Talent for Europe

Towards an Agenda for 2020 and beyond

High-Tech Leadership Skills for Europe

March 2017

Final Report prepared to the
European Commission
Directorate-General for Internal Market,
Industry, Entrepreneurship and SMEs

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Disclaimer

Imprint

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Preface

The report *"High-Tech Leadership Skills for Europe – Towards and Agenda for 2020 and Beyond"* is a proposal to boost an EU-wide high-tech talent and leadership skills strategy. It highlights the crucial importance of these skills as well as the challenges for the EU in the world economy. It aims to help position the EU and its Member States among the frontrunners in the global race for high-tech talent.

The European Commission contracted empirica, PwC, IDC and Oxford Martin School at Oxford University to consult with industry, education and training, government and all relevant stakeholders throughout Europe. It was supplemented by a review of existing research and statistical data analysis. Stakeholder engagement included the execution of two online survey altogether involving more than 1000 experts, a series of interviews and four workshops organised in Brussels from January to November 2016 and attended by almost 200 experts. The report reflects the inputs of over 1500 individuals and organisations. They all contributed their ideas over a twelve-month period in 2016.

The need of increasing the pool of digital talent and improving managers' e-leadership skills was highlighted at the launch of the Digital Skills and Jobs Coalition[1] on 1st December 2016. The Commission invited Member States to develop comprehensive national digital skills strategies by mid-2017. To support the development of national strategies, the Commission set up a sub-group to the Digital Single Market strategic group. The outcomes of its work include a shared concept[2] for a digital skills strategy.

The need for action was confirmed by the experts attending the conference on High-tech Leadership Skills for Europe[3] on 26th January 2017 in Brussels. The demand for high tech skills is on a solid growth track. It is anticipated that the number of IT practitioners will grow from 8 million in 2015 to almost 8.7 million in 2020 in the EU. The latest estimate[4] of the gap between demand and supply is 500,000 in 2020, down from an estimate of 756,000 released in December 2015. The reduction of the gap comes at least in part from an increased number of IT educated professionals coming out of Higher Education (HE) and Vocational Training (VET). Under the scenario, 240,000 graduates from IT related HE programmes and VET schemes keep entering the labour market per year, plus more than 100,000 new people without such a formal degree (lateral entries). Jobs newly created account for a third to 40% of the number of new entrants.

The analysis of trends related to IT job statistics over the past few years hint at a growing polarization of skills: the highest skills category (management, architecture and analysis jobs) and the lowest (mechanics and servicers) have increased their shares of employment over the last five years (8.3% and 7.4% annually, respectively). Mid-level skills, especially at the associate and technician level, have seen rather little (yet still some) gains and might get under pressure as productivity gains from automation and commoditization of IT services continue. Continuous, life-long education and training therefore gain more relevance than ever as the industry strives for maturing the IT profession and keeping pace with disruptive change.

Cross-disciplinary leadership skills that exploit new digital and key enabling technologies[5] for enterprises to excel in their business are crucial factors for an increasing high-tech economy. We estimate that 600,000 leaders who combine a T-shaped digital, business and strategic expertise portfolio were in post in 2015. In addition, regarding the group of six key enabling technologies, we estimate the total number of high tech leaders at 200,000 in 2015. To sum up for the purpose of defining the target group to be reached and fostered by high-tech leadership skills policy, we estimate that there are 800,000 high-tech leaders in EU.

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1 https://ec.europa.eu/digital-single-market/en/digital-skills-jobs-coalition

2 A common European response to shared goals: a concept for tackling the digital skills challenges in Europe

3 http://leadership2017.eu/

4 Source: empirica, January 2017

5 Key enabling technologies (KETs) are a group of six technologies: micro and nanoelectronics, nanotechnology, industrial biotechnology, advanced materials, photonics, and advanced manufacturing technologies. https://ec.europa.eu/growth/industry/key-enabling-technologies_en

We developed several scenarios and under a conservative growth scenario, we expect that each year there will be a need for on average 43,000 new digital leaders and 7,000 leaders in the KETs domain. Summing up these figures, the scenario will require Europe to generate around 50,000 additional high-tech leaders per year in the years up to 2025, or a total of around 450,000 until 2025. They should be provided with relevant education and training opportunities and exposing them to the necessary leadership role and experience. If Europe does not manage to foster the supply of these high-tech leaders it runs the danger of severely missing out on innovation opportunities and leaving them to be taken up by its competitors.

A new type of leaders is needed, able to spot, create and serve fundamentally new markets. The two main directions of action include measures related to the educational processes before entering the job market, and measures related to advancing of the workforce 'on the job'. Redesigned curricula need to stimulate multidisciplinary orientation and entrepreneurial agility. On-the-job training, in turn, needs to maximise the exposure of the workforce to the relevant job experiences. Measures here include mobility along the value chain, mobility to application areas, multi-disciplinary teams etc. Multiple good practices already exist that build on the abovementioned principles and need to be disseminated and adopted on a broader scale.

There is a broad agreement that Europe needs to tackle the high-tech leadership skills issue and mobilise stakeholders in a joint EU-wide effort to scale up the supply of talent. Experts believe there is a need to focus particularly on new aspiring entrepreneurs and leaders - also at mid-level management. This kind of people is in high demand globally and the demand is not likely to be met by the current supply from formal education and training institutions.

There is a job to do to increase Europe's talent pool and reduce skills gaps, mismatches and shortages. This requires the right mindset among politicians and stakeholders and the recognition that lifelong learning and retraining is crucial and that national education systems are enabled to respond and act properly.

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More information

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Executive Summary

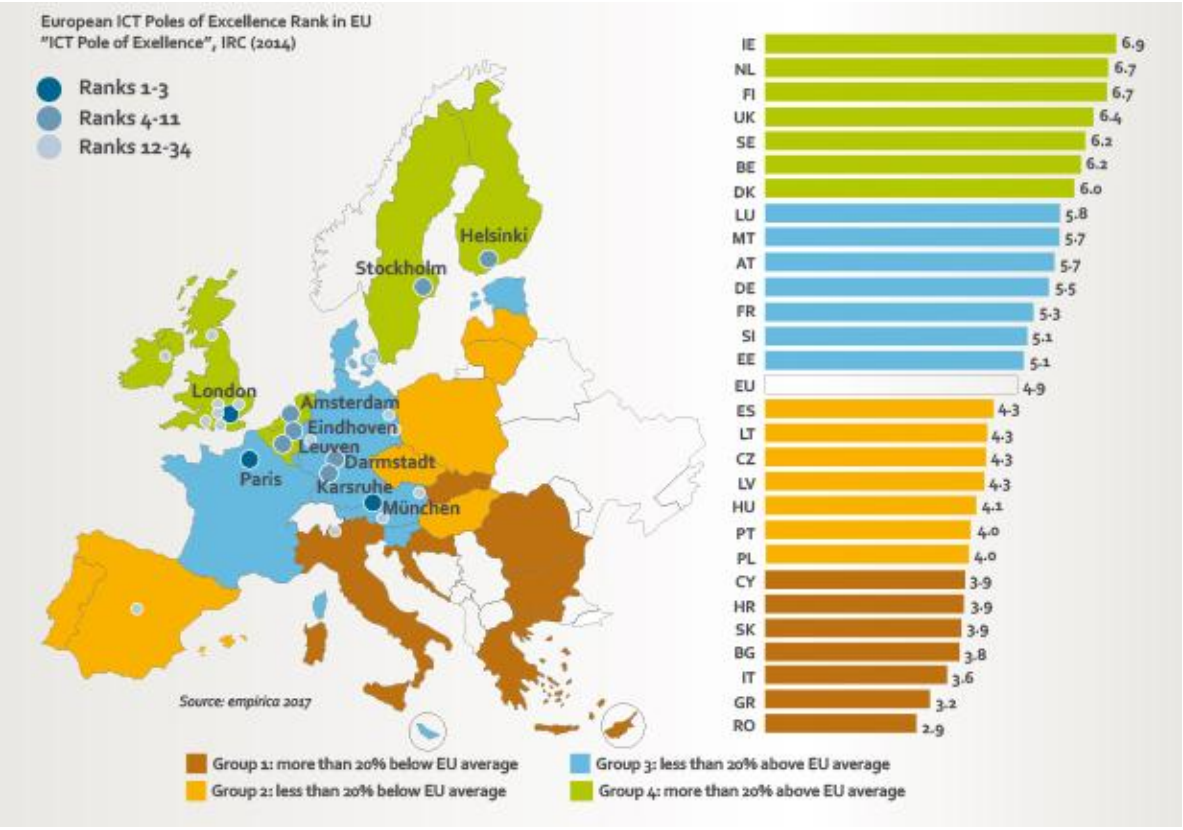
For European enterprises to compete, grow and create jobs, EU Member States must ensure that they have access to a large pool of people who can lead the high-tech innovation and transformation of their industry. New digital and key enabling technologies are a key engine for growth fuelled by the ideas of highly-skilled professionals and leaders. However, shortages of IT specialists are forecasted to reach around 500,000 by 2020 and we estimate that Europe would need 50,000 new high-tech leaders each year till 2025.

Success will be dependent on EU Member States commitment to increase investments in innovation, equip the workforce with relevant skills at all levels and deliver higher-value goods and services successfully traded globally. With favourable framework conditions and a flourishing high-tech ecosystem at EU and national levels, there is a chance to become leaders in the new high-tech economy. This will depend on the ability to capture the benefits of emerging new technologies. Industrial sectors will continue to be reshaped in the next 3-5 years. However, technology adoption and innovation rates remain relatively low which is also due to the lack of technology savvy leaders who can assess and implement technological innovation. This especially holds true for traditional SMEs that acutely need skilled innovation leaders, but have limited means to train of find a suitably skilled workforce to effectively adopt and leverage new technologies.

It is against this background that this report is proposing practical recommendations to help position EU Member States among the frontrunners in the global race for high-tech talent. These proposals address government, industry and education and training actors and key stakeholders at all levels: EU, national and regional. The report includes a description of the technological disruptions taking place and their impact on skills and jobs in Europe followed by the latest business, industrial and technological trends and how these impact on the needs for high-tech leadership skills. Quantifications of current and future developments and skills gaps are provided to illustrate the magnitude of the phenomenon. It allowed the development of an experimental scoreboard and index showing the level of maturity and the readiness of EU Member States. Both make use of available data usable for monitoring progress in high-tech leadership skills related areas.

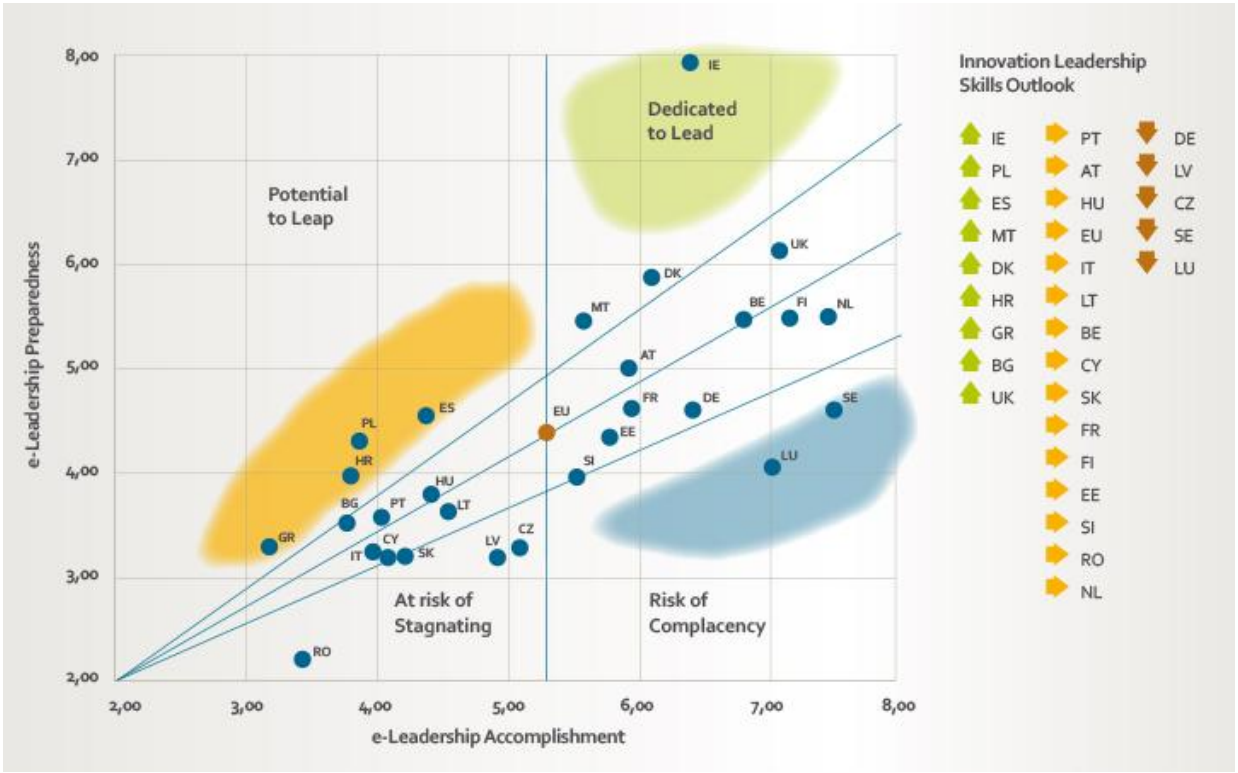
The first version of this experimental scoreboard is - for the time being - focusing only the digital subset of high-tech leadership skills, also called e-leadership skills. The scoreboard indicators have been used to benchmark and compare country performance and to produce an outlook on the likely future development of innovation leadership skill supply in the respective countries based on developments visible today which have a likely impact on the future. This is achieved by dividing the indicators used in the scoreboard into ‘lagging’ and ‘leading’ indicators. An ‘accomplishment index’ was calculated using the values of the ‘lagging’ indicators for all countries. The same procedure was used for the calculation of a ‘preparedness index’ based on the values of the ‘leading’ indicators for each country. Plotting the country averages of the two variable groups, named preparedness and accomplishment index, and taking the EU average as a benchmark and connecting the EU values to the charts origin (0;0), a benchmark line can be derived that divides expectations for likely future performance from today’s performance.

