e-Leadership Skills

Vision Report

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RESEARCH TEAM

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Executive summary

e-Leadership Skills
e-Skills for Competitiveness and Innovation

This report is one of the products of an initiative launched in January 2012 by the European Commission's Directorate General Enterprise and Industry in support of the EU e-skills strategy, and composed of several distinct but interconnected components, including a foresight scenario exercise regarding e-skills demand and supply in Europe by 2020. In that context, the objective of the present report is '*to develop a vision for Europe's e-skills for competitiveness and innovation, and to examine ways to face current and future challenges in this regard*'.

Faced with multiple challenges, the European Union also needs to be aware of its strengths and of its potential to be able to not only surmount such challenges, but also to use times of crisis as a source of energy and impetus to transform and gear up to new opportunities. Among the challenges to address, diminished competitiveness, insufficient innovation, and endemic unemployment (especially among young Europeans) are particularly pressing. Among Europe's strengths, its human capital, high levels of education, and record of success in information technologies and high-tech industries need to be built on. Hence the critical importance of addressing e-leadership skills (the talents and abilities required by a global and highly competitive knowledge economy) at this point in time: What are they? Where are they needed most? What can be done to address current and foreseeable gaps between demand and supply of such critical skills for competitiveness and innovation?

The report offers an innovative way to address these questions by building on the pioneering work produced by the European Commission over the last decade: starting from its e-skills pyramid (e-business/strategic skills, practitioners skills and users skills) a dynamic 'skills eco-system' is designed, through which 'e-leadership skills' are identified and defined.

A critical assessment of available literature on the subject of e-skills reveals that, although several components of the eco-system have benefitted from significant analytical insights, remarkably little has been said or discussed on e-leadership skills defined from the strategic perspective adopted here.

This has led the authors of this report to identify a series of practical approaches and measures that should be considered by key stakeholders (European institutions, national governments, business, education and academic institutions, and civil society generally) to address the issues surrounding current and anticipated gaps in Europe's e-leadership skills.

Recognizing that the innovative fashion in which e-skills are defined in the report does not easily lend itself to quantification (existing definitions and taxonomies being of little help), the actions identified are organized around four main pillars, namely (1) Joining forces to use e-leadership skills as a key to foster Europe's job rich recovery, (2) Towards a Grand Coalition on e-leadership skills bringing all stakeholders together, (3) Investing more decisively in Human Capital, and (4) Improving the business climate. Under each of these pillars, specific actions are described, and the potential respective roles of specific stakeholders in their successful implementation are outlined.

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Among the main conclusions emanating from this report, the following cannot be overemphasized: (1) faced with a combination of major crises, Europe has the possibility to adopt path breaking measures and policies to generate the skills it needs to restore its competitiveness and leading role as an innovator, (2) e-leadership skills, defined strategically and in a future-oriented fashion, should be a high priority of such actions and policies , (3) since producing skills and talents can take a long time (up to a generation in some cases), a central part of the efforts required will need to focus on re-training and up-skilling workers; yet efforts to update curricula, adopt new methods of learning, and engage stakeholder to engage jointly must be pursued and accelerated in parallel.

A job-rich recovery in Europe is possible, and e-skills initiatives may very well spearhead a change of mind-sets about what is feasible in Europe. Joint, coordinated and multi-stakeholder approaches will be necessary. A 'Grand Coalition' is clearly a key component in such a context. Its success will rely in part on how it will be perceived by governments, businesses and individuals. Concrete, measurable and visible actions will be a key ingredient to make it attractive and successful. E-leadership skills form a good place to start.

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1 Context, objectives and scope of the Vision Report

1.1 Context

This is a vision report. It is expected to provide a unique, original and action-oriented view regarding the skills that are most critically needed for success in tomorrow's information-driven economy. Indeed, with close to universal access to ever increasing large amounts of data and information, having the skills to usefully exploit the most sophisticated available information and communication technologies (ICT) is what will make a difference to innovation and competitiveness.

The challenge in producing such a vision is to find the right balance between two competing expectations. On one hand, economists and managers have a constant and understandable hunger for operational definitions, benchmarks and statistics: what they expect is a set of data and pointers that would allow them to better understand where the mismatches are (between demand and supply, per type of skills, and if possible per sector and geographies), and make relevant decisions in how to manage their own programs and how to try to influence their external environment at the macro-level. On the other hand, investors, practitioners and business leaders who will largely determine how our societies handle the human dimension of future growth at the enterprise and the micro-level, are eagerly looking for the latest 'mega-trends' and the organic description of what the crucial dynamics of success in tomorrow's economy will be. Policy makers need both perspectives, although they traditionally mostly rely on a macro-level.

For the first category of players, longer term ideas and visions may be too fuzzy, imprecise and complex to be a basis for immediate action. For the second category, attempts at being too precise with definitions and measurements (although the limitations of statistics are well known) would diminish the interest of the analysis, since it may be too easily contradicted by disruptive innovations, changed business models and shifts in government policies, to name but a few sources of change.

The structure of the current initiative[1] allows for these competing expectations to be addressed. Empirica, IDC and INSEAD have been contracted by the European Commission to address in a coherent fashion the various aspects of e-skills for competitiveness and innovation. The resulting vision, roadmap and foresight scenarios will focus on how the European Union can seize opportunities in innovation, new technologies and emerging forms of organization and production, while maintaining its priority on inclusive growth. Understanding what jobs of the future will require and how the acquisition and combination of relevant skills can lead European citizens to live better lives while contributing to collective value creation needs to rest on rigorous, evidence-based analytical approaches. Yet, Europe's ability to generate value and competitiveness from knowledge and innovation also demands that such analytical rigour be meshed with the right dose of imagination and foresight.

[1] This initiative was launched in January 2012 by the European Commission's Directorate General Enterprise and Industry in support of the EU e-skills strategy. It is composed of several distinct but interconnected components, including a foresight scenario exercise regarding e-skills demand and supply in Europe by 2020. The present report is the first and most important of those components. Its main objective is 'to develop a vision for Europe's e-skills for competitiveness and innovation, and to examine ways to face current and future challenges in this regard'.

1.2 Objectives

The ultimate objective of the initiative is to contribute to reduce innovation skills shortages, gaps and mismatches in Europe by providing new insights grounded in solid empirical evidence on how demand and supply for e-leadership skills are evolving in Europe. To this end, it will develop a shared, coherent vision of what types of e-leadership skills are likely to take centre stage, both for innovation in ICT and for ICT-enabled innovation, and how their demand and supply may evolve under different economic scenarios.

An important objective is to develop frameworks from its findings that encourage and facilitate dialogue and cooperation between policy makers and stakeholders at the EU and national levels about implications and required actions to be taken to address the issues at stake. The focus is on e-leadership skills and on the development of a vision for what can be done to foster excellence. Special attention will be paid to high-tech and innovative start-ups, to SMEs with high growth potential, and those selling their products and services internationally.

As mentioned earlier, this report is a vision report. It is built on the identification of major trends, and the possible dynamics that may change the parameters of the e-skills equation in the short and medium term. To do so, it will not shy away from making broad (and sometimes bold) assumptions, venturing original hypotheses and referring to a variety of fields related to innovation and competitiveness, rather than start from a pure 'e-skills' perspective.

Yet, since the final report also aims to provide an actionable roadmap and a series of strategic recommendations, it will make an attempt at combining such views and prospects with the other more definition-based and data-centred components of the overall initiative. Thus, the present report will give due attention to defining and analysing e-leadership skills. Yet, its main ambition will remain to offer eye-opening perspectives and new ways of considering how e-leadership skills can be better produced, maintained, developed and acquired in a world where competitiveness and innovation will be the key drivers of government policies and business decisions.

1.3 Scope and definitions

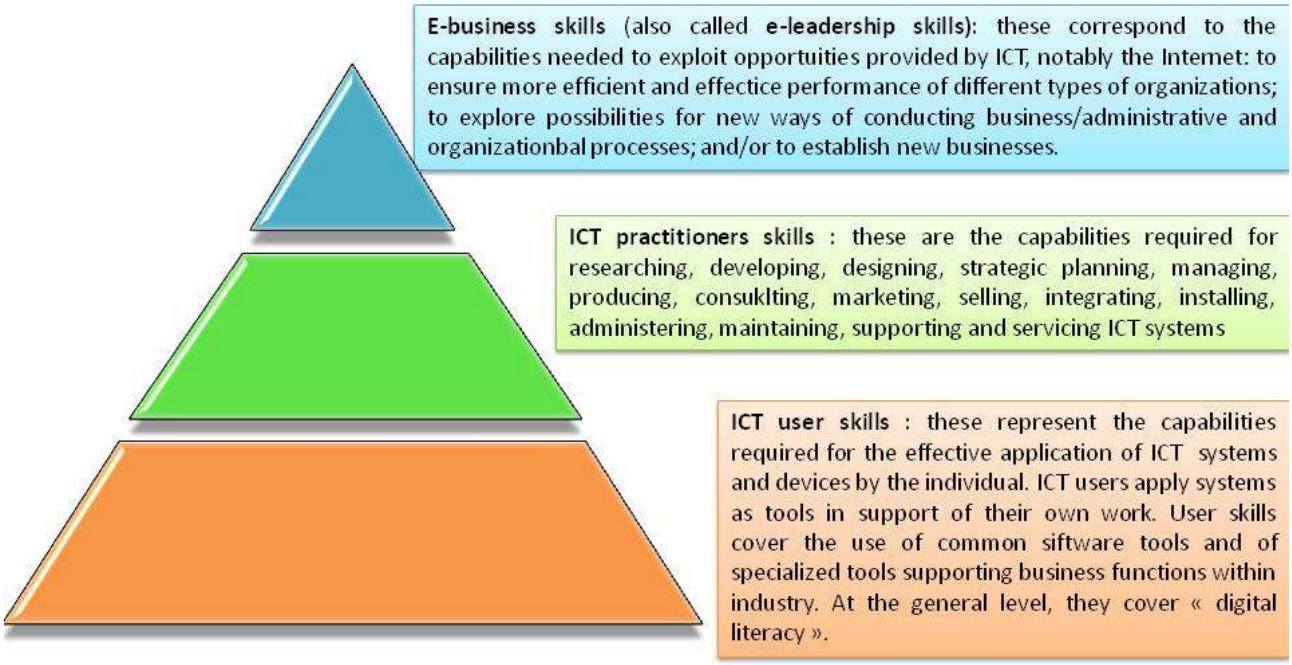
Beyond ICT skills

It has long been recognized that the availability of adequate skills for developing, implementing and using information and communication technologies (ICT) is an important condition for Europe's competitiveness and innovation capabilities. The skills that are required go far beyond the narrow confines of ICT practitioner skills within the ICT industry. They also comprise ICT practitioner skills in user industries, ICT user skills and e-business skills, as defined by the European e-Skills Forum in its Synthesis Report (2004), and Figure 1.1:

- **e-Business skills** (also called **e-leadership skills**) are the capabilities needed to exploit opportunities provided by ICT, notably the Internet, to ensure more efficient and effective performance of different types of organisations, to explore possibilities for new ways of conducting business and organisational processes, and to establish new businesses;

- **ICT practitioner skills** are the capabilities required for researching, developing and designing, managing, the producing, consulting, marketing and selling, the integrating, installing and administrating, the maintaining, supporting and service of ICT systems;
- **ICT user skills** are the capabilities required for effective application of ICT systems and devices by the individual. ICT users apply systems as tools in support of their own work, which is, in most cases, not ICT. User skills cover the utilisation of common generic software tools and the use of specialised tools supporting business functions within industries other than the ICT industry.

Figure 1-1: The European e-Skills Forum e-Skills Pyramid



Source : European e-Skills Forum (2004)

The speed and breadth of changes that continue to develop the fields of ICT constantly requires new skills. There is no reason to think that this will change in the years to come; hence any vision of e-skills for competitiveness and innovation needs to anticipate that such definitions will need to evolve.

Ten years ago, few analysts (and even fewer educators) would have anticipated the growing need for 'big data' skills (semantic bots), or the new legal dimensions of intellectual property stemming from social networks, collaborative innovation or cloud computing. The business models created around network-

based information flows (social networks, freemium[2], viral marketing) have also created new business opportunities for those who have (or can acquire) the right e-skills. The advent of ubiquitous broadband, and the acceleration it has provided to convergences between the fields of telecommunications, information and multi-channel communications also calls for new 'inter-disciplinary' e-skills which were not produced before. What a company like Google had identified in 2004 (the importance of recruiting mathematicians and statisticians and not just engineers[3]) made its success in the following years, and it has remained competitive so far by continuing to evolve its ideas, organisation and practices. What kind of e-skills should companies and national economies be looking to be competitive and innovative in 2015-2020?

The need for flexibility

We shall hence need to adopt a flexible approach in order to produce a compelling vision. Although the focus in this report is on the category e-leadership skills[4], we shall also discuss the "e-leadership skills aspects" of the other two categories.

For example, for the practitioners it is increasingly the case that a combination of technical, business and soft skills is required in order to fully exploit the opportunities offered by different technologies.[5] One example of this is the changing role of Chief Information Officers (CIO). These are increasingly getting involved on the business process and client relations management side of running a business. As the e-Skills Forum definition points out, there are two aspects of user skills. On the one hand, consumers/users need to be able to use ICT in order to engage in e-commerce. On the other hand, even some basic ICT skills may be required even in small "non-technology" SMEs, for example, in order to digitize part of their business (operations, management, accounts, communication, etc.), starting from tasks as simple as doing accounts in excel or accounting software, doing electronic invoices and bills e.g. in word or pdf, and knowing how to send them electronically or print them. There may also be a range of entrepreneurs who could qualify as advanced users and have sufficient awareness and understanding of the technologies on offer, and new and upcoming technologies and applications, to identify ways of improving their business, or even ways to start doing or offering new products, and new ways to deliver them to businesses and individuals.

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[2] The word "freemium" is combining the two aspects of the business model: "free" and "premium". Freemium is a business model by which a product or service (typically a digital offering such as software, media, games or web services) is provided free of charge, but a premium is charged for advanced features, functionality, or virtual goods.

[3] See for example, Stefanie Olsen 'Google recruits eggheads with mystery billboard', CNET News, 9/01/2004 http://news.cnet.com/Google-recruits-eggheads-with-mystery-billboard/2100-1023_3-5263941.html and Stephen Baker, 'Math will rock your world', Bloomberg Business Week, 22/01/2006 www.businessweek.com/stories/2006-01-22/math-will-rock-your-world.

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

[5] For example, in a 2012 survey, hiring managers reported they need people with not only the basic tech skills that have always been required, and the range of these skills also increases as new technologies continuously emerge (e.g. mobile, wireless and communications systems, cloud computing and Web security), but who also have business and communication skills and/or customer service abilities (Pratt, 2012).

In fact, it is very important to distinguish between different types of firms/SMEs in order to understand their different skill requirements. A very small "local" micro-SME will have different skills needs from high growth, innovative and internationally operating start-ups and SMEs.

Our focus in this vision report is on the latter group of firms, SMEs with the ambition and potential to grow fast and develop internationally, who with the help of ICT tools develop new business models and find and apply new innovative ways of doing things, including running the business, producing/delivering products, interacting with suppliers and intermediaries, managing client relations and customer service, innovating, and managing human resources and skills.

In search of a new doctrine

Part of the challenge in producing a vision has to do with making it both encompassing and intellectually stimulating. The times when such a vision is most needed are typically times of disruptions in the existing models, theories and accepted ways of looking at the world and designing new doctrines and action plans.

The Copernican vision of the solar system or the emergence of relativity and quantum physics as 'new ways of looking at the world' have all yielded practical advances in the way we live and work today. In the same fashion, the shocks generated by military conflicts have often reverberated into waves of re-thinking strategy. For example, after European entrepreneurs had had the opportunity to travel to the United States to join allied forces during the Second World War, and discover new ways of teaching and learning business strategy, management and marketing, they came back with a sense of urgency to create business schools in Europe.

We may very well be at a similar threshold when dealing with e-skills: European society has not yet fully managed the transition to the new industrial revolution and the service economy[6]. Yet, the switch to a knowledge/information based economy is being made all over the world (and not just in advanced economies as had been traditionally the case when such switches occurred). It is hence hardly surprising that our minds, intellectual tools and practical ways of operating have not yet adapted to such fundamental and structural changes. In the case of skills – and particularly e-skills – this is particularly striking. Looking at the existing literature on the subject of information and communication technology and its role in generating jobs, competitiveness and innovation, little stands out a consistent set of principles and economic or managerial laws: the field is still clearly awaiting its own Copernican revolution.

However, and using again a military analogy, every innovation in armaments (e.g. when armoured vehicles replaced horses, or when nuclear weaponry and inter-continental missiles became available) has generated fundamental changes in conflict prevention, strategy and combined arms battlefield tactics. The same is true in the field of information technology and information networks: current and future innovations will continue to affect radically the field of ICT, as well as the ways in which they are used in non-ICT sectors. Thinking strategically about e-skills for competitiveness and innovation requires a bold and imaginative intellectual attitude, combining a candid look at available definitions and available data with a readiness to apply new approaches and ideas to a field in which more rigid doctrines may have short life expectancies.

[6] Industry is going through major transformations with new production techniques based on digital technologies, advanced materials, key enabling technologies, robotics, renewable energy, recycling and reuse of raw materials. See: http://ec.europa.eu/enterprise/policies/innovation/policy/conference-mission-growth_en.htm

1.4 Who should read this report?

This report focuses on e-skills for competitiveness and innovation, with entrepreneurs, managers, ICT practitioners and advanced users working throughout the various sectors of the European economy as target groups. Special attention is devoted to SMEs and start-ups. The report provides an overview of the available analytical and empirical evidence on e-Leadership skills and related areas, as well as insights obtained from experts through feedback at workshops where drafts of this report were presented, and interviews and stakeholder surveys. Based on the analysis of the evidence discussed, the report presents a vision for the development and promotion of e-skills for competitiveness and innovation in Europe, as well as the recommendations and actions needed to achieve the vision. The report is addressed to those who are interested in the more in-depth background and supporting materials of the vision, and specifically:

- Policy makers in EU Institutions and Member States
- Decision makers in industry, including business and employers organisations, business leaders and entrepreneurs, human resources professionals and recruiters
- Decision makers in the educational and training sectors
- NGOs and Individuals interested in developing e(-leadership) skills to become e-entrepreneurs or to improve their employability

By working together in multi-stakeholder interdisciplinary partnerships, these actors can not only start to build a renewed long-term and sustainable e-skills strategy, but also to start implementing actions immediately, while noting that there is no “one size fits all” approach and that countries, regions, and individual cases may require tailored solutions and actions.

1.5 Structure of the report

The report is organised as follows. Chapter 1 provides the context and scope of the report and Chapter 2 defines the different categories of e-skills for competitiveness and innovation. Chapter 3 presents an overview of the available related evidence, both in terms of the literature and the data. In particular, it discusses a survey of the literature (Section 3.1) and a look at what is known about if and how to foster e-leadership skills (Section 3.2). Measurement related issues are discussed in Section 3.3, broadening the data scope to targets groups in education-related areas, as well as SMEs. Section 3.4 takes stock of what is missing in Europe. A four-pillar “Vision for e-skills for competitiveness and innovation” in Europe is presented in Chapter 4. Chapter 5 suggests an action priority list of recommendations needed to implement and achieve the vision, and lists existing initiatives that can be built on and should continue to be developed in parallel. Chapter 6 concludes.

2 The skills equation

2.1 Defining e-leadership skills

The skills pyramid constitutes one useful way of conceptualizing the skills debate, going from more general skills at the base to more specific skills at the top, as represented, for example, by the INSEAD eLab Skills Pyramid (Figure 2.1).[7] It is important to note that these are not 'sequential layers', but separate levels of skills for different people – there is no implicit or explicit assumption that people will move from one level to the next. However, it is also possible to think of a skills pyramid for each separate skill level (users, professionals and leaders) whereby people move up in the level of skills within each category through experience and learning by doing. Indeed, this is often how innovation occurs, and especially user-driven innovation. This report will focus on a combination of the top Tier skills – global knowledge economy (GKE) talents – combined with the e-Skills Forum definition of e-business skills to think about what strategic (e-)skills are needed for competitiveness and innovation, though not only at the top of the pyramid but, indeed, throughout the pyramid (Figure 2.2).

Figure 2-1: The INSEAD eLab skills pyramid – definitions

Overall, Europe is performing relatively well in the bottom two layers, but lagging behind in the top layer. INSEAD (2009) ranked and graded countries on the basis of their total skills pyramid score (in the American "letter scoring" system,[8] as well as by each of the three types of skills. Europe as a whole is graded a "B" for literacy and basic skills, a "B-" for occupational skills, and a "C" for global knowledge skills. However, looking

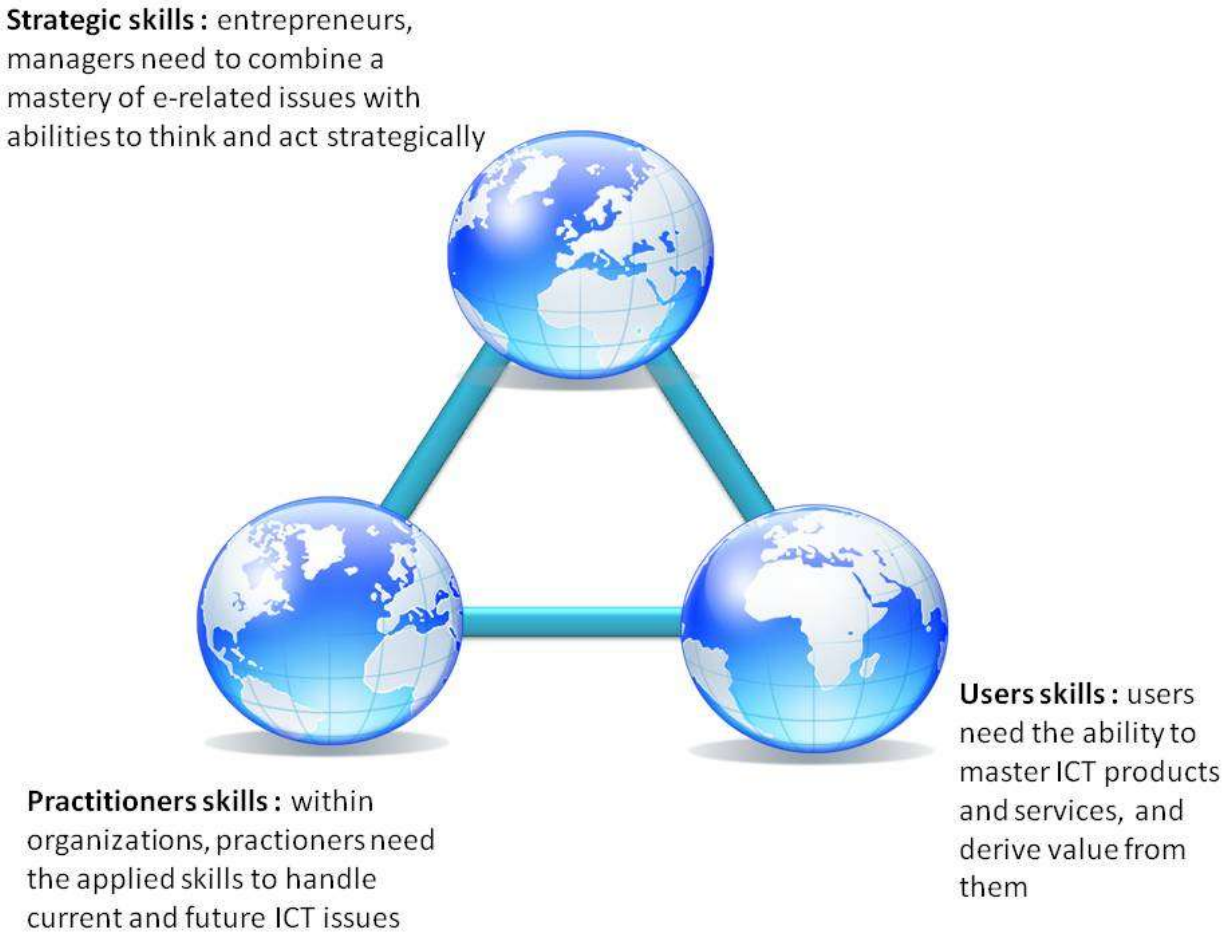
[7] Another example is the skills pyramids used by the US Department of Labor – Employment and Training Administration (www.doleta.gov), including for IT skills in their IT Sector Competency Model (www.careeronestop.org/competencymodel/pyramid.aspx?IT=Y , last accessed 27.02.2012).

[8] Where A is the top score and F the lowest score.

at Europe as a whole masks significant cross-country differences and what can be called a true “skills divide” among individual countries.

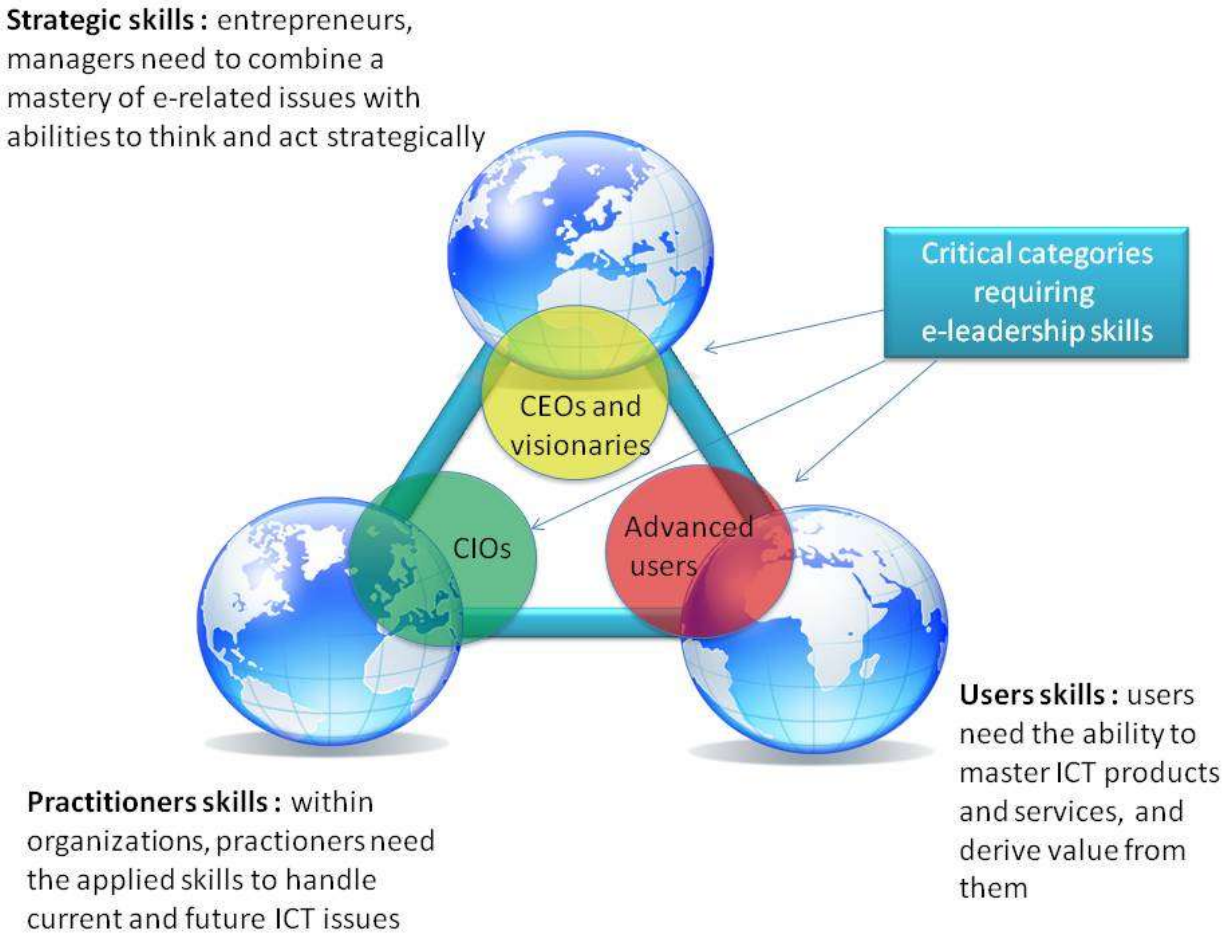
While keeping in mind the three main categories identified by INSEAD (GKE skills, occupational skills and basic skills) we can rename them in a way that reflects the most usually accepted models or organizations, i.e. respectively: strategic skills, practitioners skills and users skills. By organizing them as an ‘atomium’ (i.e. using the symbolic disposition of spheres connected to each other) instead of using the classical 'e-skills pyramid', we obtain a ‘non-hierarchical’ representation of such skills (see Figure 2.2a).

Figure 2-2: The e-leadership skills ‘atomium’ – an e-skills typology



In such a context, it becomes clear that a critical component of what will determine the future ability of corporations and organizations to compete and innovate successfully will be ‘e-leadership skills’. Yet, it would be wrong to think that such skills correspond to a specific category of workers (e.g. totally included in the ‘strategic skills’ sphere): **e-leadership skills are the skills that will be critically important in each of the spheres of the e-skills atomium (strategic, practitioners, users)**. See figure 2-2b below.

Figure 2-3: The e-leadership skills 'atomium' – e-leadership skills



The three circles defining e-leadership skills overlap with the three spheres of the 'atomium'[9], but they also extend beyond the traditional definitions to which those spheres refer. They all require "**dual-thinkers**": people who have the skills to identify and develop new business opportunities, and the technical skills that allow them to identify which technologies to use do so, and how, or even to spot new business opportunities directly in technologies and applications. Notwithstanding obvious difficulties to be expected when available and potential skills will need to be measured (see Section 2.2), it is key to identify and grow such skills at all three levels, because it is the only way to develop a consistent skills eco-system at the European level.

- In the yellow circle (CEOs, entrepreneurs and visionaries), e-leadership skills are the ones that will allow European start-ups and companies to get innovations to market, and to translate technological advances into business successes, growth and job creation.
- In the green circle (CIOs), e-leadership skills will allow the managers of IT departments to fully play their role, at the interface between the practitioners (engineers, programmers, architects, analysts)

[9] The three e-skills circles cover only a part of each sphere, which means that not all e-skilled workers will need (or want) e-leadership skills. However, the non-hierarchical representation used here indicates that e-leadership skills can be found (and provided) to any member of any sphere: user-driven innovation for example will offer the possibility to 'empower' any user with such skills.

and the rest of the organization (company board, other departments), enhancing in particular the capacity of business strategies and IT strategies to be fully aligned around competitiveness and innovation objectives.

- Last but not least, the red circle (advanced users) incarnates the importance of involving users in any deployment of innovative technologies; enhancing the e-leadership skills of 'advanced users' (or power users) – especially among SMEs and companies from non ICT sectors[10] - will be the best guarantee that technology adoption is accelerated, productivity gains are maximized and possible additional innovations are encouraged.

So, what are e-leadership skills and who needs them?

Using the typology and graphical simplification described above, e-leadership skills appear as those contained in the e-leadership triangle inscribed in the skills atomium (Figure 2.2c).

Figure 2-4: The e-leadership skills triangle

[10] Public sector organizations should also be considered as an important target for such efforts: in larger organisations (public or private), the CIO department can contribute by bridging the gap between the business leaders and the technological experts. Increasingly, technical experts are also expected to have a certain number of business-related skills, and business leaders and entrepreneurs should have a certain degree of understanding of the possibilities offered by (new) technologies. Increasing importance is also given to e-leaders and CIOs in the public sector, and to the digital transformations that can be achieved there, including through e-government and e-governance. Efforts along those lines are illustrated for example by the outcome and main conclusions of a March 2012 OECD Meeting on "New ICT Solutions for Public Sector Agility"

See: (www.oecd.org/site/0,3407,en_21571361_39745767_1_1_1_1_1,00.html , accessed June 2012).

Coming up with an operational definition for e-leadership skills is hence a complex exercise as it should cover different types of skills at different levels of the skills spectrum, though in different combinations and with varying emphasis and importance according to where you are situated in the pyramid layers. The definition should combine elements from three essential components, reflecting 'dual-thinkers' and entrepreneurial activity:[11] business skills, technical skills and an entrepreneurial mind-set.

These cover a range of skills, attributes and attitudes that would include in particular: business and management skills; technological knowledge and awareness; ability to conceive and communicate a vision; strategic thinking; risk taking; identifying opportunities; embracing and managing change; cultural diversity awareness; creativity; collaboration; networking; knowledge exchange; flexibility; managing knowledge flows and managing and using "big data". Many of these skills and capabilities are also required at the top level of the pyramid, strategic skills, but the combinations and degree to which skills and various combinations of skills matter will vary according to where in the pyramid they are exercised.

2.2 Methodological implications: measurement and 'gap identification'

A major difficulty in offering any kind of 'vision' in a field like that of skills, is to combine a dynamic and forward looking definition of such skills on one hand, and the data, indicators and time series that one would need to fully estimate current and future gaps between e-skills demand and supply in Europe.

A possible way to address this issue is to disaggregate the e-leadership skills and strategic e-skills mentioned earlier into a sufficiently detailed list of e-skills. Some of them will recoup existing typologies (e.g. e-business skills), for which existing data can still be used. For other (newer) types of e-skills, proxies will have to be used, and estimates will need to be offered.

The necessary 'fuzziness' of any visionary definition of e-leadership skills creates special difficulties for those whose task it is to provide data, measurement and forecast relative to expected demand and supply of such skills. The methodological choices made in this regard are described in greater detail in the reports produced for other components of the present initiative (i.e. its scenario and forecast segments).

An additional effort can be made to identify some of the key components of each of the categories of skills identified above. Particular attention should be brought to generating 'dual thinkers', for example. This raises a number of challenges that will be examined in greater detail in this report. When it comes to combining business/management skills and IT skills, three well-known problems need to be considered and addressed, namely:

[11] Entrepreneurial activity can be defined as "the enterprising human action in pursuit of the generation of value, through the creation or expansion of economic activity, by identifying and exploiting new products, processes or markets" (OECD, 2011). Focusing on 'doing something new' highlights that not all businesses, not even all new businesses, are necessarily entrepreneurial.

1. There is a mismatch between the skills that are needed in practice and those supplied by the educational system. What is needed are (i) business-oriented and demand-oriented ICT people: dual-thinkers – these people are crucial for innovation, for the renewal and digital transformation of any business, and for the creation of new, innovative and high-growth start-ups, and (ii) business leaders and managers with an understanding of what technologies can do for the business, who have a vision of what ICT can do for the business, in transforming it, and in continuously innovating the business.

2. Many top vacancies remain difficult to fill: baby boomers are retiring and many of the people currently available do not have the right skills.

3. Fewer young people are taking ICT-related courses and degrees, creating a potential lack 'in the pipeline' with more acute gaps and mismatches in the future.

