.

Graduates from mathematics, sciences, engineering and other fields into IT

The share of non-IT graduates who enter into IT is not known. We estimate that these account for 25% of all entrants with a tertiary degree (75% being computer science graduates).

It is also conceivable that the share of non-IT entrants is depending on the general level of demand. Therefore the forecasting sheet contains a correction factor, namely the ratio of natural unemployment rate for IT professionals (set to 2.65%) and actual unemployment rate of IT professionals. If the actual unemployment rate for example climbs to 5.3% (twice the natural unemployment) the inflow of non-IT graduates will be reduced to one half.

Graduates from sub-tertiary education into IT

Computer science graduates might not always graduate from tertiary education, but might as well be trained in different courses that do not lead to a tertiary degree. This kind of non-tertiary education of IT practitioners plays an important role for example in Germany, Poland and Greece.

Exhibit 6-14: Baseline figures: Graduates from sub-tertiary education into IT

	2007
EU27	62,127
United Kingdom	0
France	325
Germany	21,028
Italy	0
Poland	12068
Spain	4,387
EU21	24,319

Source: Based on figures retrieved from Eurostat Education Database

As with ICT graduates from tertiary education, the share ICT graduates from sub-tertiary education who enter ICT occupations is set to 50%.

Adjustments for the occupational definition chosen

All inflow measures are set to meet the core ISCO definition. If we look at the core ISCO definition (ISCO-88 213 and 312) it is reasonable to assume that 50% of CS graduates (tertiary or sub-tertiary) enter such a position. Of course, if we broaden up the definition, more graduates will enter occupations which fall under these definitions. Also, more graduates from outside IT studies will enter the market.

As it becomes nearly impossible to define the possible educational paths in a satisfying way the broader the definition becomes, we simply assume that additional inflows exist for the other definitions which are proportional to the labour market size per definition. These are displayed in the following table.

Exhibit 6-15: Baseline figures: Correction factors for inflows for definitions other than "Core ISCO"

	Core	Broad	Very broad
EU27	1	1.25	1.83
UK	1	1.60	1.91
FR	1	1.13	1.67
DE	1	1.12	1.63
IT	1	1.31	1.87
PL	1	1.17	2.19
ES	1	1.20	1.88
EU21	1	1.18	1.86

Source: e-Skills Monitor 2009

Non-graduate entries

There are entries other than graduates from university or sub-tertiary schools or apprenticeships. Data on career changers to ICT professional jobs, re-entrants of ICT professionals after the end of the family phase, or by those having attended further education and training courses to bring them back into the labour market or for other reasons but also data on the number of IT professionals immigrating from other countries could, however, not be identified.

For the time being we will neglect the supply potential coming from career changers, re-entrants and immigration of IT Professionals in our calculation of IT professional supply figures assuming that they will be negligible in number, or rather, that on balance, these inflows will balance out emigration, career changers and temporary exits out of IT jobs.

Intra-European migration of graduates

A measure not included in the simulation is intra-European migration. It is apparent that some countries educate massively more young people in IT than their home market can probably absorb (notably Poland). The migration between European countries has not yet been included in the models, however, because no empirical evidence about the size and directions of such migration is available.

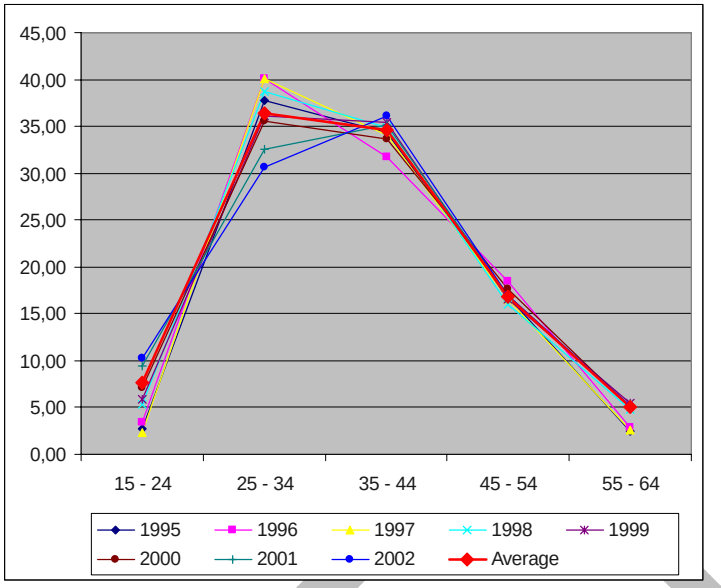
Retirements

Based on data from to the WANE project[7] for the time span between 1995 and 2002 for the countries Germany, Netherlands and UK, we have found that the age distribution for age 35+ remained relatively stable for almost a decade, which means that the retirement just balances out the growing older effect.

For Germany we found approx. following age distribution for ages 35+: $f(x) = 0{,}0303*x^2 - 2{,}079*x + 34{,}5583$, which means that the delta in 1 year is ~ 2.04%.

[7] http://www.aging.unc.edu/programs/wane/index.html

Exhibit 6-16: Age distribution ICT practitioners in Germany



Source: Data from WANE project

The described procedure (computation of averages and graphic representation) allows for estimating the future trend of IT workforces. The created equation depicts the rate of IT professionals of ages 35 to 64 who are still working in x years.

Since we find a relatively well fit parabolic approximation, we can assume at least for the time span until 2015 the retirement rate to be at a stable 2% annually-

The shape of the parable is of course different, if a younger workforce prevails, as is the case in the UK and the Netherlands, the only countries for which data are available. In Netherlands, the presumed rate is 1.8%, while it is 1.7% in the UK. We assume that the national rates in Europe all fall into this range.

6.5 The Foresight Model Structure in a Nutshell

The following table presents in detail the structure of the foresight model and the parameters which can be changed at will to test different estimates. This same structure underlies all the five global scenarios; what changes are the demand and supply absolute numbers and growth rates for each scenario.

Exhibit 6-17: Basic forecasting assumptions

		Baseline 2007	Forecast 2015
	DEMAND		
1	Posts (filled and vacant)	4+5	(1) $_{t-1}$ multiplied with scenario specific growth factor
2	Demand allowing for off-shoring effects	4+5 (for baseline figures in (1) already include off-shoring effects)	(1) $_{t}$-(20) $_{t-1}$
	SUPPLY		
3	Total supply	Identical with (4) since no excess supply	(19) $_{t-1}$
	Demand-Supply Match		
4	Post (filled)	According to definition the core, broad or very broad data as in table 6-4. *Definition adjustable, other entries possible*	Min((3) $_{t}$;(2)$_{t}$)
5	Excess demand	(4) multiplied by an excess demand factor (4% for EU27, *percentage adjustable*).	=(3)$_{t}$-(2) $_{t}$
	MARKET DYNAMICS		
	ENTRIES		
6	Computer science graduates into CORE ISCO IT	50% of the CS graduates (as in table 6-8, first degrees only to avoid double counting) (*Percentage adjustable*)	Ditto. The number of graduates is forecasted based on the historical elasticity as described in 6.3 results are expanded or curbed according to the education sub-scenario
7	Graduates from maths, sciences, engineering and other fields into CORE ISCO IT	33% of (6) (*Percentage adjustable*), i.e. 1 in 4 new ICT professionals with tertiary degree comes from outside Computer Science	Ditto multiplied by a factor accounting for demand side effects: if unemployment is high, external recruitment will diminish. Factor is natural unemployment / actual unemployment.
8	Graduates from sub-tertiary education into CORE ISCO IT	50% of CS graduates from non-tertiary education (as in table 6-10) (*Percentage adjustable*)	Ditto. The number of graduates is forecasted based on the historical elasticity as described in chapter 6.3 results are expanded or curbed according to the education sub-scenario
9	If not *Core ICT* definition selected: Additional other graduates	Additional graduates by multiplying (6) by a correction factor as in table 6-11	Ditto
10	Immigration	For the time being "0", *free entry possible*	Ditto
11	Career changers / Re-entrants / Other	For the time being "0", *free entry possible*	According to the education sub-scenario, the balance between (11) and (14) may deviate from 0. See chapter 6.3
	EXITS		
12	Retirements	2% of workforce (as described in 6.3 – Retirements)	Ditto
13	Emigration	For the time being "0", *free entry possible*	Ditto
14	Career changers, Temporary Exits, other	For the time being "0", *free entry possible*	According to the education sub-scenario, the balance between (11) and (14) may deviate from 0. See chapter 6.3
15	Unemployed	(16)*[(4)*(1+(16))]	(17) $_{t}$ +(3) $_{t}$ If (3) $_{t}$ negative. (17)$_{t}$ if (3) $_{t}$ positive

16	Unemployment rate (IT professionals)	For 2007 an unemployment rate of 2.65% is assumed across the board.	$(15)_t / ((4)_t+(15)_t)$
17	Persistent unemployment (mismatch, frictional)	=(16) (minimum = natural unemployment)	$=2.65\%*(4)_t$
18	Remaining labour supply	Factor 80% *(adjustable).* This takes account of the fact that not all unemployed IT professionals will remain in the labour market, some will find jobs outside IT, others will give up searching. The remainder will be supply in t+1. The percentage is only applied to unemployment above the natural unemployment in (17).	$((15)_t -(17)_t)$ multiplied by the remaining labour supply factor (here: 80%)
19	SUPPLY (t+1):	=(4)+(6)+(7)+(8)+(9)+(10)+(11)-(12)-(13)-(14)+(18)	Ditto
	OFFSHORING IMPACT		
20	Job displacements to offshore	25% of off-shoring budget / average wage	Ditto

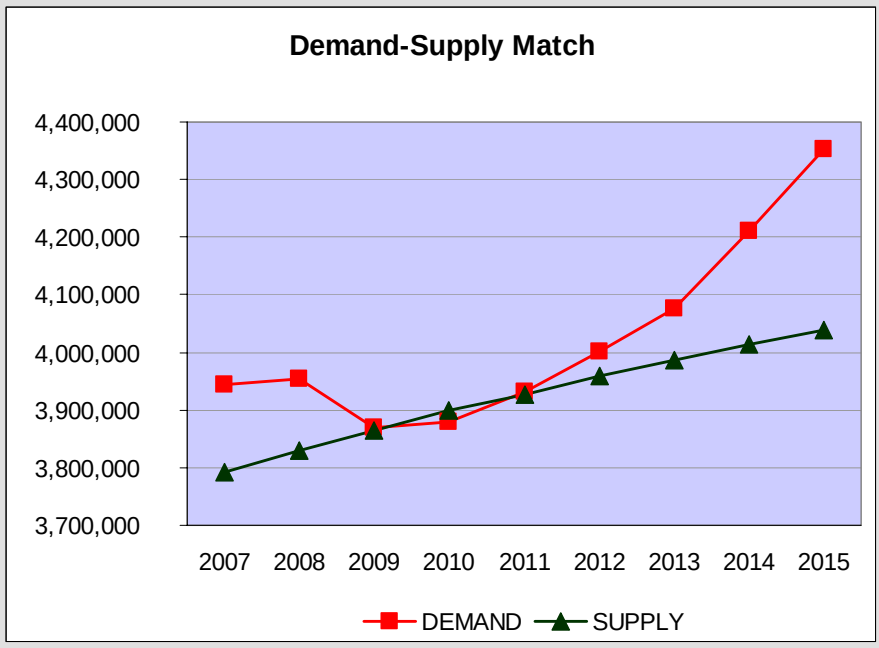
Source: e-Skills Monitor 2009

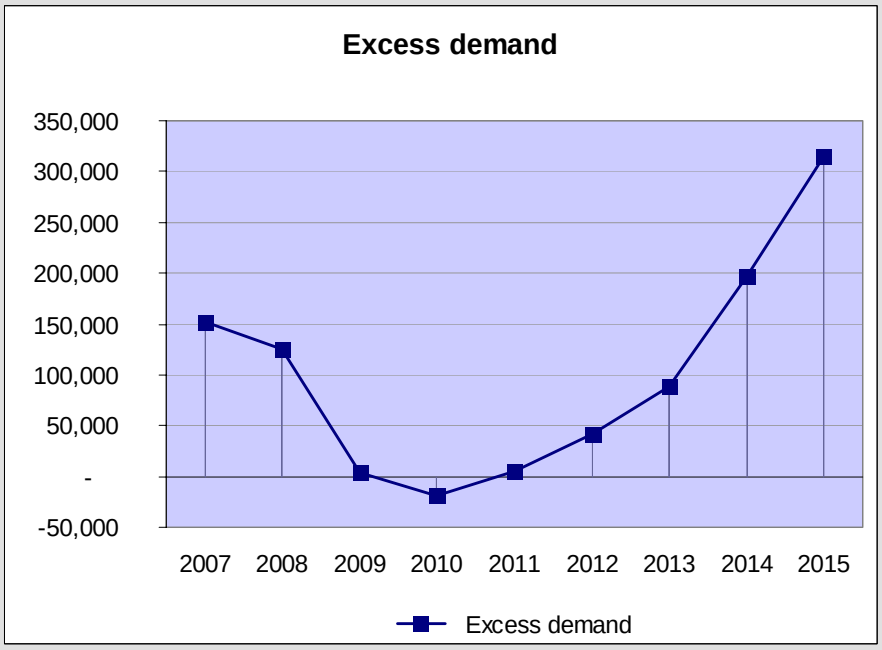
7 ANNEX IV – Foresight Model Results by Scenario – Core and Very Broad e-Skills