European Map of e-Leadership Index quartiles



Source: empirica, 2016

e-Leadership skills accomplishment v. preparedness plotting for the mid-term outlook in Europe



Source: empirica, 2016

It may be argued that a relatively higher preparedness index value (i.e. above the benchmark line) relates to a likely better future outlook, the country is prepared to grow beyond its current status (or, more correctly, beyond the European average expectation given their departure point).

This outlook can be measured as distance from the benchmark line and is highest currently for Ireland, followed by Poland, Croatia, Greece and Spain. At the other end of the spectrum, future preparedness (i.e. talent pipeline and policies) are least likely to be fit for expansion, or potentially not even for sustaining status-quo, in Member States such as Luxembourg, Sweden, Germany and the Netherlands. This situation is calling of action of different type even in countries seen as good performers having moved ahead fast in the past to become European leaders now starting to become complacent.

The report finishes with practical recommendations aimed at building Europe's talent base for today and the future. The recommendations are organised according to strategic priorities:

The recommendations and proposals for action for each strategic priority have been described under the following headings:

1. **Monitoring, benchmarking and forecasting**
   a) Definitions, segmentations and classifications regarding high-tech leadership skills
   b) Scoreboard and index and new ways of measurement and quantification
   c) Mutual learning from world-class best practices
   d) European one-stop-shop to high-tech talent monitoring and benchmarking

2. **Industry, education and training**
   a) Universities for lifelong-learning, new partnerships and players
   b) European Software Universities for education, training and research in software-based innovation
   c) Build ecosystems
   d) Workforce Credentialing
   e) Embedding technical multi-disciplinarity in the curriculum
   f) Embedding non-technical courses in technical curricula
   g) Updating the skills of teachers/professors
   h) Reverse mentoring

3. **Platform-based digital services for career support and recruitment**
   a) Platform-based digital services supporting diagnosis and self-assessment

4. **Better coordination and funding**
   a) Better information about and more strategic use of available funding
   b) Government-driven public procurement of innovation
   c) Incentive individuals
   d) European quality level leap of worldwide recognition in high-tech leadership education and training

5. **National digital and high-tech skills strategies**
   a) Longer-term policy commitment and concrete action plans
   b) National advisory boards for informed policy development

6. **Promotion and awareness raising for leadership skills for the high-tech economy**
   a) European promotion of multi-stakeholder partnerships and campaigns on leadership skills for the high-tech economy
   b) Role models and success stories

Implementing recommendations and action proposals will contribute to ensuring that European businesses are well equipped to respond to the challenges of an evolving global economy and at the same time making Europe an even better place to live and work. The necessary investments and policy choices need to be done now and at EU as well as national level.

1 Introduction

New disruptive technologies (especially digital technologies together with a group of six key enabling technologies (KETs): micro and nanoelectronics, nanotechnology, industrial biotechnology, advanced materials, photonics, and advanced manufacturing technologies) will generate new business opportunities and models and major sectoral transformation in Europe. New technologies require the availability of the necessary skills at all levels – in particular at the leadership level – to put these into successfully practice, fully exploit their potential and reap the benefits.

The availability of a large talent pool would contribute to make Europe a better place to invest and do business. High-tech talent is scarce and there is a global race for talent. In the EU, skills shortages of IT specialists were at 270,000 (2016) and would reach 500,000 in 2020, down from an estimate[6] of 756,000 released in 2015**.** For high-tech leaders, the number of vacancies is estimated to be 16,500 (2016). We expect that Europe will need to generate around 50,000 additional high-tech leaders per year, or a total of around 450,000 until 2025.

This report on 'high-tech leadership skills for Europe' is investigating thoroughly this topic and is presenting – after the consultation of a large group of experts – a shared vision and concrete recommendations for an ambitious joint agenda towards 2020 and beyond. The aim is to better prepare the necessary industrial transformation and seek commitment for action among relevant stakeholders. The recommendations are meant to help unlock the unprecedented and still vastly unexploited business opportunities – especially by SMEs – help create the necessary high-tech leadership to allow organisations to succeed. This work builds on the results of previous initiatives supported by the Commission on e-leadership[7] and on skills for KETs[8].

The preparation of the report involved stakeholders from industry, education, government, social partners etc. across Europe in intensive consultations through surveys, interviews, workshops and events throughout the year 2016 with the aim to reach agreement and obtain their commitment to a shared vision and the associated recommendations and agenda for action. The authors have made all reasonable efforts to ensure the accuracy of the information contained herein and the fair reflection of the diverse perspectives gathered during the consultations leading up to this document.

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6 Hüsing, T., Dashja, E., Korte, W.B.: IT Professional Skills in Europe: Estimation of Demand, Supply and Forecasting 2017 – 2020 - 2025, empirica Working Paper, January 2017 (forthcoming)

7 See: www.eskills-guide.eu and www.eskills-lead.eu

8 http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=8764

2 Background

2.1 Digital Disruptions and the Impact on Skills and Jobs in Europe

The recent and rapid evolution of automation beyond routine work and its expansion - in combination with artificial intelligence - into machine learning and mobile robotics has opened up a wider range of more complex tasks that will affect jobs and skill demands in Europe for the coming decades. Estimates suggest that as many as 54 percent of current jobs in the EU could be computerised, including many medium to low-skill jobs in manufacturing, construction, transportation and logistics. The implications of these trends are widely perceived by enterprises: in 2016, for the fourth survey in a row, the importance of automating and improving business processes increased in the McKinsey Global Survey[9]. More than half of respondents now cite these as a top-three priority for their organisation.

At the same time, we see the emergence of completely new occupations which will accompany significant changes in skills demands. High-tech technologies such as advanced manufacturing technologies coupled with increasing labour costs in third country (e.g. in China) offers new opportunities for Europe in terms of job growth. It could allow for re-shoring manufacturing in developed countries. In a survey[10] of American manufacturing enterprises by the Boston Consulting Group in 2016, 37% of those with annual sales above $1 billion said they were planning or actively considering shifting production facilities from China to America. Of the very large enterprises, with sales above $10 billion, 48% came out as "re-shorers". Re-shoring is perceived by many experts as a potential source of renewed job creation particularly in hard hit sectors such as manufacturing, which have been the most exposed to off-shoring activities in the past.

The rapid technological progress that is transforming companies and industries in Europe has implications for the demand for skills. New technologies increasingly benefit skilled workers, and thus countries with a relative abundance of skills. Skill-biased technological change (SBTC) has contributed to the increase in income differences across countries and can also account for much of the widening wage gap within countries, as well as the high concentration of economic activity to skilled cities. Thus, relative to technological breakthroughs such as the railroad, the automobile, and the telephone, which created vast employment opportunities for relatively unskilled workers, recent developments in digital technology has mainly benefited a small share of highly skilled workers clustering in skilled locations such as Munich, London, and Stockholm. Advanced technologies are likely to contribute to a surge in productivity over the forthcoming decades, while raising concerns that associated benefits are unlikely to be widely shared unless substantial investments are made to upskill the European workforce. Importantly, there is growing evidence that the slow convergence in high-tech employment within the European Union reflects the slow diffusion of skills across Member States.

Although technological change is rapidly destroying jobs and transforming others, it also creates entirely novel types of jobs and industries; app development, big data analysis and software design are all examples of new work created in the wake of the digital revolution. A growing body of work, however, suggests that the pace of new job creation has slowed since the Computer Revolution of the 1980s. Estimates by Lin (2011), for example, show that while 8.2 percent of the US workforce shifted into new jobs in the 1980s, that share had fallen to 4.4 percent in the 1990s. A recent report by Berger and Frey (2015a) similarly shows that a meagre 0.5 percent of US workers are employed in technology-related industries—such as audio streaming and online auctions—that have been created in the twenty-first century.[11] Although the

[9] Economic Conditions Snapshot, December 2016: McKinsey Global Survey results, December 2016: http://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/economic-conditions-snapshot-december-2016-mckinsey-global-survey-results

[10] Boston Consulting Group: Transformation: Delivering and sustaining breakthrough performance, 2016: http://media-publications.bcg.com/transformation-ebook/BCG-Transformation-Nov-2016.pdf

[11] It shall be noted that these figures are not directly comparable, and that estimating the share of new jobs resulting from the emergence of new technologies is associated with some measurement problems. Nevertheless, they remain suggestive of a downward trend in new job creation.

data is not available to repeat these exercises for European Member States, these estimates suggest that the digital revolution has not created new employment opportunities to the same extent as technological revolutions of the past—as aptly summarized by Bart van Ark (2014, p.11): "while they may be cool places to work, ICT producers are still not net job creators in Europe."

While new technologies have not created many new jobs directly, the arrival of new technologies is, however, significantly changing the demand for skills beyond the technology sector: across occupations and industries new job tasks are emerging as technologies are being implemented. As a result of these trends the vast majority of workers will be required to have (at least) basic digital skills. Yet, some 10 percent of European workers—as many as one in four in countries such as Poland—lack fundamental skills such as using a mouse or navigating a web browser. Among managers, especially advanced analytics skills are in shortage: some 73 percent of respondents to a recent survey conducted by the Harvard Business Review, stated that data analytics was extremely important to their business, while only one in five managers rated their skills as "high" in this area.[12]

2.2 Major Trends and their Impact on High-Tech Leadership Skills

There is a powerful innovation push from new trends in information technologies (IT), and key enabling technologies (KETs: micro and nano-electronics, nanotechnologies, industrial biotechnology, advanced materials, photonics and advanced manufacturing technologies). Their transformational impact on the economy and society in coming years will dramatically increase the demand for new skills, especially for high-tech leadership skills.

The demand varies according to different technology trends and skill types, but Big Data, the Internet of Things and the combination of cognitive systems and robotics are expected by expert opinion to be the most disruptive and to create the highest demand. Approximately 70% of the experts surveyed for our work agree that increased demand will create skills gaps in Europe. But especially the combination of digital and key enabling technologies will increasingly create an important need for multidisciplinary skills - which is currently less visible than for digital skills - but crucial for industrial modernisation in the longer term.

Complaints about how hard it is to source skills do not necessarily translate into increased employment, even if skills become available. Mismatches abound between demand and supply, because of unrealistic expectations, wrong timing, or even simple geography. Supply in Europe is not always available where demand is. The demand for high-tech skills will translate into demand for new training and certifications for today's workforce and managers as well as into the creation of new, additional jobs.

The innovative nature and technology profiles of these trends, particularly Big Data, the Internet of Things (IoT), advanced manufacturing technologies and other key enabling technologies, is very likely to create demand for genuinely new skills and, where business revenues increase, to the creation of new jobs too.

For most of the past decade, many European organisations have focused on getting through the financial crisis with much of the attention being paid internally towards increasing efficiencies and cutting costs, wherever possible. Recently, the attention has increasingly been re-directed towards achieving top line growth, how to service customers and citizens better, how to innovate products and services, and how to increase competitive positioning.

Organisations across different industries are trying to balance cost and growth agendas simultaneously. This is a typical dilemma as the economy moves out of a downturn. What is different this time, are the significant changes that are happening in ICT and in organisations' adoption of ICT to deal with the balancing act. While many organisations have been in a "lock down" mode in the past seven years, the

[12] Harvard Business Review (2015).

possibilities for innovation using ICT have accelerated – and have in some cases taken industries by surprise.

For the adoption of new technology to be labelled **digital transformation** it has to be a continuous process by which enterprises adapt to or drive disruptive changes in their customers and markets (external ecosystem) by leveraging digital competencies to innovate new business models, products, and services that seamlessly blend digital and physical and business and customer experiences while improving operational efficiencies and organisational performance. The key elements are "continuous process" and it has to "innovate and develop new business models, products and services".

According to IDC, in the next few years the four key technologies which have driven innovation in the last few years (**Mobile, Cloud Computing, Social business and Big Data**) will combine with other emerging trends, the so-called innovation accelerators, multiplying their transformative effects on the economy. They include:

- **The Internet of Things (IoT)** enables objects sharing information with other objects/members in the network, recognizing events and changes so to react autonomously in an appropriate manner. The IoT therefore builds on communication between things (machines, buildings, cars, animals etc.) that leads to action and value creation.
- **Virtual/augmented reality** allows immersive visual experience that removes or complements external visual input and follows the user's head movement.
- **Wearables**: Wearable devices with a microprocessor, that is capable of digitally processing data.
- **3D printing**: technology used for additive manufacturing, that is able to materialize all sorts of physical things from digital blueprints — from food to clothing to eventually even living tissue and organs.
- **Cognitive systems**: Systems that observe, learn, analyse, offer suggestions, and even create new ideas — dramatically reshaping every services industry. This includes artificial intelligence (AI), machine learning, cognitive computing, and robotic process automation.
- **Robotics** is the branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing. A robot is a mechanical or virtual artificial agent, usually an electro-mechanical machine that is guided by a computer program or electronic circuitry.

Key enabling technologies (KET) empowered by ICT innovation are transforming the European industry, as documented by PwC's analysis. They include:

- **Micro and Nano electronics** providing the components for hardware and software advances;
- **Nanotechnologies**, feeding into the development of sensors and components for IoT;
- **Industrial biotechnology**, pushing to the market scientific breakthroughs in fields as different as molecular biology, biochemistry, biophysics, genomics;
- **Advanced materials** revolutionizing the very substance of new products;
- **Photonics** enabling radical innovations in communication networks and computing;
- **Advanced manufacturing technologies** complementing 3D printing and enabling additive manufacturing.

According to IDC, Mobile, Cloud, Social business and Big Data already account for more than a quarter of enterprise IT spending; one or more of innovation accelerator technologies have already been adopted by approximately 12% of European enterprises with more than 10 employees, but growth rates are expected to be very fast, as documented in the previous chapters.