Companies can resort to different strategies to fill skills needs, including retaining talents already in-house, training existing staff, sourcing talents through outsourcing, and new recruits. Kaplan *et al.* (2012) find that to retain and train talent already in-house, technology organisations are increasingly encouraging a combination of technological expertise and operational and project competencies, and, for example, actively rotate high-performers across technology domains and into business and operational functions, provide training that helps technical staff understand the business better, and allow high-performing staff to engage with external communities. External skill sourcing strategies are found to include sourcing whole teams, and maintaining a portfolio of locations – including in city centres or near universities to attract cutting edge technology talents.

The main skills gaps identified in Kaplan *et al.* (2012) relate to management capabilities (operational, risk, program, project, business relations, stakeholder, vendor and supplier). Business schools and universities should react to such findings and adapt their courses accordingly, by offering new types of curricula for 'dual thinkers', and/or by offering new modules in existing programs, especially in technology programs, which may be the way to obtain the required curricula changes more rapidly.

The experience of Agfa's Digital Transformation Program (Box 1) also highlights the need for 'dually skilled' people: business people with IT skills, and IT people with business skills. Indeed, they found that the skills most needed were: (1) Program/Project Management; Change Management, (2) Business and process/model know-how, Business Analyst/consulting, knowledge, competencies, (3) Integration skills, architects, middleware specialists (interfacing), (4) Security expertise, privacy data expertise, (5) Vendor management, (6) Certified people (ITIL, project management, Cisco, Dell, …), and (7) Team spirit and communication skills. The main skills bottle necks are found to occur at the intersection of broad management competences and conceptual technical competences (business analysts, project managers). Agfa also engages in discussions with over 20 schools and universities in order to try to increase the inflow of academic master students into Information Management Departments for Industry. However, one reported frustration is that often, in spite of such interactions, companies that engage with educational establishments see that nothing, or not enough, changes in practice in the curricula or in what and how students are being taught.

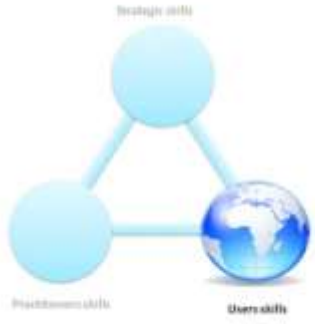
Box 1: The Digital Transformation at Agfa

Agfa[12] **Transformation Program** is a strategic re-orientation of Agfa, company-wide, launched in 2006 to secure the successful future of the Business groups by implementing new business models and business processes and by increasing their strategic autonomy, operational flexibility, financial independence, competitiveness and innovation. HealthCare grabbed this opportunity to redesign the way they work, the processes and IT application architecture and to transform into an "IT Software and Services Company". Agfa is uniquely positioned because of the strong customer relationship with one hospital out of two in the world and one printer out of two as customer. Various **business drivers** forced Agfa to "re-invent" itself. Drastic changes of the requirements of customers in the various businesses involved triggered the global change of moving rapidly to "digital" and to "IT" solutions. Agfa had to anticipate these changes by diversifying from being mainly a supplier of physical goods to also become a world class vendor of software and services. "The challenge is to transform the Businesses while transforming itself."

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

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

2.3 ICT user skills



ICT have become quasi-ubiquitous and it has become difficult to imagine today an economic or policy domain that is not affected by ICT. Indeed, ICT have become an important part of almost every aspect of the knowledge economy and

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

especially so in services activities that rely on the provision of data and information. Many aspects of producing, delivering, consuming, co-ordination and organisation, and social interactions are now taking place over the Internet and broadband communications networks (van Welsum, 2008). Developing the required skills to make the most of the changes enabled by ICT is therefore crucial especially since, ultimately, the impact of ICT depends on the use that is being made of them.

Indeed, while ICT infrastructure is a crucial ingredient of a knowledge-based economy (KBE), a skilled labour force and a supporting institutional and business environment are equally important for the optimum use of knowledge. Without the appropriate human capital and policies aimed at developing the skills required to take advantage of the adopted technologies, the potential offered by ICT is unlikely to be realised (see for example Kumar and van Welsum, 2012a,b, and the references therein[13]). New technologies both enable and support dramatic economic and societal changes and foster a new 'talent society' (Brooks, 2012), a network society that allows people with skills and talents to thrive, exploiting diverse opportunities and maximizing their creativity, whereas people that do not have these skills are likely to face challenges. It can be argued that this is an extension of the finding in the academic literature that technological change impacts different skills groups in the labour market differently (e.g. Acemoglu, 2002; Autor *et al.*, 2003).[14] In addition, whenever the pace of technological innovation increases the strategic importance of skills increases (Acemoglu, 2002).

When discussing users, the focus is usually on 'private users', or consumers. However, there are also 'business users' who require such basic user skills, to be distinguished from e-business skills. We think here, for example, of very small locally operated SMEs who will use ICT for their communications (e.g. email), send out bills or invoices (electronically, or even prepared on a computer and then printed), but nothing more sophisticated. At the same time, there are also advanced users, who, without being ICT professionals, have skills and a technological awareness that enable them to use ICT in a way that creates value for their firm, for example by finding new ways of doing things, or doing new things. Such skills are also key to many entrepreneurs at the head of start-ups, and those working in SMEs with a high innovative and growth potential.

The diffusion of ICT to SMEs is often hampered by what can be perceived as four main hurdles (van Welsum and Vickery, 2005a), essentially related to skills issues one way or another: (i) a lack of awareness regarding the possibilities that ICT can offer in terms of changing business processes and conducting e-commerce, (ii) a lack of both knowledge and experience in the field of ICT applications, (iii) a lack of trust in e-commerce

[13] Kumar and van Welsum use a range of indicators and indices that include ICT infrastructure but also other knowledge economy enabling factors, including skills, to assess the knowledge economy progress of the Gulf Cooperation Council (GCC) countries and a number of benchmark countries. They find that while these countries tend to perform well in providing a physical ICT infrastructure, more needs to be done on human capital, skills and the business environment.

[14] For example, Autor *et al.* (2003), using a "tasks framework", find that computer technologies substitute for workers performing routine tasks that can readily be described with programmed rules. However, while those engaged in routine tasks are more vulnerable to having their jobs replaced by ICT through automation, while those engaged in non-routine tasks see their productivity enhanced with ICT.

and e-business, and (iv) a lack of resources and capacity for innovation. These concerns overlap with commonly cited barriers to the adoption of ICT by SMEs, also often skills-related in some way, including: lack of skills (including a lack of awareness of what ICT can offer, or internal ICT and management knowledge), mistrust regarding ICT and ICT vendors and service providers, costs, network infrastructure issues (access and interoperability and legal uncertainties), lack of financial viability of e-Commerce, and a lack of a "one-shop facility" to get advice on their ICT needs and access to reliable experts (e.g. Kapurubandara and Lawson, 2007; Gatautis and Vitkauskaite, 2009).

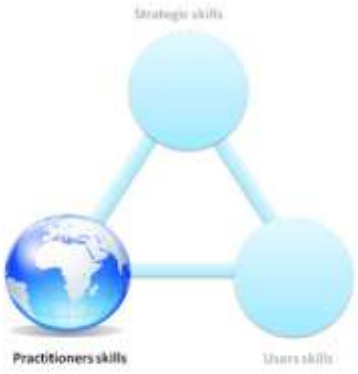
It is of concern that the uptake of ICT by small businesses still suffers from such barriers since significant economic impacts, including on innovation, can be expected to arise from the business use of ICT. Without this, countries miss out on opportunities to improve their growth potential, and hamper their creativity and innovative capacity, putting current and future competitiveness of the country's firms and economy at risk. In addition, ICT may enable SMEs to become a part of global value chains, reach new markets, and purchase goods and services they may otherwise not have been able to afford (see also Box 4). Furthermore, value addition through entrepreneurship is both a good use of ICT and a source of innovation and knowledge creation, and entrepreneurship capital has been found to have a positive impact on regional economic performance (see for example Audretsch and Keilbach, 2005).

The use of ICT in firms has also widely been found to increase productivity, and these effects are even greater when ICT are combined with complementary 'intangible' factors, enabling productivity enhancing organization changes and innovations (e.g. Black and Lynch, 2001; Brynjolfsson and Hitt, 2000). Examples include the re-organisation and streamlining of existing business processes (e.g. Atrostic and Nguyen, 2006), and the creation of new products or improvements in intangible aspects of existing products, such as convenience, customisation, timeliness, quality and variety (Brynjolfsson and Hitt, 2000). Investing in IT alone is not enough though, what you do with it and how you do it also matters; for example, IT has been found to have relatively greater effects in US firms and in US-owned affiliates abroad as a result of the internal organisation of US firms which allows them to exploit ICT more efficiently, especially through the managerial and other organisational changes they enable ("It Ain't What You Do but the Way that You Do I.T.", "Americans do I.T. better" – Bloom *et al.*, 2012). In addition, Mithas *et al.* (2012), using a sample of over 400 global firms, found that firms have had greater success if achieving profitability through IT-enabled revenue growth (e.g., using ICT to develop new products and measured through increase in sales) than through IT-enabled cost reduction (e.g., using ICT to enhance the effectiveness and efficiencies of business operations and measured through operating expenses), suggesting it is important for firms to access the skills that allow them to better exploit ICT to develop new products.

Efforts to measure this category of user skills started some time ago (e.g. OECD, 2004; e-Skills Forum, 2004; van Welsum and Vickery, 2005b) and tend to use occupational data or are based on surveys of ICT usage (household and enterprise surveys as well as occasional ad-hoc surveys). Estimates of ICT users are now published regularly, for example by Eurostat, the OECD and other international organisations,[15] as well as by many national statistical offices in individual countries. See the annexes for the some of the latest data and measurement results.

[15] See, for example, the Partnership on Measuring ICT for Development: http://new.unctad.org/default 600.aspx (last accessed 09.03.2012).

2.4 ICT practitioners skills



ICT practitioners are people responsible for development, production, rolling out, and management of day-to-day operations and maintenance of the ICT infrastructure. They are not only employed by the ICT (producing) industry itself, but also in ICT user industries and the public sector. As for the category of user skills, measurement efforts to quantify the number of practitioners started some time ago (e.g. OECD, 2004; e-Skills Forum, 2004; van Welsum and Vickery, 2005b) and tend to use occupational and educational data as well as various types of surveys. Estimates are now regularly published, for example by Eurostat, the OECD and other international organisations, as well as by many national statistical offices in individual countries, and further estimates and forecasts of demand and supply are published by organisations such as Cedefop, empirica and IDC. See the annexes for the latest data and measurement results.

On the practical side, the European e-Competence Framework 2.0 was developed as a common European framework for ICT Professionals in all industry sectors. Although it could clearly benefit from a significant updating, this framework remains an important point of reference on ICT competences for use by ICT user and supply companies, ICT practitioners, managers and human resources (HR) departments, the public sector, and educational and social partners across Europe. It was developed by European ICT and HR experts in the context of the CEN Workshop on ICT Skills, aiming to create long-term HR and competence development solutions for the European ICT community. The framework not only facilitates the link between national structures, but it also provides a set of Europe-wide jointly defined ICT practitioner and manager competences as needed and applied in practice in the workplace. It distinguishes five e-Competence areas and 36 competences (Box 2), classified according to main ICT business areas, and which can be linked directly to the European Qualifications Framework (EQF).

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

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

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

Dimension 2: A set of reference e-Competences for each area, with a generic description for each competence. 32 competences identified in total provide the European generic reference definitions of the e-CF 2.0.

Dimension 3: Proficiency levels of each e-Competence provide European reference level specifications on e-Competence levels e-1 to e-5, which are related to the EQF levels 3 to 8.

Dimension 4: Samples of knowledge and skills relate to e-Competences in dimension 2. They are provided to add value and context and are not intended to be exhaustive.

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

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

Based on the results of the work of the CEN ICT Skills Workshop, the European Commission launched an initiative[16] to support "the development of a European Framework for ICT Professionalism with the goal of enhancing ICT professionalism and mobility across Europe, and a European Training Programme for ICT Managers to promote new competences with a view to better address the challenges of ICT driven innovation and the future Internet" (IVI and CEPIS, 2012).

The skills required from ICT practitioners are continuously evolving though, posing a dual dilemma for ICT specialists, making it difficult for them to decide if and how they should specialize in certain technologies. Indeed, with new technologies emerging all the time, any technology chosen as a specialization is at risk of becoming obsolete as new ones come along. In addition, as new technologies are plentiful, it is difficult to choose which one to specialize in, if at all. Furthermore, a combination of technical skills and other non-technical skills, such as business, communication, and customer relations (Pratt, 2012) is also increasingly demanded from ICT specialists. This is illustrated by a 2011 survey on what "the hot IT skills for 2012" would be (Saia, 2011). The top 9 IT skills expected to be in demand in 2012 came out as follows: 1. Programming and application development, 2. Project management, 3. Helpdesk/technical support, 4. Networking, 5. Business intelligence, 6. Data centre, 7. Web 2.0, 8. Security, 9. Telecommunications. Similarly, non-tech skills are also in demand in high-tech start-ups, according to recruiters and industry professionals, notably in business development, sales, marketing, design, and editorial skills (Steinberg, 2012).

It can be argued that while some Chief Information Officers (CIOs) are mainly concerned with putting in place and maintaining a company's IT-infrastructure, often times, CIOS can form the bridge, or in some cases the 'missing link', between practitioners and business leaders/company management as well as the various company departments and business functions. The findings of the recent INSEAD IT-enabled leadership study (INSEAD, 2011) also suggest that the role of CIOs is evolving, with some in particular taking on e-leadership skills and roles. The study distinguished three types of IT-enabled leaders, based on how CIOs spend their time: (i) Technology-driven driven leaders ensure the organization is spending more on innovation and less on operations and maintenance; (ii) Business process driven leaders help non-IT colleagues map, re-design and improve how things get done in the organization; and (iii) Client-driven leaders help extend their organization's capacity to innovate with customers. A third of surveyed CIOs anticipate their roles will change significantly over the next three years, with almost a quarter anticipating spending more time defining and managing enterprise-wide business processes. These findings are echoed in the extensive survey of CIOs (over 3000 CIOs interviewed) by IBM (IBM, 2011) where, in order to simplify operations, business processes, products and services and to increase competitiveness in both public and private sector organisations, 83% of CIOs reported having visionary plans that include business intelligence and analytics, mobility solutions (74%), and virtualization (68%).

Estimates of ICT practitioners in the EU are provided in Table 2.1. The complete latest data and measurement results are provided in the annexes.

[16] See http://ictprof.eu/index.shtml (last accessed 29.06.2012). The study focused on ICT practitioners and ICT managers (CIOs and their equivalent in smaller enterprises) working in the European economy.

Table 2-1: Estimates of number of ICT professionals, various categories, 2011

	Management and Business Architecture level skills	Core ICT practitioners	Other ICT technicians	ICT mechanics and manual	Total
EU-27	**1.422.000**	**4.239.000**	**1.006.000**	**1.390.000**	**8.058.000**
UK	383.400	918.300	40.800	138.800	1.481.300
DE	304.600	677.200	164.900	225.900	1.372.600
FR	95.900	499.600	244.700	90.900	931.100
IT	64.600	409.700	91.500	172.000	737.800
ES	74.200	322.600	75.500	132.300	604.500
PL	51.300	220.500	91.000	126.700	489.400
NL	127.700	154.900	33.300	23.300	339.100
SE	87.400	118.700	28.900	37.500	272.500
CZ	9.400	125.500	28.400	52.400	215.700
RO	20.900	81.800	19.100	80.100	201.800
BE	38.800	108.200	21.500	33.000	201.500
HU	6.500	70.200	11.600	75.000	163.200
AT	25.400	77.700	28.100	22.500	153.800
FI	28.900	85.600	10.700	19.700	144.900
SK	8.800	41.200	35.200	43.700	128.900
DK	21.700	75.500	17.800	9.300	124.300
PT	10.400	55.800	20.400	22.100	108.600
IE	11.500	48.400	2.100	20.200	82.100
BG	15.000	35.400	10.700	16.600	77.700
GR	9.100	38.300	12.900	12.900	73.300
SI	7.700	16.800	4.300	12.700	41.400
EE	2.700	14.000	2.800	8.500	28.000
LT	4.700	12.800	4.400	5.700	27.600
LV	5.900	15.800	2.600	2.100	26.400
LU	2.100	6.500	1.300	1.000	10.800
CY	1.900	4.200	1.000	2.600	9.500
MT	1.300	3.800	1.200	3.200	9.400

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

Notes: The data are averages of Q1 and Q2 data 2011. ISCO08 -based definitions.

Source: European Labour Force Survey. The first attempt to measure practitioners with e-leadership skills (based on a mapping of CEN profiles to ISCO occupations) is presented in Table 2.3. This is a rough and first approximation, but an illustration of the fact that measurement of e-leadership skills will be an extremely challenging exercise and will require an original and creative approach. Approximations may have to consider multiple sources, considering various related aspects, such as, for example, entrepreneurship courses, MBAs, courses and initiatives directly aimed at developing 'dual thinkers', innovative start-ups, and high growth SMEs. The pragmatic approach for direct measurement along the lines of how user skills and practitioners' skills are measured does not seem feasible for e-leadership skills (and indeed not for strategic skills, discussed in Section 2.5, either). Chapter 3 will look in more detail at avenues to explore in

the academic literature and existing (policy) initiatives, and will start to think about alternative sources to consider in measurement approaches that can help to build up a more complete picture of strategic e-leadership skills measurement.

Using the approach taken for practitioners, namely mapping CEN profiles to ISCO occupations, first estimates are provided in Table 2.2.

Table 2-2: Estimates of number of "ICT profiles with e-Leadership skills", based on a mapping of CEN ICT profiles to ISCO occupations, 2011

	Management and Business Architecture level skills
EU-27	1.422.000
UK	383.400
DE	304.600
FR	95.900
IT	64.600
ES	74.200
PL	51.300
NL	127.700
SE	87.400
CZ	9.400
RO	20.900
BE	38.800
HU	6.500
AT	25.400
FI	28.900
SK	8.800
DK	21.700
PT	10.400
IE	11.500
BG	15.000
GR	9.100
SI	7.700
EE	2.700
LT	4.700
LV	5.900
LU	2.100
CY	1.900
MT	1.300

Source: empirica calculations based on an LFS data retrieval done by Eurostat.
Notes: The data are averages of Q1 and Q2 data 2011. ISCO08 -based definitions.

2.5 Strategic skills

This 'new' category of skills is found at the top of the atomium in Figure 2.2. One aim of this work is to update and develop a more detailed definition and a more thorough understanding of these skills as well as of e-leadership skills (which can be found at the top of each layer in the pyramid). In addition to what can be learned from various part of the academic literature, for example on entrepreneurship, we are received the input from major stakeholders and experts to guide us towards a commonly agreed upon definition that will be used by the European Commission in its reports and actions and in future research and analysis, much in the same way as the European e-Skills Forum came up with the above cited definitions of e-skills.

Strategic skills are key skills for competitiveness and innovation, and are a combination of the e-business skills proposed by the e-Skills Forum in 2004, and the Global Knowledge Economy Talents – the top layer of INSEAD's skills pyramid (Figure 2.1):

- ***e-Business skills (also called e-leadership skills)***: are the capabilities needed to exploit opportunities provided by ICT, notably the Internet, to ensure more efficient and effective performance of different types of organisations, to explore possibilities for new ways of conducting business and organisational processes, and to establish new businesses;

- ***Global Knowledge Economy Talents***: include the capacity to generate innovation, ability to lead in cross-cultural environments, ability to manage virtual teams, collective and individual capacity to address new issues. A clear example of how important such skills are can be found in many global companies for which innovation is vital. A study carried out by INSEAD for Logica, for instance, showed European companies tend to be less prone than their competitors to mix cultural and professional backgrounds in research teams. Collaborative innovation (often web-based) requires brainstorming sessions (typically by video-conference) and strict implementation strategies (when innovations have to be brought to market and turned into products and services) for which leadership takes different shapes and requires different skills[17].

Strategic skills are skills needed by entrepreneurs and managers, combining a mastery of e-related issues with abilities to think and act strategically. These may include for example innovation-oriented skills, or the capacity to inspire and manage multi-cultural, multi-disciplinary and virtual teams. For strategic skills at the top of the pyramid you would expect more of these skills to be present, and in particular those related to business management and innovation.

[17] See 'Are you innovation ready?' a study produced by INSEAD eLab for Logica, September 2010. www.insead.edu/facultyresearch/centres/elab/research/documents/INSEADLogica_innovationreport.pdf

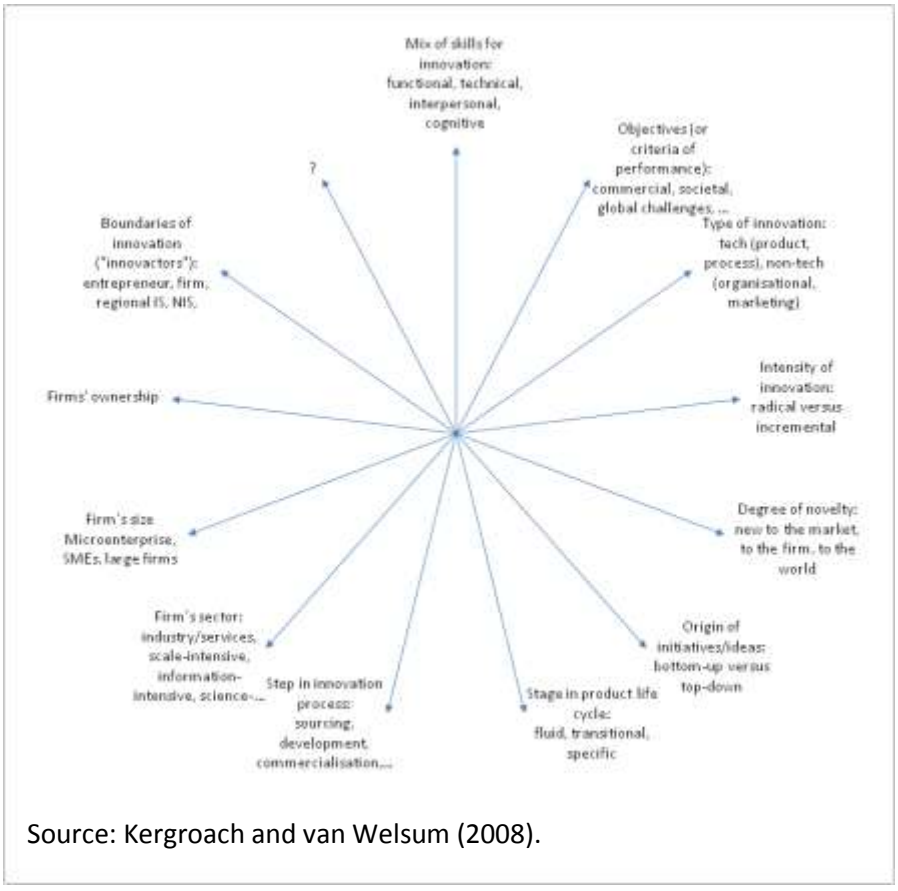
A particularly strategic set of e-leadership skills: skills for innovation

Skills for innovation are not only very closely related to the types of skills we are interested in here, they are also notoriously difficult to define and measure. Based on existing classifications, Kergroach and van Welsum (2008) propose to distinguish six "families" of skills for innovation:

1) *Basic or "platform" skills* to function in a knowledge-based society (including "digital-age literacies", multicultural openness and innovation-friendly society, etc.);
2) *Technical skills* to evolve in professional environments (including S&T, engineering, management, implementation, monitoring, analysis, marketing, financial, legal, design skills, etc.);
3) *Soft skills* to interact and collaborate with others while respecting social rules (including teamworking, communication, networking, flexibility, emotional and aesthetic skills, etc.);
4) *Cognitive skills* to process information and think (including creativity, critical thinking, knowledge and complexity management, constant learning, etc.);
5) *Entrepreneurship and intrapreneurship skills* to undertake, manage and take responsibility (including basic employability skills, autonomy, risk-taking, personal responsibility, acceptance of failures, etc.);
6) *Leadership skills* to lead and influence (including team building and steering, coaching, lobbying, negotiating, coordinating, etc.).

The complexity of the e-leadership skills we are trying to identify in this Vision Report also stems from the multitude of factors that have an impact on them, just like for skills for innovation (illustrated in Figure 2.5).

Figure 2-5: Factors *having an impact on the nature and mix of skills for innovation*



Source: Kergroach and van Welsum (2008).

Kergroach and van Welsum (2008) conclude three points from their review of the literature related to skills for innovation, and these conclusions also apply to e-leadership skills:

1) The nature of skills required to innovate [*the nature of e-leadership skills*] is closely related to the final purpose they deserve.

2) Skills needed to successfully innovate are multiple, and the optimal mix of skills for innovation varies according to a large variety of factors: typology of innovation, characteristics of the innovative firm, objectives of the innovation, etc.. Therefore, one of the challenges to defining skills for innovation comes from of the complexity to delimit and characterize the innovation process (Figure 2.3).

3) Traditional measurement tools struggle to capture the changing nature of innovation and the complexity of skills for innovation.

INSEAD also produced pioneering research around innovation skills, focusing in particular on how education curricula needed to be improved to generate such skills in Europe (Box 3).

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

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

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

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

Source: INSEAD, 2010b.

3 What can we learn from existing sources?

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

3.1 An overview of the (academic) literature

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

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

As part of their research, Dyer *et al.* (2008) interviewed a sample of innovative entrepreneurs, founders of at least one highly successful new venture (but who often also had experienced some failures). Interestingly, many of these innovative entrepreneurs[18] who were interviewed are directly or indirectly related to ICT goods or services, and/or have had an innovative idea using ICT. Another noteworthy fact is that most of these innovative and highly successful ICT-related ventures more generally originated in the US (e.g. Android, Apple, Google, Microsoft, Amazon, etc.). In addition to well-known influences on entrepreneurship, such as regulation and access to capital, culture, and being allowed "to fail", it would be

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

interesting to analyze more closely if and where differences in skills and attitudes can be identified. For example, a commonly mentioned factor that is thought to differentiate attitudes in the US and Europe is the willingness to take risks; business skills and differences in the attitude towards "selling", yourself or a product, are other factors thought to shape cross-Atlantic entrepreneurial differences.[19]

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

The characteristics of the entrepreneur, and therefore his/her behaviour, tend to be linked to the characteristics of small businesses and how innovative they are, especially at the time of their creation and in the early development phase,[20] and also vary significantly across sectors (Romero and Martinez-Roman, 2012).[21] For example, the impact of education on innovation in small businesses appears through two main channels, (i) its effect on self-employed motivations, and (ii) its influence on the management style of small businesses. In addition to education, previous work experiences, cultural values, personality, attitude, and behavioural traits, the motivation for becoming an entrepreneur has also been found to matter: whether it is to exploit a business opportunity or out of necessity because people are unemployed or unhappy in their job (Reynolds *et al.*, 2002). This is an important distinction as, especially in the current difficult economic times, more people might become self-employed entrepreneurs out of necessity (because they are unemployed), but their ventures tend to be less innovative (Romero and Martinez-Roman, 2012).

According to a survey carried out by Gallup in December 2009, 55% of respondents in the EU who had started up a business or were currently taking steps to start one said they were doing so because they saw an opportunity, 28% said it was out of necessity. In the US, 62% considered themselves an opportunity-driven entrepreneur. In contrast, in Korea this percentage was as low as 18% (and 64% necessity-driven). In China and Japan, 50% of respondents answered that they had starting/were starting a business out of necessity (Gallup, 2010). The Global Entrepreneurship Monitor – GEM (2011), and its Extended Report (Bosma *et al.*, 2012) also provide an overview of entrepreneurial attitudes and perceptions across

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

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

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

countries. The crisis in Europe transpires in these data in the low perceptions of entrepreneurial opportunities in many European countries, including Greece, Hungary, Portugal and Spain. However, some Asian countries, including Japan and South Korea, also report very low perceived opportunities. In the US, the perception of opportunities is also relatively low, but they report greater confidence in their abilities than Europeans, combined with a lower fear of failure, overall (Table 4). More than half of the population aged 18-64 considers entrepreneurship a good career choice in all but three of the countries included in the sample (Japan, Finland and Ireland). Media attention for entrepreneurship in Europe (measured by whether or not people think there are many news and other media items on new and/or growing firms) is perceived to be especially low in Greece and Hungary.

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

Some argue that most of the leadership characteristics found in traditional bricks and mortar organisations are equally valued in the digital economy, but that some characteristics are emphasised within e-businesses, including a propensity for risk taking, entrepreneurialism, networking ability, as well as the requisite technical skills. However, the environment in which e-businesses operate can be considered to be significantly different from that in which traditional bricks and mortar businesses operate in terms of three key variables: (i) the task environment, (ii) the motivation and skills of the workforce, and (iii) the lifecycle stage of the organisations (Horner-Long and Schoenberg, 2002).[22] The unprecedented speed of technological change and the new opportunities continuously being created and offered by and over the Internet and associated technologies reinforces the finding by Francalanci *et al.* (2001) over a decade ago that e-leadership is likely to require a greater technical awareness of the capabilities and limitations of ICT than may be expected of traditional CEOs.

A recent Harvard Business Review article also argues that "the world of work has changed dramatically over the past decade", with increasingly global companies and operations, diversified employee groups, less hierarchical and more collaborative organizational models, and fully networked offices. The article identifies three specific skills executives should cultivate to deal with the challenges that arise from being a manager in this new environment: (i) Code Switching Between Cultures ("managers must overcome psychological barriers in order to act in ways that other cultures find appropriate"), (ii) Wielding Digital Influence ("the devolution of hierarchy has increased the value of building and wielding influence through digital networks"), and (iii) Dividing Attention Deliberately (managers should "get over their fears about distraction and embrace the brain's natural tendency to divide attention") (Molinsky *et al*., 2012). Using a Delphi model, Lin and Hsia (2011) identify thirteen core capabilities for e-business innovation[23] in three main areas:

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

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

Business technology

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

Business management

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

Collaboration

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

Successful e-business firms are often found to "exploit e-business innovations through value networks outside of their current operations in order to generate value co-creation" (Lin and Hsia, 2011). Thus, clearly, at least some knowledge about what IT can do for the enterprise and the business model is crucial to have a vision about where to take the company and identify new business opportunities. Knowing how to optimize the use of social and other networks in new and innovative ways to business and innovation purposes will become increasingly important.[24]

Petrie (2011) notes that over time, the leadership environment has become more complex, volatile and unpredictable, and that the skills needed for leadership increasingly require more complex and adaptive thinking abilities. These changes can be expected to be even more acute in the e-world, which is increasingly complex and interconnected. In addition, the Internet and social networking tools enable new organizational structures with flatter hierarchies and more decentralized control.[25] As McGonagill and Doerffer (2010) argue, "a new leadership paradigm seems to be emerging that is marked by an inexorable shift away from one-way, hierarchical, organization-centric communication toward two-way, network-centric, participatory and collaborative leadership styles. Most of all, a new mind-set seems necessary, apart from new skills and knowledge. All the tools in the world will not change anything if the mind-set does not allow and support change." That study recommends managers and organisations to take the following 7 steps to encourage "a strategic approach to adapting to a new culture of transparency, openness, interaction and collaboration", each related to people acquiring some knowledge about how to put the Web to good use:

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

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

- Managers should become Web literate and should encourage members of their team to do the same.
- A strategic planning process should be adopted to develop Web strategies.
- Organisations need to develop policies regarding the use of social media.[26]
- Members of the organisation's "C-suite"[27] should be encouraged to start a blog.
- Human resources, marketing and communications departments should be encouraged to experiment with social media.
- Organizations should learn about common barriers and pitfalls of adopting Web tools.
- Sole ownership of Web strategies by the IT department should be discouraged.

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

Some of the challenges created by new opportunities include:

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

Box 4: Global sourcing of talent, skills and ideas

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

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

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

up with numbers of the same order of magnitude, including 20% of employment in "impersonally deliverable services" potentially offshorable in the US for Blinder (2005), later revised up to some 22-29% to become potentially offshorable over the next two decades (Blinder, 2007), and 30% of "tradable employment" in the US for Jensen and Kletzer (2005).

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

The ability to source work, talent, skills and ideas globally lies at the heart of the internationalization of the operations of SMEs, giving rise to so-called micro-multinationals (Varian, 2005), and is a pre-requisite for these companies to be able to grow, mature, and create local jobs. Varian also notes that it is, in fact, easier for micro-multinationals to deal with the inconvenience of outsourcing than it is for the big international corporations, as some of these inconveniences also come with being small, and/or new, such as being up at all hours of the day and night for constant supervision, communication and coordination at a distance, using ever cheaper ICT. Thus, Varian argues, while large companies were among the first to benefit from the changes enabled by ICT, their impact on SMEs "may yet turn out to have the most impact on the economy." The same idea is also behind what Mettler and Williams (2012a) refer to as the "talent-as-a-service model", and the "project economy", in which more and more tasks are performed by temporary teams of workers that come together (sometimes even just 'virtually') for a particular task or project, and then go their separate ways again. Such a model responds to business' need for adaptability and flexibility, but also to how current and future generations are likely to increasingly want to work: having the freedom to work with the world's most talented people on projects they are passionate about, giving them the opportunity to "meet and collaborate with other talented people in an environment that thrives on innovation, and a meritocratic incentive system where value-creators share in the profits."[28] In the same vein, Cherny (2011) argues that "America and other modern economies have entered what might be called the new work order – an economy where most workers are untethered from large institutions and bouncing from one job to the next. In this economy, each worker is, in effect, their own small business – responsible for guiding their own career and economic future."

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

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

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

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

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

It is often argued that the willingness to share information is one of the success factors of Silicon Valley, with people working there effectively sharing information, including by changing companies and exchanging ideas informally. For example, Saxenian (1990) identified the interaction of employees as key to the emergence of Silicon Valley and Boston’s Route 128 as major innovation clusters.[29] The increased exposure of people to new ideas has been found to be crucial for the emergence of radical innovation, and can take place in different ways, for example through employees changing firms more regularly, or with scientists being more autonomous and performance oriented in their choice of research projects (Herrmann and Peine, 2011). Add to all that a culture of investment, a willingness to take risks, and the availability of venture and seed capital, and you get something that might resemble Silicon Valley.

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

Can (e-)leadership skills be taught? Entrepreneurship education and training can be provided at all levels of schooling,[30] from primary and secondary schools, to vocational colleges and tertiary and university education. Such training is often aimed at creating an entrepreneurial spirit or mind-set, creating a disposition in people to want to create their own businesses (OECD, 2010a). However, the OECD report also points out that there is often a “learning-by-doing” aspect to it, with entrepreneurs learning in practice in the working environment rather than through formal education.[31] In addition, the evidence shows that

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

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

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

people employed in SMEs participate less in formal and informal training than their counterparts in larger firms. This has been shown to hold back innovation and is, therefore, an important issue to address.