Back to normal scenario

Exhibit 7-1: Forecast EU27 – Back to normal scenario, core e-skills

European Union (EU27) – 'Back to normal' CORE definition of ICT practitioners

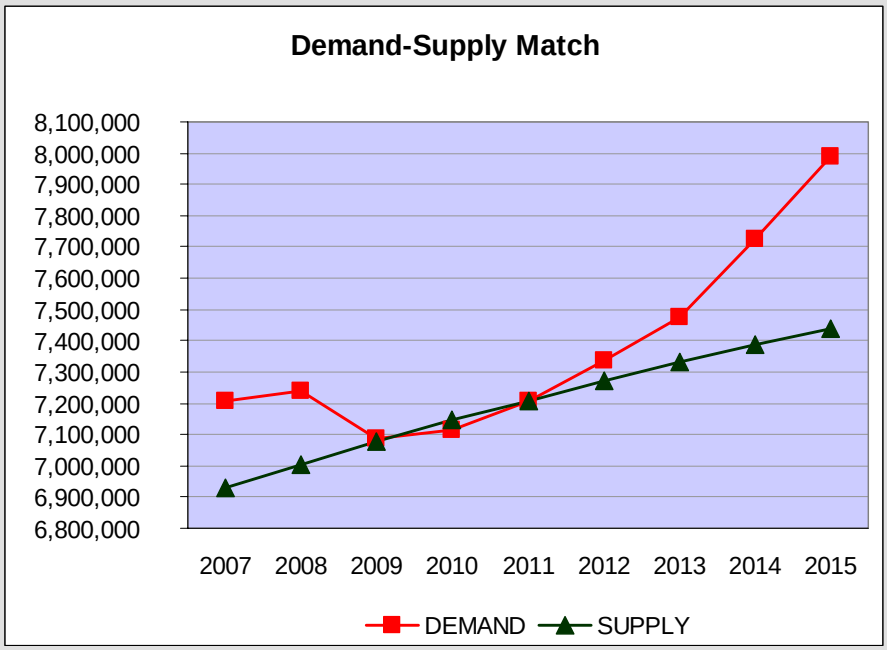


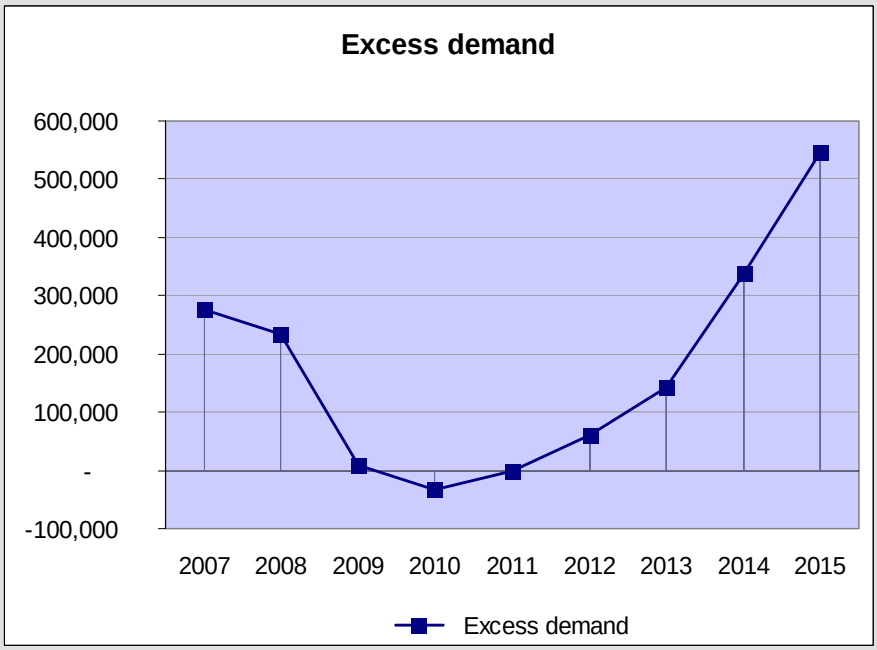


Source: e-Skills Monitor 2009

Exhibit 7-2: Forecast EU27 – Back to normal scenario, very broad e-skills

European Union (EU27) – 'Back to normal', very broad definition of ICT practitioners

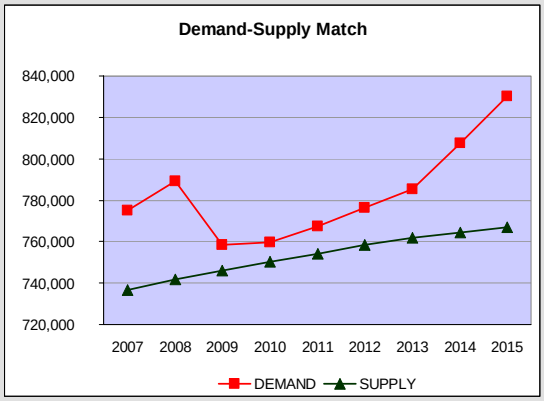




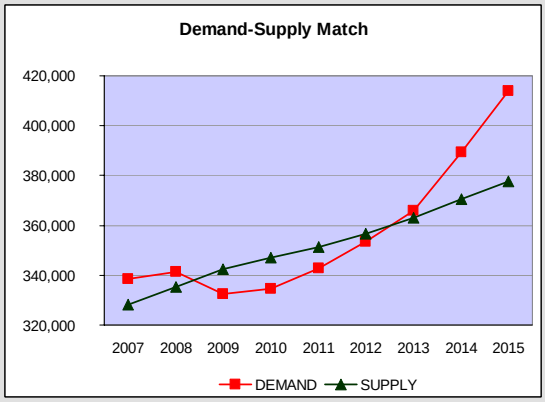
Source: e-Skills Monitor 2009

Exhibit 7-3: Forecast countries - Back to normal scenario, core e-skills

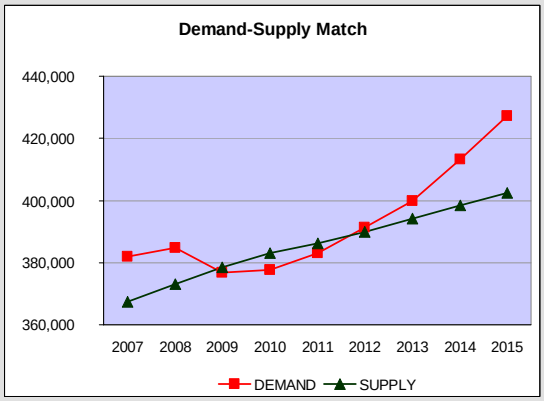
GERMANY (DE) - 'Back to normal' CORE definition of ICT practitioners



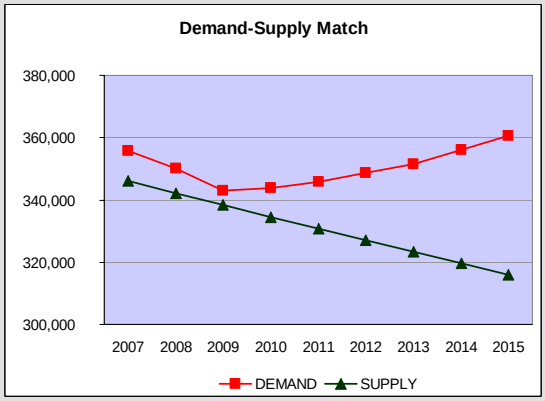
SPAIN (ES) - 'Back to normal' CORE definition of ICT practitioners



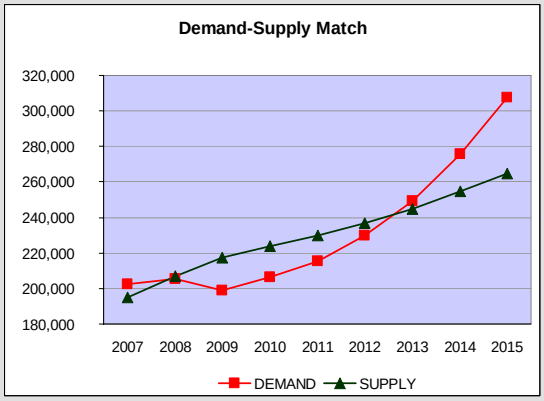
FRANCE (FR) - 'Back to normal' CORE definition of ICT practitioners



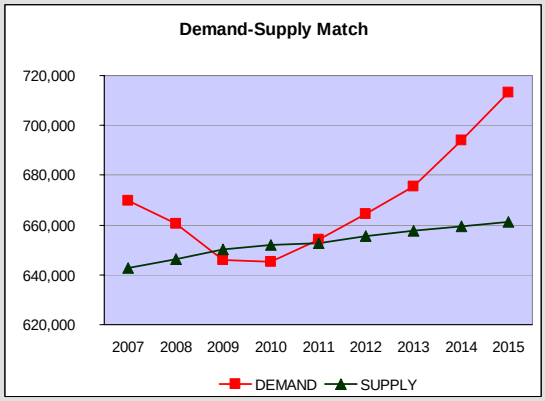
ITALY (IT) - 'Back to normal' CORE definition of ICT practitioners



POLAND (PL) - 'Back to normal' CORE definition of ICT practitioners



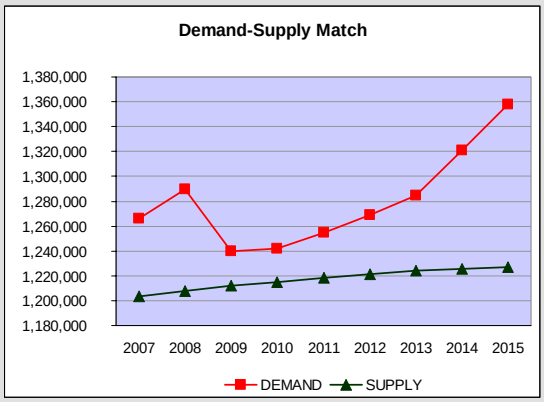
UNITED KINGDOM (UK) - 'Back to normal' CORE definition of ICT practitioners



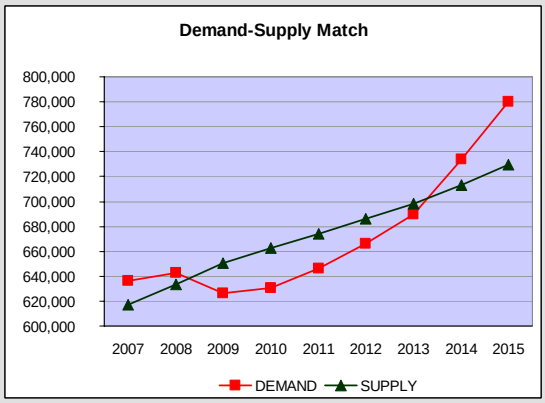
Source: e-Skills Monitor 2009

Exhibit 7-4: Forecast countries - Back to normal scenario, very broad e-skills

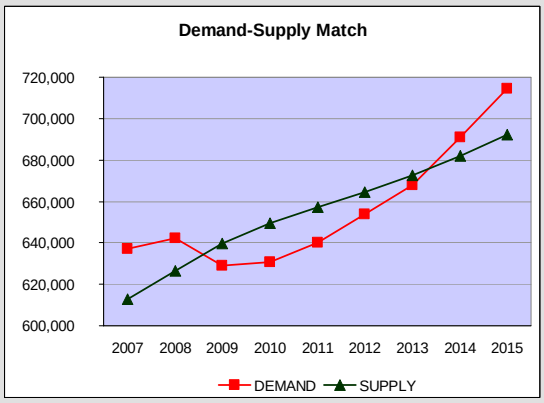
GERMANY (DE) - 'Back to normal' very broad definition of ICT practitioners