Digital transformation is a massive undertaking at which European organisations are still at the start of the journey. IDC has developed an approach of measuring the maturity of adoption of technologies which has also been applied to the broader concept of digital transformation. According to IDC's European Digital Transformation maturity benchmark, only 5% of European organisations can currently be termed digital disruptors while at the other end of the spectrum, one in five can be characterised as digital laggard. Many

organisations are only laying the groundwork in terms of establishing the enabling ICT environments that will allow them to transform digitally, but this is expected to change rapidly in the next years.

2.3 The Importance of Leadership Skills for the High-Tech Economy

The skills required to achieve successful technological innovation are crucial in developing Europe's competitiveness and innovative capacity. The modern economy depends on individuals with the ability to design new business models and to seize opportunities making best use of new technologies to deliver value. The T-shape metaphor together with the presentation of the leadership skills triangle is useful to describe "future ready" professionals who are adaptive innovators with the necessary high-tech talent and leadership skills.

The present policy roadmap and agenda comes timely for consideration by the Commission for its Communication on "A New Skills Agenda for Europe" and related initiatives. It follows the EU long term e-skills strategy and the Commission Communication of 2007, 'e-Skills for the 21st Century: Fostering Competitiveness, Growth and Jobs', which presented a long term e-skills agenda that included five major EU action lines for the period 2008-2010. In November 2007, the Competitiveness Council of Ministers subsequently adopted Conclusions on a long term e-skills strategy and the Commission adopted a Communication on e-Inclusion. Other EU flagship initiatives related to innovation, employment, education and industrial policy also include references to the EU e-skills strategy. These include the Employment Package (2012), the Digital Agenda for Europe (2010) and the Grand Coalition for Digital Jobs (2013). In 2013 the Commission started an e-Leadership Skills Initiative (www.eskills-guide.eu) which was in 2014 expanded to also cover and address SMEs (www.eskills-lead.eu). These initiatives total address the digital skills of the workforce and citizen, IT specialist skills and leadership skills for digital and key enabling technologies[13].

The issues around and problems relating to a high-tech skills and talent gap in our economies are the same around the globe and rather similar across European Member States and Europe's main competitors in the world like the USA, Canada, Japan etc. They all see the need for action to successfully build up the trans-disciplinary talent needed. For example, the International Society of Service Innovation Professionals (ISSIP) is promoting 'T-shaped' professionals who are "future ready" adaptive innovators. In March 2016 the T-Summit took place in Washington bringing together government, industry and academia to "maximize dissemination on the latest learnings of T-Shaped professionals, and how policies, curriculum, and student and employee behaviour can prepare the future workforce." Simply, T Shape is a way to navigate and present individual career experience with breadth of experience (top of the T) with depth of mastery of a recognized discipline (the I of the T). The core idea is to facilitate the ability of professionals to work in collaborative teams with others in complementary disciplines and to be able to pivot with uncertainty and changing workplace requirements.

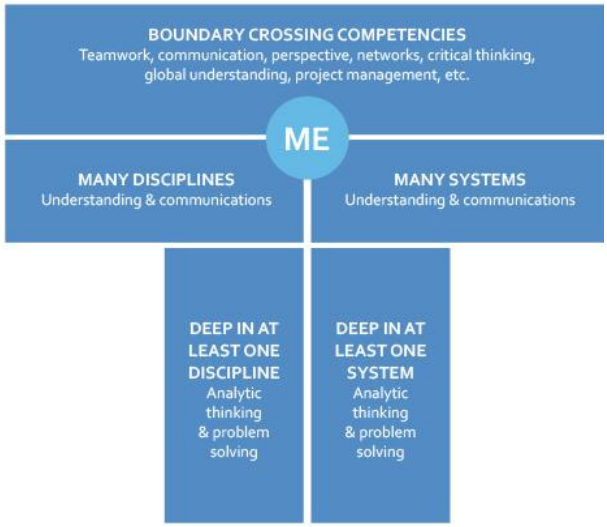
The T-shape metaphor together with the presentation of the leadership skills triangle is useful to describe "future ready" professionals who are adaptive innovators with the necessary high-tech talent and leadership skills. They display:

- **Strategic Leadership**: to lead inter-disciplinary staff, and influence stakeholders across functional and geographic boundaries
- **Business Savviness**: to innovate business and operating models, delivering value to organisations, and
- **High-tech Savviness**: to envision and drive change for business performance, exploiting the innovation opportunities in high-tech trends.

[13] For more information: 'e-Skills for growth and jobs': http://ec.europa.eu/growth/sectors/digital-economy/e-skills/index_en.htm

These are depicted in the leadership skills triangle.

T-shaped professional metaphor[14]



High-tech Leadership Skills Triangle

Cross-disciplinary leadership skills that exploit new digital and key enabling technologies (KETs) for enterprises and industry to excel in their business are crucial factors for the high-tech economy. We estimate that 600,000 leaders who combine a T-shaped digital, business and strategic expertise portfolio were in post in 2015. Regarding KETs, we estimate the total number of high tech leaders at 200,000 in 2015. To sum up for the purpose of defining the target group to be reached and fostered by policy, we estimate that there are **800,000 high-tech leaders in EU.**

We developed several scenarios and under a conservative growth scenario, we expect that each year there will be a need for on average 43,000 new leaders in the digital leadership domain and 7,000 leaders in the KETs domain.

Summing up figures, the above scenario will **require Europe to generate around 50,000 additional high-tech leaders per year in the years up to 2025**, or a total of **around 450,000 until 2025**, by providing them with relevant education opportunities and exposing them to the necessary work and leadership experience. If Europe does not manage to foster the supply of these high-tech leaders it runs the danger of severely

2.4 European Commission initiatives

If Europe is to compete, grow, and generate jobs in the 21st century, it must address the current acute shortage of talent capable of leading the innovation needed to capitalise on advances in new digital and key enabling technologies. Economic growth to create jobs requires that innovation opportunities are identified and effectively exploited. This in turn demands good high-tech leadership skills. These are the skills that lead towards designing business models and taking advantage of innovation opportunities, making best use of digital and key enabling technologies outlined above, and delivering value.

[14] Adopted from the following source: T Summit 2016 Event: http://tsummit.org/t

The Commission saw the need to keep momentum relating to these skills going and provide consolidation to the efforts and activities carried out from 2013-2016 with the aim is to promote them and provide Europe with a larger talent pool of highly-skilled entrepreneurs, managers and professionals.

DIGITAL LEADERSHIP

- CIOs, large corporations
- January 2013 – March 2015
- www.eskills-guide.eu
- www.eskills2014conference.eu

- SMEs and Start-ups
- January 2014 – September 2015
- www.eskills-lead.eu
- www.leadership2015.eu

SKILLS FOR KEY ENABLING TECHNOLOGIES

- January 2014 – October 2015
- www.leadership2015.eu

It is against this background that a comprehensive agenda for high-tech leadership skills for the economy was elaborated and is presented in the present document. The agenda is sufficiently broad to exploit synergy with emerging leadership skills requirements in businesses exploiting ICT, Advanced Manufacturing Technologies and the further key enabling technologies outlined above, and is to be explicitly international in scope. The agenda has taken digital education and entrepreneurship policies fully into account, addresses labour market disruptions resulting from advanced technology developments. Throughout Europe all stakeholders concerned – national and European policy makers and governments, higher and executive and other education and training providers, industry and professional associations – were invited to join forces in the agenda development initiative with those already actively pursuing actions in this area.

2.5 Awareness and relevance

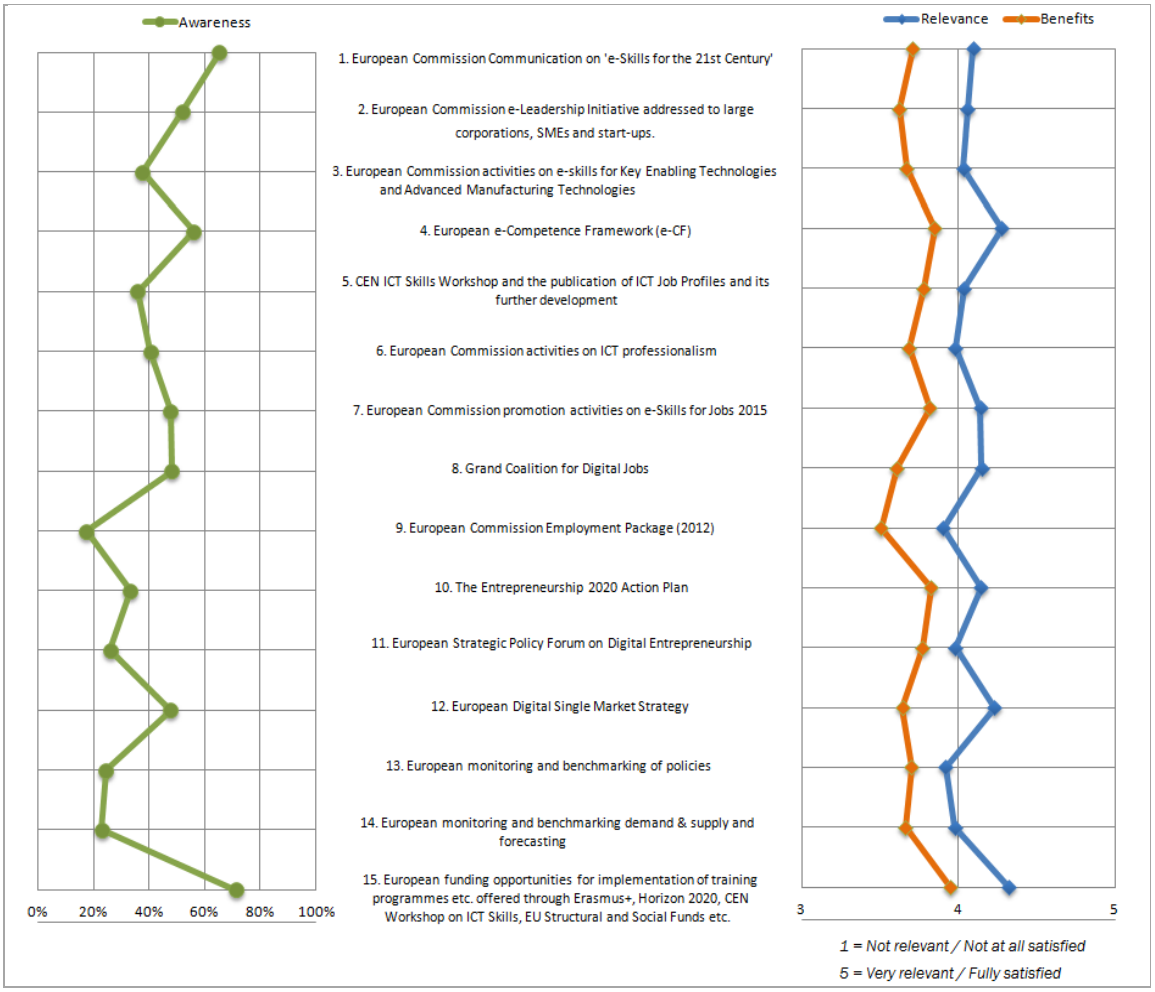
The Commission has in the early years of this century started a range of activities to help improve the digital, e-skills, key enabling technology skills and leadership skills and create the necessary and sustainable talent pool in and for Europe to become more innovative and competitive in a global market.

There still is a job to be done to create higher levels of awareness about relevant European policies and initiatives related to high-tech leadership skills for the economy. At present, only those related to funding opportunities and instruments are well known among stakeholders in Europe. These are followed by the European e-Leadership initiatives, the European e-Competence Framework and the Digital Single Market strategy. Despite mostly rather low levels of awareness, most measure receive very high relevance rankings, i.e. all listed European policies and initiatives prove relevant to address challenges derived from digital disruption on creating the required talent pool able to unleash opportunities that new technology developments and trends presents.

Communication activities for the creation of higher awareness levels and the promotion of these activities need to be improved to create the necessary awareness and perception of the need for European and national policy development in these fields throughout Europe.

Awareness of relevant Commission activities varies significantly.

Stakeholder assessment on awareness, relevance and benefits of European activities: policies, initiatives, partnerships etc.



Through a late 2015 survey of more than 700 stakeholders and policy developers throughout Europe it became apparent that only few of these are well known.

- Highest awareness ratings were received by funding opportunities for implementation of training programmes through Erasmus+, Horizon2020, the CEN Workshop funding mechanisms or the Structural Funds and Social Funds.
- Three other initiatives have awareness ratings of more than 50%: e-leadership initiative, European e-Competence Framework (e-CF) and the Communication on 'e-Skills for the 21st Century'.
- Initiatives with awareness levels below 30% are: the European Commission Employment Package, the monitoring and benchmarking demand & supply and forecasting, the European monitoring and benchmarking of policies and the European Strategic Policy Forum on Digital Entrepreneurship.
- Measures with the highest relevance ranking are the Digital Single Market strategy (4.23), the European e-Competence Framework (e-CF) (4.27) and funding opportunities (4.32).
- Highest benefits are seen for the Entrepreneurship 2020 Action Plan (3.82), the European e-Competence Framework (e-CF) (3.85) and the funding opportunities for implementation (3.95).

Results reveal that funding mechanism are most well-known, which is highlighting the fact that, quite obviously, financial incentives are as important here as anywhere. The awareness that the e-CF receives

and also the relevance it finds is based on highest quality work and commitment that has been pursued over an extended period of time now. This pays off in a well-regarded product that meets appreciation among the stakeholders. There are high awareness levels for the Grand Coalition for Digital Jobs and for the Digital Single Market strategy. Both still show, as yet, some gap between acknowledged relevance and perceived benefits. Interestingly, the respondents' general opinion reveals that expected benefits have not yet been fully exploited, that is also reflected in their assessment on perceived relevance of listed measures which rates higher in each case from the benefits achieved.