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

The effect of entrepreneurship education on entrepreneurial intentions has also been found to depend on the mode of education (active, e.g. business plan seminars, vs. reflective, e.g. theory lectures), on the regional (economic and entrepreneurial) context, and was found to be complemented by individual characteristics (e.g. role models or work experience) (Dohse and Walter, 2010).[32] Specifically, active modes of entrepreneurship education are found to directly increase intentions and attitudes, whereas the impact of reflective modes depends on the regional context[33] and is weaker in regions that do not have an entrepreneurial tradition or 'local role models'.

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

Leadership skills development more generally also needs to change, as do people's mindsets. Petrie (2011) observes that even though (i) the leadership environment has changed (more complex, volatile and unpredictable), and (ii) the skills needed for leadership have changed (necessitating more complex and adaptive thinking abilities), the methods that are being used to develop leaders have not changed much, and even current leaders who are 'trained and mentored' on-the-job seem to lag behind in the adaptive changes that are needed.[34] Based on a study of the approaches taken to developing leaders at several

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

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

[34] Recruiters and human resources executives also recommend people who are aiming for promotions into the C-suite to accept multiple postings abroad as this is thought to develop "their ability to manage complex, interconnected operations—skills that just can't be developed back at headquarters or in one brief foreign assignment" (Kwoh, 2012). This confirms the finding that "cross-functional experience and international exposure have also been shown to be early discriminators for chief executives, providing skills in general management and

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

- Increase the focus on vertical development: relatively more time is being spent on competencies (horizontal) development, which can be transmitted by experts, but not enough on development stages (vertical), which an individual needs to 'earn'.
- Transfer greater development ownership to the individual: if people feel they are responsible for their own development (rather than the HR departments, managers or trainers) they will progress faster.
- Increase the focus on collective rather than individual leadership: leadership capacity will increasingly spread throughout the organization rather than sit with one person or role.
- Greatly increase the focus on innovation in leadership development methods. "An era of rapid innovation will be needed in which organizations experiment with new approaches that combine diverse ideas in new ways and share these with others. Technology and the web will both provide the infrastructure and drive the change. Organizations that embrace the changes will do better than those who resist it." In addition, "pivoting" and "iterating" are also becoming increasingly common, especially in start-ups in Silicon Valley, with people trying out new ideas until one works, or until their money runs out (Chapman, 2012).
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Reflecting these changes, the interviewed experts by Petrie (2011) identified the following skills, abilities and attributes as crucial to future leaders(hip): (i) adaptability, (ii) self-awareness, (iii) boundary spanning, (iv) collaboration, and (v) network thinking; in addition, the literature review also pointed to (i) creativity, (ii) collaboration, (iii) strategic thinking, (iv) change management, and (v) system thinkers comfortable with ambiguity.

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

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

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cross-cultural understanding respectively (Horner-Long and Schoenberg, 2002). In addition, the study argues that managers require technical skills (to solve problems, evaluate performance and direct subordinates), interpersonal skills, and especially communication skills (to build relationships with employees and other stakeholders, to articulate organisational goals and to persuade others to commit to them), and conceptual skills such as analytical ability and industry understanding (essential for effective planning, problem solving and strategy formation).

become an entrepreneur; only 25% agreed that their education had also made them interested in becoming an entrepreneur. In Turkey, the US and China between 68% and 73% agreed that that their school education had helped them to develop an entrepreneurial attitude.

Gallup (2010) also found the US and China to be ahead of the EU when measuring the impact of school education on entrepreneurship. When asked to agree that a sense of initiative had been engendered, an understanding of entrepreneurship gained, and the necessary skills and interest developed, the proportions of Americans and Chinese respondents agreeing were, respectively, 51%-73% and 53%-75%, but only 25%-49% for the EU. Furthermore, in the US these numbers have increased since 2007, whereas in the EU they have been decreasing.

Wagner recommends that students should not merely be passive 'consumers' of education, but should be 'creators', acquiring skills and knowledge as part of solving a problem, creating a product or generating a new understanding. In order to succeed in the new world, "students must learn to analyze and solve problems, collaborate, persevere, take calculated risks and learn from failure" (Wagner, 2012). In addition, he argues that in today's world, knowledge has become a commodity that everyone can obtain, what matters is what you can do with it.[35] He argues that "the set of core competencies that every student must master before the end of high school is:

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

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

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

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

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

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

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

Source: INSEAD (2010b).

3.3 Can we measure e-leadership skills?

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

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

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

For the quantification of the e-Leadership skills the study team now proposes the use of the "European ICT profiles" from the draft CEN CWA, Nov. 2011 and matching the European ICT profiles to relevant ISCO occupational groups from the ISCO-08 classification. In this approach e-Leadership is assumed through professional role which is the same approach as already used for ICT practitioners. It can be seen as a

deductive approach using European ICT Profiles mapping to ISCO coded Labour Force Surveys (LFS) statistics. For the e-Leadership skills the e-CF Dimensions 'Manage' and 'Design' have been selected as those best reflecting these skills. The related ICT profiles have been positioned into these dimensions. In a further step these ICT profiles had to be mapped to the ISCO occupational groups using the further developed ISCO-08 classification in use by most national Labour Force Surveys (LFS) for data gathering since 2011. The validation of the first mapping and any further refinement of the mapping of the European ICT Profiles to the ISCO-08 occupational groups will require close collaboration with the CEN Workshop ICT Skills experts to achieve best possible results (Vision initiative Inception Report, January 2012). The annexes provide more details on the methodology.

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

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

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

A summary of such data and findings can be found in the Annexes to this report. An analysis of current initiatives to develop dual thinkers in Europe and elsewhere is also provided in the Annexes.

3.4 What is missing in Europe?

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

1. We are still lacking an appropriate framework and set of definitions to identify the critical skills that Europe needs to foster innovation and competitiveness across its various sectors;

2. No comprehensive action plan is yet available to allow various players (European institutions, member countries, businesses, educators, individuals) to make informed choices about how much they should invest in generating the skills required;

3. The notion of 'e-skills' has often been confined to the concerns of the IT sector, and hence disconnected from non IT objectives (typically innovation, competitiveness) or diluted into broader social objectives (e.g. inclusion)

We are now reaching a critical point, where new definitions can lead to new objectives and plans of action. This is the focus of the subsequent sections of this report.

4 A four-pillar Vision for promoting e-Leadership skills for competitiveness and innovation in Europe

"Skills are the most efficient tool to reduce inequalities; skills will be the global currency of tomorrow" (Angel Gurria, Secretary-General of OECD, addressing the Second Conference on the State of the European Union, Brussels, 31 May 2012)

ICTs hold the promise of continuously and profoundly transforming our economies and social life, provided people have the required skills to exploit the technologies and reap the benefits offered: the impact of ICT depends on the use that is made of them. For businesses, maximising the benefits offered by new technologies, and optimising the opportunities they create requires people with e-leadership skills who not only have business and management skills, but also a technological awareness that allows them to identify new business opportunities offered by ICTs. This includes, for example, the development of new products, business models, delivery models, sourcing of talents and ideas, collaboration and communication with customers, suppliers and staff. In addition, the successful and profound transformation of businesses will also require an entrepreneurial mind-set, and a business environment and eco-system conducive to innovation and creativity. Failing that, countries are not only putting their current, but also their future competitiveness at risk. Several flagship initiatives have already been put in place by the European Commission that address these framework conditions (such as the "Digital Agenda for Europe", the "Innovation Union", "New skills and Jobs", "Youth on the move", and other elements of industrial policy aimed at supporting a more energised business climate, for example), but to date there are no initiatives supporting e-leadership skills specifically. It will be very important to not only recognise the vital importance of e-leadership skills to Europe's competitiveness and innovation capacity, but also to support building these skills with the appropriate resources and funding commitments.

With that in mind, it is absolutely crucial for Europe to develop a long term agenda for actions at EU and national levels by public authorities and stakeholders to ensure the needs for e-leadership skills for innovation and competitiveness are correctly anticipated and can be met in practice. This requires taking stock of demand and supply of these skills, complicated by the fact that these skills are diffuse and spread out across occupations and sectors throughout the economy, but also arriving at a shared Vision for the promotion of these skills in Europe. This section aims to develop a Vision for promoting e-leadership skills for competitiveness and innovation in Europe (Box 6). Recommendations and actions are then derived from the Vision to overcome existing barriers. It is important to note, however, that one size does not necessarily fit all, and actions may have to be tailored to specific situations in each country.

Formulating a vision is always an act of faith. It relies on available evidence, mixed with a dose of instinct, and a conviction that appropriate action can make such a vision a reality.

Box 6: A Vision for promoting e-leadership skills for competitiveness and innovation

1. E-Leadership Skills will rapidly be seen by a majority of stakeholders as a powerful ingredient of a job-rich recovery in Europe for which they are, indeed, a crucial ingredient.

2. A range of collaborative approaches will be designed and launched (among EU institutions, national governments, business and academia) to take advantage of such potential, and address in a concerted and forceful fashion the most urgent e-leadership skills gaps that Europe is facing.
3. Europe's education systems and society combined will soon become able to produce creative and innovative 'dual thinkers' with entrepreneurial mind-sets who can take advantage of the opportunities offered by new technologies and applications to set up businesses that drive competitiveness, innovation, growth, and job creation in Europe.
4. Europe's business climate will soon benefit from a more supportive environment, including through the flagship initiatives that have already been put in place, for example through reduced red tape, the emergence of SME-supportive regulations, and the achievement of a true single European digital market.

These points will be developed in more detail below.

4.1 Pillar 1: Joining forces to use e-leadership skills as a key to foster Europe's job rich recovery

Such prioritization should happen both at the EU level and within each of the Union's member countries. It is crucial to raise awareness among all stakeholders of the importance of addressing e-leadership skills needs urgently. In a similar vein to the recently launched *OECD Skills Strategy,*[36] the European Commission should develop a long-term e-leadership skills agenda and accelerate the implementation of its Europe 2020 strategy. Some e-skills aspects are already addressed as part of current initiatives, with the Digital Agenda for Europe, for example, strengthening digital literacy skills, and with the promotion and awareness raising efforts of the European e-Skills Weeks. However, such initiatives do not yet exist to specifically support e-leadership skills and it is important to identify specific target groups for which to design, implement, fund and support e-leadership skills initiatives. These include target groups include students and other talents, young workers, SMEs with strong (international) growth and innovation potential, innovative start-ups, and future entrepreneurs with the greatest potential to develop e-leadership skills and use them to create new companies and business opportunities, improve competitiveness and innovation, and create jobs.

This effort should not be limited to the areas in which ICT have a well identified role as a sector of activity or employment, but should be seen as a priority in cross-cutting domains such as innovation, labour and competitiveness for the economy as a whole. As more attention is being devoted to growth supporting measures, advantage must be taken of the new mindset among policy makers to enhance support for education, innovation, job creation and competitiveness through the development of e-leadership skills. Such efforts will resonate positively at the level of national governments if synergies between the public, private and academic sectors can lead to visible joint efforts to stimulate entrepreneurship and employment creation in the respective national contexts of EU27 countries.

4.2 Pillar 2: Towards a Grand Coalition on e-leadership skills bringing all stakeholders together

A range of collaborative approaches have been designed and launched bringing together the main stakeholders (including EU institutions, national governments, business and academia), to identify and address the most urgent skills gaps, and to ensure skills are at the heart of the economic recovery efforts in

[36] See www.oecd.org/document/6/0,3746,en_2649_37455_47414086_1_1_1_37455,00.html and http://skills.oecd.org/ .

Europe. However, these initiatives and flagship efforts to not specifically address e-leadership skills. In our Vision, these collaborative approaches will ensure that:

The public and private sector, in collaboration with academia, form strategic multi-stakeholder and interdisciplinary partnerships to ensure e-leadership skills needs, and the conditions to address them, are met rapidly. This is in part also addressed for example in the Innovation Union, but not with a view to developing these partnerships to target e-leadership skills specifically. Indeed, the Commission will support business-academia collaborations through the creation of "Knowledge Alliances" between education and business to develop new curricula addressing innovation skills gaps, and will help universities to modernise towards inter-disciplinarity, entrepreneurship and stronger business partnerships. It is crucial that this is also translated to the specific field of developing e-leadership skills.

The public sector enables and enhances the private sector, understanding its needs for skills, and e-leadership skills in particular, flexibility, top level ICT infrastructure, and the free circulation of people, goods and services. Public resources are spent efficiently on supporting education and training initiatives for e-leadership skills. For these to be efficient and pay-off they need to be accompanied by measures such as the recognition of private sector training initiatives to improve transparency in the (international) recognition of skills and enhances the mobility of talent. These initiatives are rigorously evaluated on their actual impact and outcomes so they can match expectations in practice.

Europe enhances its ability to attract and retain talents, including through the development of globally open universities and research centres, surrounded by a vibrant ecosystem of financial and business players, ready to support imaginative young entrepreneurs in the ICT sector. This would also contribute to reducing the dramatic levels of youth unemployment in Europe. There is a good definition of e-leadership skills, with the appropriate metrics to measure supply, demand, gaps and mismatches. International organisations and national statistical institutes work together to ensure internationally harmonized data are being collected in an efficient and timely manner to monitor developments, and identify gaps and mismatches quickly. This will contribute to evidence-based policies adapting to changing needs.

4.3 Pillar 3: Investing more decisively in Human Capital

Creative and entrepreneurial people, men and women, and youth,[37] live and work in conditions that allow them to exploit their ideas, embrace change, innovate, and create and grow new enterprises, thereby creating jobs, and driving innovation and growth. This forms a wider and long-term background strategy that will foster an environment that facilitates and promotes the emergence of talent with e-leadership skills. Such an enabling background environment is, in part, supported by some of the flagship initiatives already in place, but these need to be supplemented and reinforced with initiatives to specifically foster the development of a pool of talented people equipped with e-leadership skills.

In such an enabling background environment, children, teenagers and students, boys and girls, learn in an environment where they can express their creativity, explore ideas, are allowed to fail and learn from it: they learn to learn. The educational system prepares them for a world where you no longer stay with one employer or one job, where you embrace learning and life-long learning, where you embrace change. They are interested in multidisciplinary approaches, combining STEM courses with other disciplines such as management and business, to become innovative and successful entrepreneurs. They learn how to become 'dual thinkers', combining different subject areas with technologies, enabling them to exploit new ideas

[37] Very high youth unemployment (for those under the age of 25, the unemployment rate was 22,4% for the EU27 in April 2012, and much as 52.7% in Greece (in February 2012) and 51.5% Spain) is a threat to economic peace and prosperity, and an incredible waste of precious resources. Countries and governments should remember the words of Franklin Delano Roosevelt (the 32nd US President, 1933-1945): "No country, however rich, can afford the waste of its human resources. Demoralization caused by vast unemployment is our greatest extravagance. Morally, it is the greatest menace to our social order."

with the help of technologies. Their teachers have the skills to teach in new ways, moving away from a context where pupils and students were mere 'consumers of education,' providing a new interactive and participative learning environment. The educational system and teachers interact with the business community to get a thorough understanding of what students need to increase their 'employability", ensuring teachers are well-positioned to advise students on their educational and career choices. An increasing number of young people will learn to create their own jobs and employment opportunities, rather than necessarily trying to find (an existing) one. Workers adjust to a life-long learning mentality in models that allow them to continue to train and re-train themselves, including the self-employed and employees in SMEs. The European workforce is mobile, flexible, and equipped with the skills and competencies actually required by firms in the labour market.

Europe needs the leaders, managers and entrepreneurs able to exploit their skills and creativity, as well as those of their workforce, to drive innovation, growth, competitiveness, employment, and social cohesion. Ideas, talents and skills can flow freely, among sectors, companies, and countries.

4.4 Pillar 4: Improving the business climate

SMEs and firms adopt ICT and have the "user" skills to exploit them; they effectively use technology to generate productivity gains and innovation. This is crucial as large economic impacts, including on innovation, can be expected to arise from the business use of ICT. SMEs and all firms across sectors and countries have the e-leadership skills to put the ICT infrastructure to good use, creating new companies and business models, providing countries with opportunities to improve their growth potential, exploit and develop their creativity and innovative capacity, and enhancing current and future competitiveness.

A high-quality and affordable ICT infrastructure, including high-speed broadband, is available everywhere in Europe. Firms, and in particular SMEs, can access ideas, talents and skills which can flow freely, among sectors, companies, countries. Workers are not encumbered by barriers such as a lack of portable health, unemployment, and pension benefits.

The single market for services and the digital single market have been achieved. An efficient, modern, and economical IPR regime is in place that further drives and enables innovation, including across borders. It is easy, quick, and less costly to set-up a business with a reduced administrative burden and less red-tape. Access to capital, including venture capital, becomes easier for European entrepreneurs and innovators, who are also allowed to try, fail, learn and try again.

Existing flagship initiatives, including the Digital Agenda for Europe, the Innovation Union and integrated industrial policies in the context of globalisation will contribute to achieving this environment which will foster the emergence and development of initiatives by people equipped with e-leadership skills.

5 Implementing the Vision: an Action Priority List

"A vision without an implementation plan is called a hallucination"

What can the public sector, at various levels, including national and European, do to achieve the vision, in collaboration with other stakeholders? It is important to not only have an educational system that provides the right skills, but to also provide the right business environment both for individuals and firms to succeed. Creating a solution to the skills problem requires a multi-pronged, multi-stakeholder approach. Some of the recommendations have been made in the past; however, nothing, little, or not enough has been done to put them into practice. It is now urgent for all stake-holders to take responsibility for their share of what they can achieve, and to act. Europe cannot afford to keep talking about what it should do, it has to just do it, or else it will jeopardise not only current, but also future competitiveness. Many existing recommendations and initiatives help to create a broader environment that contributes to fostering talent, and which allows those with a talent and potential for, and interest in, e-leadership skills to emerge and/or be identified and targeted through more specific initiatives.

Moving successfully from vision to implementation will require a strong level of engagement from all stakeholders involved in creating, using and acquiring the skills necessary for competitiveness and innovation. This will hence require a list of priorities that should:

1. Be based on a coherent, set of principles acceptable by all stakeholders and in which they would recognize value for the pursuit of their own objectives and responsibilities.

2. Be limited in number (between 5 and 10, which can be easily operationalized over different time frames).

3. Be defined in a crisp and readable manner, allowing each type of stakeholder to interpret/adapt them to their own respective environments, constraints and objectives.

4. Be linked to equally crisp definitions of typical actions to be taken by each category of stakeholders separately or jointly (and then leadership should be identified).

Principles

Building on the elements produced in the previous sections of this vision report, the principles that should guide the selection of recommendations to build e-leadership skills for competitiveness and innovation are the following.

Principle one: offer a clear and resilient strategy. Information technologies will continue to change at a fast pace, often higher than that of the rest of the economy. In many respects, the 'technology frontier' will be a 'business model frontier', and a 'social and organizational model frontier'. This implies that any vision or strategy based on precise definitions of e-leadership skills (for example that would make reference to skills required to exploit specific technologies or applications) would be subject to the challenges of time and of the unavoidable disruptions that innovation will entail. Resilience should hence be a central goal of any vision or strategy in this area, and it will best be served by focusing on

the ways in which e-leadership skills should be produced and what such production will require, especially from educators. We have identified three major areas of priority there, namely:

(1.) Adopt a 'revolutionary view' of what e-leadership skills curricula should be. Furthermore, as e-leadership skills need to bring together skills from different disciplines it may be relatively more complicated to teach them and to set up curricula, that also need to be continuously monitored for their relevance, and adapted if needed. Expert bodies that bring together leaders and experts from the various relevant disciplines should work on the development and monitoring of e-leadership skills curricula.

(2.) Make systematic use of advanced technologies in teaching e-leadership skills (practice what you preach).

(3.) Start with providing educators with the right understanding of the dual thinking skills required to develop e-leadership skills, including by giving them a thorough grasp of business realities and needs, including through increased interactions with the business community, and (e-)teaching skills.

Principle two: give priority to areas where measurable results can be felt by key stakeholders (what is in it for me?). The success of the vision offered in this report will depend on how timely, original and purposeful it is seen as being. It hence needs to establish itself beyond the strict limits of the ICT sphere, and display a central and strategic ability to contribute to what will be Europe's main objective in the years to come, i.e. the building of a job-rich recovery, and the rejuvenation of its worldwide leadership in competitiveness and innovation. It is important to set this vision for the development of e-leadership skills within the context of existing initiatives to support the development of e-skills more generally, while highlighting the specific gaps and needs for the development of e-leadership skills. To do so, we have singled out three major areas of top priority:

(1.) Focus on the segment of Europe's demography that offers the greatest potential: including the young – students, young talent, young entrepreneurs, and more generally those who are dynamic, entrepreneurial and smart, with the greatest potential to develop themselves as "creators", of opportunities, innovation, growth, and jobs.

(2.) Support such initiatives with e-leadership skills development efforts based on a life-long learning approach, in order to maximize employment effects (and 'pick first the low hanging fruit'). Indeed, some people already working, on the ICT side of the skills equation (e.g. certain CIOs) or on the business side (certain managers), are also among those who should be targeted for e-leadership skills development initiatives;

(3.) Give preference to efforts that offer stakeholders new ways of engaging collaboratively around e-leadership skills goals, thus preventing the all too frequent emergence of 'not my problem' attitudes. Identify areas of potential collaboration within existing (flagship) initiatives, and areas where gaps remain and where efforts should be focussed and targeted to e-leadership skills and target groups.

Principle three: identify possible roadblocks and address them explicitly. After more than a decade of efforts (in the European Commission and elsewhere) to better define and develop the most needed e-skills, the problem is still largely unresolved. In addition, a new dimension is effectively being added

with a new focus on e-leadership skills which are not currently addressed in the context of existing initiatives. By and large, the elements that were available ten years ago to establish a diagnosis of the e-skills situation in Europe have not changed. If our vision were to remain limited to identifying gaps, measuring differences between expected demand and supply for specific skills, the unavoidable reaction of a majority of the report's audience would be 'What is new ?'. To break with the vicious circle of repeated self-reference and reformulation of recipes already tried, it is hence vital to identify what prevented previous analyses, strategies and roadmaps from being successfully implemented. We have identified three such blocks, which are being addressed by current European Commission flagship initiatives, but which do not pay due attention to the e-leadership skills development dimension, namely:

(1.) An insufficiently energized business environment. While current initiatives, e.g. the Digital Agenda, address this aspect of providing an environment in which e-leadership can be exploited, the implications for specific target groups in the business environment for e-leadership skills (e.g. innovative and potentially high growth start-ups and SMEs) are not explicitly drawn out and taken into account. Identifying these target groups and designing specific initiatives to help and promote them where they face barriers is crucial. This requires a more efficient organisation of both the business and political environment in order to build an efficient coalition that can identify and address specific issues, devoting the appropriate energy, resources and funding to them.

(2.) A lack of cohesion and efficiency in the European legal, regulatory and fiscal environments. In the context of e-leadership skills this is, for example, reflected in a lack of recognition for industry-provided training and skills development.

(3.) The absence of relevant instruments to fund, measure and stimulate performance in achieving e-leadership skills objectives. Indeed, it is important to identify target groups (as mentioned above, both on the 'business side' and the 'human capital side'), develop e-leadership skills development initiatives, ensure the recognition of such education and training, and to provide the required resource and funding allocation in a coherent manner, and commensurate to their importance. Indeed, high returns can be expected from investing in the development of e-leadership skills initiatives because of their key importance for businesses, competitiveness and innovation.

Priorities and their hierarchy

The three principles enunciated above are sufficiently strategic and broad to require (and allow) a simultaneous pursuit. However, each category of stakeholders (European institutions and governments, educators and education systems, business, civil society and individuals) will have only limited resources, time and energy to devote to them at any point in time. It is hence vitally important for the successful implementation of the vision developed in this report that (1) building blocks be established and developed among such priorities (Chapter 5), and (2) clear (and acceptable) divisions of responsibilities be established among various stakeholders in leading or contributing to the actions that they require. In addition, the current European Commission flagship initiatives also partly address some of the issues related to the broader background of the environment conducive to the (longer term) development of e-leadership skills (for example with reforms in the educational and teaching environments, labour market reforms, and making the business environment more dynamic). In other

areas there are specific gaps and barriers to e-leadership skill development that need to be addressed separately (e.g. inter-disciplinary curricula development for 'dual thinkers', and increased recognition of industry-provided education and training).

The following building blocks are proposed as a starting point. These building blocks should not be seen as indications of 'sequences' (one step does not need to have been fully completed before another one starts), and will need to remain flexible, and adaptable to changing conditions, interests and expectations. In addition, these building blocks and recommendations will also provide guidance for the identification, subsequently, of some 5-10 actions to be operationalized in the context of a timed roadmap for the development of a e-leadership skills strategy, and which should contain points that are actionable immediately, over the next 6 months or so, the short term (say 2 years), and medium and longer term, respectively, supplementing where current initiatives do not address the specific needs for the development of e-leadership skills for competitiveness and innovation in Europe.

Building block 1: Offer a clear and resilient strategy by focusing on educators. This is important as e-leadership skill development brings together different skills and disciplines, making them relatively more complicated to be taught. The following actions are required, in order of priority:

1. **Overhaul curricula**: make courses and programs 'dual', i.e. combine technology courses with business related disciplines and vice versa. Make course material, at all levels, more applied to real life, for example through increased use of case studies and business involvement. Get input from the business community on skills needs and realities. This is, in part, also addressed in other flagship initiatives, such as the Innovation Union, but specific initiatives for the development of e-leadership skills need to be developed in collaboration with experts from the IT and business community, and, for example, representatives from companies that have successfully managed a process of digital transformation. The recognition of such skills is also crucially important. Initiatives such as 'New skills and Jobs' and 'Youth on the move' address this issue to some extent, but efforts need to also focus specifically on e-leadership skills, especially since these skills often involve industry-provided education and training, often still characterised by a lack of recognition.
2. **Change the teaching environment**: use modern teaching technologies, platforms and tools such as games and simulations to make learning more interactive and participatory. This may also act as an eye-opener to some young talent and 'wet their appetite', and enable the identification of target groups for the development of e-leadership skills.
3. **Equip teachers and academics with the right skills**: they need the skills to teach in new learning environment and with new tools and platforms, but also need business insights, especially into business and skills realities to better inform student choices and increase their employability and/or capacity to create their own start-ups and business opportunities.

Building block 2: highlight and promote areas where measurable results can be felt by key stakeholders. Communicating with key stakeholders (including the media) about how e-leadership skills strategies can contribute to a job-rich recovery in Europe, and to restoring Europe's leadership as a global competitor and innovator will require actions in the following order of priority:

1. **Focus on target groups for e-leadership skills development**: notably, young, smart, dynamic and entrepreneurial people with the potential and interest in creating opportunities and

obtaining e-leadership skills, for example by raising awareness about the broad opportunities and career paths available in "IT", change the image the IT profession has among youth, use real-life example and applications in learning, use role models and interventions by the business community in schools, and inform people about the skills that increase their employability.

2. **Promote life-long learning**: raise awareness of the importance of being flexible and open to changing skills needs, communicate skills needs clearly, provide continuous learning and training opportunities and personal development plans, provide coaching and mentoring, encourage individuals to take on responsibilities in personal development plans, raise awareness of freely available online resources and other training and certification options. This is a broader background environment recommendation, in part addressed under European Commission flagship initiatives, but some actions could be focussed more, or developed specifically, with a view to developing e-leadership skills, for example by raising awareness of the specific skills required, and how and where to obtain them (several dual masters programs exist, and certain industry-provided education and training initiatives also contribute).
3. **Build multi-stakeholder and inter-disciplinary partnerships**: create partnerships that bring together all the relevant stakeholders, create new 'exchange' programs for teachers and academics to spend time in business, create programs 'twinning' educational institutions with businesses. Some flagship initiatives, such as the Innovation Union, also address the need for such partnerships, but partnerships specifically aimed at developing e-leadership skills should be developed and highlighted, including by raising awareness of existing partnerships that could function as best-practices to be built upon.

Building block 3: **identify possible roadblocks and address them explicitly**. This will require the following key actions, in the following order of priority:

1. **Energise the business environment**: cut red tape and simplify administrative procedures, including for doing business across borders, provide a top class and affordable ICT infrastructure, and promote the adoption of ICT in business, improve access to capital and promote venture capital and angel investment. The Digital Agenda for Europe, and other initiatives such as industrial policies in a globalised era, address some of these issues. However, they are crucial to the longer term sustainable development and exploitation of e-leadership skills and therefore warrant due attention, also in the specific context of e-leadership skill development, initiatives and policies. The business and political environment need to come together with mobilised actors specifically targeting their energy and resources. The Grand Coalition is one example, but something more focussed on e-leadership skills is also required.
2. **Improve the framework conditions**: continue to streamline and harmonise regulation, promote the mobility of workers, talent and ideas, protect IPR, so that businesses can access talent where and when they need it. Member States need to implement the measures achieving the Single Market for Services and the Digital Single Market without any further delay. Again, several European Commission initiatives, related to the Digital Single market, education and IP address these issues. Nonetheless, they are crucial to the longer term development and sustainability of e-leadership skill development and exploitation, and in some cases require specific actions. One example would be increased recognition for industry-provided training for e-leadership skills.
3. **Develop and promote better funding instruments, metrics and impact evaluation**. It is crucial to align in the e-leadership skills development realm new objectives, policies, and the corresponding and necessary instruments and funding required for achieving them. This is vital

as e-leadership skills are new and have not previously been addressed, nor are they specifically addressed or targeted under the current flagship initiatives. In addition, returns to investments in these skills can be expected to be high because of their key importance to businesses, competitiveness, innovation, growth and job creation. It is also important to bring together international organisations and national statistical offices to (i) coordinate a new definition and measurement method of e-leadership skills, (ii) collect the required data for measuring and monitoring this new definition, and (iii) get agreement on new, timely and internationally harmonised indicators and data required for measuring and monitoring the 'Internet economy', innovation and competitiveness, and to inform policy decisions; make impact a more important part of commissioned research, and carry out more and more rigorous impact evaluations of commissioned research, programs and initiatives.

Next, we develop and list some broader existing recommendations and initiatives that help to create the broader background and environment that contribute to fostering talent – these are largely covered by the existing European Commission flagship initiatives. This, in turn, allows the emergence and identification of those with a talent and potential for, and interest in, e-leadership skills to be targeted subsequently through more specific initiatives.

5.1 What can we build on?

We highlight some existing policy recommendations and initiatives from EU institutions and national governments that are relevant to the development and exploitation of e-leadership skills.

5.1.1 Foster Human capital and skills

Many of the ideas and recommendations below are covered by existing initiatives, for example, under the 'Innovation Union', 'New Skills and Jobs', and 'Youth on the Move', but we list some below as they contribute to fostering the environment that will be important for a longer term strategy and 'pipeline' for developing e-leadership skills.

It is important to encourage STEM education, including in combination with courses in other disciplines. One way to do this is by making STEM attractive to students, by changing the boring or 'nerdy' image some of these disciplines may have, and by showing the kinds of jobs students can hope to find equipped with this kind of education. Role models, including female role models, can help to change the image. Educating students about the salaries they can expect to earn is also important.

It is also important to encourage the re-thinking of curricula and ways of making education at all levels more applied, including through the development of hands-on, active, participative learning, interdisciplinary courses, and by making greater use of "case studies, games, projects, simulations, real-life actions, internships with start-ups and other hands-on activities that involve interaction with entrepreneurs" (WEF, 2009).[38] This also means creating an environment where children can learn, be creative, express themselves, create an interest in exploiting ideas, create and entrepreneurial mind-set.[39]

[38] In addition, WEF (2009) argues that "Active and learning-by-doing methods integrate elements of practice into the learning process. This highlights the importance of actively engaging entrepreneurs and other professionals in both course design and delivery. These individuals also serve as role models, particularly if they are alumni of the

Existing entrepreneurship education and training programs and other educational initiatives should be evaluated to make sure they lead to the desired outcomes, and the lessons learnt should be applied in the development of future programs (Section 6 in the annexes). In addition, it is important to promote the "e" and technology components in entrepreneurship education and training, putting higher emphasis on the need to train e-entrepreneurs and e-leaders by developing e-leadership skills (Section 7 in the annexes). This also goes through the more general promotion of a culture of entrepreneurship and bringing about a change in attitude. This could be achieved, for example, by encouraging increased coverage of entrepreneurship in the media, by giving 'role models' a role to play, e.g. through the development of videos to be shown in schools where successful entrepreneurs tell their success and failure stories (including 'local' examples, where possible, as these have been shown to have an impact in areas where an entrepreneurship tradition lacks).

Greater interaction between the educational system and the business community should be encouraged and multi-stakeholder partnerships in education promoted to ensure the educational system supplies the skills that business needs (Box 7). This is absolutely crucial, yet, businesses that have interacted with schools and universities about curricula changes are often left frustrated as, in the end, they find that nothing changes in practices in spite of promises to change. The European Commission and Member States need to act here, including under the initiatives of the current flagships, to ensure schools and universities adapt their curricula to match skills needs and to bring employable graduates to the market. Additional measures to promote this could be through the inclusion of measures of business interaction and employability of graduates in the evaluation of schools and universities.

The European Commission (and Member States) could also create new programs for teachers and university professors to spend time in businesses to learn about industry realities in practice. This could take the form of sabbaticals spent in business, with the Commission/Member States contributing to the salary paid during that period. On return from such an 'exchange', a presentation of key learning points should be made to colleagues to maximise the impact of the experience and insights gained.

It would also be advisable to raise awareness about freely available education and training resources and encourage their use (see Section 8 of the annexes for some examples). For example, a number of courses from Stanford, Harvard, MIT and several other top US universities are available for free online, in computer sciences and related (tech) subjects, as well as many other academic fields. [40]

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school, as well as coaches and mentors. They also enhance entrepreneurial spirit within the university and create stronger links between the university and the local community."

[39] According to WEF (2009), "Schools and training programs provide a safe environment for encouraging students to stretch and test themselves, to experiment and develop an understanding of risk-taking and to turn ideas into action. It is important that students have the opportunity to experience both successes and failures – and to learn from both experiences. Most importantly, they need to learn to try, even if they fail, and then to start over and try again."

[40] See, for example, the courses available at: www.openculture.com/freeonlinecourses (and Annex 8.7 for a list of the computer science and artificial intelligence courses available from that web site, as an illustration of what is on offer). There appears to be a new trend emerging for (top US) universities to offer free so-called "massively open online courses" (MOOCs). Early May 2012, Harvard and MIT announced a new nonprofit partnership, called edX, to offer free online courses from the two universities rewarded with a course certificate (EdX is expected to offer its first five courses in fall 2012 and will be overseen by a nonprofit organization governed equally by the two universities, both having committed $30 million to the project). In addition, Stanford, Princeton, the University of Pennsylvania and the University of Michigan announced their partnership with a new commercial company, Coursera (https://www.coursera.org/), with $16 million in venture capital. And by May 2012, more than 200 000 students had already registered for the six courses available from Udacity (www.udacity.com/), the company founded by Sebastian Thrun, the Stanford professor who made the news headlines in the fall of 2011 when 160 000 students signed up for his Artificial Intelligence course (Lewin, 2012).