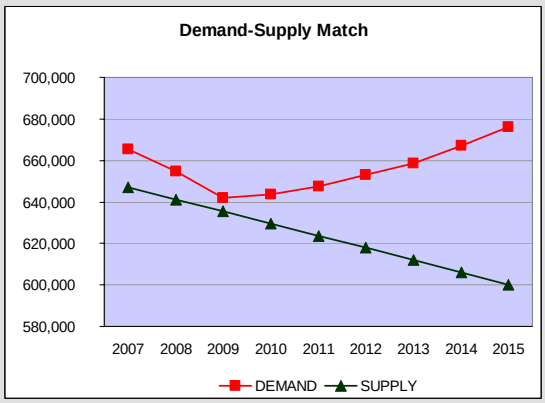
SPAIN (ES) - 'Back to normal' very broad definition of ICT practitioners



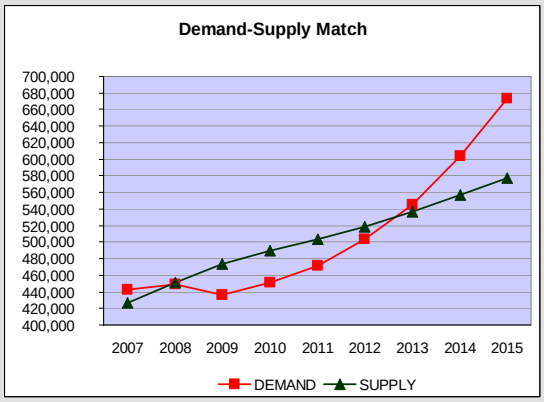
FRANCE (FR) - 'Back to normal' very broad definition of ICT practitioners



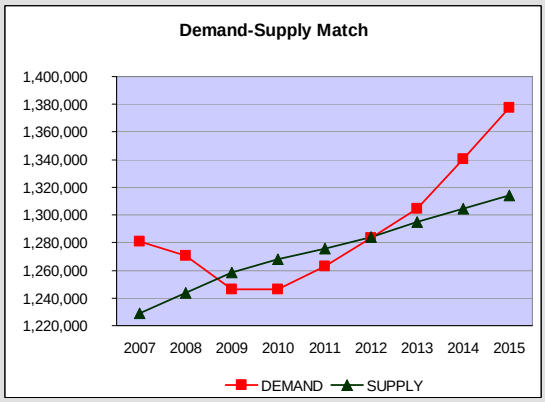
ITALY (IT) - 'Back to normal' very broad definition of ICT practitioners



POLAND (PL) - 'Back to normal' very broad definition of ICT practitioners



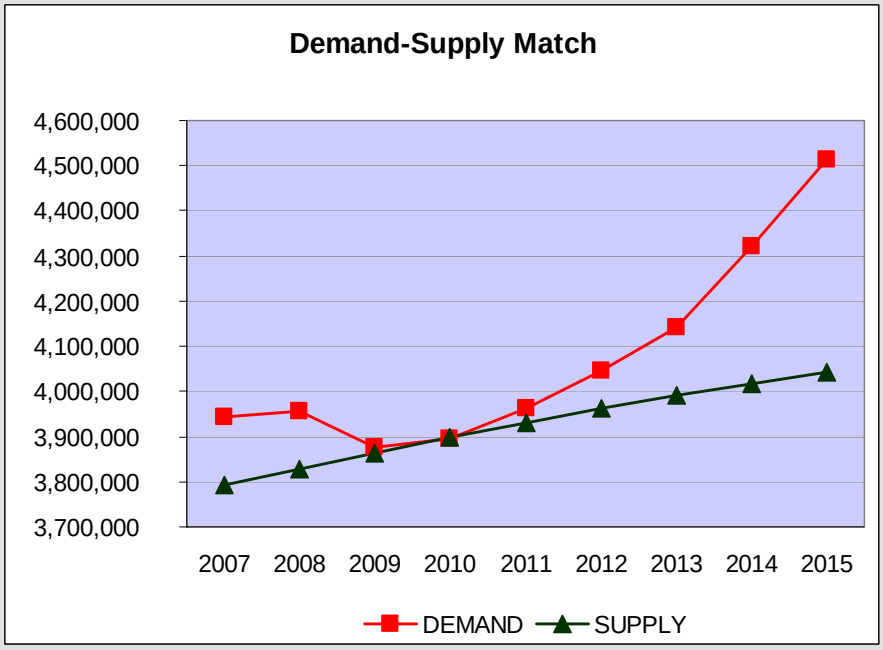
UNITED KINGDOM (UK) - 'Back to normal' very broad definition of ICT practitioners

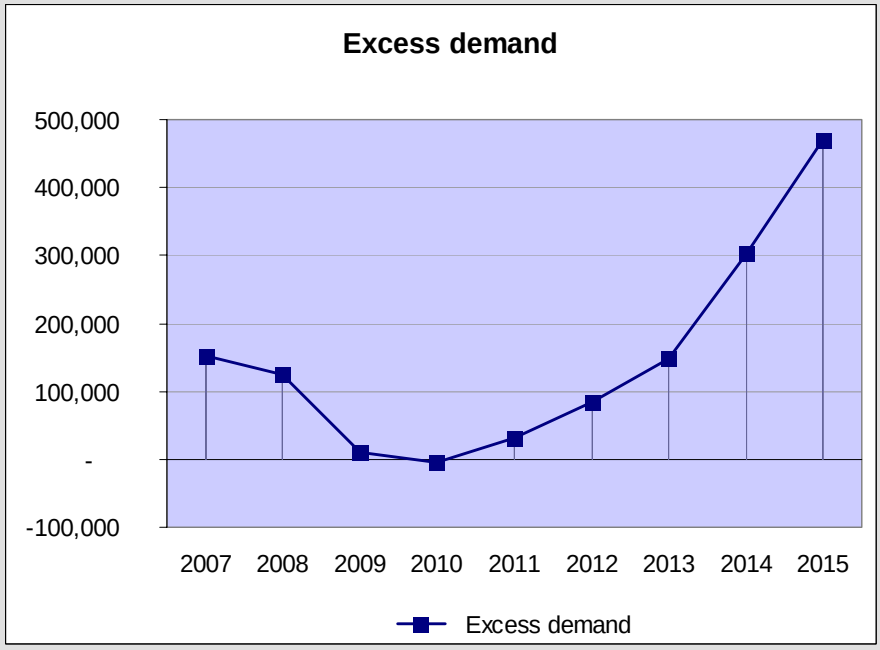


Source: e-Skills Monitor 2009

Exhibit 7-5: Forecast EU27 – Investing in the future scenario, core e-skills

European Union (EU27) – 'Investing in the future' CORE definition of ICT practitioners

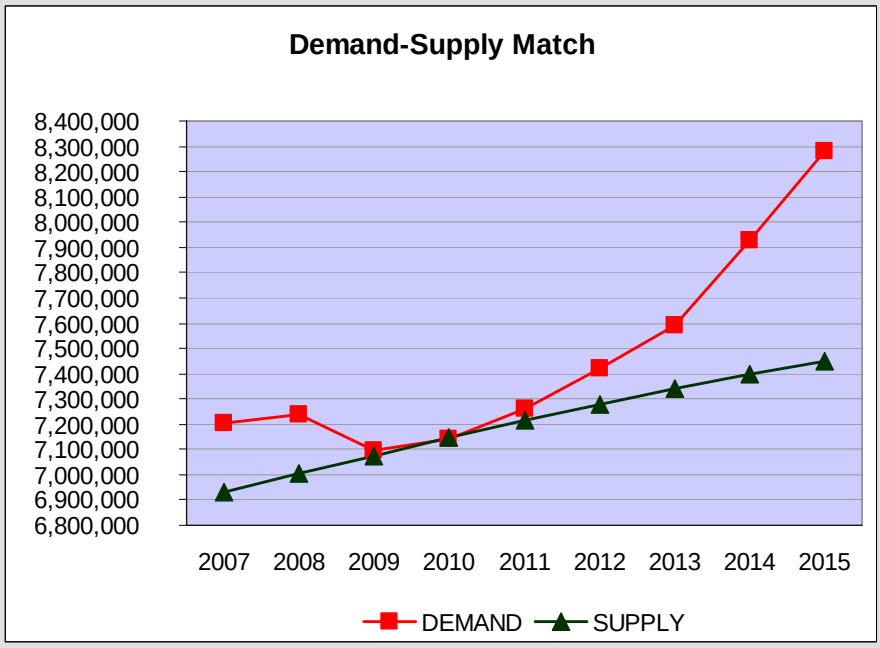


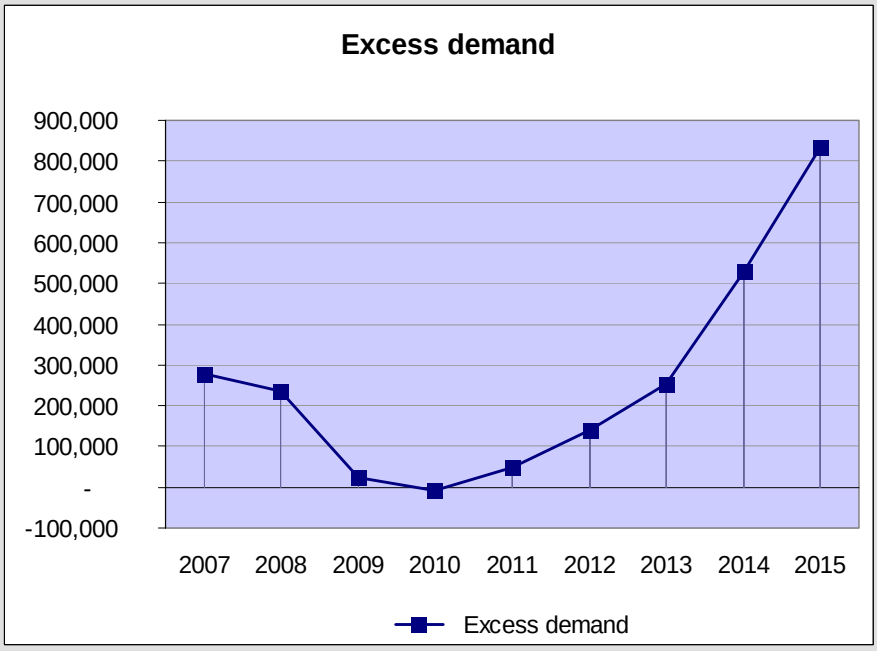


Source: e-Skills Monitor 2009

Exhibit 7-6: Forecast EU27 – Investing in the future scenario, very broad e-skills

European Union (EU27) – 'Investing in the future' very broad definition of ICT practitioners

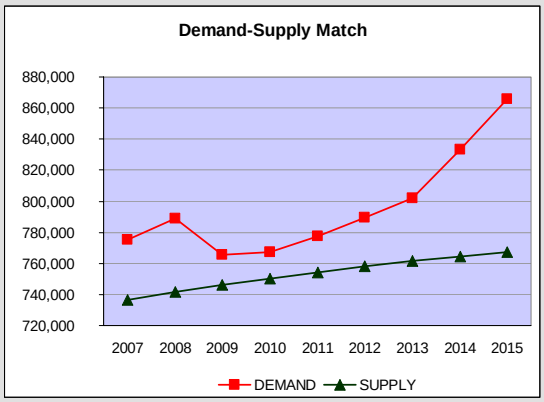




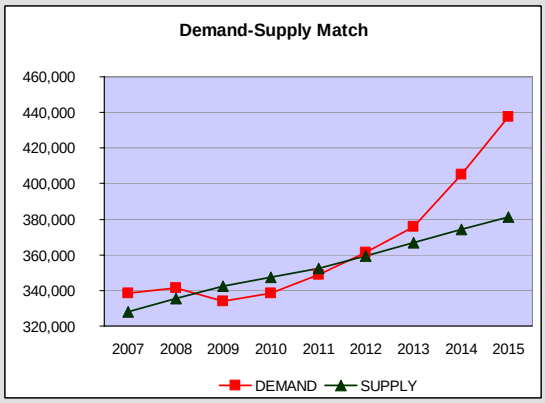
Source: e-Skills Monitor 2009

Exhibit 7-7: Forecast countries – Investing in the future scenario, core e-skills