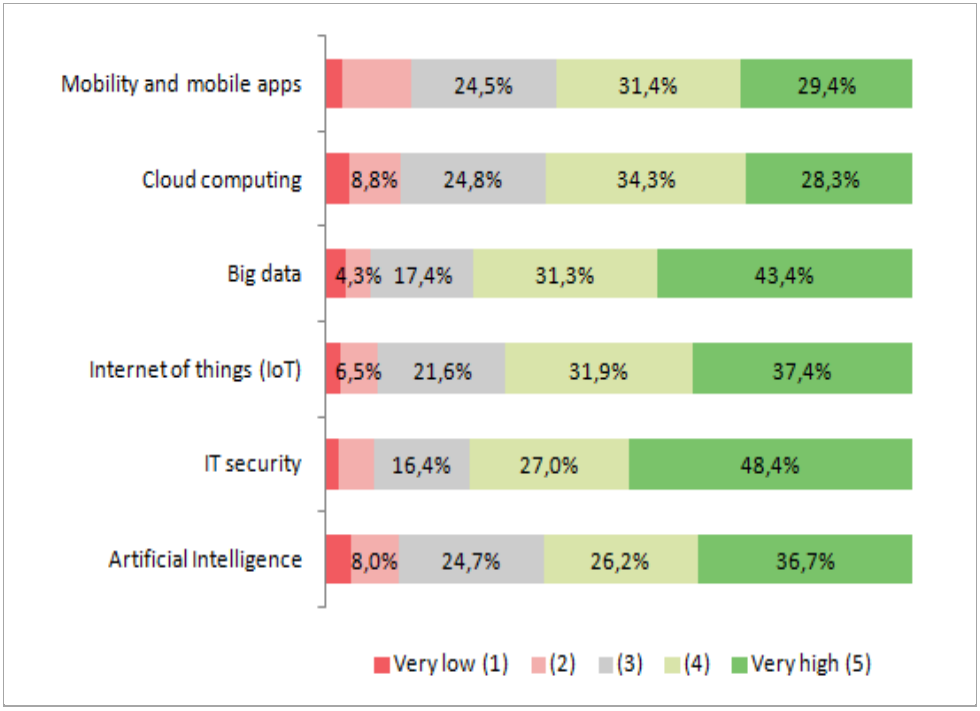
2.6 Expert opinions on high-tech leadership skills

Much broader availability of talent and workers and executives with leadership skills for the high-tech economy is seen as an absolute must by experts if Europe is to compete, grow and generate job. Europe has to address the current acute shortage of people capable of leading the innovation needed to capitalise on advances in ICT and key enabling technologies. Economic growth to create jobs requires that innovation opportunities are identified and effectively exploited. In a recent survey around 90% of European experts responding agree that high-tech savviness is crucial for leadership positions now and in the future. No expert disagreed with this view. Almost all experts believe that for companies to stay competitive in the future, leadership need to become more digital-savvy. More than 80% also argue that people in leadership positions require more knowledge on the possibilities that new technologies have to offer and even more see the need for these experts to be better at integrating digital technology in their business approach.

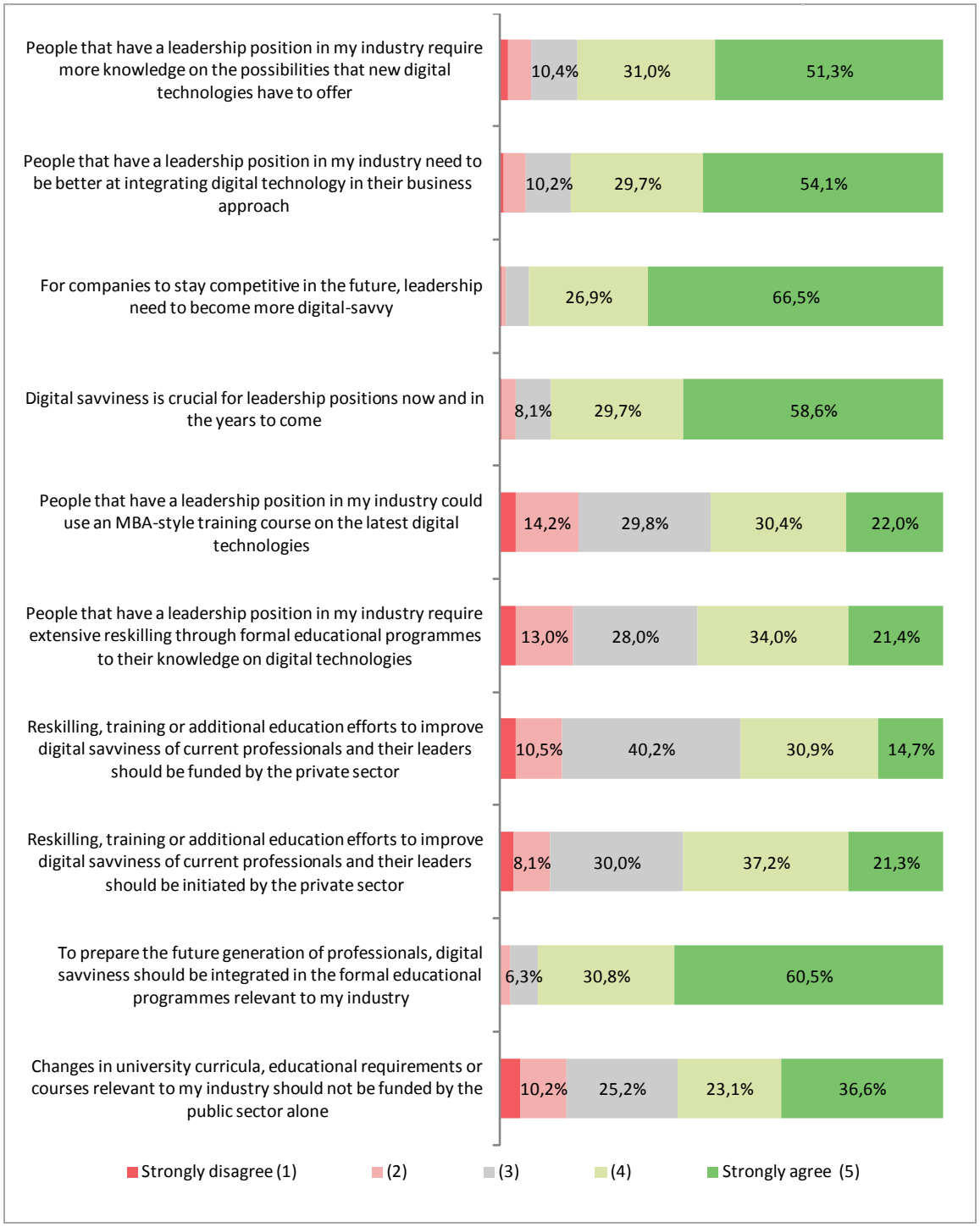
Finally, and to best prepare the future generation of professionals, more than 90% would like to see technology and high-tech savviness integrated in the formal educational programmes in (higher and executive) education and training.

A survey of more than 700 experts carried out throughout in Europe summer/autumn 2015 highlights the main pain points in sourcing skills now experienced in the market and expected to become worse due to the impacts of the main technology trends and the disruptive nature of the combination of IoT, Big Data and Cloud, which will pose great challenges in skills recruitment.

Impact of Key ICT and Technology Trends on the Risks of Skills Gap in Europe, % of Respondents by score



Experts Opinions on Leadership Skills for the High-Tech Economy



According to the experts' survey, some of the actions to be taken could be:

- To integrate high-tech savviness in formal educational programmes relevant by industry (60% of respondents strongly agree)
- To promote MBA-style training courses on high-tech savviness for managers (53% agree)

However, opinions are more varied about the role of the private sector in paying for reskilling and training. While 59% of respondents agree that the public sector should not be the only one funding changes in education which are needed by a specific industry, 48% agree that the private sector should initiate efforts to improve high-tech savviness in the current professionals and managers, and only 44% agree that this

should be funded by the private sector. This should include reskilling, training and/or additional education efforts on high-tech leadership skills for the economy.

2.7 High-tech leadership at a glance

Starting from the premise that direct measurement of the prevalence of high-tech leadership skills is currently not possible based on existing official statistics of occupations, we created experimentally a European scoreboard which makes use of readily available data usable for monitoring progress in high-tech leadership skills related areas.

The first version of this experimental scoreboard is - for the time being - focusing only the digital subset of high-tech leadership skills, also termed e-leadership skills. We did not develop a comparable scoreboard for each of the six key enabling technologies domain as it would have requested considerable efforts and resources by far exceeding the scope of our work.

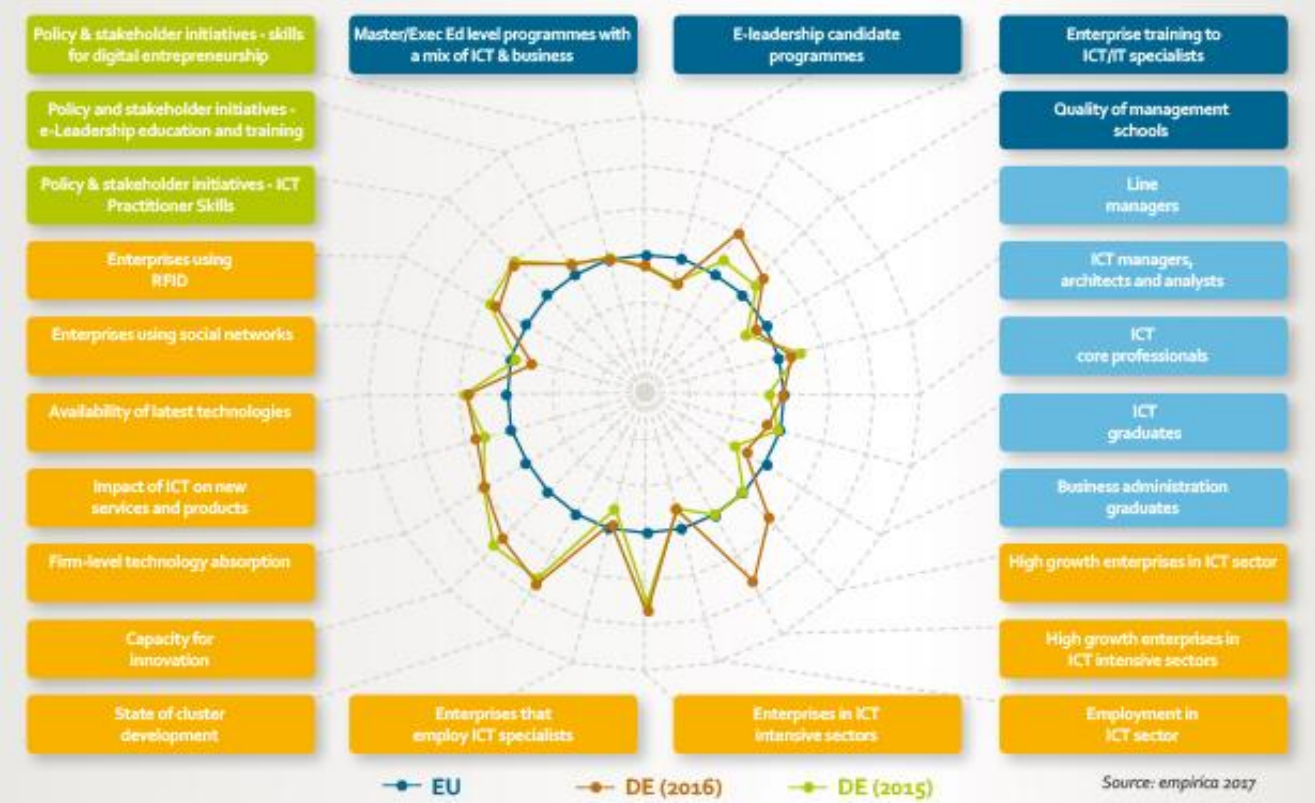
It is composed of domains such as:

- e-leadership education,
- Proportion of the workforce with e-leadership potential
- Structural variables that permit opportunities of e-Leadership to be exploited, and
- e-leadership enabling policies or other drivers.

Based on 24 indicators from primary and secondary sources, the scoreboard compares “performance” across EU Member States and identifies strengths and weaknesses of e-leadership eco-systems, to feed into national and EU policy discussion.

It measures the factors likely to affect demand and supply for e-leadership skills in each country and so provides insights into performance in distinct e-leadership domains. It can be used by policy developers and by industry, higher and executive education both to counter threats and to suggest new avenues of opportunity.