Teacher training also needs to be overhauled as teachers need to have the skills to teach in new ways, and need to be able to use and exploit the opportunities offered by ICT, including in education. Innovation in the delivery of education will be crucial. In addition, teachers need to have a thorough grasp of the realities of the labour market and a profound understanding of what businesses need to advise students on their career and educational choices and improve their employability. In addition, when students are properly informed about the skills that are needed by business they will also be able to choose to go to those universities that offer courses that will make them employable at graduation. These informed choices by students can also provide additional incentives for universities to adapt their curricula to attract students.

A culture of life-long learning and training should be promoted, on the job, for people to continuously up-skill and change with business' needs, but also for the unemployed to increase their employability. The use of free online courses could be considered here too, especially as they can be taken online anytime, anywhere.

Box 7: Coordination and consultation between the higher education system and the business community

Ho (2007) argues that higher education is a crucial element of the innovation eco-system and that the education system's output (namely, knowledge and knowledge workers) should match what society and businesses need. Therefore, the educational system should be in tune with economic development, and especially local economic development. To this effect, Ho argues that university curricula and the professorial body have to take the following points into account.

For education:

- ***Employability***: schools and universities need to make sure that the skills their students acquire match what businesses look for in practice on the labour market. In particular, Ho recommends collaboration between industry and businesses, notably to gain real life work experience and industry insight. He argues that internship and traineeship should be part of degree requirements.
- ***Versatility***: jobs are increasingly multi-disciplinary, and curricula and degrees should reflect this. Ho recommends that university programs should allow students to have a wide spectrum of disciplines for their degrees to prepare for industry realities and to allow them to be innovative.
- ***Adaptability***: flexibility and adapting to changes are becoming increasingly important. Indeed, as technology and its environment change ever more quickly, Ho recommends "students should prepare to expect the unexpected." Educational content should be adapted to this requirement and offer more framework and methodology, where different content can be filled in as required later.

For research:

- ***Quality***: "In a competitive environment, selection of subjects for research at universities has to be based on practical reasons, avoiding me-too research. Universities should concentrate on research areas where they excel and focus on what they do better than others rather than on what they do best."
- ***Pertinence***: It is important to make sure the research provides value added to end-users, and the strategic objectives of businesses and governments in particular, including with a view to future funding. In addition, he argues that collaborations with businesses and governments are also important for student training.
- ***Sustainability***: "if research cannot create value for some end-users or sponsors, it cannot be sustained."

Only if these points are taken into consideration can education assume its role of not only disseminating and creating knowledge but also applying knowledge to social and business challenges, thereby contributing to competitiveness and innovation.

Source: Ho (2007).

Finally, 'dual thinkers' should be also be developed and promoted in the public sector: public sector workers and leaders also need training on entrepreneurship, technology, and change management. Like for teachers and professors, new programmes also need to be created for policy makers to spend time in businesses to understand industry realities and improve their policy skills. On return from such an 'exchange', a presentation of key learning points should be made to colleagues to maximise the impact of the experience and insights gained.

5.1.2 Energize Europe's business environment

Many of these recommendations are covered by current initiatives, e.g. under the Digital Agenda for Europe and the Digital Single Market, as well as industrial policies in a globalised era, but we list some of them here as they are important to creating an environment that is conducive both to the development and exploitation of e-leadership skills.

It is important to promote a culture of entrepreneurship: not only on skills and attitudes, but also through practical measures on the business side. Such measures could include tax breaks or incentives for new businesses, for example linked to the number of jobs that are being created. Improving the ease of doing business is crucial, and especially for start-ups, and reducing costs, for example by streamlining and harmonising procedures, including by making it possible to do them online, reducing red tape, improving the information about procedures but also resources available to businesses and start-ups. Other important measures include encouraging improved access to capital, including by fostering venture capitalism and angel investments, for example through tax breaks, and raising awareness in the financial and banking system providing access to capital about the importance of being allowed to fail and try again, which is crucial for creating a dynamic, innovative and entrepreneurial business environment. Failing should not prevent people from being able to try again.

As promoted under the Digital Agenda, providing a top class and affordable ICT infrastructure, and continuing to aim at reducing the costs of mobility, especially across borders (for example by reducing roaming and international data use charges) are crucial framework conditions. In addition to issues related to access and use, it is also important to address concerns related to the online protection of rights (including IPR), privacy, security, online payment systems, and international and online dispute resolution. Continue to encourage the business use of ICT, and especially in SMEs, for example by continued information and skill development campaigns, encouraging the uptake of high-speed broadband and other technologies, for example through tax breaks/incentives for technology investment (similar to what exists for R&D investment, for example).

The mobility of workers, across firms, sectors and countries also needs to be facilitated. Measures need to relate to mobility aspects such as increasing the portability of health, unemployment and retirement benefits, international recognition of qualifications, and immigration rules and procedures. Promote women entrepreneurs and women participation in management, for example by raising awareness through initiatives such as the OECD's pre-G20 event in 2011 on "Growing Economies through Women's Entrepreneurship."[41] It is also important to encourage training initiatives, especially in SMEs and for the self-employed, including through online resources, especially since these add increased flexibility as to when and where a person spends time on them. Identifying the barriers is paramount to increasing the amount of training employees notably in SMEs will receive. It also enables policy makers to then offer the

[41] See www.oecd.org/document/24/0,3746,en_21571361_44315115_48971480_1_1_1_1,00.html, and noting that "women entrepreneurs are still facing many obstacles", including more difficulties in getting access to credit, resources, and education, relatively higher legal and regulatory barriers, impacting their attractiveness and risk profiles for financial institutions, and resulting in many women business-owners continuing to be "concentrated in small, low growth enterprises, which are often unable to fully mature."

right incentives. Other factors also contribute, e.g. promoting and raising awareness of changing office environments and cultures, especially by allowing increased flexibility (e.g. in terms of working times and contracts) but also about the positive effects of increased teamwork and exchanging information and knowledge which may stimulate creativity. This can also include raising awareness about modular, flexible physical and virtual working spaces and arrangements, especially since this is increasingly attractive for younger people and future generations. Work-life flexibility and balance should become a part of (corporate) culture. Facilitating a fully developed service economy is a pre-requisite framework condition for micro-multinationals to be able to thrive,[42] including by completing the Single Market for Services and the Digital Single Market soon as possible. This also involves facilitating cross-border transactions with (i) clients, (ii) suppliers, (iii) human resources (international sourcing of talent, skills, ideas) - inside the EU by achieving the Single Market for Services and the Digital Single Market, and inside and outside EU through measures such as reducing the cost and admin burden of customs rules and regulations, cutting red-tape, further harmonising tax and custom procedures, and getting rid of non-tariff barriers. The IPR regime needs to be reformed to reflect modern needs, and facilitate cross-border innovation processes. The introduction of the European patent should reduce costs.

Labour markets should also reform and become more flexible, and immigration policies need to be adjusted, in line with the Employment Package (Box 8).

Box 8: The employment Package: Towards a job-rich recovery

The Communication "Towards a job-rich recovery" (adopted on 18 April 2012; European Commission, 2012a) presents new measures and identifies key opportunities for EU job-rich recovery. It focuses on the demand-side of job creation, and proposes ways for Member States to encourage hiring by reducing taxes on labour or supporting business start-ups more. In addition, it identifies three areas with the greatest promise of job potential for the future: the green economy, health services and ICT. The Communication recommends that "support for job creation and (re)allocation of labour should be aimed at growing sustainable activities, sectors and businesses, particularly among SMEs."

The employment package urges Member States to strengthen their national employment policies through a range of suggestions, including by encouraging Member States to create the right conditions for job creation and labour demand, such as hiring subsidies that create new jobs, by providing support for self-employment, and by supporting an increase in highly qualified ICT labour and promoting digital skills throughout the workforce.[43] The Communication also identifies key areas for labour market reform, including: stimulating internal flexibility, ensuring appropriate contractual arrangements, and higher investment in skills to address the skills mismatches in Europe's labour markets, as well as better anticipation of skills needs. The employment package also aims to create a "genuine EU labour market", notably by improve labour mobility. "The Commission is fully committed to removing legal and practical obstacles to the free movement of workers such as improving the portability of pensions, the tax treatment of cross border workers or awareness of rights and obligations. It calls on Member States to allow for the export of unemployment benefits for jobseekers in another country (for a period of up to 6 months)." Jobs in the public service throughout the Union should be open to nationals from all Member States.

Finally, the employment package also calls for reinforced coordination and monitoring of employment policies at EU level in line with EU economic governance. Source: European Commission (2012a) and *Employment, Social Affairs and Inclusion*, News: Commission presents new measures and identifies key opportunities for EU job-rich recovery (http://ec.europa.eu/social/main.jsp?langId=en&catId=101&newsId=1270&furtherNews=yes)

[42] For example, "Innovative hubs like San Francisco and Boston have highly developed service economies that specifically cater to start-ups and small companies with everything from IT support and data management to legal services and venture capital close at hand. If a need is underserved by local providers there is often also the option of turning to the kind of web-based service solutions." (Mettler and Williams, 2012a).

[43] According to Reimsbach-Kounatze and Serra Vallejo (2012), ICT skills and employment continue to be among the top ten long-term policy priorities in OECD countries: 24 of the countries who responded to the OECD Information Technology Outlook Policy Questionnaire 2010 reported an increase in the priority of at least one ICT policy area in view of facilitating economic recovery; 15 countries even made ICT skills and employment a priority in their policy agenda, in combination with policies promoting the diffusion of broadband.

5.1.3 Promote new metrics and evaluation

There is a need for more rigorous evaluations of the impacts of initiatives and programs aimed at improving entrepreneurial skills, attitudes and mindsets, not only in the short run but also long term. There is also a need for new and more appropriate data, on e-leaders and e-entrepreneurs, skills demand and supply, but also, for example, on SMEs, the self-employed, innovation outputs, intellectual assets, and services activities.

The rather generic definitions provided here are fit for a 'vision report'. Yet, to guide action on what will actually be needed to address Europe's needs in terms of e-leadership skills, policy makers, educators, investors and various other stakeholders will need at least some approximate definitions and quantitative orders of magnitude of what is needed in which sectors, and through which education/training streams. To achieve that goal, a further 'segmentation' of e-leadership skills will be required. Subsequently, a set of data will need to be compiled and/or collected to provide some initial quantification of the objectives to be reached, and hence of the resources to be mobilized.

Each of these recommendations can also be mirrored in recommendations to the education sector (notably in terms of curricula development, the teaching environment, teacher skills, and collaborating with the business community), the business community (for example by participating in multi stake-holder and interdisciplinary partnerships, in the re-thinking of curricula, clearly communicating business' skills needs, with a view to creating innovative, employable dual thinkers,[44] offering internships and practical work experiences to students, and tutoring and mentoring within companies, making interventions in schools, and re-thinking career development and life-long learning education and training plans to fit changing skills needs), and finally to individuals to be creative, open to change and new things, flexible, and entrepreneurial.

[44] For example, in India IT companies play an active role in shaping college curricula and delivery to ensure better access to skills (McKinsey Global Institute, 2012).

6 Conclusions

The current economic crisis hits Europe hard, especially since it has contributed to additional Euro area difficulties and constraints, and the proposed austerity measures are debated heatedly by politicians and economists alike. Pressures resulting from decreasing demand and restricted access to credit could either make the situation worse, or will help to address it by adding a heightened sense of urgency. Furthermore, businesses are experiencing recruiting difficulties even though there are close to 25 million unemployed people in Europe (in April 2012). The situation of young Europeans is particularly dramatic (with rates of youth unemployment above 20% in the EU27, and even over 50% in Greece and Spain), and calls for urgent action. Skills and mobility are the two factors most likely to address the apparent recruiting paradox.

One important issue regarding skills is that they take a long time to build, both by the formal education sector (primary, secondary and tertiary) and by firms (as staff acquire the internal knowledge related to corporate culture, organization specifics and customer relations, for example). Laying-off workers in times of reduced demand may hence be a short term decision which will be difficult to reverse when activity picks up. In sectors where the rate of technological innovation is high, laid-off workers may find it difficult to re-enter the labour market after a period of inactivity if they have stopped updating their skills and knowledge on a regular basis; conversely, firms which have been too quick to curtail their staff may find it difficult to re-create the appropriate skills mix to face competition when activity resumes.

From a business and economic point of view, this means the following:

1. Enterprises could actually make the current crisis worse (for themselves and for Europe's economy) by curtailing their staff too quickly and too drastically.

2. The re-skilling of Europe's labour force should be a priority during the crisis: without it, the skills shortage which was already increasing before the crisis will constitute a major handicap in post-crisis times, holding back Europe's ability to innovate and compete on global markets.

European enterprises have long insisted on the difficulties they felt or anticipated about attracting and retaining the right talents. The IT sector has been particularly active in this area, with the creation of an 'e-skills Industry Leadership Board' in 2007). Other sectors had expressed similar concerns about the scarcity of technical skills, including engineers. However, it would be wrong to consider that the priority attention devoted by enterprises to the availability of appropriate skills stems only from micro-economic concerns. At the macro-economic level, available evidence and research shows that skills are, indeed, a key determinant of innovation, competitiveness and growth.

Regarding the specific case of e-leadership skills, the main conclusions emanating from the present report are the following: data is scarce is limited, literature is abundant but scattered (from CIO concerns to curriculum building), frameworks established by the European Commission (among others) need to be adapted to reflect new dimensions of the knowledge economy, and focus on what Europe needs most, i.e. 'top of the pyramid' e-leadership skills. The current situation of emergency in Europe (youth unemployment, diminished competitiveness and challenges for new innovators) must be seen as an opportunity to mobilise various players (EU institutions, national governments, business, academia, trade unions, civil society) around e-skills objectives. A job-rich recovery in Europe is possible, and e-skills initiatives may very well spearhead a change of mind-sets about what is feasible in Europe.

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Annexes

A-1) Measurement of skills categories

A-1.1 - User skills

Table A-1: Percentage of individuals who carried out certain number of computer related activities

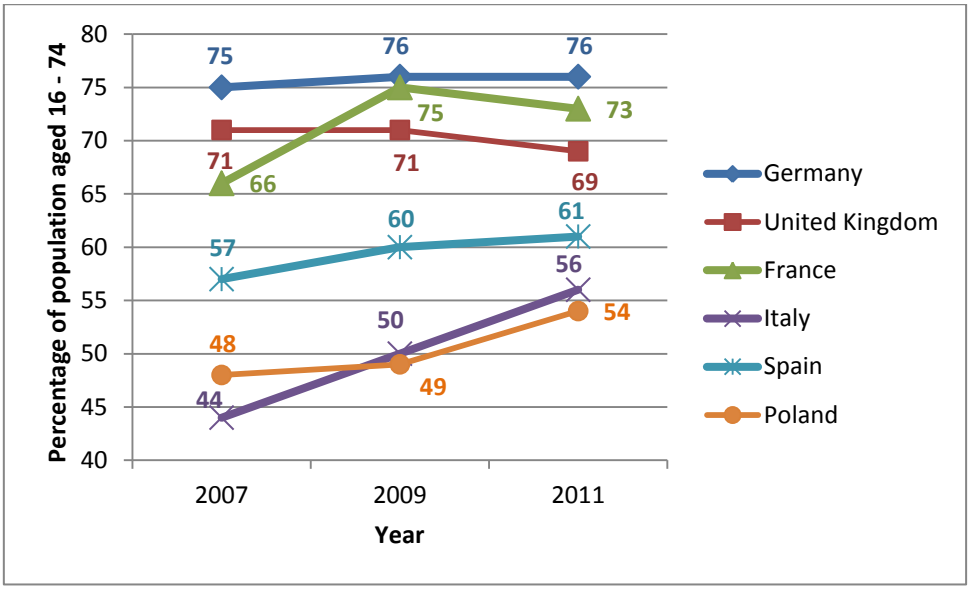
	2007				2009				2011			
Country/Number of computer related activities	1 - 2	3 - 4	5 - 6	Total	1 - 2	3 - 4	5 - 6	Total	1 - 2	3 - 4	5 - 6	Total
EU (27 countries)	13	24	23	60	14	25	25	64	14	25	27	66
Belgium	16	24	22	62	18	27	18	63	16	29	28	73
Bulgaria	10	15	7	32	11	18	7	36	14	17	11	42
Czech Republic	17	21	17	55	14	20	19	53	15	23	25	63
Denmark	13	30	36	79	15	35	31	81	12	34	39	85
Germany	15	32	28	75	16	32	28	76	18	33	25	76
Estonia	11	20	24	55	10	20	28	58	10	22	32	64
Ireland	16	21	18	55	12	20	22	54	12	25	26	63
Greece	11	16	15	42	13	15	13	41	9	16	24	49
Spain	9	20	28	57	10	22	28	60	10	19	32	61
France	12	27	27	66	10	35	30	75	16	28	29	73
Italy	8	17	19	44	9	18	23	50	10	21	25	56
Cyprus	10	18	19	47	7	16	29	52	10	22	23	55
Latvia	16	23	14	53	11	23	17	51	11	22	29	62
Lithuania	9	21	19	49	8	19	27	54	9	18	32	59
Luxembourg	10	29	39	78	12	31	42	85	11	32	43	86
Hungary	10	22	27	59	14	22	27	63	13	23	32	68
Malta	9	20	17	46	12	18	20	50	13	25	24	62
Netherlands	16	31	32	79	13	30	40	83	18	34	32	84
Austria	12	26	33	71	13	29	29	71	11	25	42	78
Poland	16	20	12	48	16	19	14	49	15	21	18	54
Portugal	9	16	22	47	11	16	27	54	11	20	28	59
Romania	14	10	5	29	17	10	9	36	15	14	10	39
Slovenia	12	21	28	61	12	21	28	61	12	23	31	66
Slovakia	18	30	18	66	17	33	21	71	18	33	23	74
Finland	17	26	29	72	18	26	33	77	12	27	43	82
Sweden	18	33	27	78	23	30	21	74	16	27	42	85
United Kingdom	15	30	26	71	15	27	29	71	28	19	22	69

The computer related activities mentioned above comprise: copy or move a file or folder, use copy and paste tools to duplicate or move information within a document, use basis arithmetic formula (add, subtract, multiply, divide) in a spreadsheet, compress files, connect and install new devices (e.g. a printer or a modem), write a computer program using a specialized programming language.

The percentage of individuals who carried out computer related activities demonstrates increasing trend in EU countries: 60 percent of individuals carried out 1 - 6 computer related activities in 2007 while in 2011 this number increased to 66 percent. The growth can be seen at categories of individuals who carried out 1 – 2 and 5 - 6 computer related activities. The share of individuals who carried out 3 – 4 computer related activities decreased slightly – from 25 percent in 2009 to 24 percent in 2011.

However, 5 largest EU economies exhibit slightly different patterns.

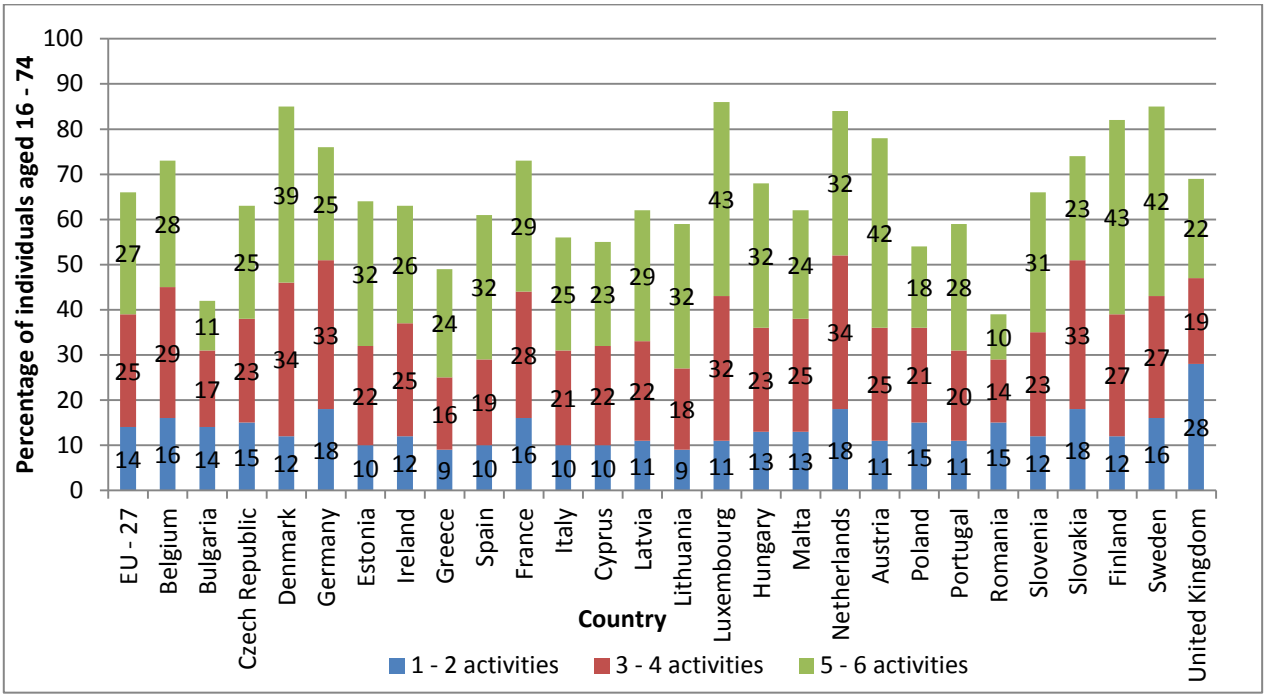
Figure A-1: Percentage of individuals who carried out 1 – 6 computer related activities in 6 largest EU economies



Source: empirica, based on Eurostat tsdsc460.

In Germany there was no growth in the share of computer related activities users since 2009, while United Kingdom and France experienced slight declines. Italy, Spain and Poland, represent trend of growth; while the increase of computer related activities users in Spain was moderate (3 percent in 2009 and 1 percent in 2011), Italy experienced the fastest growth (6 percent from 2007 to 2009 and from 2009 to 2011) among six largest EU economies. This let Italy to bypass Poland which grew at the slower pace (1 percent in 2009 and 5 percent in 2011).

Figure A-2 Percentage of individuals in EU countries by amount of computer related activities in 2011



Source: empirica, based on Eurostat tsdsc460.

The variations in the percentage of individuals carrying out computer related activities across countries are significant. The percentage of individuals who carried out 1 - 6 computer related activities exceeds 80 percent in Denmark, Luxembourg Netherlands, Finland and Sweden, while Bulgaria and Romania is at approximately 40 percent level. Analysing the percentages of individuals who carried out 1 – 2 activities, the high number in United Kingdom stands out – 28 percent exceeds the average significantly. The lowest percentages (9 percent) of 1 – 2 computer related activities users are reported in Greece and Lithuania. In 3 – 4 computer related activities usage group the highest numbers are reported in Netherlands (34 percent), Denmark (34 percent), Germany (33 percent) and Slovakia (33 percent), while the lowest – in Romania (14 percent), Greece (16 percent) and Bulgaria (17 percent). The highest percentages in 5 – 6 computer related activities usage group are reported in Luxembourg (43 percent), Finland (43 percent), Sweden (43 percent) and Austria (42 percent). Bulgaria and Romania reported the lowest numbers, which are more than two times below than the EU average.

Table A-2: Percentage of individuals who carried out certain number of computer related activities by occupation, education and age groups in EU – 27

	2007				2009				2011			
Indicator/Number of computer related activities	**1 - 2**	**3 - 4**	**5 - 6**	**Total**	**1 - 2**	**3 - 4**	**5 - 6**	**Total**	**1 - 2**	**3 - 4**	**5 - 6**	**Total**
Occupation												
Employees, self-employed, family workers	14	29	28	**71**	14	30	31	**75**	15	29	33	**77**
Students	11	37	47	**95**	11	36	48	**95**	10	35	52	**97**

	2007				2009				2011			
Indicator/Number of computer related activities	**1 - 2**	**3 - 4**	**5 - 6**	**Total**	**1 - 2**	**3 - 4**	**5 - 6**	**Total**	**1 - 2**	**3 - 4**	**5 - 6**	**Total**
Retired and other inactive	11	12	6	**29**	12	13	7	**32**	14	14	8	**36**
Unemployed	14	23	20	**57**	14	23	21	**58**	14	26	24	**64**
Education												
Individuals with no or low formal education	11	16	11	**38**	12	19	12	**43**	14	19	14	**47**
Individuals with medium formal education	15	27	23	**65**	16	27	24	**67**	16	28	26	**70**
Individuals with high formal education	12	32	44	**88**	11	32	46	**89**	11	31	49	**91**
Age groups												
16-24 years old	13	35	41	**89**	12	35	43	**90**	11	35	45	**91**
25-54 years old	14	27	26	**67**	14	28	28	**70**	15	28	31	**74**
55-64 years old	13	17	10	**40**	14	19	12	**45**	15	19	13	**47**
65-74 years old	8	8	3	**19**	10	10	4	**24**	12	10	5	**27**

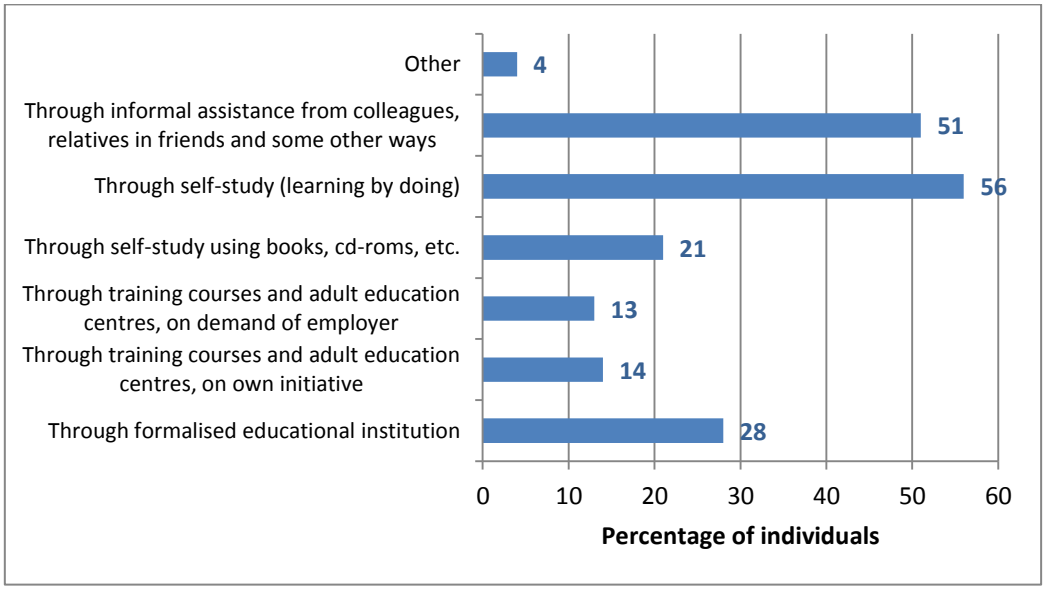
Source: empirica, based on Eurostat tsdsc460.

The highest percentage of computer related activities usage among different types of occupations is reported in the group of students. In 2007 this number reached 95 percent while in 2011 it increased to 97 percent. It is also worth to mention that the highest share of students carried out 5 – 6 computer activities, which shows that this group is not only active in computer usage, but proficient as well. The share of employees, self employed and family workers who carried out 1 – 6 computer related activities increased from 71 percent in 2007 to 77 percent in 2011. Approximately the same percentage carried out 3 – 4 and 5 – 6 computer related activities within the aforementioned group, while the share of those who carried out 1 – 3 computer related activities was significantly lower than the former two. The percentage of unemployed who carried out 1 – 6 activities was above 50 percent and exhibited trend of growth in 2007 – 2011. Retired and other inactive people reported the lowest level of computer related activities usage. The distribution within this group is also different from the previously analysed groups – much smaller share of individuals carried out 5 – 6 activities and the larger share carried out 1 – 2 activities.

The statistics of computer related activities usage by education represents the general trend: the higher the formal education, the higher is the percentage of computer related activities usage as well as the higher the percentage of 5 – 6 computer related activities usage. Basically, this implies that education contributes to both - the popularity and the proficiency of computer usage.

Computer related activities usage is also more popular among younger people: in 2011 91 percent carried out 1 – 6 activities in the age group of 16 – 24, 74 percent – in the age group of 25 – 54, 47 percent – in the age group of 47 and the number decreased to 27 percent among individuals aged 65 – 74.

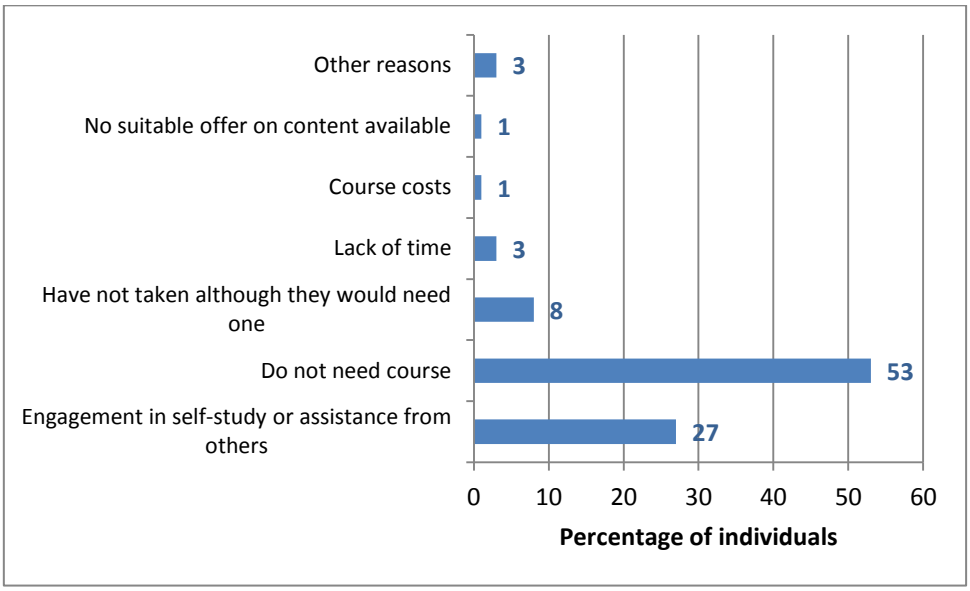
Figure A-3: The way individuals obtained e-skills in EU – 27 in 2011



Source: empirica, based on Eurostat tsdsc460.

The most popular way of obtaining e-skills was self-studying (learning by doing). 56 percent of individuals reported it as a way of obtaining computer skills. 51 percent of individuals used informal assistance from colleagues, relatives, friends, etc. Self-studying approach using books, CD-rooms and etc. was much less popular – 21 percent of individuals reported that they used this way of obtaining e-skills. Among institutional education the most popular are formalised education institutions. It is also worth to mention that the percentage of individuals who took training courses or attended adult education centres on their own initiative and on the demand of employer are about the same (14 percent and 13 percent respectively).

Figure A-4: Reasons for not having taken computer course in the last 3 years in EU – 27 countries (2011 data)



Source: empirica, based on Eurostat tsdsc460.

More than a half of individuals reported that the main reason they have not taken computer course in recent 3 years is that there was no need for it. 27 percent of individuals found self-studying or assistance from others to be sufficient for fulfilling their need of e-skills knowledge. Small, although significant enough, group of individuals (8 percent) felt the need for computer courses, but even though they have not taken one. Lack of time, course costs, no suitable content and other reasons played minor role (none of these reasons exceeded 3 percent) in individuals' decision not to take computer courses.

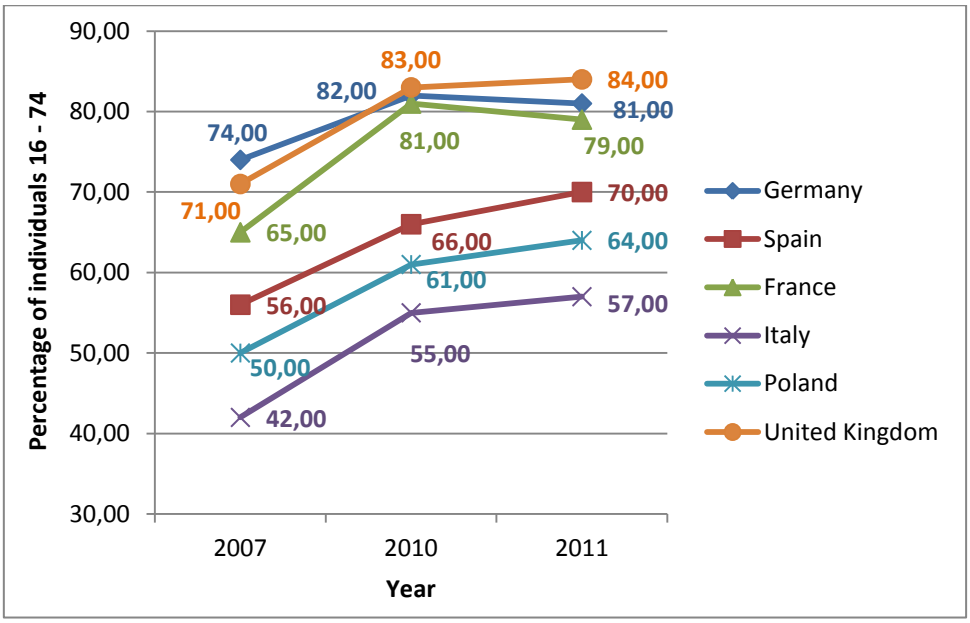
Table A-3: Percentage of individuals who carried out certain number of internet related activities

	2007				2009				2011			
Country/Number of internet related activities	**1 - 2**	**3 - 4**	**5 - 6**	**Total**	**1 - 2**	**3 - 4**	**5 - 6**	**Total**	**1 - 2**	**3 - 4**	**5 - 6**	**Total**
EU (27 countries)	29	23	8	**60**	32	30	10	**72**	30	32	11	**73**
Belgium	40	23	5	**68**	39	30	8	**77**	34	35	10	**79**
Bulgaria	13	15	7	**35**	21	18	7	**46**	19	22	9	**50**
Czech Republic	25	17	11	**53**	31	32	7	**70**	28	34	12	**74**
Denmark	37	34	12	**83**	36	40	11	**87**	29	46	15	**90**
Germany	41	27	6	**74**	41	33	8	**82**	42	34	5	**81**
Estonia	20	25	20	**65**	23	32	17	**72**	19	35	21	**75**
Ireland	42	15	3	**60**	36	23	5	**64**	36	30	7	**73**
Greece	22	11	4	**37**	25	18	4	**47**	20	26	8	**54**
Spain	23	25	8	**56**	30	29	7	**66**	28	31	11	**70**
France	26	27	12	**65**	31	32	18	**81**	31	35	13	**79**
Italy	15	18	9	**42**	20	23	12	**55**	21	24	12	**57**
Cyprus	25	12	3	**40**	24	24	6	**54**	20	29	8	**57**
Latvia	22	26	11	**59**	22	29	19	**70**	12	30	31	**73**
Lithuania	18	20	13	**51**	17	24	23	**64**	13	26	27	**66**
Luxembourg	28	37	14	**79**	37	40	11	**88**	30	47	13	**90**
Hungary	22	24	8	**54**	24	31	12	**67**	22	35	15	**72**
Malta	22	19	5	**46**	24	31	7	**62**	19	36	13	**68**
Netherlands	39	33	12	**84**	48	36	6	**90**	:	:	:	**:**
Austria	38	23	8	**69**	38	31	6	**75**	35	36	9	**80**
Poland	24	19	7	**50**	28	24	9	**61**	29	25	10	**64**
Portugal	16	19	8	**43**	15	27	11	**53**	20	28	10	**58**
Romania	16	10	2	**28**	25	16	1	**42**	20	17	7	**44**
Slovenia	25	23	10	**58**	30	28	12	**70**	23	31	16	**70**
Slovakia	34	23	7	**64**	29	41	9	**79**	27	40	12	**79**
Finland	39	29	11	**79**	48	33	5	**86**	29	41	19	**89**
Sweden	45	25	8	**78**	38	37	14	**89**	30	42	20	**92**
United Kingdom	41	22	8	**71**	38	36	9	**83**	35	38	11	**84**

Source: empirica, based on Eurostat tsdsc460.