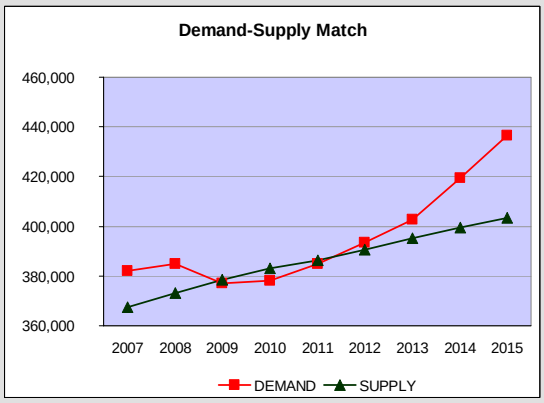
GERMANY (DE) – 'Investing in the future' CORE definition of ICT practitioners



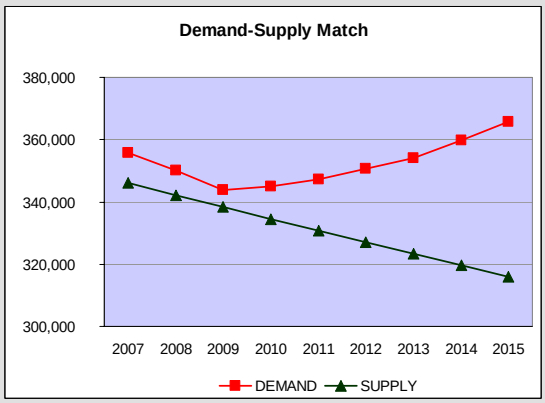
SPAIN (ES) – 'Investing in the future' CORE definition of ICT practitioners



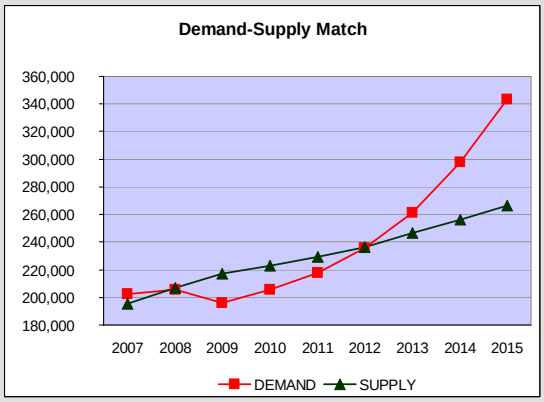
FRANCE (FR) – 'Investing in the future' CORE definition of ICT practitioners



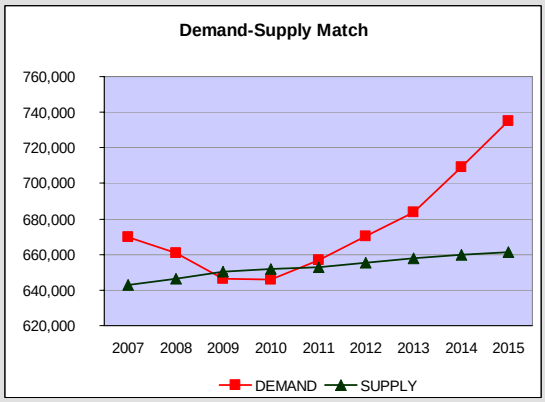
ITALY (IT) – 'Investing in the future' CORE definition of ICT practitioners



POLAND (PL) – 'Investing in the future' CORE definition of ICT practitioners



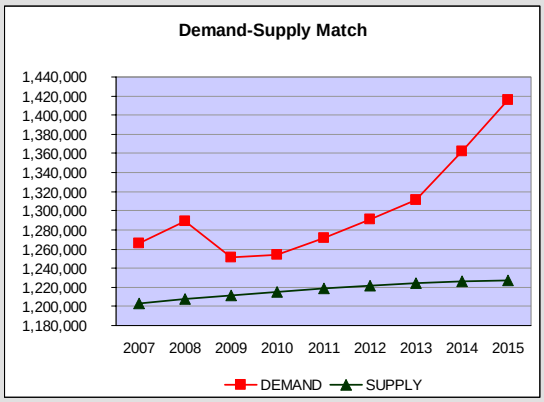
UNITED KINGDOM (UK) – 'Investing in the future' CORE definition of ICT practitioners



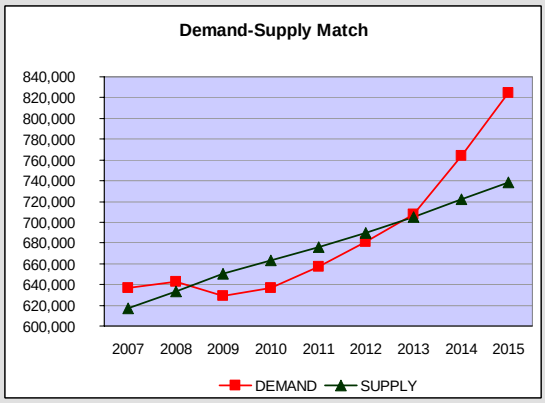
Source: e-Skills Monitor 2009

Exhibit 7-8: Forecast countries – Investing in the future scenario, very broad e-skills

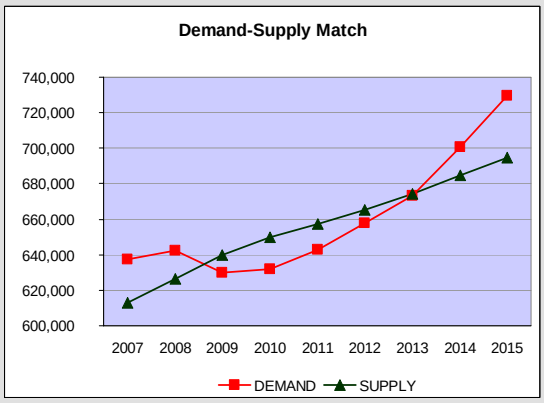
GERMANY (DE) – 'Investing in the future' very broad definition of ICT practitioners



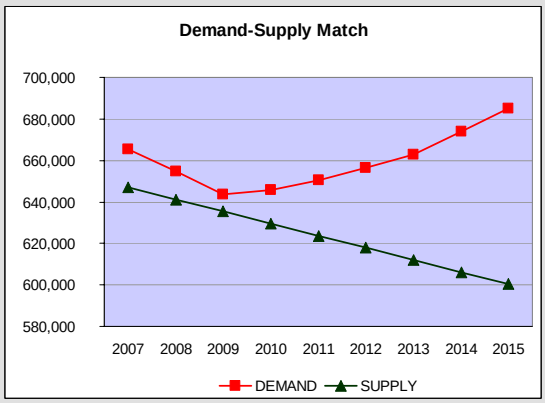
SPAIN (ES) – 'Investing in the future' very broad definition of ICT practitioners



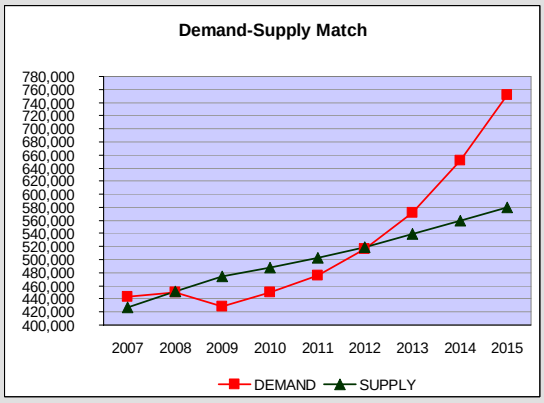
FRANCE (FR) – 'Investing in the future' very broad definition of ICT practitioners



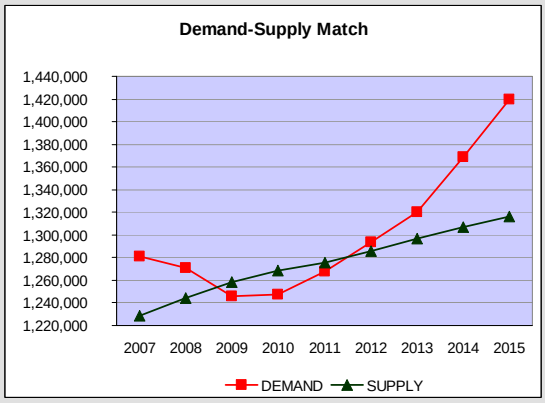
ITALY (IT) – 'Investing in the future' very broad definition of ICT practitioners



POLAND (PL) – 'Investing in the future' very broad definition of ICT practitioners



UNITED KINGDOM (UK) – 'Investing in the future' very broad definition of ICT practitioners

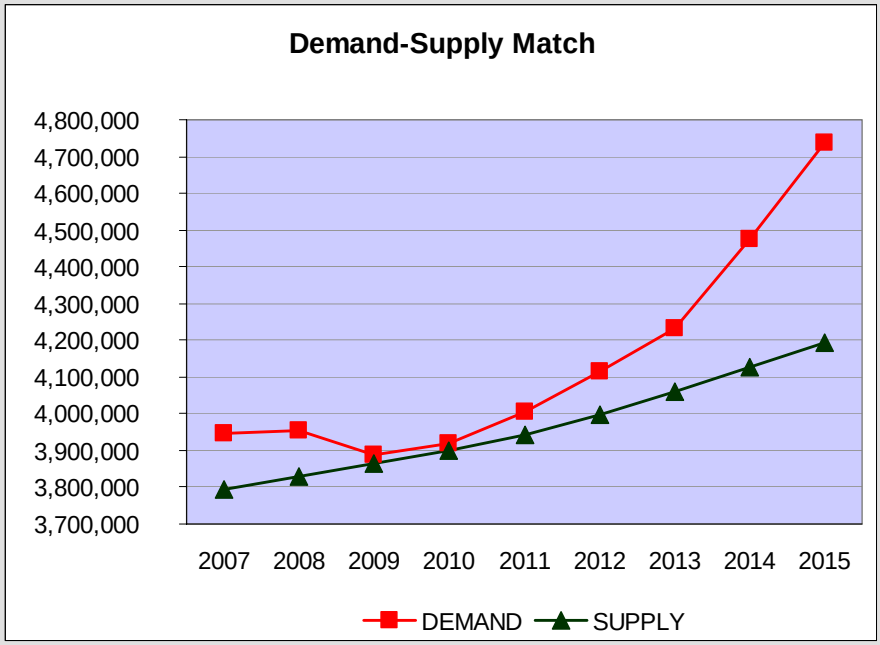


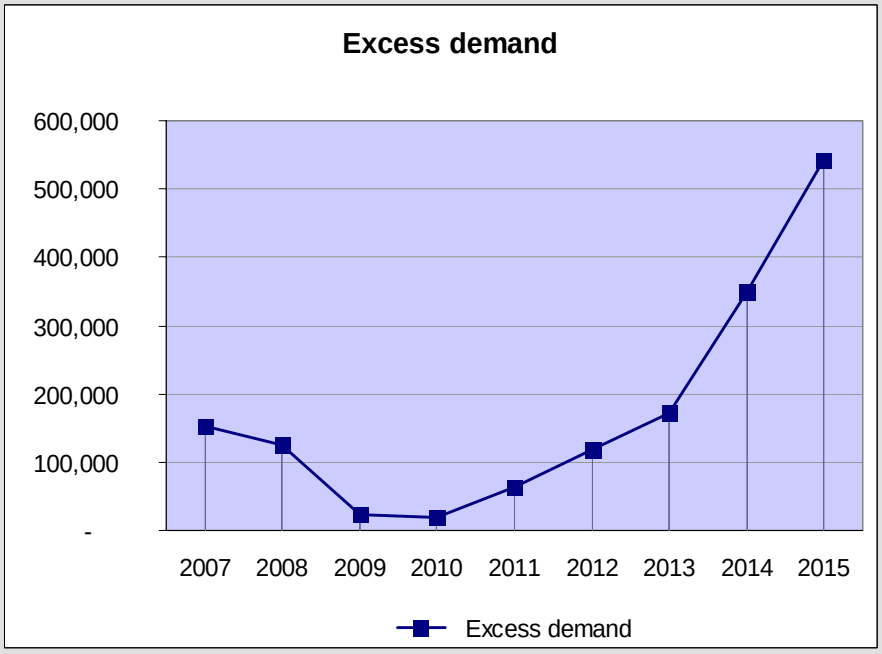
Source: e-Skills Monitor 2009

Turbo knowledge economy scenario, CORE definition of e-skills

Exhibit 7-9: Forecast EU27 – Turbo knowledge economy, core e-skills

European Union (EU27) – 'Turbo knowledge economy' CORE definition of ICT practitioners