Experimental European high-tech leadership scoreboard



Source: empirica, 2016

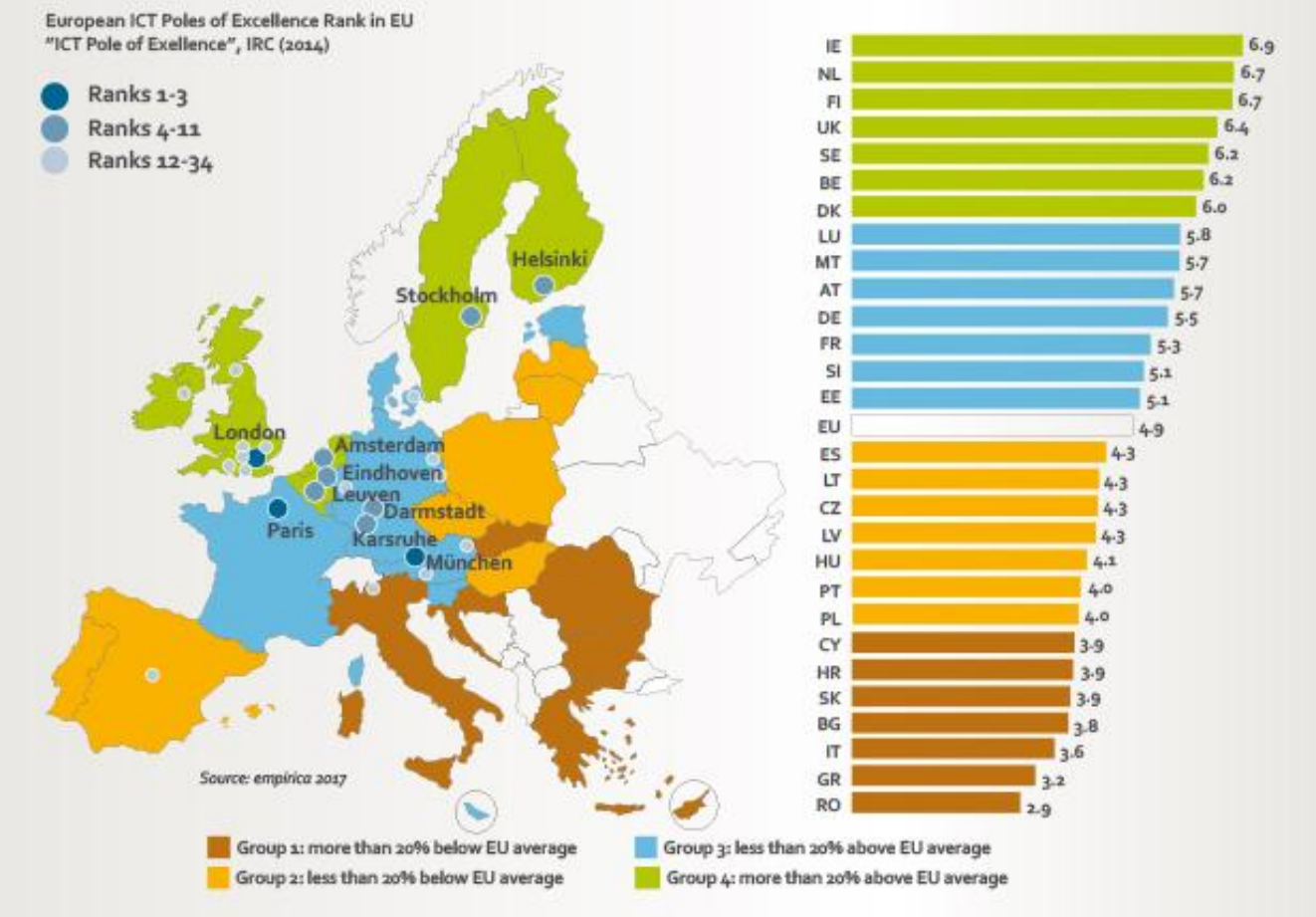
2.8 High-tech leadership Benchmarking Index

The index combines each of the different component dimensions of the e-leadership scoreboard to benchmark EU Member States policies in this field. It locates Member States in four performance groups:

- (Group 4) Ireland, Netherlands, Finland, UK, Sweden, Belgium and Denmark are frontrunners, with performance more than 20% above the EU average;
- (Group 3) Luxembourg, Malta, Austria, Germany, France, Slovenia and Estonia perform less than 20% above or close to the EU average;
- (Group 2) Spain, Lithuania, Czech Republic, Latvia, Hungary, Portugal and Poland perform less than 20% below the EU average.
- (Group 1) Cyprus, Croatia, Slovakia, Bulgaria, Italy, Greece and Romania are more than 20% below the EU average.

Ireland had the top performance score in 2016, closely followed by the Netherlands and Finland. Group memberships remain generally as for 2015, except for Croatia, which moved down to Group 1, while Portugal and Poland moved up to group 2.

European map of high-tech leadership Index quartiles



Source: empirica 2016

2.9 Mid-term outlook in Europe

The experimental scoreboard indicators can not only be used to benchmark and compare country performance, but also to produce an outlook on the likely future development of high-tech leadership skill supply in the respective Member States based on developments visible today which have a likely impact on the future. This is achieved by dividing the indicators used in the scoreboard into 'lagging' and 'leading' indicators. A term used predominantly in finance, a lagging indicator describes phenomena that are preceding the indicator incidence by a certain time. For instance, the unemployment rate tends to be a lagging indicator of economic performance, with the labour market reacting to economic growth, or slump, with a certain delay. Similarly, we argue that the indicators under the heading business environment and innovation opportunities can be viewed as a consequence of high-tech leadership being practiced.

Leading indicators are indicators that are correlated with later instances of the phenomenon represented. High-tech leadership skilling, as an input to leadership skills creation, naturally precedes the execution of high-tech leadership. The same holds true, arguably, for indicators that measure the pool of potential (later) e-leaders and the maturity of policies fostering e-skills and e-leadership skills.

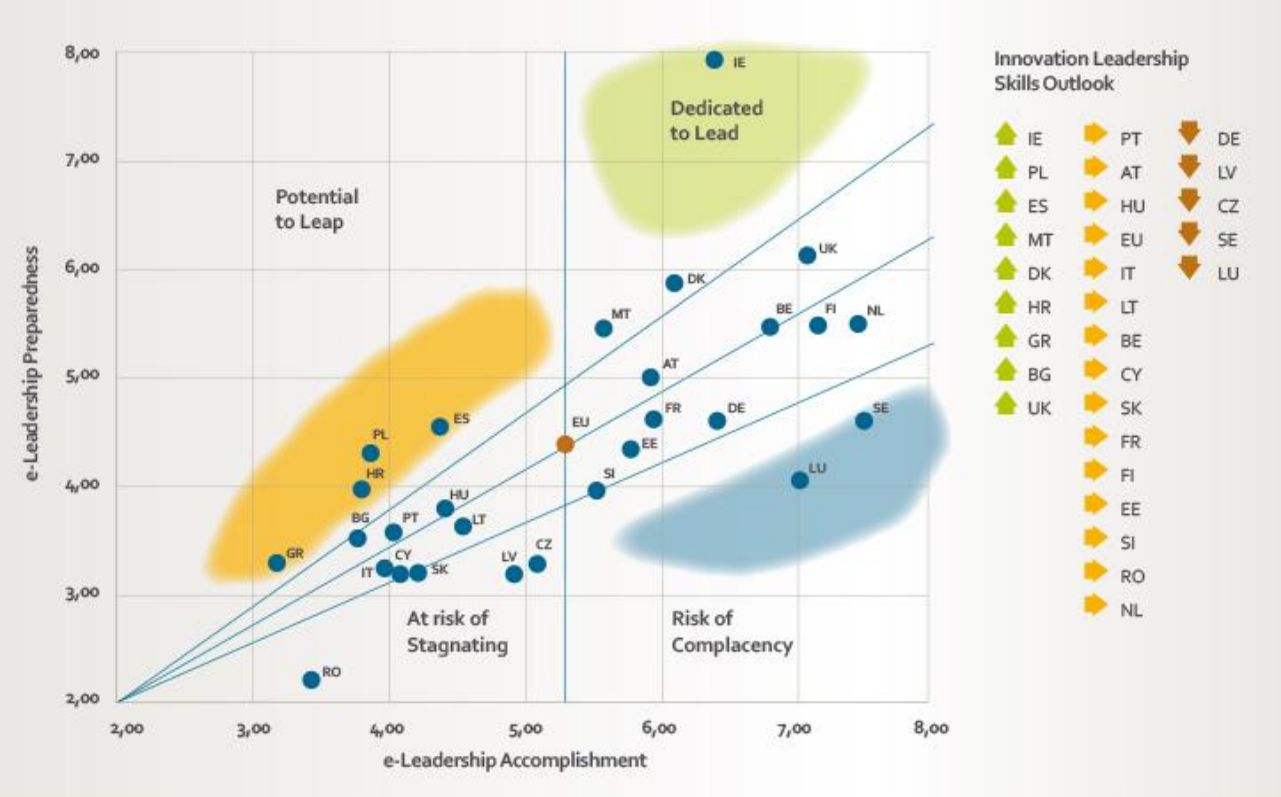
The indicators that are under the heading of high-tech leadership skilled professionals can be understood as coincident indicators, i.e. indicators that are correlated in the same time interval, as they represent an economy's status of professionalization of management and advanced technologies. They have also been

grouped with the lagging indicators to work as a proxy measure to assess high-tech leadership accomplishment.

An 'accomplishment index' can then be calculated using the values of the 'lagging' indicators for all EU Member States as a simple average of the three indicator groups. The same procedure was used for the calculation of a 'preparedness index' based on the values of the 'leading' indicators for each country. Plotting the country averages of the two variable groups, named preparedness and accomplishment index, and taking the EU average as a benchmark and connecting the EU values to the charts origin (0;0), a benchmark line can be derived that divides expectations for likely future performance from today's performance.

It may be argued that a relatively higher preparedness index value (i.e. above the benchmark line) relates to a likely better future outlook, the country is prepared to grow beyond its current status (or, more correctly, beyond the European average expectation given their departure point). This outlook can be measured as distance from the benchmark line and is highest currently for Ireland, followed by Poland, Croatia, Greece and Spain. At the other end of the spectrum, future preparedness (i.e. talent pipeline and policies) are least likely to be fit for expansion, or potentially not even for sustaining status-quo, in Member States such as Luxembourg and Sweden. This situation is calling of action of different type even in Member States seen as good performers having moved ahead fast in the past to become European leaders now starting to become complacent.

High-tech leadership skills accomplishment v. preparedness: the mid-term outlook in Europe



Source: empirica, 2017

2.10 Relevant EU Member State policies and initiatives

The Commission has in 2013 started a European e-Leadership Initiative (www.eskills-guide.eu) and expanded it to also cover SMEs in 2014 (www.eskills-lead.eu) and is presently continuing with this as already outlined above. This initiative had been accompanied by a large-scale promotion and awareness raising campaign on 'e-Skills for Jobs 2015-2016' http://eskills4jobs.ec.europa.eu/. These activities build on previous activities following the Commission Communication "e-Skills for the 21st Century: Fostering Competitiveness, Growth and Jobs".

These activities have triggered policy and stakeholder activities in this domain in EU Member States. These have been monitored for the first time in 2009 and results were published by the Commission in October 2010 (http://ec.europa.eu/growth/sectors/digital-economy/e-skills/index_en.htm).

Monitoring and benchmarking of policies and multi-stakeholder partnerships on e-skills and leadership skills for the high-tech economy in the EU Member States, with a special focus on education and training initiatives and policies, have continued regularly since and the latest results were published in October 2015 in a report and in 28 EU Member State Country Reports (http://eskills-lead.eu/documents/; http://eskills-lead.eu/fileadmin/lead/reports/lead_final_report.pdf).

The topic of leadership skills for the high-tech economy education & training is touched upon – more or less explicitly – in a whole range of policy fields in the EU Member States, such as policies on: higher & vocational education; research & innovation; entrepreneurship; skills; SMEs; investment support; immigration; and the Digital Agenda, which itself represents a horizontal policy domain cutting across all the ones mentioned. At the intersection of these policies, the topics related to leadership skills attract increasing interest in many Member States.

Only in Ireland, Italy and Scotland, however, are measures for strengthening these skills explicitly mentioned in policy strategies. The general impression from our analysis is that the need for providing SMEs and entrepreneurs with the skills is treated as a secondary objective, with limited need for concerted action once the more well-established objectives of policy intervention (such as take-up of present-day ICTs; basic ICT user skills; adoption of e-government and e-business; access to venture capital; start-up subsidies) have been taken care of.

The policy analysis had to take into account that some Member States feature powerful regions with own policy strategies bearing upon leadership skills for the high-tech economy. This applies, in particular, to Belgium, Germany, Spain and the U.K.

The analysis identified the following key policy approaches to the topic in Europe:

Policies on higher & vocational education: The focus is on adapting existing and introducing new programmes in higher and vocational education to provide offers for acquisition of e-Leadership skills. Depending on the established governance structures in the area, some governments have joined forces with universities and other education providers to initiate development of course programmes that meet the needs of the business community, mainly in terms of study duration and learning outcomes. In other Member States, related developments have taken place without a significant degree of policy intervention,

as public universities, business schools and the like strive to develop their competitive edge by offering course programmes that provide a combination of executive management, business innovation and ICT competencies.

Research & innovation policies: These policies often include strategic approaches to improving the capacity of SMEs to invest in product or process innovation. Existing schemes often include the transfer of e-Leadership knowledge into SMEs, but this happens more often through one-to-one consultancy rather than SME participation in training programmes.

SME policy: Driven forward by the European Commission's "Small Business Act" (SBA) from 2008, the majority of Member States have dedicated policies in place for supporting SMEs and for making it easier to establish a new business. Many of these also include schemes for providing SMEs with more attractive and better suited offers for participation in training about leadership skills for the high-tech economy, as such training is understood to boost SME competitiveness but often hampered by high barriers to uptake. There is a range of instruments available for this purpose, see the next section. Skills are also being provided in the course of subsidy schemes for ICT-enabled product and process innovation, and as part of support packages for helping SMEs internationalise their operations. Examples include Austria's Go Silicon Valley initiative.

Entrepreneurship policy: Promotion of entrepreneurship is on the policy agenda in most if not all Member States; the range of policy interventions includes establishment of "entrepreneurship education" in school and university curricula, business plan competitions and awards, and financial and hands-on support for fledgling start-ups (similar to what is offered to SMEs that seek to innovate). It appears that governments tend to avoid putting a special emphasis on ICT-driven start-ups, but in practice most promising start-ups will require digital leadership skills to be able to grow. Our analysis suggests, however, that most schemes for supporting entrepreneurs give only limited attention to training of these skills.

Skills policy: Policies dedicated to identification of skills shortages, gaps and mismatches have a long tradition in some Member States such as the U.K. and Ireland, while in others skills related issues are spread across a range of policies under responsibility of different ministries. Against this background the Commission's Communication on "e-Skills for the 21st Century", which presented an EU long term e-skills agenda, and in particular the "Grand Coalition for Digital Jobs" launched in 2013 have had a strong impact on policy-making in many EU Member States, especially those that joined the EU since 2004. Examples include the Slovak Republic, where the country's national coalition for digital jobs "Digital Future" and an energetic Digital Champion have initiated a strong boost to e-skills policy initiatives, many of which touch upon the issue e-Leadership skills. Another example is Bulgaria's Digital National Alliance (DNA) which focuses on action to enhance digital skills including leadership skills.