The percentage of individuals who carried out 1 – 6 Internet related activities demonstrated increasing trend in EU – 27 countries. The share of individuals who performed 1 – 6 Internet related activity increased from 60 percent in 2007 to 73 percent in 2011. The highest percentage of individuals was within the group of those who performed 1 – 2 Internet related activities in 2007 and 2009 (29 and 32 percent, respectively), however in 2011, due to the faster growth, 3 – 4 Internet related activities users group bypassed the former. The percentage of individuals who performed 5 – 6 Internet related activities increased moderately.

Figure A-5: Percentage of individuals who carried out 1 – 6 Internet related activities in 6 largest EU economies

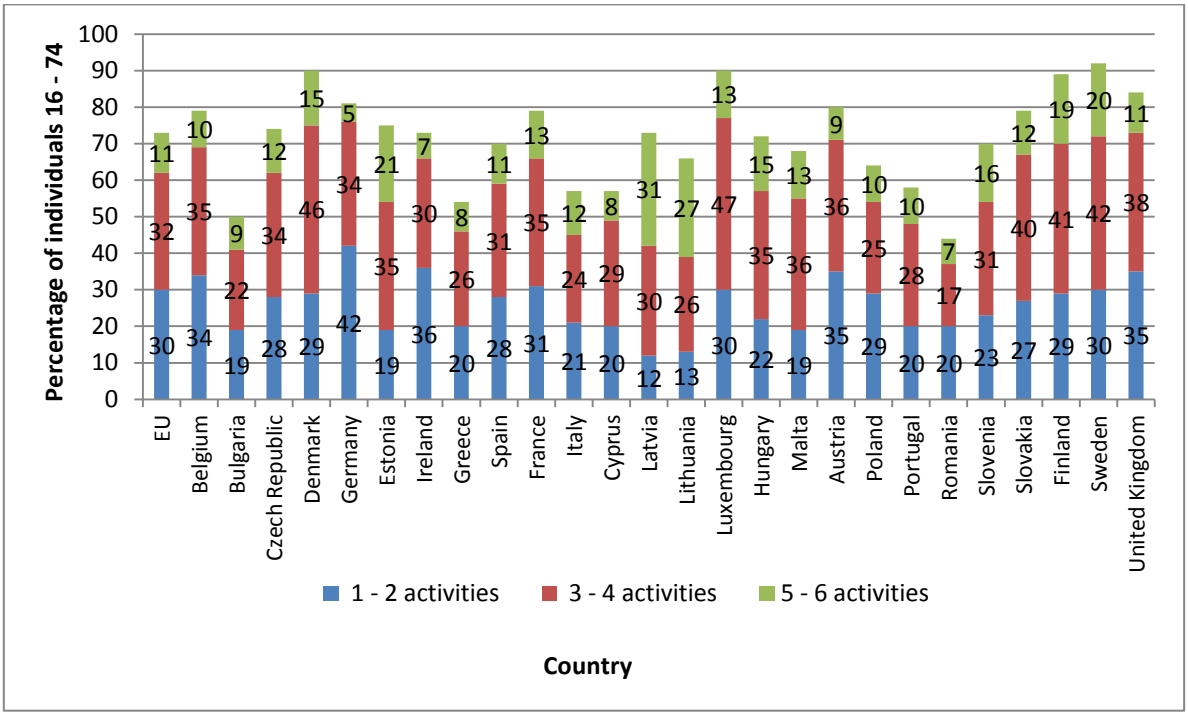


Source: empirica, based on Eurostat tsdsc460.

The share of individuals who carried out 1 – 6 Internet related activities increased in all six largest EU economies in 2010 compared to 2007. The fastest growth was seen in France, in which the percentage increased by 16 percent. In 2011 the growth rates were decelerating or even decreasing in all six countries. Italy, Poland, Spain and United Kingdom reported numbers which rates of growth were decelerating, while Germany and France experienced a slight decrease in the percentage of Internet users.

In general, the average increase in the percentage of Internet users over the period of 2007 – 2011 was very similar in 5 largest EU countries: the share of Internet users in Italy increased by 3.75 percentage points, in Spain, France and Poland by 3.5 and in United Kingdom by 3,25 percentage points. The aforementioned number in Germany was a little lower – 1.75 percentage points, which led to the fact that Germany gave up its position of country with the highest share of Internet users to United Kingdom in 2010 and 2011.

Figure A-6: Percentage of individuals in EU countries by amount of Internet related activities in 2011



Source: empirica, based on Eurostat tsdsc460.

The variations in the Internet skills are significant across countries: the percentage of individuals who carried out 1 – 6 Internet related activities reaches 90 percent level in Sweden, Denmark, Luxembourg, while in Romania and Bulgaria it does not exceed 50 percent. The highest percentages of individuals who carried out 1 – 2 Internet related activities is reported in Germany (42 percent). In Latvia and Lithuania the aforementioned number reached only 12 and 13 percent levels, respectively. The largest shares of individuals who carried out 3 – 4 computer related activities were reported in Luxembourg (47 percent) and Denmark (46 percent) while in Romania, Cyprus and Bulgaria this number was 7 – 9 percent. Latvia and Lithuania reported exceptionally large percentages of individuals who carried out 5 – 6 Internet related activities (31 and 27 percent, respectively) which are nearly three times larger than the average of EU (11 percent).

Table A-4: Percentage of individuals who carried out certain number of Internet related activities by occupation, education and age groups in EU - 27

	2007				2009				2011			
Indicator/Number of internet related activities	1 - 2	3 - 4	5 - 6	Total	1 - 2	3 - 4	5 - 6	Total	1 - 2	3 - 4	5 - 6	Total
Occupation												
Employees, self-employed, family workers	36	26	9	**71**	38	35	11	**84**	35	37	12	**84**
Students	19	48	28	**95**	17	51	29	**97**	14	53	31	**98**
Retired and other	18	8	1	**27**	26	12	2	**40**	25	14	2	**41**

	2007				2009				2011			
Indicator/Number of internet related activities	1 - 2	3 - 4	5 - 6	Total	1 - 2	3 - 4	5 - 6	Total	1 - 2	3 - 4	5 - 6	Total
inactive												
Unemployed	25	22	8	**55**	30	29	10	**69**	29	32	11	**72**
Education												
Individuals with no or low formal education	18	14	5	**37**	23	20	7	**50**	25	22	7	**54**
Individuals with medium formal education	34	23	8	**65**	37	31	9	**77**	34	33	11	**78**
Individuals with high formal education	39	36	13	**88**	35	42	16	**93**	32	45	18	**95**
Age groups												
16-24 years old	22	43	23	**88**	19	50	25	**94**	17	51	27	**95**
25-54 years old	35	25	8	**68**	37	33	10	**80**	35	36	11	**82**
55-64 years old	27	11	1	**39**	35	16	2	**53**	34	18	3	**55**
65-74 years old	13	4	0	**17**	22	7	0	**29**	21	9	1	**31**

Source: empirica, based on Eurostat tsdsc460.

Students are the most active Internet users group among different types of occupation groups. The percentage of students who carried out 1 – 6 Internet related activities increased from 95 percent in 2007 to 98 percent in 2011. The high percentages in 5 – 6 Internet related activities category reveals the fact that this group is highly Internet proficient as well. The share of employed individuals who carried out 1 – 6 Internet related activities reached 71 percent in 2007 and 84 percent in 2009 and 2011. However, the distribution of percentages among the number of activities carried out shows that this group tends to carry out less diverse Internet related activities than students. The Internet usage among unemployed individuals was above 50 percent level and experienced increasing trend in 2007 – 2009. Retired and other inactive individuals remained the least active Internet users group with very low percentage in the category of 5 – 6 Internet related activities usage.

Individuals with higher education tend to use Internet more actively: in 2011 95 percent of people with high formal education carried out 1 – 6 Internet related activities while in the groups of medium and no or low formal education the numbers were 78 and 54, respectively. Individuals with high formal education tend to perform more varied Internet related tasks too. However, this difference is not very significant. For example, in 2011 19 percent of individuals who used Internet carried out 5 – 6 Internet related activities while in the other two groups these numbers are 14 (medium formal education) and 13 percent (no or low formal education).

The highest percentage of individuals who carried out 1 – 6 Internet related activities is within the age group of 16 – 24 years. In general, the Internet usage and the usage of more varied Internet activities decreases as age group increases.

A-1.2) Practitioner Skills

Table A-5: Labour Force Survey data on e-Skills demand and supply

	Management and Business Architecture level skills	Core ICT practitioners	Other ICT technicians	ICT mechanics and manual	Total
EU-27	1.422.000	4.239.000	1.006.000	1.390.000	8.058.000
UK	383.400	918.300	40.800	138.800	1.481.300
DE	304.600	677.200	164.900	225.900	1.372.600
FR	95.900	499.600	244.700	90.900	931.100
IT	64.600	409.700	91.500	172.000	737.800
ES	74.200	322.600	75.500	132.300	604.500
PL	51.300	220.500	91.000	126.700	489.400
NL	127.700	154.900	33.300	23.300	339.100
SE	87.400	118.700	28.900	37.500	272.500
CZ	9.400	125.500	28.400	52.400	215.700
RO	20.900	81.800	19.100	80.100	201.800
BE	38.800	108.200	21.500	33.000	201.500
HU	6.500	70.200	11.600	75.000	163.200
AT	25.400	77.700	28.100	22.500	153.800
FI	28.900	85.600	10.700	19.700	144.900
SK	8.800	41.200	35.200	43.700	128.900
DK	21.700	75.500	17.800	9.300	124.300
PT	10.400	55.800	20.400	22.100	108.600
IE	11.500	48.400	2.100	20.200	82.100
BG	15.000	35.400	10.700	16.600	77.700
GR	9.100	38.300	12.900	12.900	73.300
SI	7.700	16.800	4.300	12.700	41.400
EE	2.700	14.000	2.800	8.500	28.000
LT	4.700	12.800	4.400	5.700	27.600
LV	5.900	15.800	2.600	2.100	26.400
LU	2.100	6.500	1.300	1.000	10.800
CY	1.900	4.200	1.000	2.600	9.500
MT	1.300	3.800	1.200	3.200	9.400

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

Notes: The data are averages of Q1 and Q2 data 2011. ISCO08 -based definitions are found below.

Source: European Labour Force Survey.

Table A-6 : Labour Force Survey data on e-Skills demand and supply – as percent of Labour Force

	Management and Architecture	Core ICT practitioners	Other ICT technicians	ICT mechanics and manual	Total
EU-27	0,7%	2,0%	0,5%	0,6%	3,7%
SE	1,9%	2,6%	0,6%	0,8%	5,9%
FI	1,2%	3,5%	0,4%	0,8%	5,9%
MT	0,8%	2,2%	0,7%	1,9%	5,6%
SK	0,4%	1,8%	1,5%	1,9%	5,5%
UK	1,3%	3,2%	0,1%	0,5%	5,1%
LU	0,9%	2,9%	0,6%	0,4%	4,8%
EE	0,5%	2,4%	0,5%	1,4%	4,7%
DK	0,8%	2,8%	0,7%	0,3%	4,6%
IE	0,6%	2,7%	0,1%	1,1%	4,5%
BE	0,9%	2,4%	0,5%	0,7%	4,5%
SI	0,8%	1,8%	0,5%	1,4%	4,4%
CZ	0,2%	2,6%	0,6%	1,1%	4,4%
HU	0,2%	1,9%	0,3%	2,0%	4,3%
NL	1,5%	1,9%	0,4%	0,3%	4,1%
AT	0,6%	1,9%	0,7%	0,5%	3,7%
FR	0,4%	1,9%	1,0%	0,4%	3,6%
DE	0,8%	1,7%	0,4%	0,6%	3,5%
ES	0,4%	1,8%	0,4%	0,7%	3,3%
IT	0,3%	1,8%	0,4%	0,7%	3,2%
PL	0,3%	1,4%	0,6%	0,8%	3,1%
LV	0,6%	1,7%	0,3%	0,2%	2,8%
BG	0,5%	1,2%	0,4%	0,6%	2,7%
CY	0,5%	1,1%	0,3%	0,7%	2,5%
PT	0,2%	1,1%	0,4%	0,5%	2,2%
RO	0,2%	0,9%	0,2%	0,9%	2,2%
LT	0,3%	0,9%	0,3%	0,4%	2,0%
GR	0,2%	0,9%	0,3%	0,3%	1,8%

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

Notes: The data are averages of Q1 and Q2 data 2011. ISCO08 -based definitions are found below.

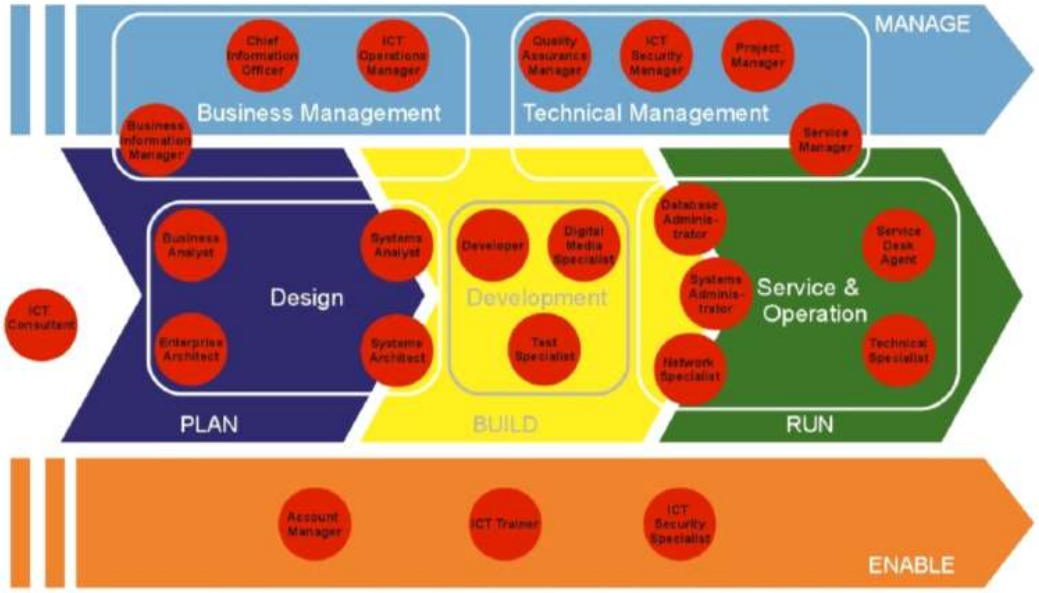
Source: European Labour Force Survey.

Definition “practitioner skills”

The quantification of the **ICT practitioner skills** uses the new ISCO-08 classification and the European ICT Profiles. Since from 2011 onwards the ISCO-08 classification will be used by the national statistical offices, it is necessary to develop some mapping of the much more detailed occupational groups of relevance in ISCO-08 to the previously used rather general occupational groups. Eurostat does not offer this mapping between the two versions of the ISCO classification. For the forecasting exercise, the study team will try to map ISCO-08 as much as possible to the older classification, but we propose to use the break in the ISCO series of statistical data to also introduce a new classification scheme to define groups of occupations as statistical compounds.

The results of a first mapping exercise for ICT practitioner skills are provided in the overview tables below.

Figure A-7: ICT Profiles structured by families and positioned within the ICT Business Process (e-CF Dimension 1)



Source: CWA 16458:2012: European ICT Profiles, p.5.

We took this as a starting point and mapped (a subgroup of) these ICT profiles to the new ISCO categories. However, not only occupational groups covered by the CWA but further ISCO groups are included, as in the Table below.

Table A-7 : Mapping of ICT profiles to ISCO-08 categories

European ICT Profile title	Functions	ICT Profile Summary statement	*Alternative titles used on the market for similar Profiles*	Initial Mapping to ISCO-08	Statistical ICT practitioner partition
Account Manager	Enable	Senior focal point for client sales and customer satisfaction.	• Sales Advisor (AITTS) • Customer Representative (General multi-sector use)	**1221 Sales and marketing managers** **2434 Information and communications technology sales professionals**	**None** **Core ICT practitioner skills**
Business Analyst	Design	Analyses Information System for improving business performance.	• Business Development Manager (ICT Role, ACS) • Business Intelligence Developer (Microsoft) • Business/ Systems Analyst (ICT-Role)	**2511 Systems analysts** (definition explicitly includes "Business analyst (IT)")	**ICT Management and Business architecture skills**
Business Information Manager	Manage, Design	Proposes plans and manages functional and technical evolutions of the Information System within the relevant business domain.	Ditto	**133 ICT service managers**	**ICT Management and Business architecture skills**
Chief Information Officer	Manage	Develops and maintains Information Systems for the Business and Company needs.	• Head of Computing (Demand side title)	**133 ICT service managers**	**ICT Management and Business architecture skills**
Database Administrator	Build, Run	Designs and implements, or monitors and maintains databases.	• Database Developer (Microsoft) • Database Manager (Eucip)	**2521 Database designers and administrators**	**Core ICT practitioner skills**
Developer	Build	Builds/codes ICT solutions and specifies ICT products according to the customer needs.	• Component Developer (AITTS) • Application Developer (ITA-J) • Programmer (IBM)	**2512 Software developers** **2514 Applications programmers** **2519 Software and applications developers and analysts not**	**Core ICT practitioner skills**

European ICT Profile title	Functions	ICT Profile Summary statement	*Alternative titles used on the market for similar Profiles*	Initial Mapping to ISCO-08	Statistical ICT practitioner partition
				elsewhere classified	
Digital Media Specialist	Build	Creates websites and multimedia applications combining the power of digital technology with effective use of graphics, audio, photographic and video images.	• Web & Multimedia Master (Eucip) • Web Content Manager (UK-Gov) • Web Developer (Bring-IT-On, • Microsoft, UK-Gov) • Web Editor (UK-Gov) • Digital Media Developer (AITTS) • Multimedia Designer (Bring-IT-On) • Multimedia Developer (ACS)	**2513 Web and multimedia developers** **3514 Web technicians**	**Core ICT practitioner skills**
Enterprise Architect	Plan	Designs and maintains the Enterprise Architecture	•	**133 ICT service managers**	**ICT Management and Business architecture skills**
ICT Consultant	*Outside*	Helps to provide understanding of how new ICT technologies add value to a business.	• Consultant (ACS) • Consultant and Contractor (ACS) • Enterprise Solutions Consultant (Eucip) • Logistics & Automation Consultant • (Eucip) • Sales & Application Consultant (Eucip) • Technical Consultant (Bring-IT-On)	**2421 Management and organization analysts**	**ICT Management and Business architecture skills**
ICT Operations Manager	Manage	Manages operations, people and further resources for the ICT activity.	• IS Service Manager (Airbus) • Service Advisor (AITTS) • Computing Manager (Demand side title)	**133 ICT service managers**	**ICT Management and Business architecture skills**

European ICT Profile title	Functions	ICT Profile Summary statement	*Alternative titles used on the market for similar Profiles*	Initial Mapping to ISCO-08	Statistical ICT practitioner partition
ICT Security Manager	Manage	Manages the Information System security policy.	• Security Advisor (Eucip) • Security Analyst (ACS) • Security Service Personal (UK-Gov) • Security Services Specialist (ITA-J) • Security Specialist (aux, ICT Role) • Security Technician (AITTS)	**133 ICT service managers**	**ICT Management and Business architecture skills**
ICT Security Specialist	Enable (also Plan, Run, Build?)	Ensures the implementation of the organizations security policy	Ditto	**2529 Database and network professionals not elsewhere classified** (definition explicitly includes "Security specialist (ICT)")	**Core ICT practitioner skills**
ICT Trainer	Enable	Educates and trains ICT professionals and practitioners to reach predefined standards of ICT technical /business competence	• Technical Trainer (IBM) • Instructor (multi-sector common title)	**2356 Information technology trainers**	***Core ICT practitioner skills***
Network Specialist	Build, Run	Ensures the alignment of the network domain to organization communication needs.	• Network Engineer (Bring-IT-On, UK Gov) • Network Manager (Eucip, UK Gov) • Network Services Specialist (ITA-J) • Network Support (ACS)	**2523 Computer network professionals** **3513 Computer network and systems technicians**	Core ICT practitioner skills
Project Manager	Manage	Manages project to achieve optimal performance that conforms to original specifications.	• IS Project Manager (Eucip) • Project Coordinator (AITTS)	**133 ICT service managers**	**eLeader**
Quality Assurance Manager	Manage	Guarantees that Information Systems are delivered according to organization policies (quality,	• Quality Management Coordinator(AITTS) • Quality Manager (SME)	**133 ICT service managers**	**ICT Management and Business architecture skills**

European ICT Profile title	Functions	ICT Profile Summary statement	*Alternative titles used on the market for similar Profiles*	Initial Mapping to ISCO-08	Statistical ICT practitioner partition
		risks, Service Level Agreement).			
Service Desk Agent	Run	Provides first line telephone or email support to clients with technical issues.	• Help Desk Supervisor (Eucip) • Helpdesk Professional (UK-Gov)	**3512 Information and communications technology user support technicians**	**Core ICT practitioner skills**
Service Manager	Manage, Run	Plans implements and manages solution provision	• Service Advisor (AITTS) • IS Service Manager (Airbus)	**133 ICT service managers**	**ICT Management and Business architecture skills**
Systems Administrator	Build, Run	Administers ICT System components to ensure service required	• Network Administrator (ACS) • Server Administrator (Microsoft) • System Administrator (SME) • Database Administrator (Microsoft) • Enterprise Administrator (Microsoft) • Enterprise Messaging Administrator • (Microsoft)	**2522 Systems administrators**	**Core ICT practitioner skills**
Systems Analyst	Plan, Build	Ensures the technical design and contributes to implementation of new software and/or enhancements.	• Information Scientist (UK-Gov) • Information Systems Analyst (Eucip, ACS)	**2511 Systems analysts**	**ICT Management and Business architecture skills**
Systems Architect	Plan, Build	Plans and is accountable for the implementation and integration of software and/or ICT systems	• Telecommunications Architect (Eucip)	Probably a mix of **133 ICT service managers** **2511 Systems analysts 2521 Database designers and administrators**	**ICT Management and Business architecture skills**

European ICT Profile title	Functions	ICT Profile Summary statement	*Alternative titles used on the market for similar Profiles*	Initial Mapping to ISCO-08	Statistical ICT practitioner partition
Technical Specialist	Run	Maintains and repairs hardware and software on client premises.	• Computer Service and Repair Technician (UK-Gov) • Consumer Support Technician (Microsoft) • Service Engineer (general multi-sector use) • Customer Engineer (IBM)	Probably a mix of **3511 Information and communications technology operations technicians** **3514 Web technicians**	**Core ICT practitioner skills**
Test Specialist	Build	Designs and performs testing plans.	• Computer Games Tester (UK-Gov) • Software Tester (SME) • Systems Integration & Testing Engineer (Eucip) • Test Specialist (ITA-J) • Tester (AITTS)	Probably a mix of **2511 Systems analysts** **2512 Software developers** **2514 Applications programmers** **2519 Software and applications developers and analysts not elsewhere classified**	**Core ICT practitioner skills**

Columns 1-3 are reproduced from the CEN Draft CWA.

Table A-8: Definition of ICT skills in terms of ISCO-08

		Management and Architecture	Core ICT practitioners	Other ICT technicians	ICT mechanics and manual workers
1330	Information and communications technology service managers	1			
2421	Management and organization analysts	1			
2511	Systems analysts	1			
2152	Electronics engineers		1		
2153	Telecommunications engineers		1		
2356	Information technology trainers		1		
2434	Information and communications technology sales professionals		1		
2512	Software developers		1		
2513	Web and multimedia developers		1		
2514	Applications programmers		1		
2519	Software and applications developers and analysts not elsewhere classified		1		
2521	Database designers and administrators		1		
2522	Systems administrators		1		
2523	Computer network professionals		1		
2529	Database and network professionals not elsewhere classified		1		
3511	Information and communications technology operations technicians		1		
3512	Information and communications technology user support technicians		1		
3513	Computer network and systems technicians		1		
3514	Web technicians		1		
3114	Electronics engineering technicians			1	
3139	Process control technicians not elsewhere classified			1	
3252	Medical records and health information technicians			1	
3155	Air traffic safety electronics technicians			1	
3211	Medical imaging and therapeutic equipment technicians			1	
3521	Broadcasting and audio-visual technicians			1	
3522	Telecommunications engineering technicians			1	
7421	Electronics mechanics and servicers				1
7422	Information and communications technology installers and servicers				1
8212	Electrical and electronic equipment assemblers				1

Source: empirica, 2012

A-2) Doing Business Indicators

Table A-9: Ease and cost of doing business, ranks, 2011

Economy	Ease of Doing Business	Rank EU-26	Starting a Business	Dealing with Construction Permits	Getting Electricity	Registering Property	Getting Credit	Protecting Investors	Paying Taxes	Trading Across Borders	Enforcing Contracts	Resolving Insolvency
Singapore	1		4	3	5	14	8	2	4	1	12	2
Hong Kong SAR, China	2		5	1	4	57	4	3	3	2	5	16
United States	4		13	17	17	16	4	5	72	20	7	15
Denmark	5	1	31	10	13	11	24	29	14	7	32	9
Norway	6		41	60	12	8	48	24	27	9	4	4
United Kingdom	7	2	19	22	60	68	1	10	24	13	21	6
Korea, Rep.	8		24	26	11	71	8	79	38	4	2	13
Ireland	10	3	13	27	90	81	8	5	5	21	62	10
Finland	11	4	39	45	25	25	40	65	28	6	11	5
Sweden	14	5	46	23	8	19	48	29	50	8	54	19
Australia	15		2	42	37	38	8	65	53	30	17	17
Germany	19	6	98	15	2	77	24	97	89	12	8	36
Japan	20		107	63	26	58	24	17	120	16	34	1
Latvia	21	7	51	112	84	32	4	65	67	15	17	32
Estonia	24	8	44	89	48	13	40	65	51	3	29	72
Lithuania	27	9	101	47	81	7	48	65	62	28	15	40
Belgium	28	10	36	51	87	174	48	17	77	36	20	8
France	29	11	25	30	62	149	48	79	58	24	6	46
Portugal	30	12	26	97	34	31	126	46	78	26	22	22
Netherlands	31	13	79	99	67	48	48	111	43	13	28	7
Austria	32	14	134	76	21	35	24	133	82	25	9	21
South Africa	35		44	31	124	76	1	10	44	144	81	77
Slovenia	37	15	28	81	27	79	98	24	87	50	58	39

Economy	Ease of Doing Business	Rank EU-26	Starting a Business	Dealing with Construction Permits	Getting Electricity	Registering Property	Getting Credit	Protecting Investors	Paying Taxes	Trading Across Borders	Enforcing Contracts	Resolving Insolvency
Cyprus	40	16	33	78	96	123	78	29	37	19	105	23
Spain	44	17	133	38	69	56	48	97	48	55	54	20
Slovak Republic	48	18	76	50	102	10	24	111	130	95	71	35
Luxembourg	50	19	81	33	63	134	150	122	17	31	1	49
Hungary	51	20	39	55	103	43	48	122	117	74	19	66
Bulgaria	59	21	49	128	133	66	8	46	69	91	87	90
Poland	62	22	126	160	64	89	8	46	128	46	68	87
Czech Republic	64	23	138	68	148	34	48	97	119	70	78	33
Turkey	71		61	155	72	44	78	65	79	80	51	120
Romania	72	24	63	123	165	70	8	46	154	72	56	97
Italy	87	25	77	96	109	84	98	65	134	63	158	30
China	91		151	179	115	40	67	97	122	60	16	75
Greece	100	26	135	41	77	150	78	155	83	84	90	57
Russian Federation	120		111	178	183	45	98	111	105	160	13	60
Brazil	126		120	127	51	114	98	79	150	121	118	136
India	132		166	181	98	97	40	46	147	109	182	128

Source: www.doingbusiness.org/rankings . Note * For Dealing with Construction Permits, one data point on cost was corrected. Rankings are adjusted once a year with each published report. Additional note: All Doing Business 2011 rankings have been recalculated to reflect changes to the methodology. For further details on changes, please refer to the data notes page.

A-3) Education-related data

This section looks at education-related indicators that are important for developing and promoting e-skills for competitiveness and innovation, notably PISA scores of 15-year-olds in reading, mathematics, and science, and enrolment in science, technology, engineering and mathematics (STEM) fields of education.

A-3.1) Country performance in reading, maths and science, and STEM education

OECD (2010b) identifies several factors that contribute to the success of educational systems, such as the role political and social leaders can play in persuading people to make the choices needed to show that they value education more than other things. Embracing the diversity in students' capacities, interests and social background with individualised approaches to learning has also been found to be important, as well as having clear and ambitious standards that are shared across the system, that focus on the acquisition of complex, higher-order thinking skills, and that are aligned with high stakes gateways and instructional systems. It is important people understand what is required to get a given qualification, both in terms of the content studied and the level of performance. The quality of teachers and principals is also crucial. Decentralisation in the school system, giving teachers and principals more control over the way resources are used, people are deployed, the work is organised and the way in which the work gets done, and providing considerable discretion to school heads and school faculties in determining content and the curriculum also plays a role. Indeed, the latter has been found to be closely related to school performance when combined with effective accountability systems. These are important findings to bear in mind when thinking about how to improve the education system in the context of 'dual thinkers' and e-leaders.

In a world where countries and firms compete globally for talent and skills it is important to look at 'talent that is in the pipeline', not only in the EU but also beyond. The 2009 PISA (Programme for International Student Assessment; OECD, 2010b) results show that students (15-year-olds) in many EU countries perform at or even below the OECD average in reading, maths and science (Table 2.5). It is important to improve this performance as it lays the foundation for skills for competitiveness and innovation, and while some non-EU countries are already performing better than certain EU member countries, others are catching up rapidly. Finland is the highest scoring EU member state, performing well in the reading and science scales, but its performance already drops on the mathematics scale. The next EU countries to be found further down the list are the Netherlands and Belgium, with already lower scores but still performing significantly above the OECD average across the three broad scales (reading, mathematics and science). A number of EU member states perform at or significantly below the OECD average, in some or all of the scales.

Table A-10: Comparing student performance in reading, maths and science, country PISA results, 2009

	On the overall reading scale	On the reading subscales					On the mathematics scale	On the science scale
		Access and retrieve	*Integrate and interpret*	*Reflect and evaluate*	*Continuous texts*	*Non-continuous texts*		
Shanghai-China	556	549	558	557	564	539	600	575
Korea	539	542	541	542	538	542	546	538
Finland	536	532	538	536	535	535	541	554
Hong Kong-China	533	530	530	540	538	522	555	549
Singapore	526	526	525	529	522	539	562	542
Canada	524	517	522	535	524	527	527	529
New Zealand	521	521	517	531	518	532	519	532
Japan	520	530	520	521	520	518	529	539
Australia	515	513	513	523	513	524	514	527
Netherlands	508	519	504	510	506	514	526	522
Belgium	506	513	504	505	504	511	515	507
Norway	503	512	502	505	505	498	498	500
Estonia	501	503	500	503	497	512	512	528
Switzerland	501	505	502	497	498	505	534	517
Poland	500	500	503	498	502	496	495	508
United States	500	492	495	512	500	503	487	502
Sweden	497	505	494	502	499	498	494	495
Germany	497	501	501	491	496	497	513	520
Ireland	496	498	494	502	497	496	487	508
France	496	492	497	495	492	498	497	498
Denmark	495	502	492	493	496	493	503	499
United Kingdom	494	491	491	503	492	506	492	514
Hungary	494	501	496	489	497	487	490	503
Portugal	489	488	487	496	492	488	487	493
Italy	486	482	490	482	489	476	483	489
Latvia	484	476	484	492	484	487	482	494
Slovenia	483	489	489	470	484	476	501	512
Greece	483	468	484	489	487	472	466	470
Spain	481	480	481	483	484	473	483	488
Czech Republic	478	479	488	462	479	474	493	500
Slovak Republic	477	491	481	466	479	471	497	490
Croatia	476	492	472	471	478	472	460	486
Israel	474	463	473	483	477	467	447	455
Luxembourg	472	471	475	471	471	472	489	484
Austria	470	477	471	463	470	472	496	494
Lithuania	468	476	469	463	470	462	477	491
Turkey	464	467	459	473	466	461	445	454
Russian Federation	459	469	467	441	461	452	468	478
Chile	449	444	452	452	453	444	421	447
Serbia	442	449	445	430	444	438	442	443
Bulgaria	429	430	436	417	433	421	428	439
Mexico	425	433	418	432	426	424	419	416
Romania	424	423	425	426	423	424	427	428
Brazil	412	407	406	424	414	408	386	405

Statistically significantly above the OECD average

Not statistically significantly different from the OECD average

Statistically significantly below the OECD average

Source: OECD PISA 2009 database.