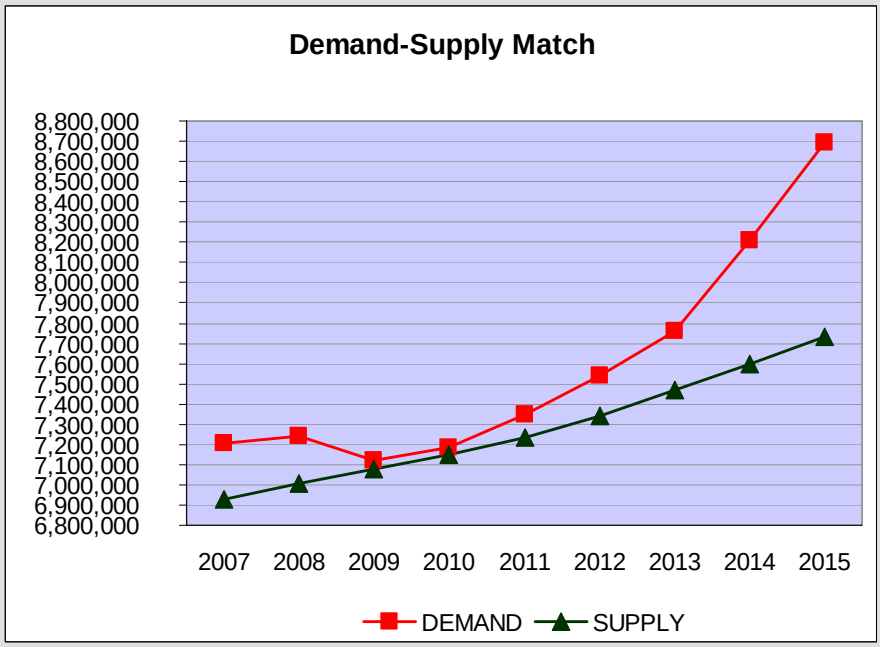


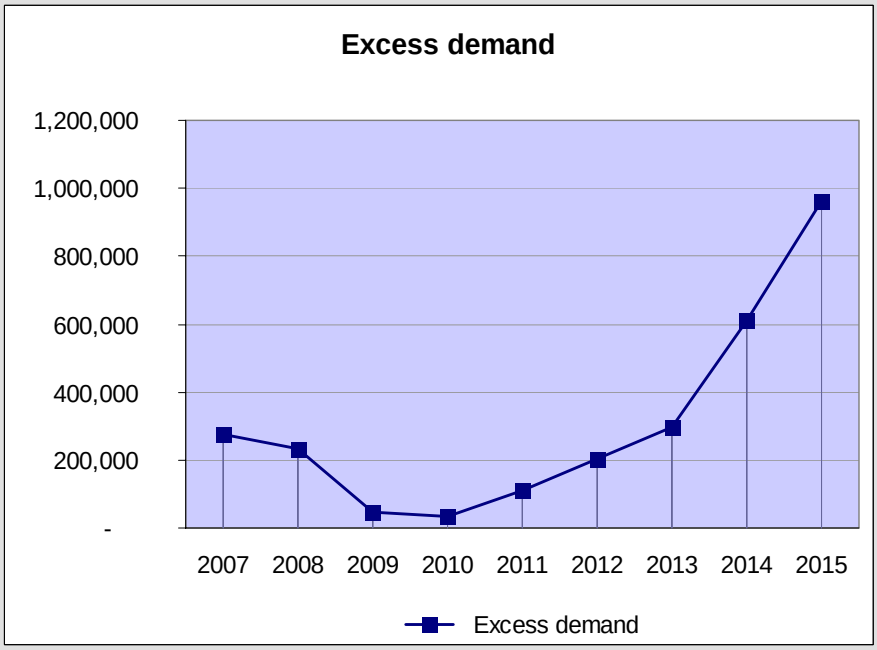


Source: e-Skills Monitor 2009

Exhibit 7-10: Forecast EU27 – Turbo knowledge economy, very broad e-skills

European Union (EU27) – 'Turbo knowledge economy' very broad definition of ICT practitioners

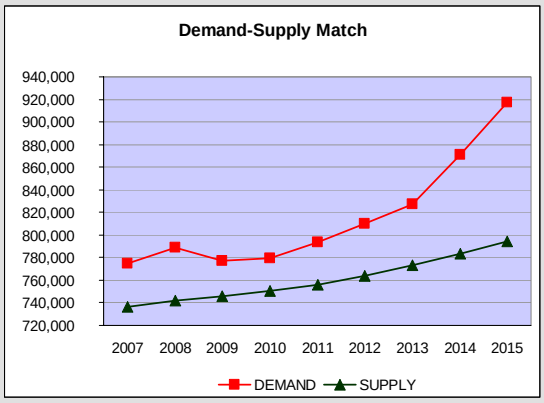




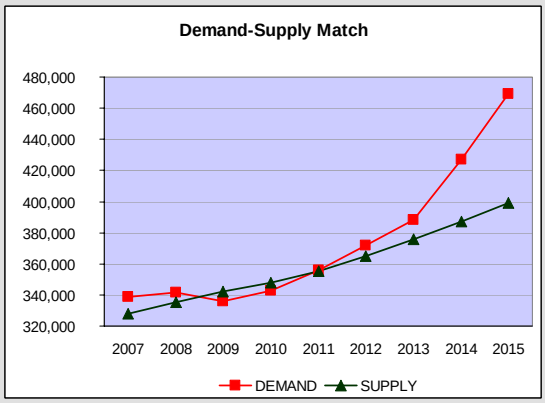
Source: e-Skills Monitor 2009

Exhibit 7-11: Forecast countries – 'Turbo knowledge economy', core e-skills

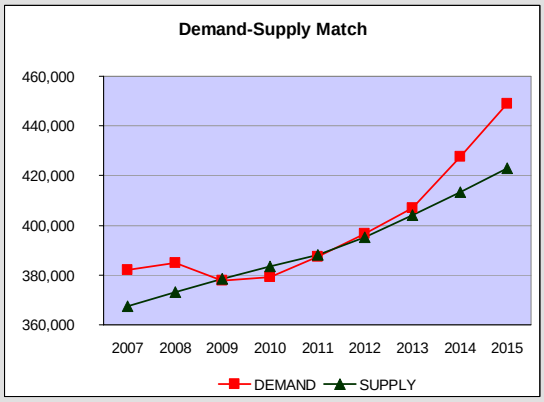
GERMANY (DE) – 'Turbo knowledge economy' CORE definition of ICT practitioners



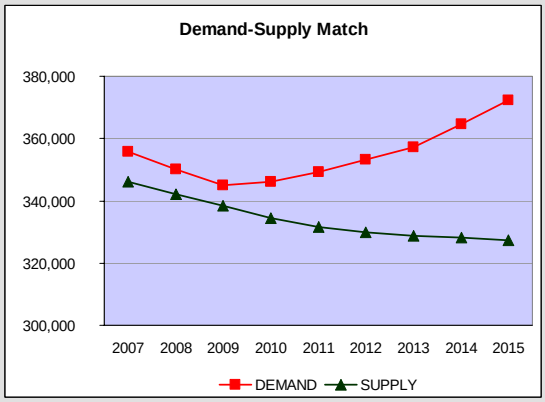
SPAIN (ES) – 'Turbo knowledge economy' CORE definition of ICT practitioners



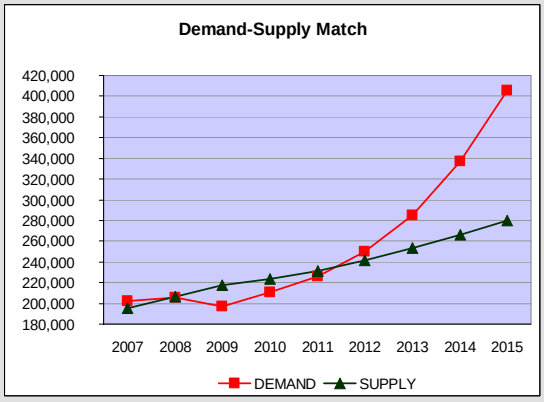
FRANCE (FR) – 'Turbo knowledge economy' CORE definition of ICT practitioners



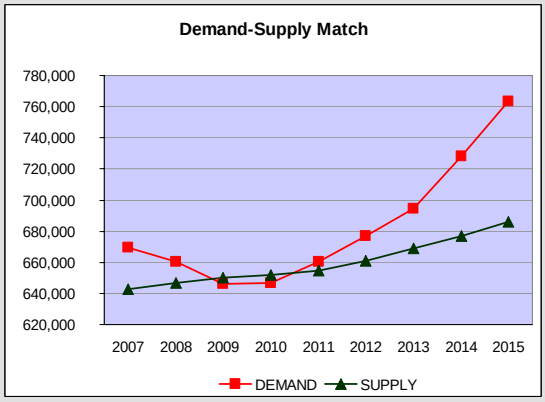
ITALY (IT) – 'Turbo knowledge economy' CORE definition of ICT practitioners



POLAND (PL) – 'Turbo knowledge economy' CORE definition of ICT practitioners



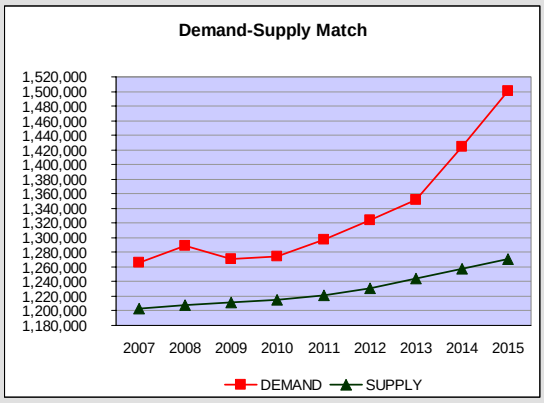
UNITED KINGDOM (UK) – 'Turbo knowledge economy' CORE definition of ICT practitioners



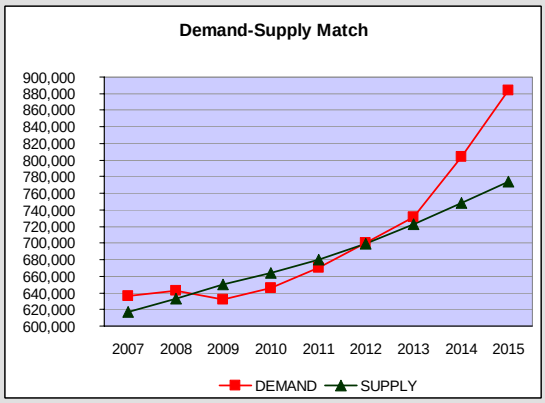
Source: e-Skills Monitor 2009

Exhibit 7-12: Forecast countries – 'Turbo knowledge economy', very broad e-skills

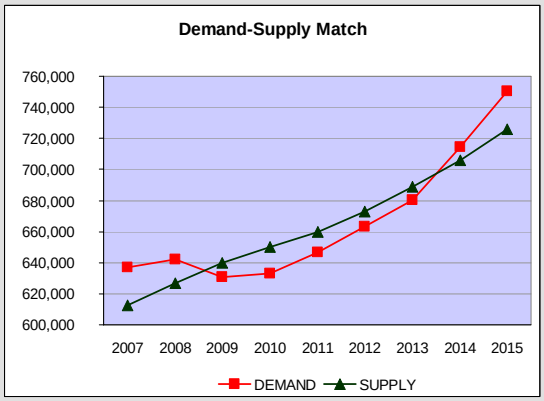
GERMANY (DE) – 'Turbo knowledge economy' very broad definition of ICT practitioners



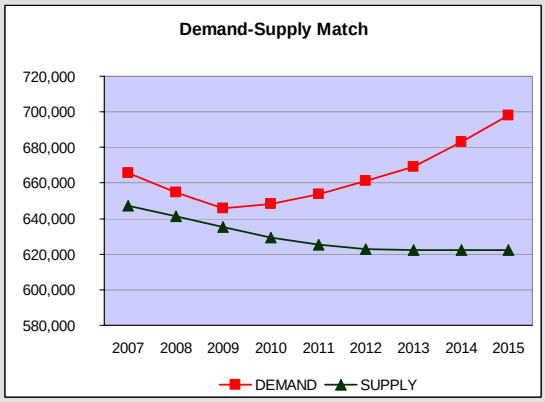
SPAIN (ES) – 'Turbo knowledge economy' very broad definition of ICT practitioners



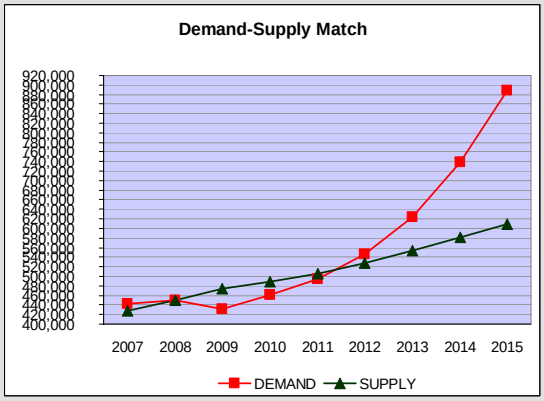
FRANCE (FR) – 'Turbo knowledge economy' very broad definition of ICT practitioners