Employment policy: The available data suggest that women are significantly underrepresented among both digital entrepreneurs and ICT management positions. In line with the general policy objective to increase the rate of female participation in the labour market, a number of Member States have devised strategies to promote a stronger role of women in management positions, including female entrepreneurship, as this remains an area of untapped potential. In Sweden, the "Promoting Women's Entrepreneurship" programme operates the "Golden Rules of Leadership" initiative. Germany's Go MINT! "National Pact for Women in IT Careers" alliance was formed in 2008 already, and Greece has a Digital Alliance for the Employment of Women. Another area where employment policy has a bearing on e-Leadership skills is the development and provision of tailored education & training targeting graduates at risk of unemployment: In the face of, on the one hand, increasing rates of unemployment also among university graduates and, on the other hand, hard-to-fill vacancies for ICT practitioners who also have advanced business skills, some Member States have attempted to channel graduates and other jobseekers towards ICT jobs in which e-Leadership is required. The Republic of Ireland has been especially successful in this area.

Digital Agenda: Following the example of the Digital Agenda for Europe, national policies that address cross-cutting issues concerning ICT take-up and use tend to be called national digital agendas today. While these deal most prominently with the underlying technological infrastructure and how to give everybody

full access to it, skills issues related to digital competences are a key component of the large majority of national digital agendas in Europe. The development and broad recognition of e-skills frameworks and occupational definitions is particularly important. These frameworks and definitions stem from national level efforts in the 1990s already (e.g. SFIA in the U.K.) and have received a strong push in recent years through the development of the European e-Competence Framework (e-CF). A large number of schemes for education and certification of e-skills in Europe make use of, or are closely aligned with, the e-CF (e.g. the iTalent standards in Malta). Some of the core competences which are an integral part of the definition of "e-Leadership skills" have been incorporated in the e-CF, such as A.1. IS and Business Strategy Alignment, A.3. Business Plan Development, A.9. Innovating, E.7. Business Change Management. The process is expected to continue regarding both the e-CF and similar or aligned national e-skills frameworks. Inclusion of e-Leadership skills in competence and e-skills frameworks will boost awareness about their importance for growth and innovation and about possible skills bottlenecks in the area; it is also likely to trigger the debate among stakeholders about whether adequate education programmes are in place or how they can be established. A good example for this approach is the new Italian Strategy for the Digital Agenda.

Investment support: The by far most important policy tool for supporting SMEs and entrepreneurs in Europe's less developed regions (which includes the territory of all East European Member States with the exception of a few mostly capital city regions, plus Croatia and large parts of Slovenia, Portugal, Greece, southern Italy and peripheral parts of the U.K.) is distribution of investment support financing from the European Structural Funds. For each programming period, Member States agree with the Commission on a Partnership Agreement, which outlines the country's overall strategy for how to invest the funds, and a number of Operational Programmes (OPs).

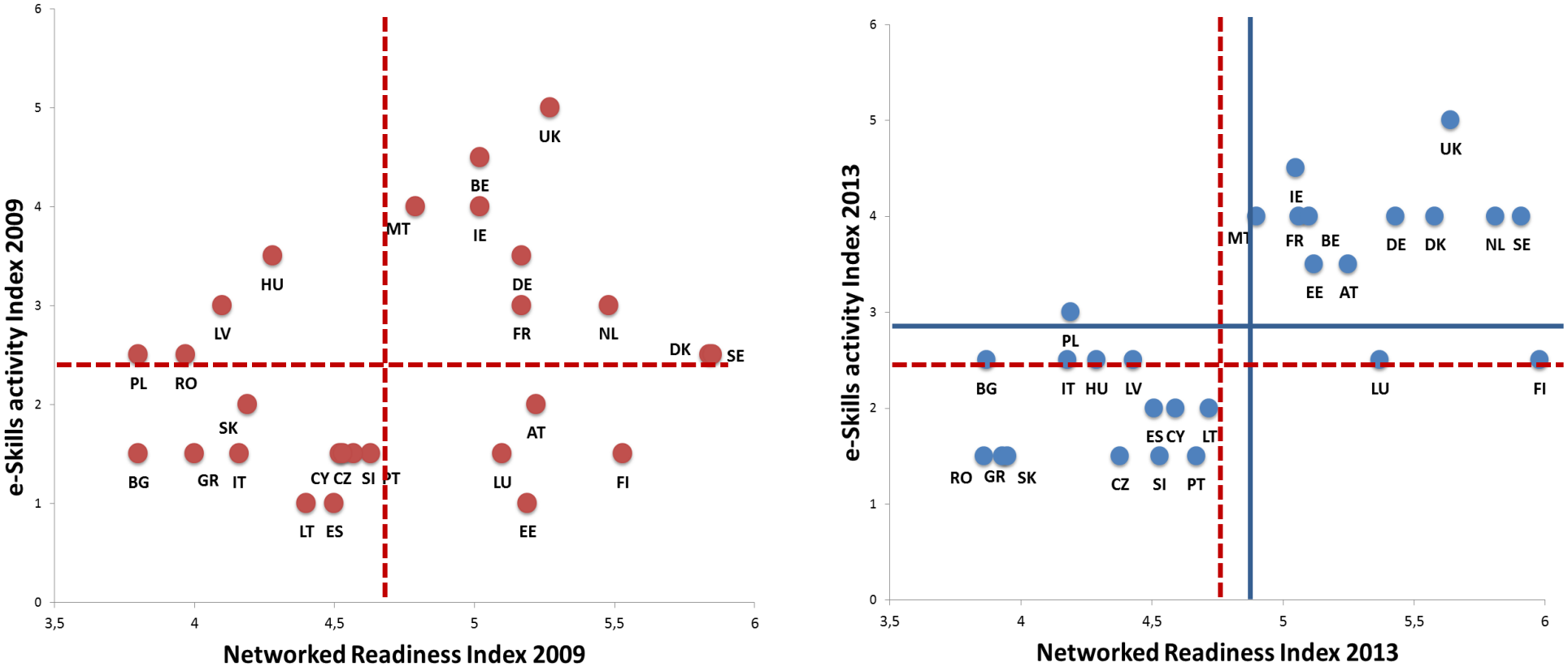
There are clear indications that the EU e-skills strategy and the subsequent e-leadership skills initiatives have triggered some Member States to engage in public debates about the issues of high-tech leadership skills. The degree of integration and consistency of policy-making is still limited in certain Member States. Several Member States lack a master strategy or the topic still does not attract policy makers.

These policies and their development over time in the EU member states computed to an 'e-skills policy activity index' may be taken as an indicator for measuring, monitoring and benchmarking policy efforts. From 2009 to 2013 increased policy efforts to set the right framework conditions and give support and incentives to develop skills can be observed. As one example, the average policy score that Member States got for the e-skills improved from 2.37 in 2009[15] to 2.87 in 2013[16] (scale 0-5). This led the Commission to launch the "Grand Coalition for Digital Jobs" in 2013.

[15] Hüsing, T. and Korte, W.B. (2010) "Evaluation of the Implementation of the Communication of the European Commission 'e-Skills for the 21st Century'"

[16] Gareis, K. Et al.: E-SKILLS FOR JOBS IN EUROPE: MEASURING PROGRESS AND MOVING AHEAD. FINAL REPORT Feb 2014

Figure 1: Increase of average e-skills policies scores between 2009 and 2013



Source: *Gareis, K. Et al.: e-skills for jobs in Europe: measuring progress and moving ahead. Final report, February 2014*

2.11 Best Practices on high-tech leadership skills

As the high-tech leadership skills training field is developing, several successful training programmes and initiatives have emerged and begun to coalesce around a number of best practices.

This section identifies these best practices addressing relevant aspects of high-tech leadership skills from our analysis of programmes and initiatives. They include examples of

- New education and training programmes and platforms,
- Excellence and mentoring multi-stakeholder partnership programmes,
- Initiatives to align education on advanced manufacturing and other innovative technologies with industry's needs
- An advanced infrastructure for training in advanced manufacturing technologies initiated and led by Industry and
- Entrepreneurship and start-up training schemes and accelerators.

BEST PRACTICE EXAMPLE 1

IMEC INTERNATIONAL – merger of imec and iMinds created a world-leading high-tech research centre driving the digital economy, Belgium

Imec performs world-leading research in nanoelectronics and delivers industry-relevant technology solutions. Imec is headquartered in Leuven, Belgium, and has offices in Belgium, the Netherlands, Taiwan, USA, China, India and Japan with about 2,500 researchers including almost 800 industrial residents and guest researchers.

Imec has been a global leader in the domain of nanoelectronics for more than 30 years, and has innovated applications in smart systems for the Internet of Things (IoT), Internet of Health, and Internet of Power. It has built an extensive and worldwide partner network, as well as in Flanders, and has generated successful spin-offs. iMinds' activities span research domains such as the IoT, digital privacy and security, and the conversion of raw data into knowledge. Its software expertise is widely renowned and its entrepreneurship activities in Flanders are first-rate.

iMinds used to be the Flanders' digital research and entrepreneurship centre with some 1,000 researchers at five Flemish universities conducting strategic and applied research in areas such as Media, Health, Smart Cities and Manufacturing. Together with its research partners – enterprises, governments and non-profit organisations – iMinds translates digital know-how into concrete products and services. In addition, iMinds supports researchers and (start-up) entrepreneurs in the successful market introduction of their ideas.

In late 2016 the nano-electronics research centre imec and the digital research and incubation centre iMinds merged into a high-tech R&D hub. Using the imec name, the combined entity is now creating a world-class, high-tech research centre for the digital economy combining longstanding leadership in microchip technology with in-depth expertise in software and IT.

http://www2.imec.be/

BEST PRACTICE EXAMPLE 2

Software Campus – an innovative high-tech leadership programme for excellence, Germany

Software Campus is a unique cooperation between government, education and industry that supports young researchers in becoming high-tech leaders. Each participant works on an academic project, which is funded by Software Campus. After the participants are selected, the grants are required with the Ministry of Education and Research. Apart from that, the candidates receive high quality leadership training by the

participating industry partners. Therefore, they collaborate with a partner company, where they are mentored by an experienced manager and contribute with their research.

Software Campus was originated from the idea to create a new generation of managers with an advanced IT background since the new high-tech leaders of the future have to have both economic (and engineering) competences and excellent IT skills and knowledge.

A total of 19 stakeholders, consisting of universities, research institutions and enterprises, contribute to the multi-stakeholder partnership. Industry partners include major names such as Deutsche Post DHL, Siemens and SAP. It was a major priority to include enterprises from different economic sectors and foster a platform for precompetitive work.

http://www.softwarecampus.de/en/home/

BEST PRACTICE EXAMPLE 3

PROMPT – Professional master in software development, Mälardalen University, Sweden

The advanced education programme PROMPT aims at ensuring the supply of software experts to industry and to increase industrial competitiveness through customised, free university courses for engineers and developers.

PROMPT has been launched as a national educational initiative in cooperation with several academic parties and a number of leading Swedish industrial enterprises and organisations. Together the parties develop academic courses on advanced level, adapted for professional engineers and software developers. The goal is to guarantee the supply of advanced software competencies and innovativeness to industry.

The courses, all on master´s level, are developed to suit those already employed and who want to combine work and studies. The courses are produced in cooperation with the enterprises in need of the competence, and teaching has been adapted for professionals combining studies with work. The courses combine conventional studies with distance, web-based learning and teaching at the participating enterprises.

The goal of the project is partly to implement an upgrading of skills that will significantly improve competitiveness in industry, and partly to support the development of new software based innovations. The participating enterprises get a head start when it comes to integrating new research in the area into their activities.

PROMPT is an open initiative which welcomes additional enterprises and higher education institutions (HEIs). The PROMPT project has funding from the Swedish Knowledge Foundation's programme "Expertise for Innovation", and also from the participating HEIs and enterprises.

http://www.promptedu.se/

BEST PRACTICE EXAMPLE 4

IT University of Copenhagen, Denmark

The IT University of Copenhagen is a Danish globally oriented, independent university established in Copenhagen, Denmark in 1999. The IT University is a mono-faculty university with a cross-disciplinary approach and the youngest university in Denmark with around 2000 students. Based on its mission of contributing to making Denmark exceptionally good at creating value with IT the IT University strives to deliver internationally recognized and highly relevant research and education.

The IT University of Copenhagen offers 3 BSc programmes, 4 MSc programmes and an extensive PhD programme as well as professional Masters Degrees and a Diploma programme, including interdisciplinary studies within the Sciences, the Humanities, Design and Business. The students come from very different backgrounds and many are internationals, offering new perspectives and approaches. The entrepreneurial

spirit of both the University and its students is high as shown by the list of around 50 start-up enterprises founded by ITU students.

The different programmes of IT University Copenhagen teach topics which are of crucial importance and relevance for innovation and the creation of value with IT in enterprises now and in the future with a cross-disciplinary approach and a strong representation of software and data analytics in research and education.

http://en.itu.dk/

BEST PRACTICE EXAMPLE 5

DiTex – Digital Talent Executive Program, Spain

The DiTex – Digital Talent Executive Program is addressed to HR directors, talent managers and management specialists as well as training and development managers who have to lead the digital agenda of the business and talent transformation. The aim is to teach and learn knowledge of digital business in order to lead the company's talent transformation from HR, manage Digital Talent and become familiar with digital tools to manage new HR KPIs. The program consists of 8 on-campus modules and combines theory with the development of a core project. The ISDI teachers are recognized digital working professionals and specialist experts in the areas they teach.

DiTex is probably one of a few programs of this type which is very market / industry oriented and offered by a new entrant on the dedicated 'digital' and 'digital transformation' training market addressed to executives with digital working practitioners and specialists instead of academics and professors as teachers, which can easily and rapidly be adopted to changing market needs.

http://www.isdi.education/ditex

BEST PRACTICE EXAMPLE 6

Festo Didactic "Transfer Factory" – Research and Teaching platform, Germany

Digitalisation in advanced manufacturing requires workers to develop a deep understanding of the structure and programming of digital facility networks. Such skills are best taught in a real-life controlled environment, to which education providers and enterprises typically do not have access to. The CP Factory learning and research platform - a privately funded initiative from Festo Didactic - responds to this challenge by providing higher education institutes and enterprises with access to the technology and applications of Industry 4.0.