Table A-11: ISCED5 graduates all STEM fields, total and by gender, 2010 (**Source**: Eurostat educ_grad5)

	2010	total[45]	female[46]	male[47]
EU 27	740,880	22.4%	6.9%	15.5%
Belgium	8,899	13.5%	2.6%	10.8%
Bulgaria	7,761	21.3%	8.1%	13.2%
Czech Republic	13,895	20.7%	6.1%	14.6%
Denmark	6,899	17.4%	6.3%	11.2%
Germany	125,198	24.6%	7.5%	17.2%
Estonia	1,589	18.2%	6.3%	11.9%
Ireland	10,363	25.5%	7.0%	18.5%
Greece	14,234	26.6%	10.3%	16.3%
Spain	71,676	24.9%	7.0%	17.9%
France	128.771*	25.9% *	6.8% *	19.1% *
Italy	48,591	22.6%	8.8%	13.8%
Cyprus	554	13.8%	5.2%	8.6%
Latvia	2,805	13.8%	3.9%	9.9%
Lithuania	7,562	21.6%	5.7%	16.0%
Luxembourg	157	12.6%	3.8%	8.8%
Hungary	9,944	17.2%	5.0%	12.2%
Malta	427	18.8%	5.9%	12.9%
Netherlands	12,334	13.4%	2.4%	11.0%
Austria	12,948	28.4%	6.3%	22.0%
Poland	68,251	18.9%	7.0%	11.9%
Portugal	11,869	22.0%	7.6%	14.4%
Romania	33,259	17.4%	6.6%	10.8%
Slovenia	3,707	21.1%	5.7%	15.4%
Slovakia	8,302	19.4%	6.6%	12.8%
Finland	9,069	27.5%	7.3%	20.1%
Sweden	11,362	23.5%	7.9%	15.6%
United Kingdom	110,454	22.8%	6.8%	16.0%
Iceland	483	16.3%	7.0%	9.3%
Norway	4,286	14.8%	4.2%	10.6%
Switzerland	10,145	19.2%	2.8%	16.4%
Croatia	6,334	19.6%	7.2%	12.4%
Macedonia	1,934	19.4%	7.6%	11.9%
Turkey	107,536	20.7%	6.3%	14.4%
United States	352,784	16.4%	5.0%	11.4%
Japan	152,371	17.6%	2.5%	15.0%

[45] share of 2010 STEM graduates in ISCED5 graduates

*: 2009

[46] share of 2010 female STEM graduates in ISCED5 graduates

[47] share of 2010 male STEM graduates in ISCED5 graduates

Table A-12: ISCED 5 Graduates[48], Total, all fields

	2010	%[49]	2009	%[50]	2008	2007	2006	2005	2004	2003	2002
EU-27	3,310,795	100,0%	3,276,194	100.0%	3,273,268	3,092,340	3,026,274	2,932,969	2,837,966	2,731,283	2,564,888
Belgium	66,066	2,0%	63,726	1.9%	74,125	86,519	64,941	64,022	62,988	61,081	61,818
Bulgaria	36,477	1,1%	35,501	1.1%	33,656	30,946	29,830	29,535	30,836	39,011	33,866
Czech Republic	67,184	2,0%	63,487	1.9%	62,797	58,093	53,178	46,825	40,522	34,746	34,668
Denmark	39,608	1,2%	35,475	1.1%	37,390	38,241	37,229	38,731	37,008	31,408	31,608
Germany	508,261	15,4%	491,503	15.0%	420,073	393,705	371,985	301,552	296,653	281,730	270,082
Estonia	8,732	0,3%	9,062	0.3%	8,864	10,330	9,868	10,127	8,554	8,373	7,732
Ireland	40,631	1,2%	41,853	1.3%	45,340	44,783	45,556	46,653	38,643	37,584	30,395
Greece	53,514	1,6%			56,791	49,727		53,140	41,830		
Spain	287,600	8,7%	279,055	8.5%	267,879	264,796	275,493	281,256	290,280	291,922	284,520
France			496,733	15.2%	490,295	491,554	487,700	468,390		501,287	
Italy	214,965	6,5%	226,012	6.9%	235,675	256,445	279,492	297,603	267,795	234,906	208,306
Cyprus	4,011	0,1%	3,537	0.1%	3,599	3,811	3,316	3,295	3,125	2,917	2,839
Latvia	20,297	0,6%	18,704	0.6%	17,017	19,120	19,271	19,190	16,796	14,409	18,865
Lithuania	34,951	1,1%	34,968	1.1%	33,549	34,389	34,774	32,508	30,635	27,023	21,959
Luxembourg	1,244	0,0%									
Hungary	57,880	1,7%	59,095	1.8%	55,293	57,557	59,244	62,361	58,352	56,082	52,424
Malta	2,270	0,1%	2,281	0.1%	2,178	2,199	2,165	2,259		1,783	1,717
Netherlands	92,365	2,8%			89,331	92,844					77,510
Austria	45,611	1,4%	43,153	1.3%	36,126	32,063	31,069	29,658	27,649	26,486	24,366
Poland	360,396	10,9%	333,593	10.2%	328,316	315,829	299,065	293,496	284,497	275,042	265,710
Portugal	54,030	1,6%	56,401	1.7%	68,977	72,672	63,428	63,390	64,705	64,788	61,107
Romania	191,291	5,8%	214,826	6.6%	232,885	125,499	112,244	108,475	110,533	103,402	93,467
Slovenia	17,572	0,5%	15,759	0.5%	15,212	14,769	15,226	14,272	13,437	12,482	12,902
Slovakia	42,772	1,3%	54,354	1.7%	50,796	34,817	31,566	29,007	28,715	25,994	27,428
Finland	33,033	1,0%	30,943	0.9%	57,567	40,823	38,004	37,740	36,657	36,249	36,112
Sweden	48,439	1,5%	49,084	1.5%	51,664	51,952	53,125	51,378	47,342	43,610	40,762
United Kingdom	484,862	14,6%	469,853	14.3%	497,873	468,857	460,765	458,073	413,558	436,543	406,294
Iceland	2,968	0,1%	2,541	0.1%	2,869	2,918	2,973	2,609	2,542	2,321	1,973
Norway	28,904	0,9%	27,155	0.8%	27,407	26,908	26,758	26,037	27,220	25,857	25,570
Switzerland	52,896	1,6%	52,602	1.6%	52,682	50,681	44,489	40,295	39,220	36,272	35,844
Croatia	32,378	1,0%	30,156	0.9%	25,573	20,969	19,566	18,190	17,391	15,762	
Macedonia	9,944	0,3%	10,232	0.3%	10,838	8,360	6,213	5,397	5,010	4,404	3,618
Turkey	520,614	15,7%	447,132	13.6%	409,023	378,818	340,599	241,406	231,389	231,395	214,856
United States	2,146,031	64,8%	2,065,053	63.0%	2,001,555	1,948,783	1,901,219	1,843,057	1,782,940	1,712,801	1,631,351
Japan	867,814	26,2%	915,208	27.9%	934,632	963,905	974,960	971,166	966,214	958,083	968,623

Source: empirica calculations based on Eurostat database educ_grad5

[48] first degrees only to avoid double counting as much as possible

[49] EU 27 = 100%

[50] EU 27 = 100%

Table A-13: ISCED 5 Graduates[51] Total, STEM fields

	2010	total[52]	female[53]	male[54]	2009	2008	2007	2006	2005	2004	2003	2002
EU 27	740,880	22,4%	6,9%	15,5%	737,417	740,126	718,300	705,901	689,537	683,929	670,628	628,049
Belgium	8,899	13,5%	2,6%	10,8%	8,815	11,543	15,447	10,823	11,316	12,015	11,977	11,467
Bulgaria	7,761	21,3%	8,1%	13,2%	7,090	6,353	6,207	6,668	6,775	6,422	8,569	6,487
Czech Republic	13,895	20,7%	6,1%	14,6%	14,569	17,006	15,071	13,183	11,267	10,604	9,268	8,958
Denmark	6,899	17,4%	6,3%	11,2%	6,471	7,023	7,393	6,332	6,811	6,720	5,306	5,156
Germany	125,198	24,6%	7,5%	17,2%	117,154	106,983	97,155	90,149	80,353	77,771	71,979	68,047
Estonia	1,589	18,2%	6,3%	11,9%	1,563	1,621	2,040	1,859	1,986	1,405	1,385	1,233
Ireland	10,363	25,5%	7,0%	18,5%	9,842	11,821	11,416	12,685	14,307	11,231	11,409	9,189
Greece	14,234	26,6%	10,3%	16,3%		13,293	10,158		13,447	10,046		
Spain	71,676	24,9%	7,0%	17,9%	70,859	68,512	70,302	73,154	75,911	80,332	81,398	76,712
France		-	-	-	128,771	126,188	128,453	125,944	124,482	0	142,623	0
Italy	48,591	22,6%	8,8%	13,8%	50,234	50,877	55,968	63,539	69,540	65,860	59,783	51,388
Cyprus	554	13,8%	5,2%	8,6%	506	448	480	446	373	401	355	393
Latvia	2,805	13,8%	3,9%	9,9%	2,428	2,163	2,195	2,120	2,295	1,954	1,824	2,607
Lithuania	7,562	21,6%	5,7%	16,0%	7,528	6,928	7,021	7,499	7,085	6,533	5,989	5,380
Luxembourg	157	12,6%	3,8%	8,8%								
Hungary	9,944	17,2%	5,0%	12,2%	9,368	7,889	8,569	8,070	7,123	7,425	6,697	6,527
Malta	427	18,8%	5,9%	12,9%	366	310	370	274	160		189	158
Netherlands	12,334	13,4%	2,4%	11,0%	12,237	12,263	12,992	13,810	13,380	12,750	12,373	12,547
Austria	12,948	28,4%	6,3%	22,0%	12,036	10,097	9,741	9,828	8,977	7,953	7,484	7,140
Poland	68,251	18,9%	7,0%	11,9%	62,305	64,084	66,357	63,258	51,510	48,439	45,943	42,534
Portugal	11,869	22,0%	7,6%	14,4%	13,809	22,345	22,595	16,109	16,519	15,779	11,845	10,689
Romania	33,259	17,4%	6,6%	10,8%	51,100	35,793	26,599	25,230	24,844	24,261	23,977	20,427
Slovenia	3,707	21,1%	5,7%	15,4%	2,876	2,690	2,512	2,452	2,573	2,434	2,214	2,447
Slovakia	8,302	19,4%	6,6%	12,8%	10,194	9,517	7,195	6,505	6,688	6,232	5,651	6,804
Finland	9,069	27,5%	7,3%	20,1%	7,834	15,319	11,558	11,052	11,247	10,972	10,570	10,389
Sweden	11,362	23,5%	7,9%	15,6%	11,568	12,228	12,644	13,832	13,848	14,987	13,223	12,807
United Kingdom	110,454	22,8%	6,8%	16,0%	104,601	116,832	107,862	107,633	106,720	98,993	118,597	116,196
Iceland	483	16,3%	7,0%	9,3%	386	411	390	427	360	412	370	351
Norway	4,286	14,8%	4,2%	10,6%	3,828	3,614	3,405	3,492	3,536	4,319	4,232	3,885
Switzerland	10,145	19,2%	2,8%	16,4%	10,685	10,428	10,995	9,952	9,178	9,125	8,477	8,749
Croatia	6,334	19,6%	7,2%	12,4%	7,335	5,819	3,763	3,364	3,088	2,867	3,011	
Macedonia	1,934	19,4%	7,6%	11,9%	2,159	1,901	1,409	1,290	1,207	1,109	1,005	911
Turkey	107,536	20,7%	6,3%	14,4%	94,588	90,777	82,751	75,760	69,949	69,015	64,693	61,190
United States	352,784	16,4%	5,0%	11,4%	334,976	326,919	327,292	328,472	333,310	321,459	342,833	311,849
Japan	152,371	17,6%	2,5%	15,0%	161,908	167,679	174,231	179,673	181,479	182,755	187,307	190,958

Source: empirica calculations based on Eurostat database educ_grad5

[51] first degrees only to avoid double counting as much as possible

[52] share of 2010 STEM graduates in ISCED5 graduates

[53] share of 2010 female STEM graduates in ISCED5 graduates

[54] share of 2010 male STEM graduates in ISCED5 graduates

Table A-14: ISCED 5 Graduates[55] Total, Computer Science field

	2010	% of EU27	% of all graduates	%of STEM	2009	2008	2007	2006	2005	2004	2003	2002
EU27	113,281	100,0%	3,4%	15,3%	113,929	123,260	122,333	127,257	125,187	115,051	103,343	91,604
Belgium	1,339	1,2%	2,0%	15,0%	1,142	1,843	2,584	2,488	2,738	2,788	2,670	2,378
Bulgaria	978	0,9%	2,7%	12,6%	799	763	746	757	711	667	581	517
Czech Republic	2,939	2,6%	4,4%	21,2%	3,047	2,909	2,406	2,133	1,643	1,498	1,215	2,734
Denmark	1,240	1,1%	3,1%	18,0%	898	871	840	1,000	1,220	1,517	1,389	1,677
Germany	16,800	14,8%	3,3%	13,4%	17,194	16,515	16,092	14,238	12,767	11,090	8,368	6,617
Estonia	402	0,4%	4,6%	25,3%	383	384	558	499	544	362	302	212
Ireland	1,633	1,4%	4,0%	15,8%	1,410				1,076	3,357	4,003	3,215
Greece	2,256	2,0%	4,2%	15,8%		2,238	1,096		2,949	1,328		
Spain	15,068	13,3%	5,2%	21,0%	15,071	14,551	15,760	17,298	18,559	19,718	19,323	16,152
France	0	-	-	-	19,136	17,551	18,409	19,673	20,094		16,081	
Italy	2,778	2,5%	1,3%	5,7%	2,870	2,933	3,385	3,541	3,459	3,211	2,843	2,423
Cyprus	179	0,2%	4,5%	32,3%	192	222	230	183	211	206	188	143
Latvia	583	0,5%	2,9%	20,8%	576	597	607	607	564	542	521	656
Lithuania	970	0,9%	2,8%	12,8%	909	966	1,158	1,198	908	776	607	445
Luxembourg	28	0,0%	2,3%	17,8%								
Hungary	2,171	1,9%	3,8%	21,8%	2,229	2,583	3,024	2,858	1,330	1,287	636	642
Malta	149	0,1%	6,6%	34,9%	148	145	86	120	53		42	39
Netherlands	3,858	3,4%	4,2%	31,3%	3,918	4,078	4,385	4,617	3,902	3,511	1,620	1,645
Austria	1,632	1,4%	3,6%	12,6%	2,026	1,819	2,020	1,902	1,438	1,026	507	451
Poland	12,535	11,1%	3,5%	18,4%	12,406	13,023	14,209	14,788	13,116	10,681	5,879	4,112
Portugal	773	0,7%	1,4%	6,5%	1,009	4,714	4,567	3,166	3,174	2,660	892	929
Romania	2,097	1,9%	1,1%	6,3%	2,845	4,565						
Slovenia	427	0,4%	2,4%	11,5%	337	287	270	201	180	135	115	170
Slovakia	1,499	1,3%	3,5%	18,1%	1,580	1,481	1,366	1,087	1,057	1,101	959	1,042
Finland	1,230	1,1%	3,7%	13,6%	1,057	2,993	1,749	1,719	1,807	1,777	1,613	1,394
Sweden	1,401	1,2%	2,9%	12,3%	1,355	1,427	1,630	1,996	2,130	2,184	2,222	2,161
United Kingdom	19,180	16,9%	4,0%	17,4%	19,154	23,802	25,156	28,239	29,557	27,670	30,767	27,009
Iceland	72	0,1%	2,4%	14,9%	82	80	76	101	100	159	144	173
Norway	773	0,7%	-	18,0%	782	795	742	965	1,221	1,655	1,780	1,655
Switzerland	1,328	1,2%	2,7%	13,1%	1,378	1,706	1,713	2,328	1,867	2,271	1,873	1,779
Croatia	738	0,7%	2,5%	11,7%	1,245	1,151	630	465	447	358	456	
Macedonia	835	0,7%	2,3%	43,2%	867	461	157	87	62	53	44	34
Turkey	16,345	14,4%	8,4%	15,2%	13,868	13,372	12,491	10,723	8,179	8,295	7,429	6,221
United States	72,055	63,6%	3,4%	20,4%	68,000	66,772	69,882	78,726	90,284	101,333	103,878	78,264
Japan	-	-	-	-								

Source: empirica calculations based on Eurostat database educ_grad5

[55] first degrees only to avoid double counting as much as possible

A-3.2) Business schools and MBAs

Providing proper skills for innovative managers and leader has long been a core objective of international business schools such as INSEAD. Flexible and constantly updated curricula, a close cooperation with business and the ICT sector, as well as advanced research and 'frontier thinking' have been the key ingredients of efforts made to generate such skills. In large universities, an engineering school and/or an ICT-centric research laboratory often offers possibilities to mesh competencies (from faculty) and interests (from students): this is the case for example at Harvard, where Sloan's Business School, MIT and its MediaLab are located next to each other, and offer many joint programs in learning and research[56].

More recently, genuine and successful efforts have been initiated to 'engineer serendipity through inter-disciplinarity'. This is the case at Aalto, and advanced university in Finland where design, business and engineering skills are combined and taught simultaneously[57].

Other examples are also worth quoting. For example, the Association to Advance Collegiate Schools of Business (AACSB) had 1 182 registered member business schools throughout the world, with the US accounting for more than half of them (651); with a further 52 non-educational members, there were 1 234 AACSB members in total in January 2011 (AACSB, 2011). More than half of the members offer undergraduate and master's programs (52.6%) and a further 30.8% offer undergraduate, master's and doctoral programs. Furthermore, the AACSB estimated that in January 2011 there were some 13 116 educational institutions worldwide offering business degrees (any level).

Out of 623 reporting schools in 2009-2010, the AACSB found that 49.3% were offering at least one degree program in computer and information systems (CIS)/management information systems (MIS) at undergraduate level, and 16.4% at MBA level, and a further 3.5% and 2.9%,respectively, in e-business (including e-commerce). For specialised master's programs and doctoral programs these percentages were lower, with 25.5% and 23.8% in CIS/MIS, respectively, and 2.5% and 0.4% in e-business, respectively (out of 423 reporting schools).

In 2007-2008, 335 254 degrees were conferred in business and management at undergraduate level[58] (51% male, 49% female), 155 637 at master's level (55.4% male, 44.6% female), and 2 084 at doctoral level (60% male, 40% female). By comparison, in 1969-1970, 105 580 degrees were conferred at undergraduate level (91.3% male, 8.7% female), 21 561 at master's level (96.4% male, 3.6% female), and 620 at doctoral level (98.4% male, 1.6% female).

In MBA enrolment (2009-2010) some significant differences between MBA education in the US and the rest of the world show in full-time accelerated programs (3.7% in the US, 6% non-US), full-time "other"

[56] See http://cisr.mit.edu
[57] See http://www.aalto.fi/en
[58] Based on data from the US Department of Education, National Center for Education Statistics, Higher Education General Information Survey (HEGIS), as reported in AACSB (2011).

programs (4.3% US, 19.3% non-US), part-time evenings and week-ends programs (41.9% US, 13.6% non-US), part-time distance learning (6.4% US, 12.1% non-US), and traditional executive education programs (7.1% US, 15% non-US). The differences are not great in terms of enrolment by gender, with some 62-62% male enrolment in MBAs both in US and non-US, and 52-53% male enrolment in specialised masters.

Based on employer assessments, the European Foundation for Management Development (EFMD) finds that the top five MBA competencies are as follows: (1) managing strategy and innovation, (2) strategic and systems skills, (3) knowledge of general business functions, (4) managing decision-making processes, and (5) learning, motivation and leadership (EFMD, 2011). In addition, surveying over 720 prospective MBA candidates from 22 business schools in 91 countries, it was found that, out of a list of 30 options, the following four were selected by over 30% of respondents: (1) strategic management (40%), (2) managing people and organisations (35%), (3) leadership (33%), and (4) international business (31%). Information management on the other hand is found at the bottom of the list, with less than 15% (and same for financial resources management, business forecasting and modelling, and corporate finance). Overall, a stronger emphasis appears to be put on soft skills rather than on technical skills.

Similarly, the 2010 GMAC Global Management Education Graduate Survey (with responses from 7,180 graduate management students at 147 business schools worldwide, 89% of whom were enrolled in MBA programs), asked students to rate the development of knowledge, skills and abilities. The top two improvements as rated by the students were in (1) general business functions, and (2) managing strategy and innovation. However, the bottom two rated areas were 'managing tools/technology' and 'technology, design and production'.

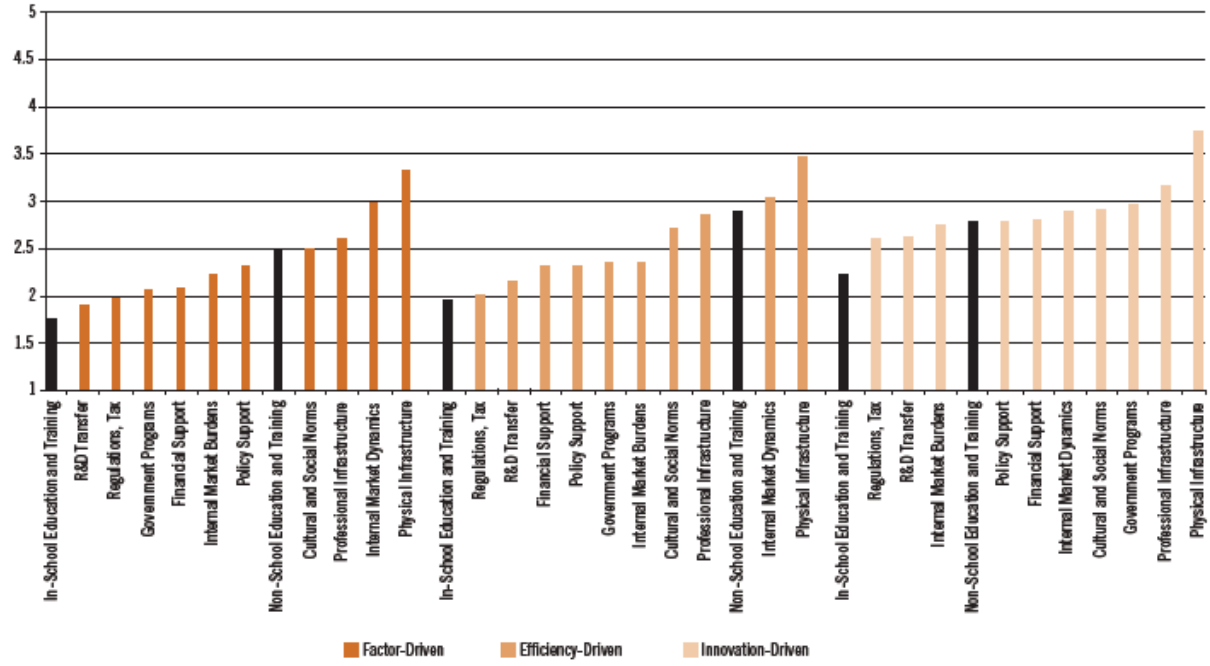
In business schools as elsewhere, one of the challenges to be acknowledged (and handled) in this area stems from the fact that students are often 'power users' of some of the most advanced technologies, and sometimes among the initiators of some of them. At INSEAD, for example, 'IT-centric courses' have tended to be much in fashion until the burst of the Internet bubble (2000-2001), and less attractive after that. Recently, demand has picked up again around social networks, or business analytics, but continues to be seen as highly fluctuating. Organizations such as EFMD have also pioneered innovative approaches in this area[59].

[59] See http://www.efmd.org

A-3.4) Entrepreneurship education and training

One area where the data suggest improvements can be made is in entrepreneurship education in schools. Indeed, in 2008, experts rated "in-school education and training" as lowest among the framework conditions for entrepreneurship in countries in each of three the country groups distinguished by the Global Entrepreneurship Monitor National Expert Survey. Thus, "in-school training and education" was rated lowest among the framework conditions in factor-driven economies, efficiency driven economies, and innovation driven economies, where the EU15 countries included in the survey are in this group of innovation-driven economies, and other European countries included in the survey are in the efficiency-driven group (Figure 2.7).

Figure A-8: Average rating of entrepreneurial framework conditions (2008)

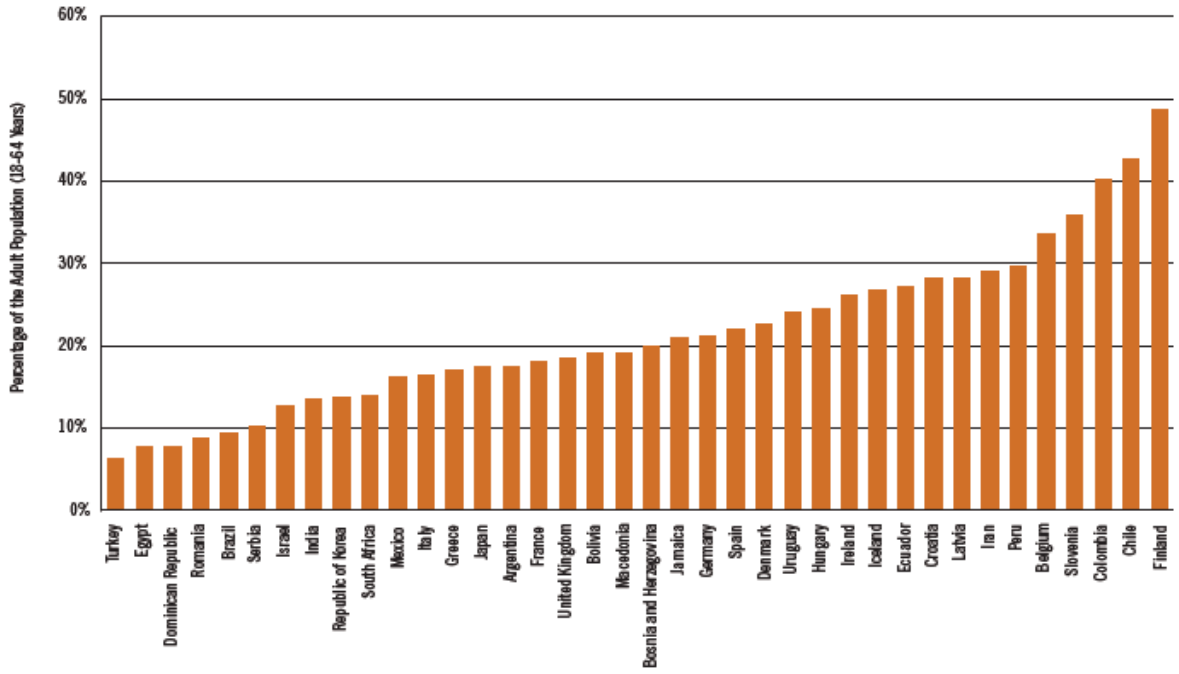


Note: Framework conditions are ordered from the lowest to the highest evaluation within each economic group. The measures range from 1 = poor to 5 = excellent. Total number of countries in sample: 31.

Note: Average ratings by national experts on the level of entrepreneurial framework conditions in their countries, by economic group.
Source: Coduras Martines *et al.* (2010), Figure 2, based on the GEM National Expert Survey 2008.

Belgium, Slovenia and Finland are the European Union countries in the sample that reported the highest rates of individuals in the workforce having received training to start a business, and Romania, Italy and Greece the lowest (Figure 2.8).

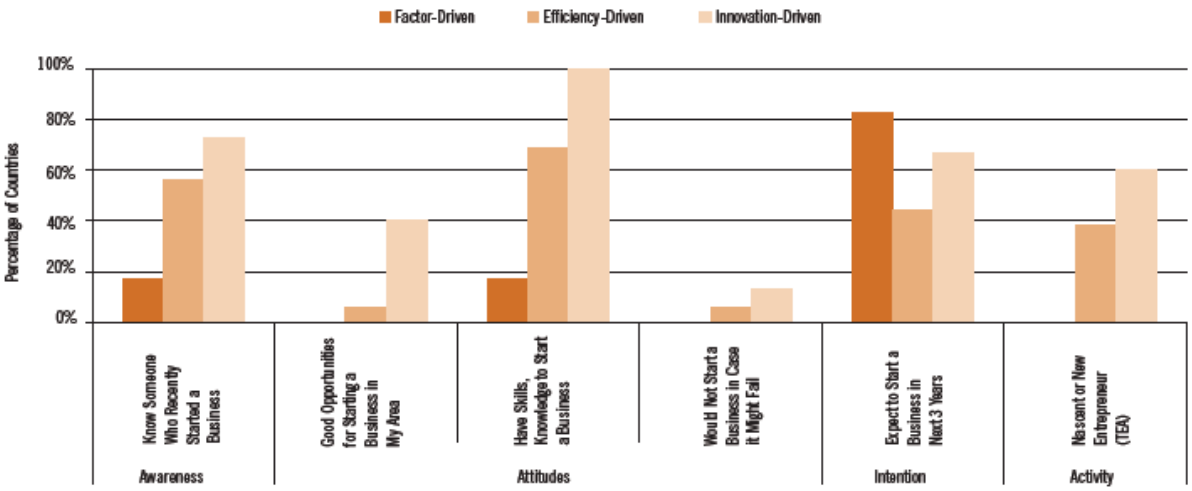
Figure A-9: Percentage of the working age population (18-64) having received training to start a business (2008)



Source: Coduras Martines *et al.* (2010), Figure 7, based on the GEM National Expert Survey 2008.

Overall, the effects of training on attitudes and awareness tend to be muted in (relatively poorer) factor-driven countries where entrepreneurship is often driven by necessity, and higher in innovation-driven countries (which also include the EU15 countries in the sample). Even though training rates are often relatively lower in the latter group, the rate of opportunity-to-necessity is also higher. Training in these innovation-driven countries tends to impact awareness, intention, and skills perception the most

Figure A-8: Percentage of countries where the gain from training is statistically significant (2008)



Source: Coduras Martines *et al.* (2010), Figure 21, based on the GEM National Expert Survey 2008.

Overall, the results from Coduras Martines *et al.* (2010) suggest that in innovation-driven economies, like most European countries, training can be expected to raise entrepreneurial activity, especially in countries where the existing level of trained people in the workforce is around or below 20%.

A-4) Target SMEs and related data

In Europe in 2008, 99.8% of firms were SMEs (<250 employees) and 92% were micro-enterprises (<10 employees), accounting for 66.7% and 29.0% of employment, respectively, and for 58.6% and 21.8% of value added. Apparent labour productivity is lowest in micro-enterprises though: 75.3% relative to total, compared to 87.8% in all SMEs, and 124.5% in large enterprises (Eurostat, 2011), suggesting that much can be gained from the adoption of ICT (see Section 1.3.a2 and Annex 1 for more detailed data on SMEs). Indeed, ICT open up many opportunities for SMEs, including scalability of operations of services, allowing them to purchase services they may otherwise not be able to afford, but also access to world-wide in- and output markets and possibilities to integrate larger (global) value chains. ICT also enable people to start-up businesses from home, contributing to a more dynamic and entrepreneurial business sector (van Welsum, 2008).

By 2009, some 32.5 million people in the EU were self-employed (European Commission, 2010). However, the innovativeness of such self-employed ventures has been shown to depend on the motivation for becoming self-employed, with relatively less innovative behaviour from those who become self-employed out of necessity rather than to pursue an opportunity (Romero and Martinez-Roman, 2012). Nonetheless, in 2009 some 45% of Europeans said they prefer to be self-employed, versus 55% of Americans (European Commission, 2010). According to Gallup (2010), 55 % of respondents in the EU who had started up a business or were currently taking steps to start one, stated that they were doing so because they saw an opportunity and 28 % were doing so out of necessity.

European SMEs tend to be viewed positively by the public (Gallup, 2010), however, they tend to (i) start and stay small, (ii) grow and shrink slowly, (iii) be held back by poor management (Mettler and Williams, 2012b). SMEs with the ambition and potential to grow fast and develop internationally, especially those who with the help of ICT tools find new business models and new ways of doing things, constitute the main target of this report.

According to Pélissié du Rausas et al. (2011), some USD 8 trillion is traded in e-commerce globally annually and about one-third of SMEs use Web technologies. As part of their research, Pélissié du Rausas et al. interviewed 4 800 SMEs in 12 countries and found that those with a strong Web presence grew more than twice as quickly as those with minimal or no presence, the share of revenue derived from exports was also twice as large, and they created more than twice the number of jobs. In addition, McKinsey's global SME survey found that for every job destroyed by the emergence of the Internet, 2.6 new jobs were created. The same survey also found that 75% of the economic impact of the Internet comes from 'traditional' companies that do not consider themselves to be "pure Internet players". Those with the biggest value benefited from productivity enhancing innovation. In order to maximize

the benefits from the Internet eco-system, Pélissié du Rausas et al. recommend that efforts should focus on four crucial aspects: (i) promote human capital, (ii) improve access to capital, (iii) develop the infrastructure, and (iv) create an attractive business environment.

The 2012 report by the Boston Consulting Group comes up with very similar results notably that the Internet is driving sales and job growth in SMEs, and recommendations. They also find that companies increasingly encourage their employees more to do new things, and especially in cases where owners/founders are not familiar or comfortable with Internet or social media. The report recommends companies to build a social media presence in order to further exploit ICT-enabled business opportunities (see also the example below), and to establish "digital balance sheets", taking stock of their digital assets and liabilities in order to identify the best strategies towards making the most of IT. The report also has five main recommendations for policy makers, namely: (i) invest in affordable infrastructure, (ii) give priority to education and skills building, (iii) encourage innovation and entrepreneurial activity, (iv) facilitate global talent mobility, and (v) look out for bottlenecks to innovation and adoption of new technologies (Dean *et al.*, 2012).

Whereas start-ups tend to "intuitively" grasp the benefits that can be reaped from ICT, for established businesses this warrants further policy attention, according to Mettler and Williams (2012b).ICT are crucial for SMEs who want to grow and expand internationally. Using the Internet as an e-commerce platform, firms can sell both to mainstream and niche markets globally. The Spanish hat company Albiñana Millinery (founded in 1924, located in Oviedo, Spain) provides a nice illustration not only of a small company serving a global niche market enabled by ICT, but also of the difficulties it encounters in trying to do so.