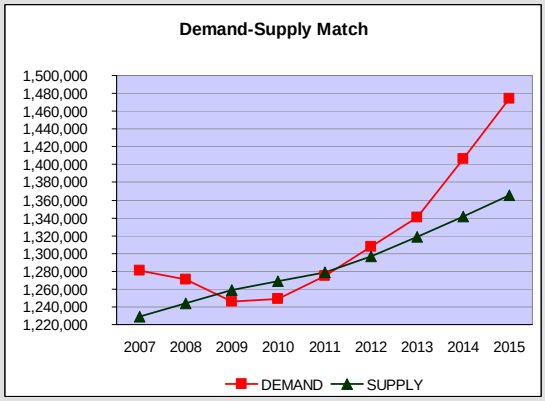
ITALY (IT) – 'Turbo knowledge economy' very broad definition of ICT practitioners



POLAND (PL) – 'Turbo knowledge economy' very broad definition of ICT practitioners



UNITED KINGDOM (UK) – 'Turbo knowledge economy' very broad definition of ICT practitioners

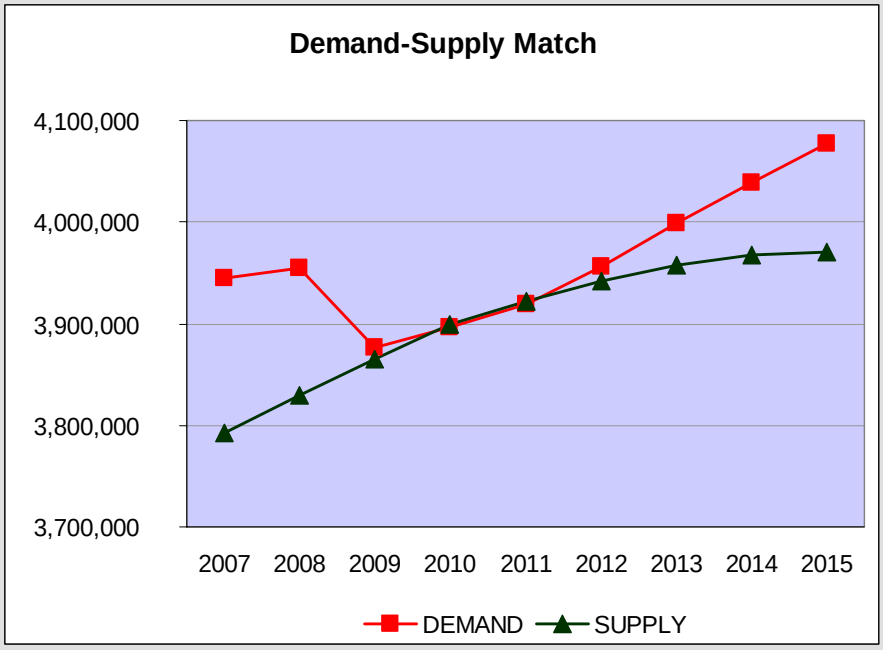


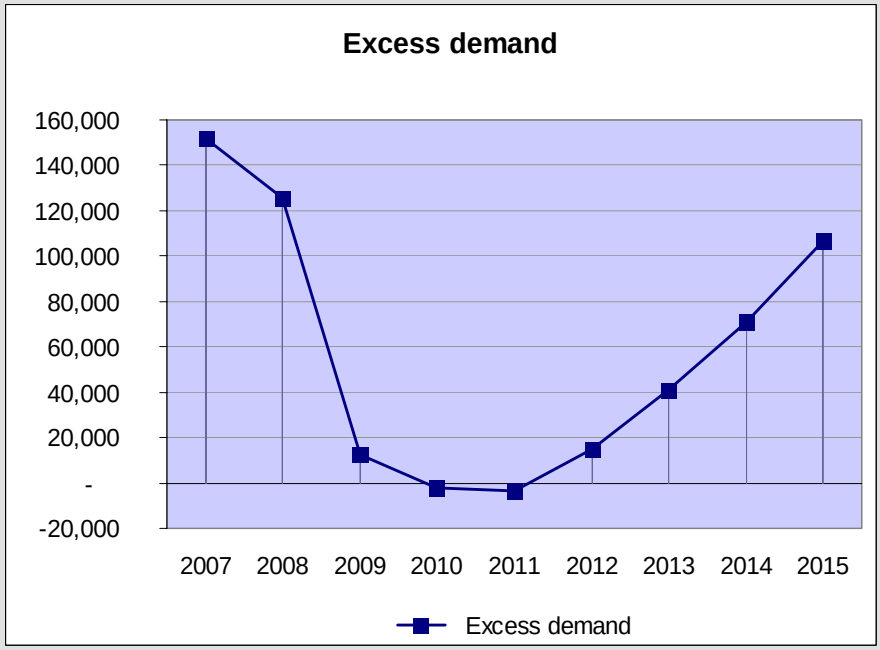
Source: e-Skills Monitor 2009

Tradition wins scenario

Exhibit 7-13: Forecast EU27 – Tradition wins scenario, core e-skills

European Union (EU27) – 'Tradition wins' CORE definition of ICT practitioners

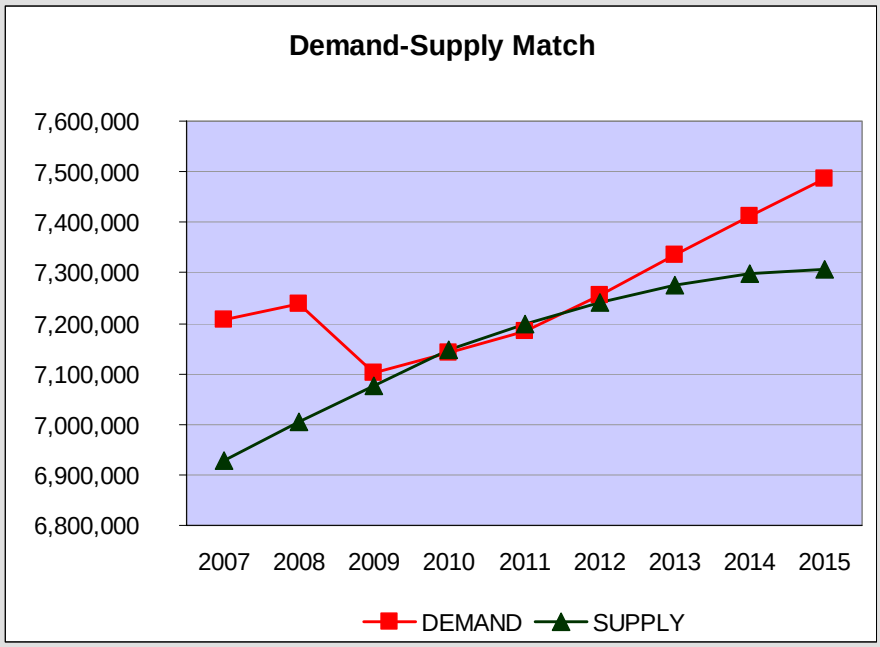


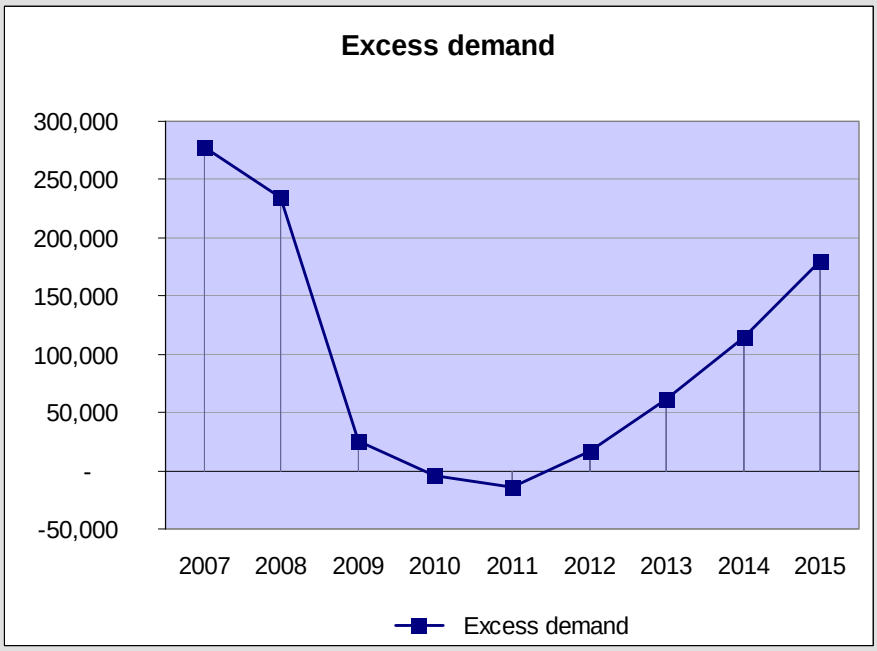


Source: e-Skills Monitor 2009

Exhibit 7-14: Forecast EU27 – Tradition wins scenario, very broad e-skills

European Union (EU27) – 'Tradition wins' very broad definition of ICT practitioners

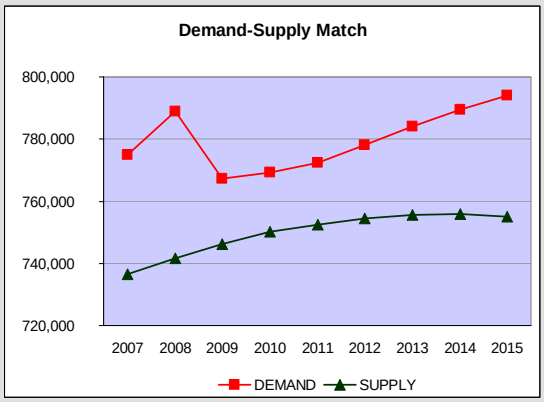




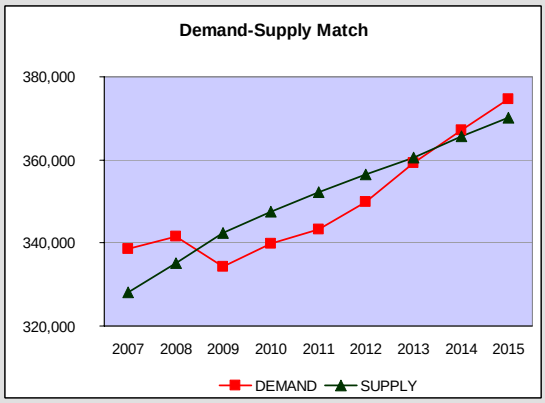
Source: e-Skills Monitor 2009

Exhibit 7-15: Forecast countries – Tradition wins scenario, core e-skills

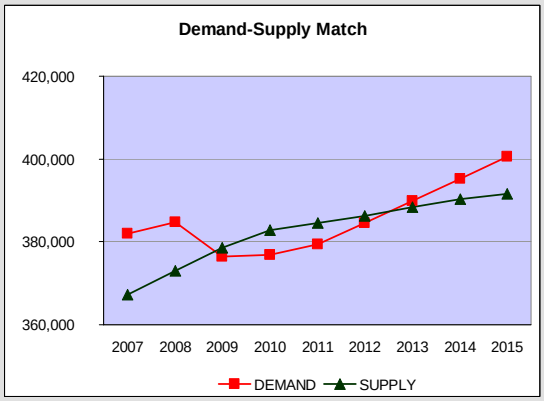
GERMANY (DE) – 'Tradition wins' CORE definition of ICT practitioners



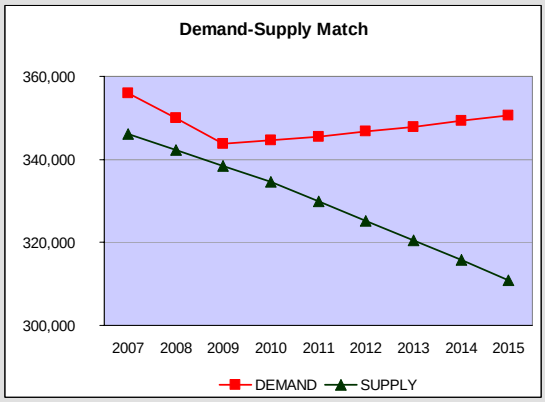
SPAIN (ES) – 'Tradition wins' CORE definition of ICT practitioners