The basis of the training platform is the MPS® Transfer Factory. The platform demonstrates the production of tomorrow in a locally controlled intelligent network and was developed for flexible training in a wide range of technologies and subjects. These subjects include facility networking, PLC programming, drive technology, sensor technology, safety technology, robotics, assembly, as well as value stream analysis and optimization.

Festo Didactic also offers individual training courses in connection with the MPS® Transfer Factory, which address communication, robotics, simulation, image processing, PLC programming, fieldbus, RFID technology, plant simulation, and troubleshooting.

It is one of the few privately funded training initiatives for digitalisation in advanced manufacturing and as such unique in the world. Moreover, the state-of-the-art training facilities are unique in Europe.

www.festo-didactic.com

BEST PRACTICE EXAMPLE 7

UK Futures Programme – Skills for innovation in manufacturing, United Kingdom

The UK Futures Programme is a series of learning programmes that target specific emerging or persistent workforce development problems.

In the "Skills for innovation in manufacturing" competition round, stakeholders from business and academia were invited to submit proposals for projects that focus on skills development to manage the innovation process and exploit innovative products or services for commercial value. Each awarded project will test skills development in their workplaces, resulting in a series of learning programmes aiming to address specific workplace skills needs. They receive co-investment from UKCES up to £150,000 per project.

The initiative is unique in its kind, as no other initiative in Europe was identified that focuses on skills development for managing the innovation process and exploiting innovative products and services in advanced manufacturing.

Organisations that submitted successful proposals include a leading UK manufacturer, an employer representative body and UK universities. The projects are based in Belfast, Cardiff, Glasgow, Swansea and Lancaster.

https://www.gov.uk/government/organisations/uk-commission-for-employment-and-skills

BEST PRACTICE EXAMPLE 8

Start-up Estonia

The Estonian government initiated Start-up Estonia in late 2011, a programme for the promotion of business start-ups in high-growth areas with a strong role of IT. Start-up Estonia is an initiative to support start-ups in digital entrepreneurship by helping local students and researchers to develop business incentive in the area of IT. Start-up Estonia brings mentors from around the world in order to share their knowledge with local entrepreneurs, organises workshops, open lectures and networking events to help collaboration and mutually beneficial information sharing.

The initiative is aimed at developing the ability of market players (e.g. financing the emergence of new accelerators) to offer start-up training, instead of offering direct support (grants) to start-ups.

The initiative has been tightly knit with funding organisations since 2014. Today and since 2016 the programme is managed by Foundation KredEx. Prior to that date it was managed by the Estonian Development Fund managing who took over from Enterprise Estonia in 2014. It is expected that the need for Startup Estonia will become obsolete by 2020 and the market will itself create start-up projects.

http://www.startupestonia.ee

3 Proposal for a European high-tech leadership skills agenda

Our recommendations are designed to help to ensure that Europe will build a sufficient talent pool of high-tech leaders in the future. They result from a number of expert consultations in workshops, surveys and interviews. More than 700 experts were involved in the survey and in interviews. Around 100 experts expressed interest in contributing to developing the agenda and around 50 finally made specific proposals.

The recommendations and proposed actions here address Europe's challenges and opportunities in developing high-tech leadership skills, streamlining education and training, and fostering talent along six strategic priorities. These recommendations provide a roadmap for action in Europe, for industry, academia, government and national stakeholders and the European Union institutions. They are proposed below including a timeline for key actions.

3.1 Towards an ambitious agenda

The new **High-tech Leadership Skills for Europe** agenda is built on results of the Commission initiatives and activities on e-skills, e-leadership skills and skills for key-enabling technologies which include micro and nano-electronics, nanotechnologies, industrial biotechnology, advanced materials, photonics and advanced manufacturing technologies.

The new agenda has been developed and validated with key stakeholders in particular so as to inform the content by broad stakeholder view and foster acceptability of and buy-in into agenda actions by this broad range of stakeholders throughout Europe. Herewith the agenda is taken forward to a wider public, hopefully triggering wide dissemination and action.

3.2 Agenda contents

The agenda is to significantly build on and extend the current scope of the Commission initiatives. It includes concrete actions at EU and Member State level recommended to build up the supply of a comprehensive range of high-tech leadership skills and ensure their future optimal availability throughout European enterprise. Actions are linked to specific targets, set in quantitative terms where appropriate, and actions and targets are given an indicative timeline for implementation. To minimise overlap and maximise effectiveness, governance mechanisms capable of delivering necessary coordination are proposed.

3.3 Supporting early action

Early actions of the agenda include in particular ensuring continued **exploitation of the results of prior action** in the Commission Initiatives and providing monitoring and progress tracking services centring on **up-to-date pan-European statistics**. Launch and implementation of action in the agenda are supported by updated and adapted statistics, an experimental scoreboard and index, enabling comparison of initial status of agenda targets and progress towards agenda objectives.

3.4 Agenda development and time schedule

The agenda on 'High-tech leadership skills for Europe' was developed in collaboration with experts from a range of national governments and associated institutions, policy developers, industry and its association representatives at national and European level, think tanks, researchers and academics as well as higher and executive education institutions and other relevant key stakeholders all providing their views on the future necessary (policy) actions and thereby directly contributing to and shaping European and Member State policy development for the coming years.

A series of expert consultations took place with many stakeholders from all over Europe active in the preparation of the agenda. This was organised through surveys, interviews and workshops throughout 2016 to which experts were invited. The agenda was presented and discussed at the European conference on 'High-tech Leadership Skills for Europe' on 26th January 2017 in Brussels. It was then finalised in February-March 2017 and is now recommending the necessary policy and actions for the years to come.

The present document contains the final version and is made publicly available as of March 2017.

3.5 Towards recommendations and actions

3.5.1 Initial set of recommendations and actions

Focussing the agenda on strategic priorities is needed to meet the ambitious targets. The priorities together with recommendations were first derived from those identified in relevant precursor studies and activities.

Secondly, these recommendations were validated, enhanced and further developed in discussions and consultations with stakeholders to align them with the experts' view of the most relevant and most important strategic priorities and recommendations addressed to different policy makers and stakeholders at all levels and the necessary actions resulting from these.

It goes without question that the 'out-of-the-box' thinking demanded from experts required that the relevant actors in Europe had to get out of their comfort zones.

3.5.2 Consolidated recommendations and actions

As mentioned above a series of expert consultations took place through workshops, surveys and interviews with a large range of stakeholders for the preparation of the agenda. Around 200 experts were involved in interviews and workshops throughout the year 2016. Already in late 2015 more than 700 experts were involved in a survey. More than 100 experts expressed interest in contributing to the initiative and agenda development with around 50 formulating proposals of how these contributions and commitments could look like. Taking the recommendations and actions from precursor activities as a starting point and together with the contributions from the around 200 experts who actively attended and contributed to the workshops and in interviews, and the contributions and commitments from the expert survey a set of recommendations and actions was developed.

The recommendations and actions are structured according to 6 strategic priorities:

1. Monitoring, benchmarking and forecasting
    a) Definitions, segmentations and classifications regarding high-tech leadership skills for the economy
    b) Scoreboard and index and new ways of measurement and quantification
    c) Mutual learning from world-class best practices
    d) European one-stop-shop to high-tech talent monitoring and benchmarking

2. Industry, education and training
    a) Universities for lifelong-learning, new partnerships and players
    b) 'European Software Universities' for education, training and research in software-based innovation
    c) Build ecosystems
    d) Workforce Credentialing
    e) Embedding technical multi-disciplinarity in the curriculum
    f) Embedding non-technical courses in technical curricula
    g) Updating the skills of teachers/professors
    h) Reverse mentoring

3. Platform-based digital services for career support and recruitment
    a) Platform-based digital services supporting diagnosis and self-assessment

4. Better coordination and funding
    a) Better information about and more strategic use of available funding
    b) Government-driven public procurement of innovation
    c) Incentive individuals
    d) European quality level leap of worldwide recognition in high-tech leadership education and training

5. National digital and high-tech skills strategies
    a) Longer-term policy commitment and concrete action plans
    b) National advisory boards for informed policy development

6. Promotion and awareness raising for leadership skills for the high-tech economy
    a) European promotion of multi-stakeholder partnerships and campaigns on leadership skills for the high-tech economy
    b) Role models and success stories

For each of these strategic priorities recommendations and actions were formulated in discussions and consultations with stakeholders to align them with the experts' view of the most relevant and most important strategic priorities and recommendations addressed to different policy makers and stakeholders at all levels and the necessary actions resulting from these.

3.6 Recommendations and actions

The recommendations and actions have been formulated using a common structure. For each the necessary background information and current state-of-play is presented, followed by some promising examples of already existing activities and best practices in these areas. For each recommendation and action the following additional information is provided:

- Target groups
- Leading (& other) relevant stakeholder groups
- Activities requiring dedicated budget
- Timeline
- Target / Output / Success criteria

At the end of each recommendation the results from an online survey attended by more than 500 experts and stakeholders well spread around the EU member states and from a wide range of backgrounds and affiliations are presented. The survey was carried out from 7 – 15 November 2016 and shows the relevance ratings of experts for each of the proposed recommendations. It becomes apparent that all receive very high ratings on 'relevance' ranging up to 90%.

3.6.1 Monitoring, benchmarking and forecasting

Monitoring, benchmarking and forecasting [1]

Definitions, segmentations and classifications regarding high-tech leadership skills for the economy [1.1]

Profound changes in workforce skills are being imposed by developments and trends in technology, industry and business, requiring new skills in an increasing number of occupations.

Industry and businesses in Europe and globally have a growing demand for highly-skilled professionals and business leaders – people capable of leading digital innovation and transformation of industries, and of bridging the 'valley of death' in start-ups in digital and key enabling technologies.

The emergence of completely new occupations will accompany significant changes in existing skills demands, while some occupations are at risk from automation. Current definitions and classifications of occupations will change profoundly.

In an increasing number of occupations new skills are needed either in addition to or replacing existing skill sets. Often these new skills reach beyond the scope and defined skills sets of traditional occupations as reflected in occupation statistics. This becomes most apparent with respect to the skills needed at the intersection of IT and strategic business development to achieve digital innovation but also in the key-enabling technologies domain representing future-oriented industries like photonics, nano-electronics, advanced manufacturing etc. In all these areas we are not unlikely to see the emergence of completely new occupations as well as significant changes in existing skills demands. At the same time, several occupations and jobs are faced with the danger of becoming (at least partially) automated.

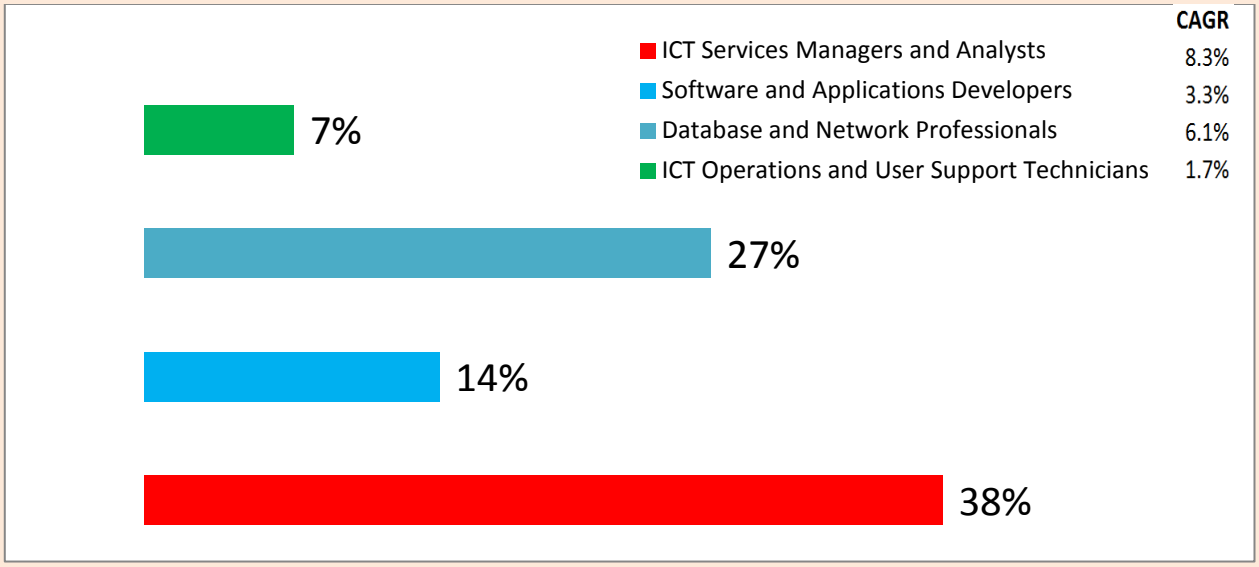
All these developments require careful analysis and where appropriate the refining and re-shaping of skill sets of existing occupations and (re-)training workers towards these new demands to ensure that those parts of the workforce affected can best be prepared for the coming changes. This includes on the one hand highly-skilled professionals and business leaders but also the (probably rather substantial number of) workers likely to be affected by automation who need to be re-trained the skills in demand in industry.

Research results from a recent empirica report has revealed that industry and businesses in Europe and globally increasingly demand highly-skilled professionals and business leaders capable of leading digital innovation and transformation of industries on the one hand and those capable of bridging what is described as the 'valley of death' in starting-up new businesses especially in the key enabling technologies (but also digital) on the other.

These types of leadership positions need to be filled with the right type of skilled experts throughout industry and at all levels not just at the top levels.