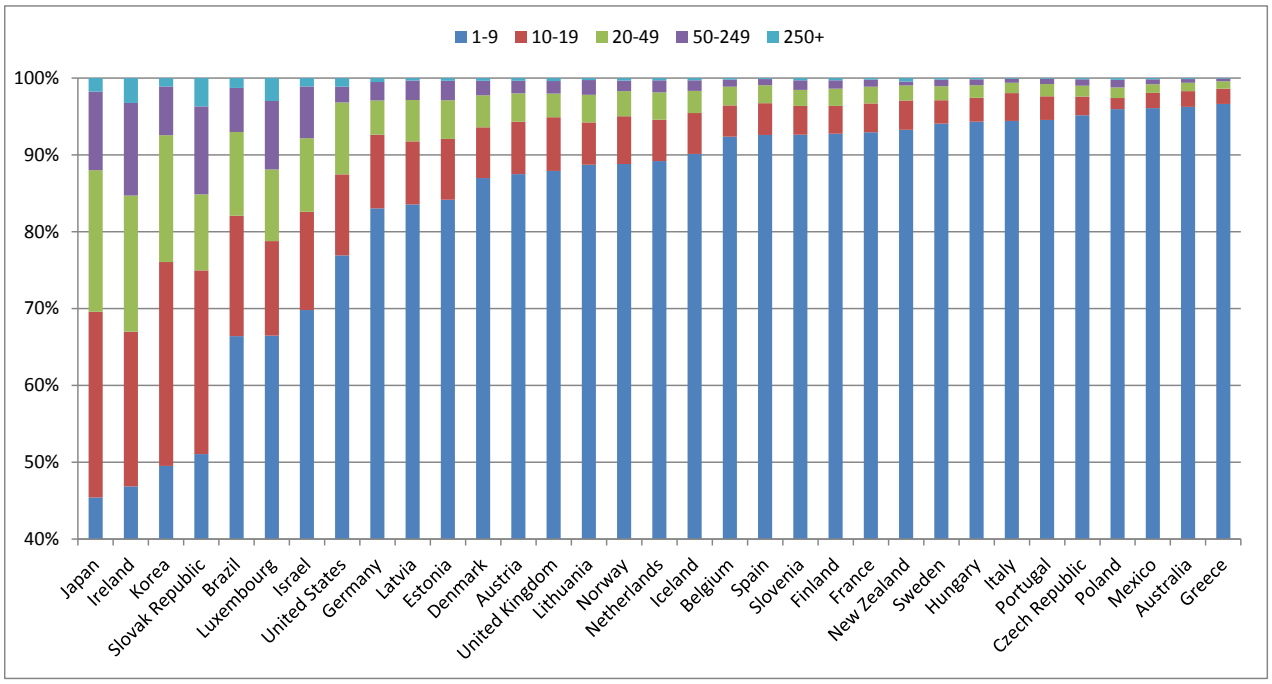
When Albiñana Millinery decided to "go online", they started by creating a web site for the store, but online sales remained elusive and they soon realized the web site was not getting any visits. So they turned to social media and started blogging about their products – to much success, the web site started to receive visitors and a 'virtual word-of-mouth' did the rest: soon the blog had received some 200 000 visits and the store was mentioned in 'the world of hats' in many Spanish speaking countries, bringing customers to the physical stores. Encouraged by this success, the company then created profiles on Facebook, Twitter and Flickr, and started directly engaging with (potential) customers. However, that's when companies like this one hit the hurdles of the physical world with the many regulatory and other barriers still in place: faced with excessive shipping costs, customs rules and regulations, and various fees, many businesses are choosing to abandon, or not get into, cross border sales, losing out on great business opportunities not only with foreign clients but also suppliers (Bobes, 2011). Policy has an obvious role to play here, for example by making online and international payment and shipping easier and cost-effective, and reducing red-tape on customs and shipping.

As Varian (2005) noted, "IT is the great enabler", begging the question "Who is big, who is small?" ICT enable SMEs to become multinationals, or micro-multinationals as Varian calls them. In addition, Mettler and Williams (2012b) argue that "micro-multinationals will not only be important innovators in their own right (especially given that their innovations are typically disruptive), but that they will also play an essential role in the innovation ecosystems of large enterprises."

The importance of the eco-system in which SMEs operate is increasingly highlighted, and the eight recommendations for policy makers made in Mettler and Williams (2012a) reflect this: (1.) Encourage new company start-ups, particularly university-based ventures. (2.) Accelerate movement towards a fully functioning digital economy and modern intellectual property regimes. (3.) Recognize the importance of internationalization and immigration. (4.) Encourage companies to become intensive users of technology. (5.) Develop and encourage the range and quality of services on offer to local businesses and individuals. (6.) Create the right incentive structures for freelancers and the self-employed. (7.) Prioritize education and skills development to ensure a large proportion of the unemployed population has a pathway to succeed in the new economy. (8.) Develop data and statistics that reflect the new economy.

Next, we show some basic statistics relating to SMEs. SMEs account for the largest share of the population of firms in most countries (Figure 2.10). For most EU countries SMEs with 1-9 employees account for over 80% of enterprises (except in Luxembourg, Slovak Republic, and Ireland).

Figure A-9: Enterprises by size class (2007)

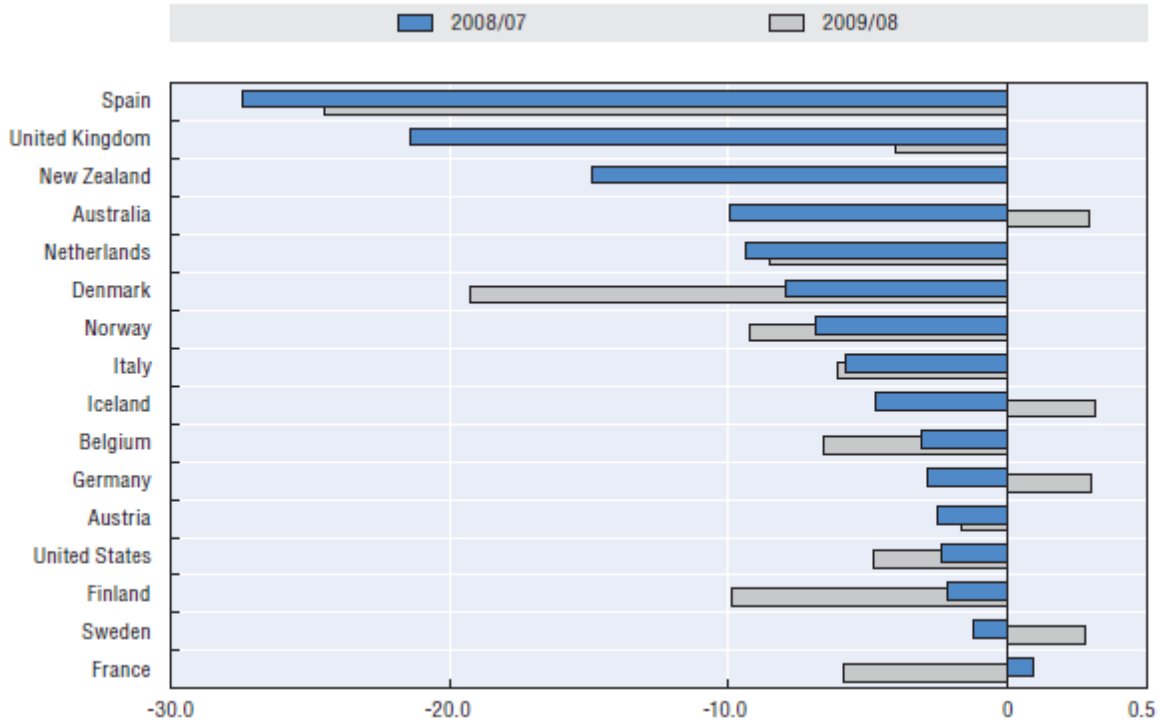


Note: For ease of visibility the vertical axis starts at 40%.
Source: OECD (2011), adapted from Part II, Figure 1.1.

The impact of the crisis is reflected in the rather worrying data on entrepreneurial performance showing that in recent years the overall number of enterprises has actually tended to decline in many countries, the strongest declines having been registered in Spain and in the UK, in 2007-2008 but also in still in 2008-2009, notably in Spain and in Denmark (Figure 2.11). France initially still registered an increase in

2007-2008, but then saw a decline in 2008-2009. In 2008-2009, the only two European countries that registered an increase in the number of new enterprises were Germany and Sweden. This also highlights the need to strengthen entrepreneurship in Europe and encourage entrepreneurial mind-sets.

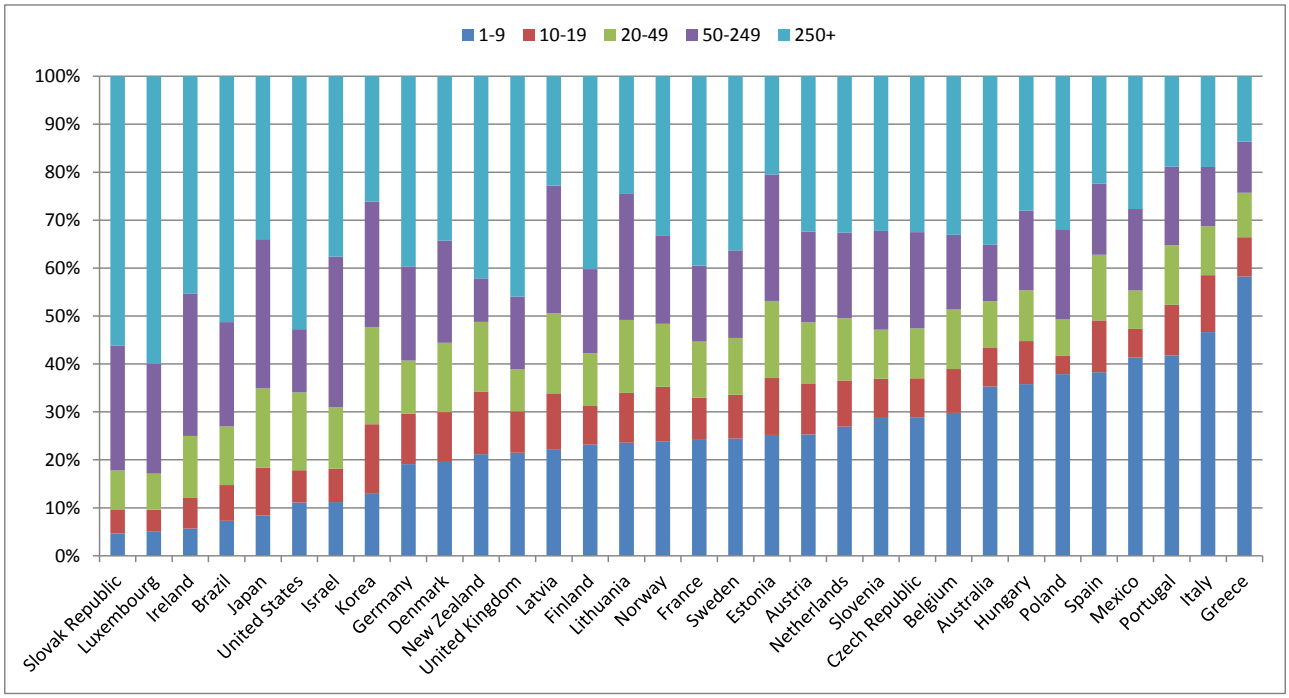
Figure A-10: The number of new enterprises (% change from previous years)



Source: OECD (2011), Part I, Figure 1.3.

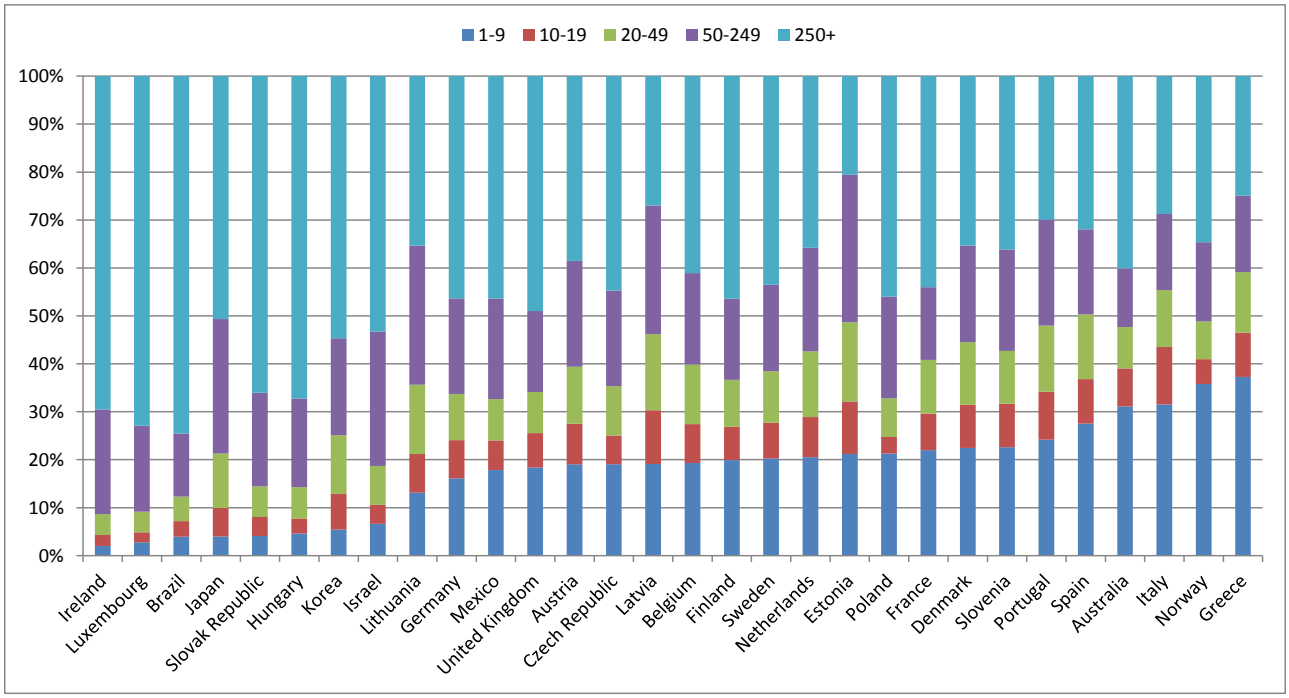
SMEs tend to account for a significant share of total employment and value added (Figure 2.12 and Figure 2.13, respectively), with substantial cross-country differences in the relative importance of different size SMEs. For example, among EU countries, the smallest size SMEs (1-9 employees) account for relatively greater employment shares in Portugal, Italy and Greece, and lowest shares in Luxembourg, Ireland and Germany. Similarly, for value added in the EU, SMEs with 1-9 employees account for the largest value added shares in Spain, Italy, and Greece, and lowest shares in Ireland, Luxembourg and Hungary. As structural variables, such as the composition of the economy and the workforce, have been found to be related to many other factors that are important for competitiveness and innovation, including different types of skills shares in the economy, and given that European countries compete for both economic activities and talent and skills globally, several non-EU countries are included in these figures (notably non-EU OECD countries and several key BRICS/emerging countries).

Figure A-11: Employment by size class (2007)



Source: OECD (2011), Part II, Figure 2.1.

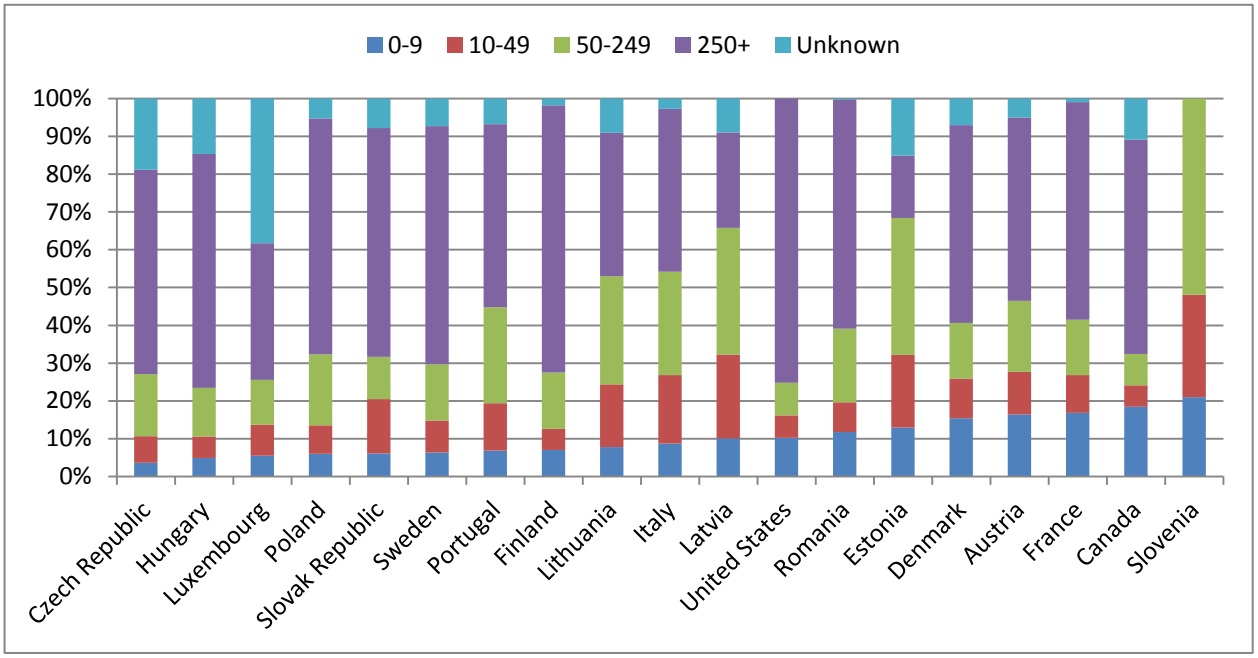
Figure A-12: Value added by size class (2007)



Source: OECD (2011), Part II, Figure 3.1.

The share of exports accounted for by SMEs tends to be somewhat smaller than their employment and value added shares, suggesting that SMEs tend to internationalise their operations less than larger firms (Figure 2.14). In the context of increasing globalisation and inter-linkages through Global Value Chains, it is important to keep a broad perspective so non-EU countries have also been included in these figures.

Figure A-13: Exports by size class (2007)

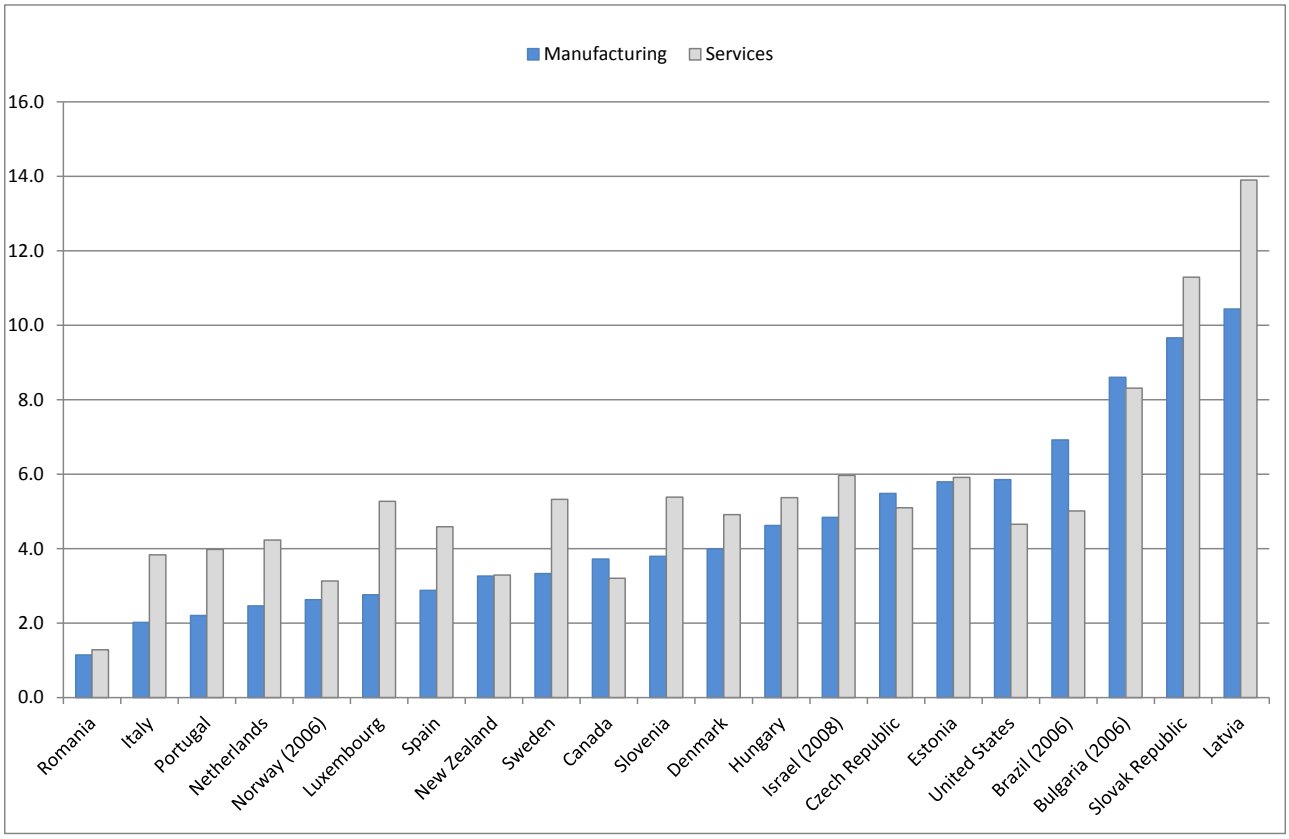


Source: OECD (2011), Part II, Figure 4.1.

High-growth enterprises, measured in employment terms, are enterprises with average annualised growth in employees of over 20%, over a 3 year period, and with 10 or more employees at the start of the observation period.[60] The share is calculated as the percentage of high-growth enterprises in the population of enterprises with 10 or more employees (Figure 2.15). Of the EU countries in the sample, in 2007, the highest share of high-growth enterprises can be observed in Bulgaria, Slovak Republic and Latvia, and the lowest shares in Romania, Italy and Portugal. In most countries, the share of high-growth firms is higher in services than in manufacturing.

[60] They can also be identified in terms of turn-over, but given our focus on skills and employment we show the employment definition here.

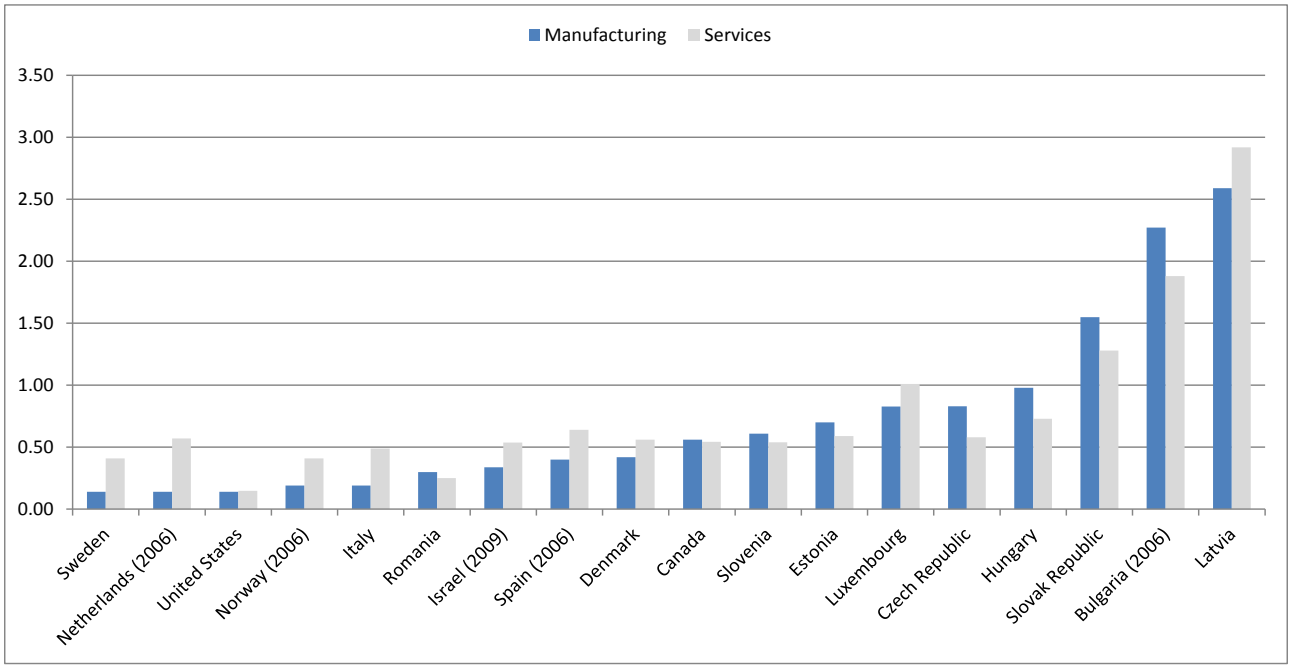
Figure A-14: Share of high-growth enterprises – employment definition (2007)



Source: OECD (2011), Part II, Figure 11.1.

Gazelles are a sub-group of high-growth enterprises: they are high-growth enterprises born 5 years or less before the end of the 3-year observation period. Measured in terms of employment, they are the enterprises which have been employers for a period of up to 5 years, with average annualised growth of in employees greater than 20% per year over a 3-year period and with 10 or more employees at the start of the period. The share of gazelles is expressed as a percentage of the population of enterprises with 10 or more employees (Figure 2.16). Of the EU countries in the sample, in 2007, the highest share of high-growth enterprises can be observed in Slovak Republic, Bulgaria, Latvia, and the lowest shares in Sweden, Netherlands, and Italy.

Figure A-15: Share of gazelles – employment definition (2007)



Source: OECD (2011), Part II, Figure 12.1.

The sectoral distribution of new enterprises is shown in Table 2.7. The sectoral share of enterprise creation is calculated as the percentage of new enterprises in each sector in the number of new enterprises in the economy as a whole. The construction, wholesale and retail, and professional, scientific and business services sectors account for the largest shares of new enterprises in the countries in the sample. In Italy, the sector "other non-classified" accounts for the largest share.

The effects of the crisis are most visible in the year-on-year growth figures which show a drop in the creation of new enterprises, notably in construction, trade and transport, but also in finance and real estate (OECD, 2011).

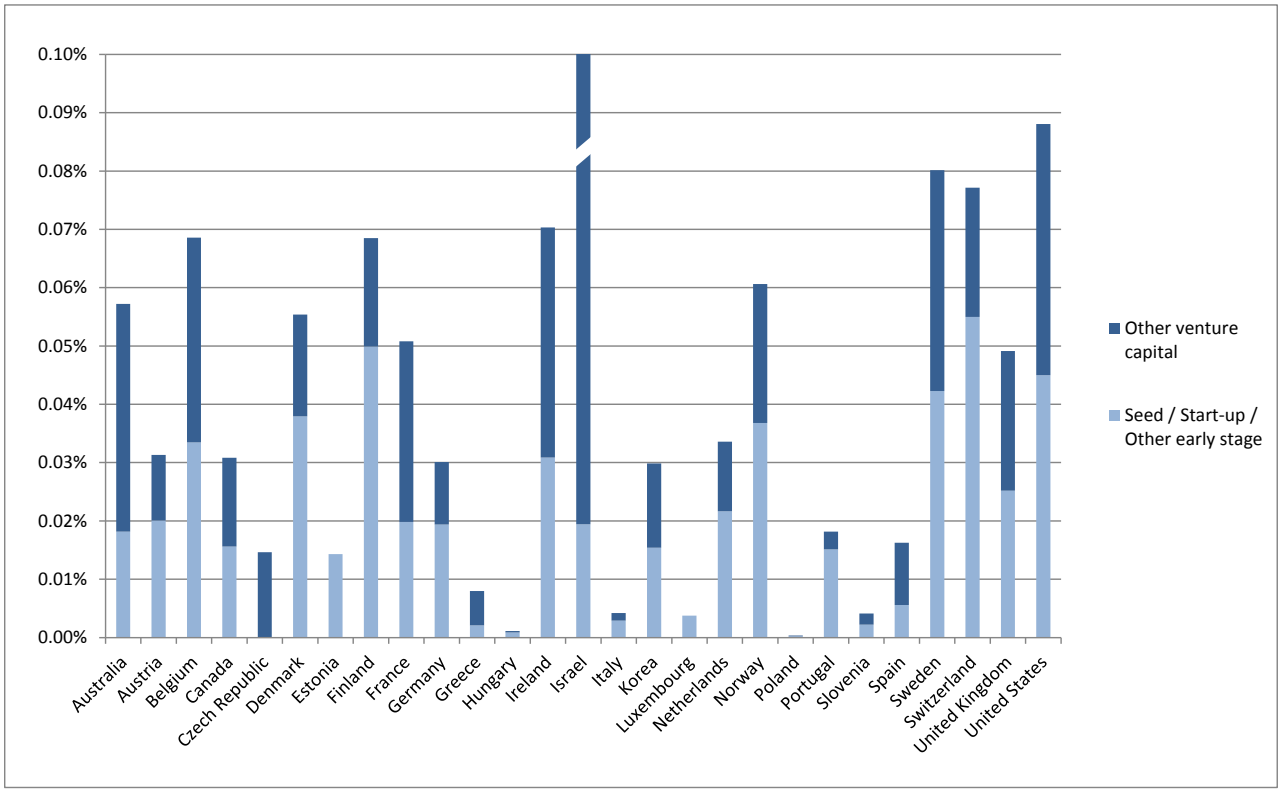
Table A-15: New enterprises by sector (% of total activity)

Activities	Finland		France		Germany		Italy		Norway		Spain		USA	
ISIC Rev. 4 /NACE Rev. 2	2007	2009	2007	2009	2007	2009	2007	2009	2007	2009	2007	2009	2007	2009
10_33: Manufacturing	6	5	5	4	6	5	7	7	4	3	4	3	2	3
41_43: Construction	19	15	18	14	11	12	17	14	13	13	22	15	13	14
45_47: Wholesale and retail trade; repair of motor vehicles and motorcycles	17	18	24	22	30	29	20	22	12	13	20	23	14	14
49_53: Transportation and storage	4	4	2	1	4	3	2	2	3	4	5	4	2	2
55_56: Accommodation and food service activities	5	5	6	5	9	9	4	4	6	3	10	13	6	6
58_63: Information and communication	5	5	4	5	..	4	..	..	..	7	2	2	2	2
64_66: Financial and insurance activities	1	1	4	2	2	4	2	2	5	4	2	3	5	4
68: Real estate activities	6	4	5	3	5	4	2	2	14	7	5	4	4	4
69_82: Professional, scientific, technical and other business support activities	21	23	17	22	21	18	6	6	21	21	17	19	23	24
85_88: Education, health and social work activities	5	5	8	9	2	2	0	0	9	12	5	6	8	8
90_96: Arts, entertainment and other service activities	9	10	7	12	8	7	3	3	11	11	7	8	7	7
Other and non-classified activities	3	5	1	1	3	3	37	36	2	2	1	1	13	12
01_99: Grand total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: OECD (2011), Part II, Table 15.1.

Venture capital (VC) is considered to play a vital part in the financing of young firms with a high innovation and growth potential, replacing or complementing more traditional forms of financing obtained through the banking sector. Therefore, the development of the VC industry, and access to VC, are seen as crucial to stimulating entrepreneurship. VC investment as a percentage of GDP measures the sum of seed and start-up capital and early development capital in a country's GDP (Figure 2.17). VC investment as a share of GDP is still very small in most countries, but VC markets are relatively more developed in Israel, Sweden, Switzerland, the UK and the US. As capital markets and many financing mechanisms and instruments are international and even global in nature, and as firms from EU countries increasingly tend to compete with firms globally, non-EU countries have been included in this figure to provide a broad and comparative perspective.

Figure A-16: VC as a % of GDP (2009)



Source: OECD (2011), Part II, Figure 21.1.

It is also interesting to look at some of the personal characteristics of company founders. Wadhwa *et al.* (2009a), based on a survey of 549 company founders in the US (still in business) found that they tend to (i) be middle-aged and well-educated, having performed better in college than in high school; (ii) come from middle-class or upper lower-class backgrounds, and are better educated and more entrepreneurial than their parents; (iii) be married with children; (iv) have shown an early interest and propensity to creating a business; (v) be motivated to become an entrepreneur because they wanted to build wealth, own a company, were motivated by the start-up culture, and/or wanted to capitalise on a business idea; and (vi) have had significant industry experience when starting their companies.

The keys to success were found to include experience, management and luck (Wadhwa *et al.*, 2009b). Professional networks, education, funding and personal networks were also found to be important. However, location, investor advice, alumni networks, and regional assistance were found to be less important. The surveyed entrepreneurs perceived few barriers, but tended to agree that entrepreneurship is very risky and hard work. Personal savings were the most significant form of funding for their business. Venture capital and private/angel investments was found to play a relatively small role in first-time start-up entrepreneurs, but the importance of this source of funding increased with subsequent business launches. Friends and family were also found to contribute. In response to the request to list challenges not mentioned in the survey, the most common responses were: (i) the stress

involved in running a business; (ii) the difficulty of maintaining a balance in life; (iii) understanding and developing products for ever-changing markets; (iv) problems with government regulations, taxes; (v) costs of employee benefits; and (vi) a lack of knowledge about raising capital.

A-5) A critical look at what has been done so far

Many initiatives exist in Europe to promote and teach entrepreneurship attitudes and skills at all levels of education: primary, secondary, tertiary and vocational. Many of these were developed in response to the Oslo Agenda for Entrepreneurship Education in Europe.[61] The Oslo Agenda has 6 main pillars: (1) a framework for policy development, (2) support to educational establishments, (3) support to teachers and educators, (4) entrepreneurship activities in schools and higher education, (5) building links and opening education to the outside world, and (6) communication activities.

The European Commission supports, follows and is involved in the evaluation of education and training for entrepreneurship.[62] For example, European Commission (2012b) evaluates the impact of entrepreneurship programmes in higher education in Europe, considering a range of aspects, including entrepreneurial attitudes, skills, and knowledge, but also entrepreneurial intentions, the individual's employment preferences, and their employability, as well as the impact on society and the economy. The evaluation is based on the outcome of a survey of alumni of higher education institutions in Europe using a group with individuals who have attended entrepreneurship education and a control group of alumni who have not participated in this type of education. The results suggest that entrepreneurship education makes a difference: those who went through entrepreneurial programmes and activities (i) show more entrepreneurial attitudes and intentions, (ii) find a job more quickly after finishing their studies, (iii) are more innovative, even as employees, and (iv) start more companies.

The spread and scope of entrepreneurship education in different types of Higher-Education Institutions HEIs) are surveyed in European Commission (2008). The results of the survey are worrying and suggest that more than half of students at the higher educational level in Europe do not have access to entrepreneurial education. In the institutions that do provide entrepreneurial education, around half of the students were found to be involved in some form of entrepreneurial educational activity. In addition, students were found to be more likely to have access to entrepreneurial education in business schools and multidisciplinary institutions with a business school department, with specialised HEIs, except specialised institutions within the technical area, lagging behind in offering entrepreneurial

[61] See http://ec.europa.eu/enterprise/entrepreneurship/support_measures/training_education/oslo.htm and the Oslo Agenda: http://ec.europa.eu/enterprise/policies/sme/files/support_measures/training_education/doc/oslo_agenda_final_en.pdf

[62] See http://ec.europa.eu/enterprise/policies/sme/promoting-entrepreneurship/education-training-entrepreneurship/index_en.htm for the initiatives and http://ec.europa.eu/enterprise/policies/sme/documents/education-training-entrepreneurship/ for the reference documents.

education. Access to entrepreneurial education is better for students in the EU15 than in the other EU countries. Having top management at the HEIs committed to the importance of teaching entrepreneurship has been found to be a key driver of entrepreneurial education, even though there were also examples of cases where the initiative to implement entrepreneurial education came from dedicated individuals. However, overall, successfully implementing entrepreneurship education throughout an entire institution requires a collective effort from top-management, as well as academic and other staff.