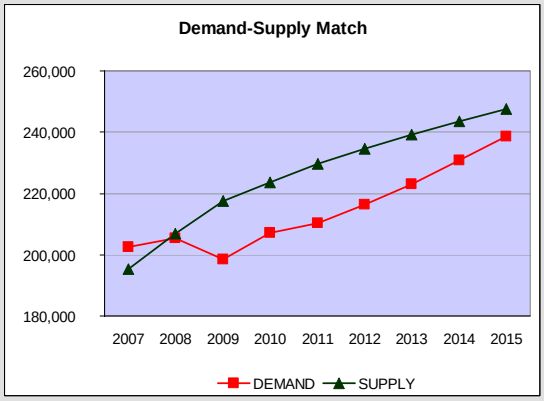
FRANCE (FR) – 'Tradition wins' CORE definition of ICT practitioners



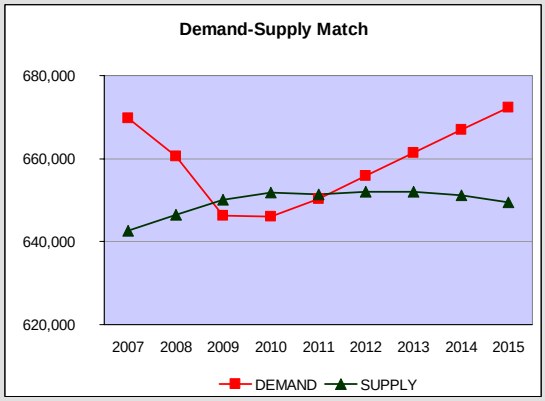
ITALY (IT) – 'Tradition wins' CORE definition of ICT practitioners



POLAND (PL) – 'Tradition wins' CORE definition of ICT practitioners



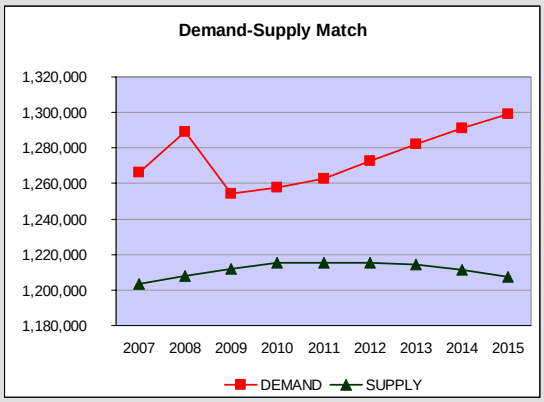
UNITED KINGDOM (UK) – 'Tradition wins' CORE definition of ICT practitioners



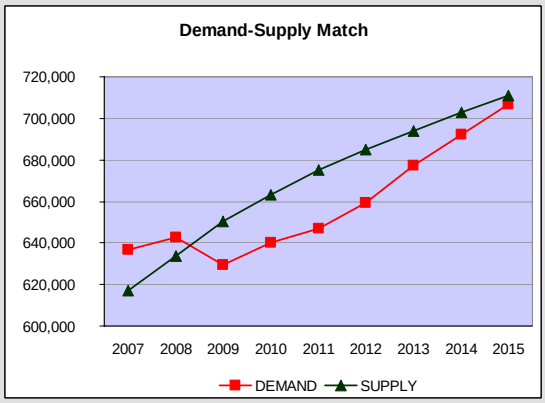
Source: e-Skills Monitor 2009

Exhibit 7-16: Forecast countries – Tradition wins scenario, very broad e-skills

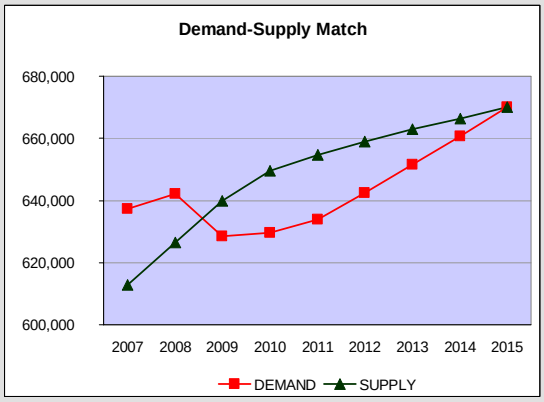
GERMANY (DE) – 'Tradition wins' very broad definition of ICT practitioners



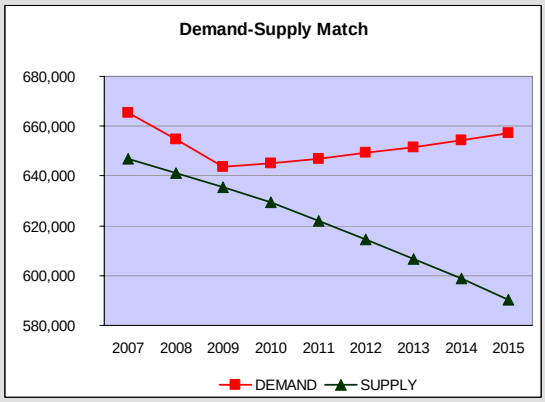
SPAIN (ES) – 'Tradition wins' very broad definition of ICT practitioners



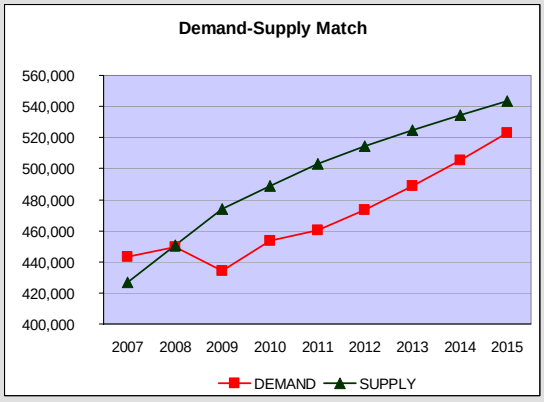
FRANCE (FR) – 'Tradition wins' very broad definition of ICT practitioners



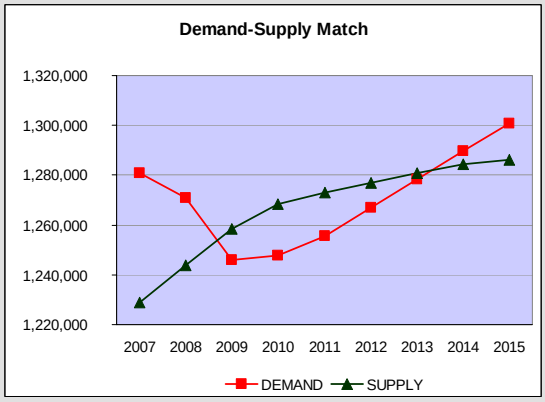
ITALY (IT) – 'Tradition wins' very broad definition of ICT practitioners



POLAND (PL) – 'Tradition wins' very broad definition of ICT practitioners



UNITED KINGDOM (UK) – 'Tradition wins' very broad definition of ICT practitioners