The scope of entrepreneurship education HEIs is surveyed across six dimensions: six dimensions: Strategy, Institutional Infrastructure, Teaching and Learning, Outreach, Development and Resource. The survey results point to considerable scope for improvement in each dimension and across the different types of HEIs (Figure 2.18). For example, while most business schools have an institution-wide entrepreneurial action plan (86%), this is the case for only 59% of technical institutions, 53% of multi-disciplinary institutions with a business school department, and 42% of multi-disciplinary institutions without a business school department. Research on entrepreneurial education is very low in technical institutions (36%). Having an entrepreneur in the classroom only figures among the top 3 teaching methods used in entrepreneurial education in business schools, where it is, in fact, the top method used, while at the other types of institutions, lecturing is the most favoured teaching method used (followed by case studies and project teams for all types of institutions as either 2nd or 3rd preferred method). Business schools also most rely on alumni in their outreach, and most support entrepreneurship in local schools. The differences are stark when looking at the average share of academic staff involved in entrepreneurship education, with 22% in business schools, at only as little as 4-6% in the other types of institutions.

Figure A-17: Entrepreneurship education in Higher-Education Institutions in Europe (2008)

Table 2-1: Results for different types of institutions on key aspects of the six dimensions				
	Business schools	Multidisciplinary institutions with a business school department	Multidisciplinary institutions without a business school department	Technical institutions*
Strategy				
Entrepreneurship part of overall strategy	In the majority of institutions (79 %)	In the majority of institutions (73 %)	In two thirds of institutions (71 %)	In the majority of institutions (73 %)
Strategic responsibility for entrepreneurship	President: 36 % Rest of top-mgmt: 21 %	President: 19 % Rest of top-mgmt : 46 %	President: 15 % Rest of top-mgmt: 36 %	President: 17 % Rest of top-mgmt : 30 %
Institution-wide entrepreneurial action plans for how to achieve E-goals	In the majority of institutions (86 %)	In half of institutions (53 %)	In half of institutions (42 %)	In half of institutions (59 %)
Institutional Infrastructures				
Entrepreneurial professors (avg.)	3.7	2.3	2.7	4.0
Presence of entrepreneurial centre	At two thirds of institutions (71 %)	At two thirds of institutions (61 %)	At half of institutions (46 %)	At half of institutions (59 %)
Research on entrepreneurial education	At majority of institutions (79 %)	At majority of institutions (80 %)	At two thirds of institutions (68 %)	At a third of institutions (36 %)
Teaching & Learning				
Avg. number of entrepreneurial courses	Bachelor: 8.8 Master's: 10.1	Bachelor: 9.7 Master's: 7.1	Bachelor: 7.9 Master's:7.1	Bachelor:9.5 Master's:7.5
	Ph.D.: 3.9	Ph.D.: 2.6	Ph.D.: 3.5	Ph.D.: 3.0
Entrepreneurial degree available	In two thirds of institutions (71 %)	In two thirds of institutions (62 %)	In half of institutions (45 %)	In half of institutions (49 %)
Three most used teaching methods in entrepreneurial education	1: Entrepreneur in classroom 2: Case studies 3: Project teams	1: Lecturing 2: Case studies 3: Project teams	1: Lecturing 2: Project teams 3: Case studies	1: Lecturing 2: Project teams 3: Case studies
Outreach				
Involve alumni in entrepreneurial education	Majority of institutions (93 %)	In two thirds of institutions (71 %)	In two thirds of institutions (67 %)	In two thirds of institutions (66 %)
Stakeholders contributing to entrepreneurial education	Company: 79 % Entrepreneur: 62 % Investors: 62 %	Company: 65 % Entrepreneur: 61% Investors: 47 %	Company: 60 % Entrepreneur: 48 % Investors: 35 %	Company: 70 % Entrepreneur: 61 % Investors: 51 %
Support entrepreneurship in local schools	Two thirds of institutions (71 %)	Two thirds of institutions (64 %)	Third of institutions (34 %)	Two thirds of institutions (66 %)
Development				
Avg. share of academic staff involved in entrepreneurial education	22 %	5 %	4 %	6 %
Provide recognition for achievements in entrepreneurial education	Majority of institutions (79 %)	Half of institutions (44 %)	Half of institutions (43 %)	In half of institutions (59 %)
Formalised procedures of evaluating entrepreneurial strategy	In third of institutions (38 %)	In third of institutions (33 %)	In half on institutions (41 %)	In third of institutions (33 %)

Source: European Commission (2008), Table 2-1.

The Eurydice Network (2012) provides an overview of entrepreneurship education in schools at primary and (general) secondary levels, spanning 31 European countries, and covering: "(1) National strategies and action plans to encourage the integration of entrepreneurship education; (2) How entrepreneurship education is currently being addressed in national educational steering documents in terms of general approaches and subject curricula; (3) Specific learning outcomes defined for entrepreneurship education and any practical guidelines to support teachers; and (4) Initiatives to promote entrepreneurship education and the current situation on educational reforms impacting on the subject." The report also provides a complete set of national descriptions, including references and links to all the relevant policy documents. The report finds that "nearly half of the countries have incorporated the objectives linked to the promotion of entrepreneurship education within broader strategies (lifelong learning, education and youth, growth), while several countries, located mainly in Northern Europe, have launched specific entrepreneurship education strategies." In addition, the report notes that "half of the countries are engaged in a process of educational reform. These ongoing changes often include the strengthening of entrepreneurship education among their objectives."

The Eurydice Network (2012) finds that while a common European understanding and approach to learning outcomes for entrepreneurship education is still to be developed, there are some elements pertaining to attitudes, knowledge and skills that emerge across countries:

- Attitudes: (i) self-awareness and self-confidence; (ii) initiative, risk-taking, creativity, critical thinking, and problem solving;
- Knowledge: (i) career opportunities and world of work; (ii) economic and financial literacy, and (iii) business organization and process;
- Skills: (i) Communication, presentation, planning, team work; and (ii) Exploring entrepreneurial opportunities, design business projects.

While the implementation of entrepreneurial education in practice depends on teachers, schools, and local educational authorities, central authorities can support teachers through the provision of central guidelines and/or teaching materials. Eurydice network (2012) finds that around one third of European countries report providing practical guidelines to help teachers implement entrepreneurship education, either as part of the guidelines for the subjects in which entrepreneurship education is integrated, and/or linked to entrepreneurship education as cross-curricular objective. In addition, teaching materials have also been developed in one third of all European countries.

While there are many very interesting and powerful initiatives to promote entrepreneurship throughout the world, we highlight just a few some entrepreneurship programmes and initiatives in the EU and beyond that provide particular lessons or insights, but this section is by no means exhaustive.

Junior Achievement (JA) Worldwide

Junior Achievement (JA) Worldwide,[63] is a partnership between the business community, educators and volunteers ().[64] It reaches 10.6 million students per year in 406 000 classrooms and afterschool locations. JA programs are taught by volunteers in inner cities, suburbs and rural areas throughout the United States and in 117 countries around the world. The objective is to "inspire young people to dream big and reach their potential". The programs are hands-on, experiential, and aim to "teach the key concepts of work readiness, entrepreneurship and financial literacy to young people all over the world".

Evaluations of the initiative show that Junior Achievement has a positive impact in a number of critical areas.[65] For example, external evaluators found that elementary school students who participate in JA demonstrate significantly higher critical thinking and problem-solving skills than their counterparts. In addition, 71% of middle school students reported that JA helped them recognize the importance of education and motivated them to work harder to achieve educational and work goals, and they were found to have a better understanding of personal finance, business, and economic concepts after participating in JA programs. As for high-school students, 79% agreed that JA positively influenced their attitudes toward continuing their education: JA students were more likely than students in general to matriculate to college immediately after high school (77% versus 69%), and most students reported that JA made the transition to college easier, encouraged them to work hard, and provided them information that was relevant. However, while these results are certainly very important and encouraging, they do not provide a picture of the programs' impact on entrepreneurship.

Junior Achievement – Young Enterprise (JA-YE) Europe

Junior Achievement- Young Enterprise (JA-YE) Europe[66] is the European branch of JA Worldwide®. JA-YE Europe is Europe's largest provider of entrepreneurship education programmes. It reached some 3.1 million students in 36 European countries in 2011 (and in total over 22 million since 2001). It is funded by businesses, institutions, foundations and individuals, and brings together both the public and private sectors to teach young people in primary and secondary schools and early university about enterprise, entrepreneurship, business and economics in a practical manner.[67]

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[63] See www.jaworldwide.org/ .

[64] As reported by Oosterbeek *et al.* (2010), the idea of setting up student companies originated in the US in the 1920s, and was supported by, among others, Henry Ford, John Rockefeller and Walt Disney, founding the association 'Junior Achievement'. The first student company was started up in New York. The program was subsequently exported to Europe in the sixties and was named Junior Achievement Young Enterprise.

[65] Evaluation results are available free upon request. Summaries of the findings also are published in the JA Programs section at www.jaworldwide.org/programs/programs_eval_overview.shtml .

[66] See www.ja-ye.org .

[67] Current initiatives include: the JA-YE Sci-Tech Challenge project (http://scitech.ja-ye.org), the European Creativity & Innovation Challenge (http://ecic.ja-ye.org), JA-YE Enterprise without Borders (www.ewb.ja-ye.org) – a high school and/or college programme that teaches the value of European trade and the practical skills necessary to function in an international market, the Social Innovation Relay (in collaboration with global partner HP:

Junior Achievement –Young Enterprise Europe carried out a survey called "Enterprise 2010 - the Next Generation"19. The survey asks 10 000 secondary school students, both participants and non-participants in JA-YE programmes, about their attitudes towards entrepreneurship. The survey compares results across 26 countries, and is scheduled to be repeated every three years. Initial results show that 77% of students participating to entrepreneurship programmes may consider self-employment as a future career option, and that young people who have not received entrepreneurship training are far more reluctant to consider self-employment than participants in JA-YE programmes.

The JA-YE Company Programme was recognised by the European Commission Enterprise Directorate General as a 'Best Practice in Entrepreneurship Education', and evaluations have shown that enterprise education stimulates entrepreneurship later on.[68] The Company Programme was a very popular programme among Junior Achievement/Young Enterprise's international affiliates. It was aimed at students aged 15 to 18, and involved them forming a mini-corporation, usually after school, under the guidance of volunteer business advisers. The programme gave students a hands-on opportunity to prepare for working life through the experience of running their own company, supported by volunteer advisers from business. One particularity of this program relative to many other initiatives providing entrepreneurship training is that this program is aimed at a general population of students and not with a group of individuals who self-selected into entrepreneurship.

However, a study conducted in the Netherlands evaluating the impact of the programme, though conducted in only one school, showed that the program did not have the intended effects: the effect on students' self-assessed entrepreneurial skills was found to be insignificant, and the effect on the intention to become an entrepreneur even negative (Oosterbeek *et al.*, 2010). The study specifically analyzes the impact of a leading entrepreneurship education program on college students' entrepreneurship skills and motivation, using two groups, one that was in the programme and the other not. Indeed, they were able to analyse the case of one particular college which offers essentially the same Bachelor program at two different locations, one offering the SMC program and the other not. The results of this study contrast the positive outcomes of earlier assessments based on the appreciation of the parties involved.

Especially in the current context of budgetary caution, it seems that such programs would need to be subjected to rigorous evaluations of their actual impact to examine if the resources being spent on them are justified, and/or how the impact can be improved. Evaluations need to go beyond merely counting the number of students they reach, and measure the effect on people's entrepreneurial intentions,

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http://sir.ja-ye.org), the Global Enterprise Project (GEP: www.globalentepriseproject.eu), and the JA-YE Social Enterprise Programme (www.sep.ja-ye.org).

[68] See http://old.ja-ye.org/Main/Default.aspx?Template=TMain.ascx&phContent=ProgrammeShow.ascx&CatID=25&LngID=0&ArtID=56 .

skills, and outcomes. This means also trying to test what the outcome would have been in the absence of a program, which is generally difficult to do.[69]

Network for Teaching Entrepreneurship

This initiative specifically targets young people in low-income communities with programs aiming to inspire them to stay in school, recognize business opportunities and plan for successful futures. It was founded in New York City in 1987 by Steve Mariotti, a former entrepreneur turned high school math teacher in the South Bronx. It started as a program to prevent dropouts and improve academic performance among students who were at risk of failing or quitting school. To date, NFTE has worked with nearly 450,000 young people from low-income communities in programs across the US and around the world, operating in 18 states in the US and 9 countries (including in the EU in Belgium, Germany and Ireland) through 11 program offices and many licensed partners. According to the NFTE web site, external research has shown that NFTE graduates start and maintain businesses at substantially higher rates than their peers, show an increased interest in attending college, have greater occupational aspirations, and achieve improved scores in independent reading.[70]

Erasmus for Young Entrepreneurs

Another interesting initiative in Europe is "Erasmus for Young Entrepreneurs".[71] This is an exchange programme, similar in spirit to the Erasmus Exchange Program for students. It gives entrepreneurs who intend to start a business or have recently started one the chance to learn from experienced owners of small businesses in other European Union countries. The exchange of experience takes place during a stay with the host entrepreneur, which helps the new entrepreneur acquire the skills needed for running a small firm. The host benefits from fresh perspectives on the business and gets the opportunities to cooperate with foreign partners or learn about new markets. The stay is partially funded by the European Union.

Project Growing America through Entrepreneurship (GATE)

One initiative to promote entrepreneurship and self-employment in the US was the Project Growing America through Entrepreneurship (GATE) created by the U.S. Department of Labor and the Small Business Administration (SBA). It was implemented in seven sites in three states—Minnesota, Pennsylvania, and Maine—between fall 2003 and summer 2005 – as a demonstration project designed to help people create, sustain or expand their own business. Benus *et al.* (2009) evaluated the effectiveness of this program offering free training to any individual interested in starting or improving a

[69] The lack of evaluation was also noted in European Commission (2005) "Not enough research has been developed so far in Europe on the impact that participation in mini-company programmes has had on the future career of students. However, the limited evidence available supports the effectiveness of these programmes in tangibly promoting the entrepreneurial spirit of young people. For instance, a survey made in Norway shows that around 20% of respondents between the age of 25 and 34 that took part in one of these programmes have established their own company. Also, these programmes seem to have a positive influence on equal opportunities between sexes".

[70] See www.nfte.com/ (accessed June 2012).

[71] See www.erasmus-entrepreneurs.eu/ and http://ec.europa.eu/enterprise/policies/sme/promoting-entrepreneurship/erasmus-entrepreneurs/index_en.htm for more information.

business. Participants were offered an initial assessment of their business needs, classroom training, one-on-one business counselling, and assistance in applying for business financing. The evaluation was carried out through a process of random assignment of individuals to a GATE group or a control group not selected to be offered the GATE services.

Overall, Benus *et al.* (2009) find that Project GATE works and that it could be replicated on a wider scale, but that is it not straightforward to know if it is also cost-effective. Fairlie *et al,* (2012) found that the GATE assignment to treatment produced a 126 per cent short-term increase and a 33 per cent long-term increase in the amount of training received. Recipients also reported the training as useful in follow-up surveys, and the treatment group was 11-13 percentage points more likely to create a business plan and 2-6 percentage points more likely to start a business. However, Project GATE was not found to have any longer term impacts (beyond 6 months) or broader impacts.

Since the completion of the initial Project GATE demonstration, four state grants (Alabama, North Carolina, Minnesota, and Virginia) have been awarded by DOL to test the effectiveness of extending the GATE model to two special dislocated worker populations: rural workers and older workers. This effort is referred to as GATE II and is currently undergoing a rigorous impact evaluation.

In sum, while it is clear that there are many initiatives to promote entrepreneurship at various levels of education and training, an evaluation of their true impact often lacks, or points to outcomes that are not necessarily always positive, or do not match the expectations. It is therefore important to do more rigorous evaluations of the impacts of these programs, not only in the short run but also long term, to make sure they are cost-effective, efficient, and lead to the desired outcomes.

In addition, while these initiatives and programmes address entrepreneurship, they do not necessarily take the "e" and technology components into account and do not focus on creating e-entrepreneurs and e-leaders.

A-6) Addressing the "e" component

A significant number of valuable initiatives currently exist to address the need to educate 'dual thinkers'. Several of them are described below.

CIO education – addressing the urgent need for professional e-skills[72]

The members of the European CIO Association (EuroCIO), over 600 larger enterprises at the "demand" side of IT and representing more than 600 000 IT-workers, have been confronted with severe shortages of "the right e-skills" for many years now. Most enterprises have vacancies in key jobs, and even if they

[72] Section contributed by Peter Hagedoorn, Secretary-General, European CIO Association.

identify potential candidates, these generally still do not have the required level of e-skills for the positions at hand.

Focusing on the top level of the ICT user organisations, the Association has scanned the European executive educational market for courses appropriate to cover and fill the specific e-skills gaps, with disappointing results. It seems that the executive education market is not tuned to the needs of the larger enterprises at the demand side of IT, precisely those enterprises that use ICT to drive innovation in their business. Therefore, the Association decided to develop its own executive education program, targeting education for the higher ranks in the CIO department, both ICT-practitioners responsible for developing new systems and e-business professionals enabled to link new technologies and business requirements.

The Association set out to develop a course for those to be employed at the highest level in the ICT demand organisations, namely the CIO or IT director. It was decided to put the course into the framework of a regular Executive MBA, so that the course could get the normal MBA accreditations like AMBA[73] and EQUIS.[74] It was also decided that all business modules should be taught from the angle of Corporate Information Management so that students (already mature and professional managers) learn to see and understand the business in the ICT context. For example, considerable time is spent on subjects like digital transformation in a larger company, or HR, finance and legal matters in the context of cloud computing and outsourcing. It was decided to start the pilot of this new MBA in the Netherlands with a programme designed by the Business School Nyenrode and the University of Delft. A Program Review Board, led by a number of CIOs, was established to discuss the required content with the professors. The courses started in October 2010 with 17 students, and by spring 2012 over 80 students were following the programme. The next step is to roll the MBA out to other European countries with the exact same modular programme set-up so that future students can choose which module to follow in which country, while still obtaining the same European certificate.

As a next step, the Association has started to develop courses for the IT professionals at the top of the ICT demand organisation. Based on polls in the Association's network, it was decided to start with a professional programme in Business & Enterprise Architecture. According to lead enterprise architects from larger enterprises, no comparable course exists in Europe to educate a future generation of highly trained enterprise architects, while the need for them is higher than ever with a more and more complex IT landscape in most organisations. The training will also include sessions on behavioural skills (such as communication, problem solving, negotiation, and working in teams), placed into an enterprise architecture context, to enhance performance in the cross functional role of the enterprise architect. This programme is now being launched in Europe, as the first in a series of courses, and will start in September 2012 at Henley (UK). It is a cooperation between four European Business Schools across Europe, namely Henley (UK), Ecole Central de Paris (France), TiasNimbas (Netherlands), and TU Munich (Germany).

[73] See www.mbaworld.com/ .

[74] See www.efmd.org/accreditation-main/equis .

Another key issue that emerged from the Association's investigation of Europe's executive educational market is that no clear picture was available about competencies required for certain roles or jobs. Also, no clear certification or qualification schemes exist in Europe for a number of important key roles, like enterprise architects or IT security officers. The European CIO Association welcomes, therefore, the European Commission's initiative to develop the e-Competence Framework at a European level, including job-profiles and curriculum guidelines for educational institutes, to be followed by international certification or qualification mechanisms. This initiative is viewed by the Association as essential for the development of a mature ICT profession at European level, and all courses developed or under development by the Association are compliant with the e-Competence Framework. The next step should be to qualify these courses as leading to a new generation of e-skilled professionals in line with the e-skills projects of the European Commission.

The Software Engineering Management Program (SEMP)[75]

The SEMP project is implemented by the European Software Institute – Center Eastern Europe (ESI), in collaboration with the Software Engineering Institute of Carnegie Mellon University (SEI-CMU), and funded by USAID and the America for Bulgaria Foundation. It was developed in response to Bulgaria's increasing demand for IT and software development managers who are both technically savvy and trained in the best management methods. SEMP's goal is to provide courses on software engineering and IT services management, with a special focus on modern training methods. The project illustrates how industrial and academic institutions (6 leading Bulgarian Universities), supporting organizations and donors can work together to implement innovative training and educational methods. The core pilot courses are under development and implementation in partnership with the SEI-CMU. The program relies on building local capacity through a "train-the-trainer" component – qualification of Bulgarian trainers, lead professors and assistants, coached by SEI-CMU and ESI lecturers. The successful implementation of the pilot project will establish the basis for a new internationally recognized master degree program in partnership with the SEI-CMU, and with the support of the Ministry of Education, Youth and Science in Bulgaria.

The SEMP program combines three important elements in software development and IT management:

1. The Technical Focus Area covers engineering aspects of software intensive-systems, including topics such as software and systems architecture, engineering notations and design tools, component technologies, quality attributes, requirements elicitation and analysis, development methods. It will help students answer questions like "What do I need to know about technology and software development techniques that will help me manage my project and make good decisions?" or "How do I know that my technical people are on the right track?".
2. The Management Focus Area teaches an academic version of the SEI professional courses on Capability Maturity Model Integration (CMMI) and process improvement, and Personal&Team Software Processes (PSP/TSP), familiarising students with the latest management models used by industry.

[75] Section contributed by George Sharkov, Director, "European Software Institute Center Eastern Europe" (http://semp.esicenter.bg).

3. The Business Oriented Focus Area teaches students how to manage organizations – private, public or not-for-profit – in an increasingly global setting. It covers the interplay of business processes and policy in important vertical areas such as health care, logistics and supply chain systems, finance, and government, as well as public policy issues that are increasingly important in the design and development of software systems.

The competences and skills covered by the SEMP are consistent with the EU supported activities in direction of modernizing the e-competences (through the e-Competence Framework (e-CF), applied mainly for "industrial" profiles) and respective EQU (e-Qualification Framework, for the academic profiles). The areas identified by global and EU industry and expressed in the CEN "ICT Certification in Action" Project[76] also addressed.

EIT ICT Labs Master School

The EIT ICT Labs Master School's objective is also to combine technical 'majors' with their innovation and entrepreneurship 'minor'. It offers a two year programme with a choice of two universities in two different European countries to build a curriculum chosen on the basis of a student's skills and interest. The degrees offered are 'double degrees', combining technical competence with a set of skills in innovation and entrepreneurship. Some 20 universities around Europe are committed to the programmes. The EIT ICT Labs EIT ICT Labs is one of the first three Knowledge and Innovation Communities (KICs) selected by the European Institute of Innovation & Technology (EIT) to accelerate innovation in Europe and address Europe's innovation gap, in particular by bringing more ICT-related innovation to market. The Entrepreneurship Support System further contributes to that objectives and is another example of bringing together technical minds and entrepreneurial spirits[77].

In addition, significant initiatives have been launched by large multinational companies, often in cooperation with academic institutions. Such initiatives include the following:

IBM's initiatives at various levels of education and post-education

IBM's initiatives range from kindergarten all the way through post-university education, life-long learning, and specific entrepreneur and SME focused tools and programs.[78] For example, a guide to early learning and technology at home and at school with free software is available for parents and teachers for kids at pre-school age (www.kidsmartearlylearning.org/EN/). It suggests ways of familiarising children with computers and technology, for example through games and stories. Tryscience is IBM's initiative at primary and middle school level to get kids interested in science and technology through on- and offline experiences in collaboration with over 400 science centers worldwide (www.kidsmartearlylearning.org).

[76] See www.ict-certification-in-europe.eu/ (accessed June 2012).

[77] Another good example is Microsoft's Bizspark initiative. See http://www.microsoft.com/bizspark

[78] An overview of IBM's involvement in education (in Ireland, for example) can be found at these links: www-935.ibm.com/services/ie/gbs/education/index.html and www.ibm.com/ibm/responsibility/downloads/profiles/Profile_Ireland.pdf (accessed June 2012).

Try engineering (www.ieee.org/education_careers/education/preuniversity/tryengineering.html) offers pre-university students, parents, teachers, school counsellors, and the general public, a chance to explore how to prepare for an engineering career, ask experts engineering-related questions, and play interactive games. Teacherstryscience (http://teacherstryscience.org/) specifically provides STEM (science, technology, engineering and math) lessons and resources for teachers and educators designed to generate student interest in STEM. The site provides free and engaging lessons, teaching strategies and resources, as well as collaboration tools to enable teachers to discuss and share effective instructional practices.

At university level, an example worth quoting is that of the IBM Academic Initiative (https://www.ibm.com/developerworks/university/academicinitiative/), which is a global program that facilitates the collaboration between IBM and educators to teach students the information technology skills they need to be competitive and keep pace with changes in the workplace. In addition, IBM is engaged in a wide array of collaborative academic research activities and projects (https://www.ibm.com/developerworks/university/research/index.html), including through fellowships, grants and funding for programs of shared interest. *IBMers* also teach and guest teach at universities[79] and contribute through the Service Science degree program.[80] Indeed, IBM is actively involved in driving curriculum change, collaborating with more than 250 universities in 50 countries that are offering courses or degree programs in Service Science, Management and Engineering (SSME). "SSME is a new academic discipline designed to produce students with the combined business and technology skills needed to enter today's workforce ready to contribute immediately to their countries' economic and innovation agendas." [81]

Finally, IBM Global Entrepreneur helps entrepreneurs to build a start-up business around the smarter planet market opportunity, which has been promoted with the full branding of IBM (https://www-304.ibm.com/partnerworld/wps/servlet/ContentHandler/isv_com_smp_startup), and the SME Toolkit provides resources for SMEs, including tutorials on how to build and grow a business, generate a business idea, write a business plan, free software, and training (www.smetoolkit.org/smetoolkit/en).

The Cisco Networking Academy

The Cisco Networking Academy provides a global ICT education program, reaching students in educational institutions in some 165 countries in 2012. While the program offers courses for designing, building, and managing networks, preparing students for globally industry-recognized certifications, higher education and entry-level careers, it also helps students develop "21st century skills", and a range of technical and business skills that can support students in the future as they prepare for work outside the ICT field, or start their own businesses. The curricula include instructor-led, web-based course

[79] See, for example, this course on IT architecture at Ireland's Dublin City University: www.registry.dcu.ie/module_contents.php?function=2&subcode=CA361 (accessed June 2012).

[80] See, for example, this Master in Service Engineering and Management at the University of Porto, Portugal: www.mastersportal.eu/students/browse/programme/10219/master-in-services-engineering-and-management.html and www.servicemanagement.cz/soubory/Cunha.pdf (accessed June 2012).

[81] See, for example www-03.ibm.com/press/us/en/pressrelease/27201.wss (accessed June 2012).

content, online skills assessments, hands-on labs, and innovative simulations, delivered through an ecosystem of partners from local educational institutions (public and private institutions such as schools and universities), national and local government, businesses, and NGOs. Cisco provides curriculum, instructor training, assessments, and equipment at cost, and the ecosystem partners provide other forms of support, such as additional funding, building space, and people. Cisco thus aims to not only improve the effectiveness and accessibility of the program, but to also increase career opportunities.

The academy program now also has an entrepreneurial skills module called "Passport21 to Entrepreneurship", which provides entrepreneurship education through a series of case studies, and Cisco Packet Tracer activities[82] that expose students to critical business and financial skills. One of the tools used for teaching business skills is "Cisco Aspire", a simulation-based game for experiential learning, which allows students to apply and practice business, financial and technical skills in a fun, simulated networking environment. It integrates aspects of gaming such as virtual worlds, competition, scoring, and challenge levels into the curricula and teaching tools, thereby making students feel they are playing rather than studying, applying their technical skills in an entrepreneurial way.

The Microsoft IT Academy[83]

The Microsoft IT Academy Program is an annual membership program for academic institutions to deliver training on Microsoft technologies to students and resources on the latest Microsoft technologies to faculty. The Microsoft IT Academy has developed a curriculum and certificates for a range of careers which consist of so-called "pathways": sequences of job roles that build on each other in terms of coursework and certificates. The Academy provides its members with a curriculum (e.g., Microsoft Official Courseware), multimedia courses (which include simulations, games, videos, and interactive text designed to help students master skills, and to provide instructors with ongoing professional development opportunities), software and resources, certification exams, instructor professional development, and marketing resources.

Microsoft has developed a range of efforts to complement its IT Academy, most notably WenS (Werk en Scholing), in the Netherlands. The WenS project trains and employs 150 students annually from 40 regional vocational colleges (all Microsoft IT Academy members), helping them get certified and find internships with industry firms and government organizations for a practical year of study. These internships often lead to permanent employment.

The SAP University Alliances Program[84]

The SAP University Alliances program (UAP) supports higher learning institutions in offering custom-tailored courses and projects to educate highly qualified graduates with critical skills for the 21st century workforce through advanced curricula, technologies and academic research. The Program specifically aims to provide University faculty with the tools and resources necessary to teach students how

[82] Cisco Packet Tracer provides a simulation-based learning environment that supplements physical equipment with virtual networks, and helps students develop critical 21st century skills.

[83] Adapted from INSEAD (2010b).

[84] Based on http://scn.sap.com/docs/DOC-7876 (accessed June 2012) and INSEAD (2010b).

technology can enable integrated business processes and strategic thinking. As hundreds of campuses participate in the UAP there are vast opportunities for (international) collaboration in including research, publishing, curriculum development, and intercampus business simulations, enabling students from campuses worldwide to collaborate on virtual team projects.

SAP provides easy-to-use, high-quality, downloadable course materials (designed by members in a range of academic disciplines) which faculty new to the program can use to create SAP-specific content for their courses. SAP also sets up workshops as part of the UAP, delivered by experienced facilitators from member campuses or by SAP topic experts. Curricula are developed by a task force established by SAP and composed of professors from all over the world organised by curricula development groups. The aim is to develop content for a variety of courses that will be useful for courses that are part of a University education rather than training for certificates. SAP has also collaborated with competitors such as Oracle to develop curricula, reflecting a key aspect of the curricula, namely that they have to be vendor-neutral, aiming to develop capabilities that will make the most of enterprise resource planning (ERP) technology rather than develop skills that are specific to SAP technologies. In Europe, SAP UAP does not want participating Universities to mention SAP and does not allow them to use SAP's logo (though participating universities in the US do use SAP's logos).

Courses are organized around core general operational processes supported by SAP's ERP technology. Processes include financials, human capital management, operations and corporate services. To support such a large number and variety of users around the globe, SAP has set up a network of University Competence Centers (UCCs), eliminating the need for individual campuses to make large investments in technical infrastructures and operational staffing, and providing members with access to the full suite of SAP software. Collaboration among stakeholders, (even competitors) has been identified as a key success factor of SAP's UAP, both in terms of curriculum design and delivery.

A-7) Freely available computer sciences courses from top American universities,

Computer Science & Artificial Intelligence -

- **Artificial Intelligence – Introduction to Robotics** – YouTube – iTunes Video – Multiple formats – Oussama Khatib, Stanford
- **Artificial Intelligence – Natural Language Processing** – Multiple formats – Christopher Manning, Stanford
- **Artificial Intelligence – Machine Learning** – YouTube – iTunes Video – Multiple formats – Andrew Ng, Stanford
- **Artificial Intelligence** – YouTube – P,Dasgupta, IIT
- **Basic Concepts of Operating Systems & System Programming** - YouTube – iTunes Video – Ion Stoica, Anthony Joseph, UC Berkeley
- **Bits: The Computer Science of Digital Information** – Multiple Formats – Harry Lewis, Harvard
- **Building Dynamic Web Sites** – iTunes - Video & Audio – David Malan, Harvard Extension
- **Building Mobile Applications** – iTunes – Web Site - David Malan, Harvard Extension

- **Computational Camera and Photography** – Download Course – Ramesh Raskar, MIT
- **Computer Graphics** – YouTube – Sukhendu Das, IIT
- **Computer Language Engineering** - Web Site – Martin Rinard, MIT
- **Computer Networks** – YouTube – S,Ghosh, IIT
- **Computer System Engineering** – Web Site – Profs, Robert Morris and Samuel Madden, MIT
- **Data Structures** - iTunes Video – Paul Hilfinger, UC Berkeley
- **Developing Apps for iOS (iPhone & iPad)** – iTunes Video – Paul Hegarty, Stanford
- **Developing iPad Applications for Visualization and Insight** - iTunes Video – Niki Kitur, Carnegie Mellon
- **Discrete Mathematical Structures** YouTube – Kamala Krithivasan, IIT
- **Intensive Introduction to Computer Science Using C, PHP, and JavaScrip**t – Multiple Formats – David Malan, Harvard
- **Introduction to Algorithms** – iTunes – YouTube - Web Site – Prof, Charles Leiserson & Erik Demaine, MIT
- **Introduction to Computer Programming for Scientists and Engineers** - iTunes Audio – iTunes Video – Roberto Horowitz, UC Berkeley
- **Introduction to Computer Science and Programming** - YouTube – iTunes – Web Site – Eric Grimson, John Guttag, MIT
- **Introduction to Computer Science: Programming Methodology** – YouTube – iTunes – Multiple formats – Mehran Sahami, Stanford
- **Introduction to Computer Science: Programming Abstractions** - YouTube – iTunes **-** Multiple formats – Julie Zelenski, Stanford
- **Introduction to Computer Science: Programming Paradigms** - YouTube – iTunes - Multiple formats – Jerry Cain, Stanford
- **Introduction to Computer Graphics** – YouTube – Prem Kalra, IIT
- **Introduction to Electrical Engineering and Computer Science I** - Web Site – Multiple Professors, MIT
- **Introduction to Embedded Systems** - YouTube – Professors Sanjit Seshia, Edward A, Lee, UC Berkeley
- **Introduction to Problem Solving & Programming** – YouTube – Deepak Gupta, IIT
- **iPhone Application Development in iOS5 (Fall 2011)** - HD Video iTunes - Standard-Def Video iTunes
- **iPhone Application Development (Spring 2009)** - iTunes – Stanford
- **iPhone Application Development (Winter 2010)** – iTunes – Stanford
- **Logic & Proofs** – Web Site – Carnegie Mellon
- **Machine Structures** – iTunes Video – David Culler, UC Berkeley
- **Machine Learning** – iTunes Video - Yaser S, Abu-Mostafa, CalTech
- **Media Programming** – Web – Carnegie Mellon
- **Multicore Programming Primer** - iTunes – Saman Amarasinghe, MIT
- **Operating Systems and System Programming** – iTunes – Multiple professors, UC Berkeley
- **Principles of Digital Communications I** - YouTube – iTunes – Profs Gallagher and Zheng, MIT
- **Principles of Digital Communications II** - YouTube – MIT
- **Programming Languages and Compilers** - YouTube – Professor Paul Hilfinger, UC Berkeley
- **Quantum Computing for the Determined** - YouTube – Michael Nielsen, The University of Queensland
- **Search Engines: Technology, Society and Business** – YouTube – Marti Hearst, UC Berkeley
- **The Beauty and Joy of Computing** – iTunes – YouTube – Brian Harvey, UC Berkeley
- **The Future of the Internet** – iTunes – Ramesh Johari, Stanford

- **The Structure and Interpretation of Computer Programs** – YouTube - iTunes – Brian Harvey, UC Berkeley
- **Understanding Computers and the Internet** – iTunes – Web Site – David Malan, Harvard University