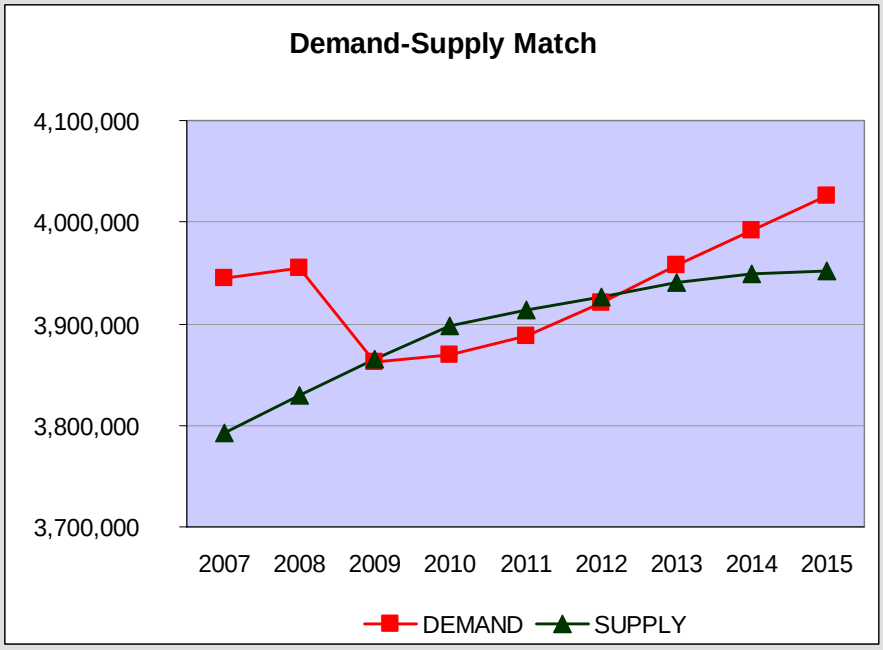


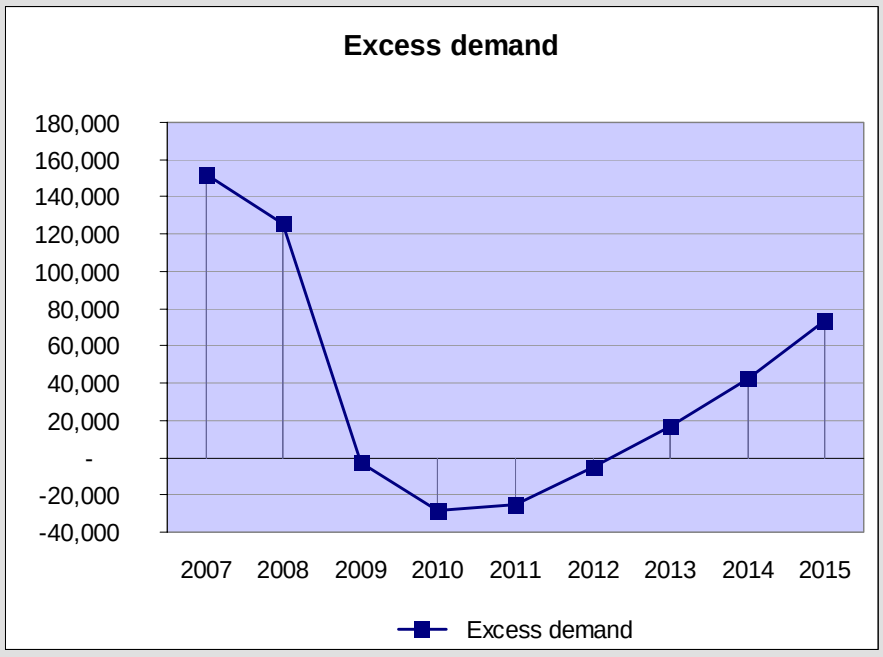
Source: e-Skills Monitor 2009

Stagnation scenario, CORE definition of e-skills

Exhibit 7-17: Forecast EU27 – Stagnation scenario, core e-skills

European Union (EU27) – 'Stagnation' CORE definition of ICT practitioners

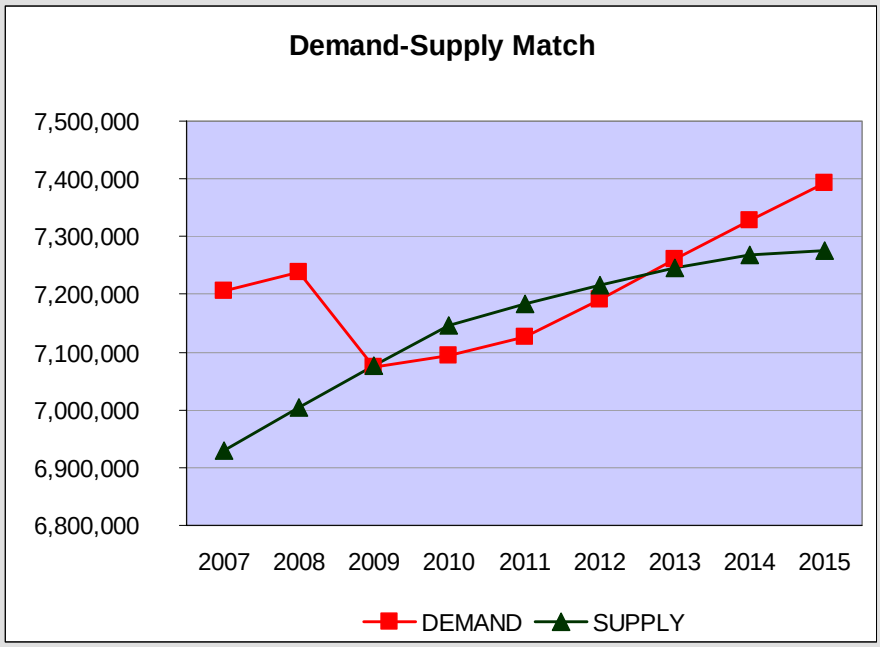


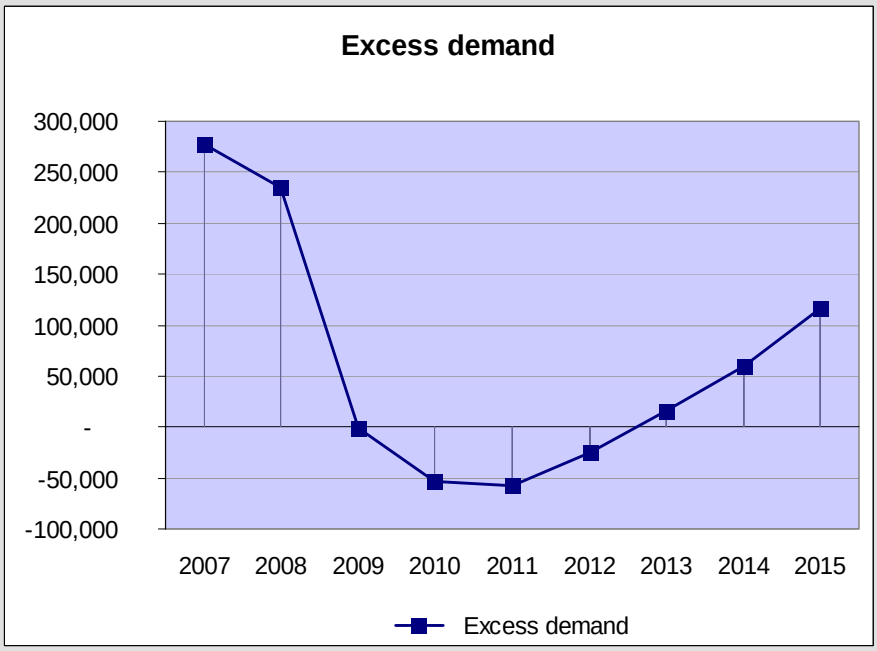


Source: e-Skills Monitor 2009

Exhibit 7-18: Forecast EU27 – Stagnation scenario, very broad e-skills

European Union (EU27) – 'Stagnation' very broad definition of ICT practitioners

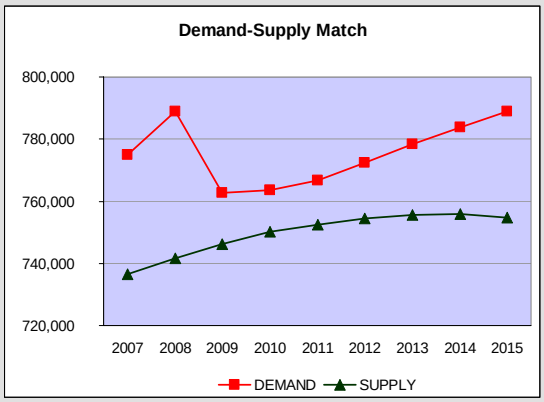




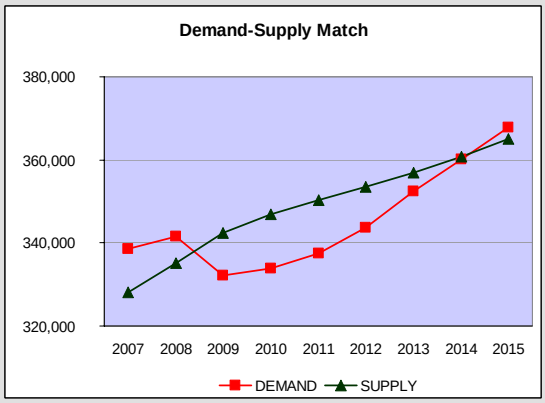
Source: e-Skills Monitor 2009

Exhibit 7-19: Forecast countries – Stagnation scenario, core e-skills

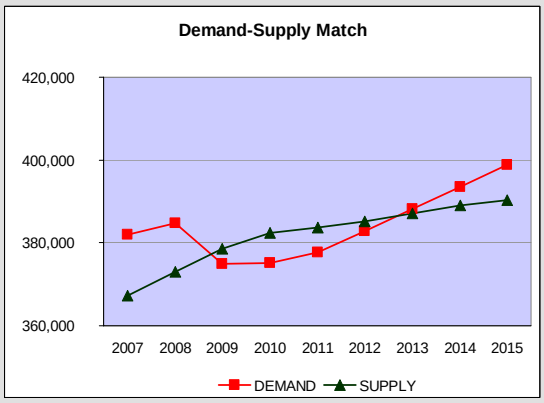
GERMANY (DE) – 'Stagnation' CORE definition of ICT practitioners



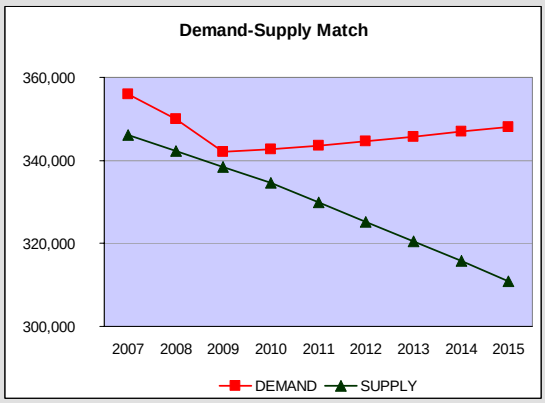
SPAIN (ES) – 'Stagnation' CORE definition of ICT practitioners



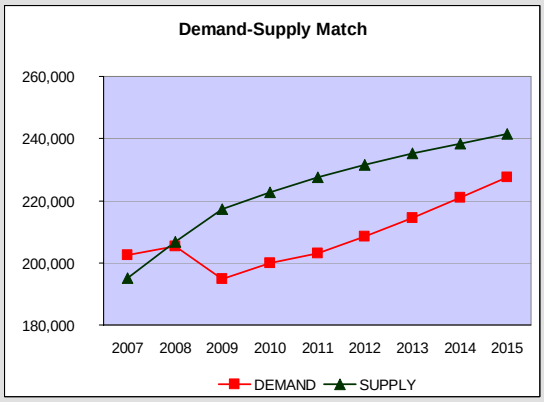
FRANCE (FR) – 'Stagnation' CORE definition of ICT practitioners



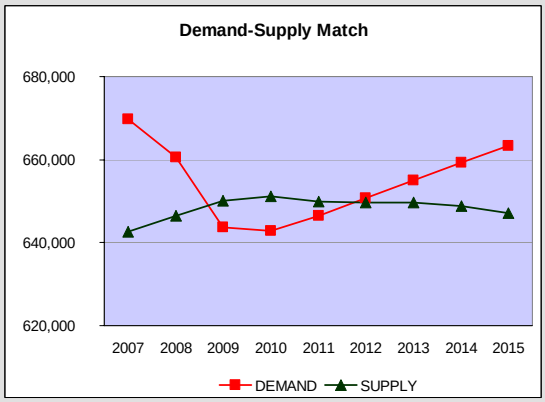
ITALY (IT) – 'Stagnation' CORE definition of ICT practitioners



POLAND (PL) – 'Stagnation' CORE definition of ICT practitioners



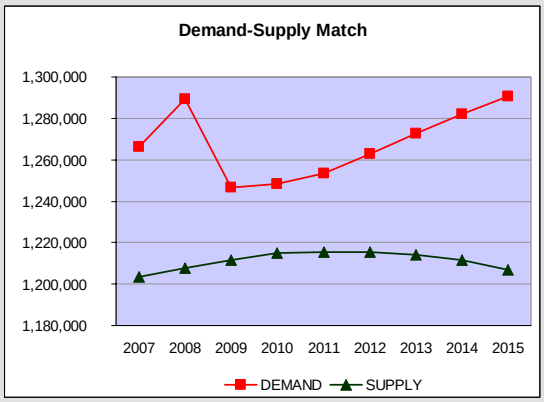
UNITED KINGDOM (UK) – 'Stagnation' CORE definition of ICT practitioners



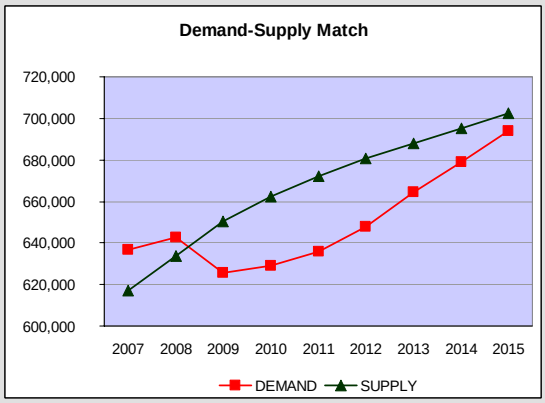
Source: e-Skills Monitor 2009

Exhibit 7-20: Forecast countries – Stagnation scenario, very broad e-skills

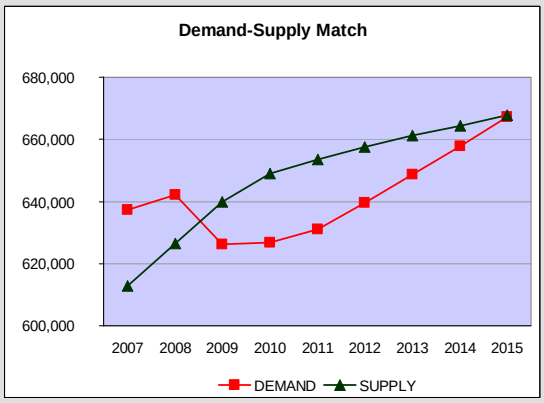
GERMANY (DE) – 'Stagnation' very broad definition of ICT practitioners



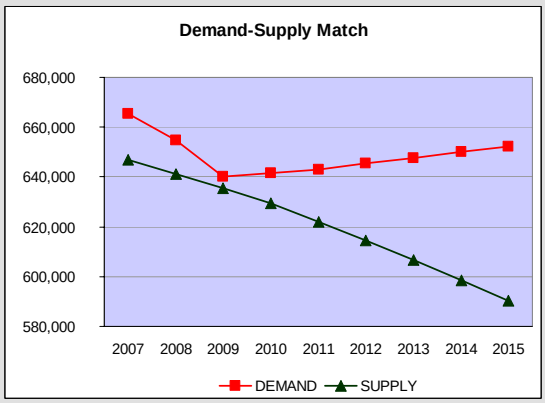
SPAIN (ES) – 'Stagnation' very broad definition of ICT practitioners



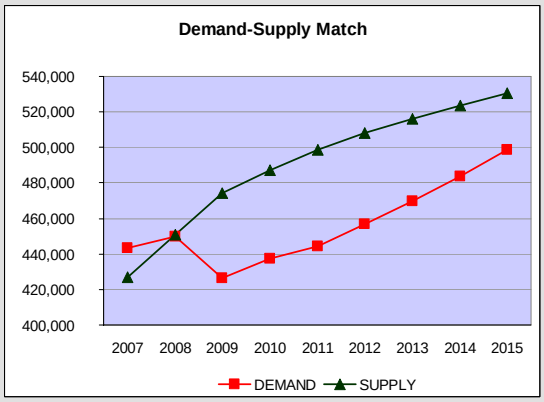
FRANCE (FR) – 'Stagnation' very broad definition of ICT practitioners



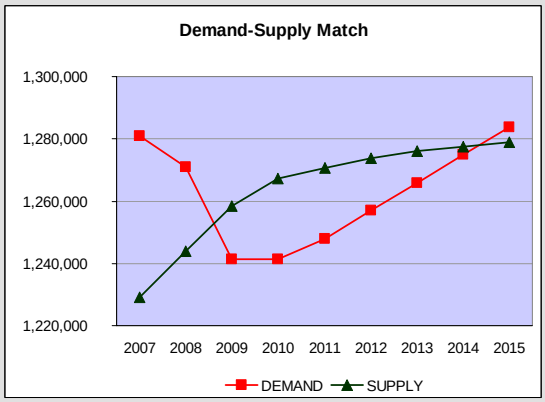
ITALY (IT) – 'Stagnation' very broad definition of ICT practitioners



POLAND (PL) – 'Stagnation' very broad definition of ICT practitioners



UNITED KINGDOM (UK) – 'Stagnation' very broad definition of ICT practitioners



Source: e-Skills Monitor 2009