In the longer-term these developments may have implications on statistical classifications such as the International Standard Classification of Occupations (ISCO) since the developments change the definition of existing occupations and bring about new ones. The same holds true for existing competence and skills frameworks like the e-Competence Framework (e-CF) which has become a European Standard through CEN in April 2016 and the associated development of EU ICT Professional profiles as part of the activities of the CEN Workshop on ICT Skills. In their further developments attention needs to be paid to the possible implications on skills and competence specifications in the e-CF and ICT job profiles likely to emerge. The same holds true for ESCO - European Skills/Competences, qualifications and Occupations currently under development and going public in its first version in 2017.

Overall growth of ICT Profession occupations in Europe from 2011 to 2015



Source: *empirica 2016*

Promising practice - The new professional profile for e-Leadership (ISDI)

The new professional profile for e-Leadership developed by ISDI – Institute for Internet Development have for the first time developed a comprehensive set of job profiles for newly emerging digital innovation leaders. These include 14 different profiles ranging from 'Chief Digital Officer' to 'Community Manager' to 'Growth Hacker'. ISDI is offering (executive) training programmes and courses of different size and type to teach these skills.

Promising practice - The e-Competence Framework (e-CF)

The e-Competence Framework (e-CF) provides a reference of 40 competences as required and applied at the Information and Communication Technology (ICT) workplace, using a common language for competences, skills and proficiency levels that can be understood across Europe. The e-CF has been turned into a European CEN standard in April 2016.

Promising practice - The EU ICT Professional profiles of CEN

The EU ICT Professional profiles have been developed in a first version as part of the activities of the CEN Workshop on ICT Skills. These will be further developed in a CEN project which started at the end of 2016.

Recommendations

Engage widely with stakeholder groups to further sharpen definitions, segmentations and classifications regarding high-tech leadership skills:

Engage widely with stakeholder groups to sharpen definitions and metrics for high-tech leadership skills to include digital as well as key enabling technologies skills. Refine and re-define the IT workforce and profession in light of developments and trends in technology, industry and business. The same holds true for the skills of workers and leaders in the key enabling technologies domain, with newly emerging jobs being created.

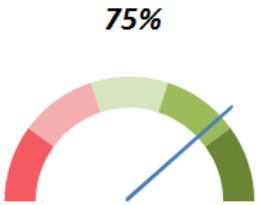
Elaborate classification and competence frameworks such as ISCO, ESCO and e-CF and develop EU professional profiles within the relevant CEN Workshop on ICT Skills.

Target groups	National employment agencies and governments, industry, education and training institutions including higher and executive, vocational and secondary education levels throughout Europe, CEN
Leading (& other) relevant	European Commission, CEN, include new players and

stakeholder groups	actors already active in the field
Activities requiring dedicated budget	Pan-European project
Timeline	Design of a pan-European scheme: 2 years
Target / Output / Success criteria	Clear and agreed definitions and metrics for measuring innovation leadership skills and their implications on innovative job profiles.

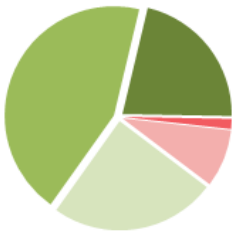
a. Definitions, segmentations and classifications regarding leadership and innovation skills for the high-tech economy

Relevance:



Not at all relevant (1)	4	1,5%
(2)	23	8,6%
(3)	66	24,5%
(4)	118	43,9%
Essentially relevant (5)	58	21,6%
Total	*269*	*100%*

N = 269 *σ = 0,9* *avg = 3,8*



Scoreboard and index and new ways for measurements and quantification [1.2]

To overcome the lack of existing official statistics on the demand for high-tech leadership skills, a recent Commission initiative is developing real-time approaches based on vacancy data and big data analytics.

Similar challenges face the quantification of the 'high-tech leadership' workforce and the measurement of demand and supply – all the more so since the high-skills leadership skilled workforce is not an occupational category, and its amalgamation of skills from different backgrounds are not captured in statistics. New methodologies and ways for measurement are needed.

Over the past years several activities – many of them initiated by the Commission or the World Economic Forum - have been carried out to develop indicators for measuring availability and progress on digital and high-tech leadership skills in the European workforce or related policy activities in EU Member States and their development and progress over time. Regularly, these indicators were compiled into indices or scoreboards to create more comprehensive measurements, monitor development and changes of the indicator, index and scoreboard values over time and use these for ranking and benchmarking different countries and their status and performance.

Typically they use different indicators and data for these indicators from different sources to compile and develop indices and scoreboards. The problem in developing meaningful scoreboards is the (lack of) availability and acquisition of data for relevant indicators. Ideally these come from available official statistics or other reliable sources which allow a regular and continuous monitoring of developments over several years backwards into the past and forecasting into the future, i.e. the development of time series data and forecasts based on a reasonable number of measurement points in the past.

Policy activity indicators and indices have also been developed for activities relating to the measurement of activity levels on policies, multi-stakeholder partnerships and different types of initiatives in the European

Union[17]. These follow a very elaborate and more qualitative policy analysis approach and have been developed in a way to allow monitoring of policy activities and progress in these different skills-related fields in all EU Member States, and in the end come up with an index-based benchmarking and a monitoring of changes over time. The results of this type of monitoring and benchmarking have been used by relevant stakeholders in several countries – especially those lagging behind in development - to motivate their governments to become more active and develop relevant policy initiatives to catch up with the more advanced countries.

The lack of sufficient statistics for relevant indicators also includes those needed for measuring supply and demand of skills in Europe. Labour Force Statistics provide the data for the quantification of the workforce differentiated according to occupations using the ISCO. Graduate and enrolment figures are also accessible through Eurostat. However, and using e-skills as an example to illustrate the present situation, e-skills supply is not restricted to computer science graduates leaving universities. There are a number of further 'inflows' for which statistical data or other types of information are not available. As a consequence all previous and current e-skills supply figures are based on a model which includes a series of figures which had to be estimated based on assumptions such as the number of Computer Science graduates growth and ICT workforce entry, STEM graduates to move into ICT workforce, VET graduates to enter ICT workforce, migration from excess supply to excess demand countries, number of entries resulting from up-skilling and lateral/side entries, natural unemployment rate and the retirement rate and other replacement demand.

There is no such statistical data available when it comes to the demand of high-tech leadership skills. In the past, demand figures were obtained through costly surveys of decision makers in organisations inquiring into their current and likely future different types of vacancies. A recent Commission initiative has now (2015/16) started to develop approaches for obtaining such information from vacancy data which allow for a obtaining real-time data on excess demand of particular types of skills at a given point in time (www.eskills-scale.eu).

Finally forecasting of the development and future demand of skills continues to be a challenge since no suitable statistics are available which could help in estimating these. So far and again illustrated using the example of e-skills, future demand growth figures had to be based on proprietary market insight data on planned future ICT investments (hardware, software, services) in organisations for each of the larger countries in Europe and total EU.

Similar challenges and a range of further ones also apply to the quantification of the high-tech leadership workforce and the measurement of demand and supply. These appear in an even aggravated form since the leadership skilled workforce is not an occupational category but an amalgamation of skills of very different background and hence not captured in statistics at all. For this domain entirely new methodologies and approaches for measurement are needed. The potential of approaches using new data sources as described above as well as qualitative and quantitative insight in the practice of the staffing/recruitment service industry for executive level jobs (which many high-tech economy leaders hold) need to be explored with the aim to identify opportunities for quantification of the above and the development of key parameters for the definition and the subsequent identification demand and supply figures based on such sources.

Promising practice – The experimental e-Leadership scoreboard

The first e-Leadership scoreboard and an e-Leadership index were developed as part of the Commission e-Leadership skills initiative in 2015 (and further developed and updated in 2016). All data source information is provided and calculations are fully transparent to ease straightforward compilation of the scoreboard and index with new data by other stakeholders. It is constantly being critically reviewed and updated with latest indicator data where available. This scoreboard could constitute the starting point for any further development of a continuous monitoring and benchmarking of European Member States and Europe's main competitors in the world, e.g. USA, Canada, Japan, Australia etc. but also BRIC economies.

[17] See: Gareis, K. et al. (empirica): e-Skills for Jobs in Europe – Measuring Progress and Moving Ahead, February 2014 (http://eskills-monitor2013.eu/fileadmin/monitor2013/documents/monitor_final_report.pdf)

Promising practice – The Digital Economy and Society Index (DESI)
The Digital Economy and Society Index (DESI) is a composite index that summarises relevant indicators on Europe's digital performance and tracks the evolution of EU member states in digital competitiveness. It is structured around five principal dimensions: connectivity, human capital, use of internet, integration of digital technology, and digital public services.

Promising practice – The different approaches to e-skills definition and quantification
e-skills definition and quantification approaches have been developed for the European Commission since 2008 with regularly updated e-skills demand and supply quantifications since then and forecasting development typically up until 2020. Regularly forecasting was also carried out using different scenarios.

Promising practice - The Global Talent Competitiveness Index (GTCI)
The Global Talent Competitiveness Index (GTCI) is an annual benchmarking report measuring the ability of countries to compete for talent. Designed as a practical tool for governments, businesses and non-profit organisations, GTCI ranks over 100 economies according to their ability to develop, attract and retain talent. Launched for the first time in 2013, GTCI is based on research conducted by INSEAD and the Human Capital Leadership Institute of Singapore (HCLI), guided by a distinguished Advisory Board and Academic Council. The Index is developed in partnership with Adecco, a global provider of HR solutions.

Promising practice – The different approaches to high-tech economy leadership skills definition and quantification
e-Leadership skills definition and quantification approaches have been developed as part of the Commission e-Leadership skills initiative. These date back to 2012/13 with an attempt to estimate e-Leadership demand based on size of organisation and ICT-intensity of a sector and supply based on 'e-Leadership quota' (estimated number of people within a NACE category who have a sufficient skills portfolio to serve as e-leaders). It continued in 2014/15 with a definition and quantification based on a CIO survey on organisation's competence in identifying and addressing opportunities for business innovation using ICT and an extrapolation to further years using the 4.7% growth trend of highly skilled ICT occupations. The latest approach (2016) is using real-time online vacancy data for carrying out a quantification of e-Leadership skills demand and using a co-occurrence analysis (using the statistical software and programming language R) for definition purposes with the results building the basis for the development of algorithms and key-word chains for online vacancy data interrogation followed allowing for the quantification of e-Leadership demand.

Promising practice – The approach to KET (key enabling technologies) skills definition and quantification
The first KET skills definition and quantification has been developed for DG GROW of the European Commission under the initiative on the "Vision and Sectoral Pilot on Skills for Key Enabling Technologies" in 2014-2016. Through sustained collaborative effort with a wide range of experts in organisations, the initiative drafted a first definition of the skills required for working in KETs. Using this definition, it quantified demand and supply of KET skills up till 2025. The methodology can be used to keep track demand and supply of these skills and may also be further refined to estimate the demand and supply of leadership skills in KETs.

Recommendations

Regularly update a high-tech leadership scoreboard and index:

Recent scoreboard and index development activities should be expanded beyond 'digital' to include progressively key enabling technologies, and especially domains of European strengths such as photonics, nano-electronics and robotics. Develop related scoreboards and an index Europe-wide and beyond, involving relevant stakeholders and regularly reporting results. These activities should build on and extend already running ones in this area including those of the European Commission relating to the Digital Economy & Society Index (DESI).

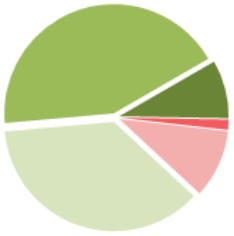
Target groups	European and national governments, policy makers and key stakeholders throughout Europe and beyond
Leading (& other) relevant stakeholder groups	European Commission

Activities requiring dedicated budget	European initiative to develop indicator, scoreboard and index updates differentiating between innovation leadership accomplishment and preparedness for the future
Timeline	Annual activity
Target / Output / Success criteria	Publication of scoreboard and analysis report published on European Commission web portal

b. Scoreboard and index

Relevance:

Not at all relevant (1)	4	1,5%
(2)	27	10,1%
(3)	98	36,7%
(4)	115	43,1%
Essentially relevant (5)	23	8,6%
Total	*267*	*100%*
N = 267	*σ = 0,8*	*avg = 3,5*



<u>Develop robust methodologies for the measurement and quantification of workforce, demand, and supply, and forecasting of high-tech leadership skills:</u>

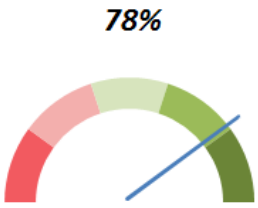
Develop robust and trusted methodologies, indicators, algorithms and covering the full spectrum of high-tech leadership skills, and forecast figures on workforce, (excess) demand, and supply including also based on vacancy data. Provide reliable estimates and data by category and group of workers, differentiated by skills levels and skill sets, permitting detailed analysis and identification of structural changes in the workforce. We recommend to favour 'clusters of competences' instead of 'occupations', and develop future-oriented approaches to defining 'sets/bundles of competences and skills'. Link findings to human resource departments in enterprises and use them in teaching and training for higher, executive and VET levels. Present results differentiated and disaggregated by gender where possible. Seek cooperation with the online vacancy data market.

Target groups	European Commission, national employment agencies and governments, Eurostat, research and consulting organisations, industry
Leading (& other) relevant stakeholder groups	European Commission, providers of multilingual CV parsing and semantic search in big data sources, matching tools and labour market statistics to accelerate and improve the process of matching demand and supply in the job market, experienced research and consulting organisations in this area, global business-oriented social networking service

	operators (e.g. LinkedIn)
Activities requiring dedicated budget	Pan-European or even global project
Timeline	Design of a pan-European / global activity: 2 years
Target / Output / Success criteria	Observatory mechanism regularly and continuously offering up-to-date and differentiated demand, supply and forecasting information, data and statistics on innovation leadership

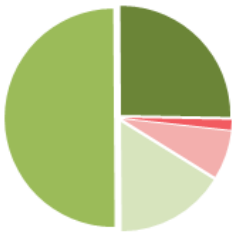
c. New approaches for the measurement and quantification of workforce, demand, supply and forecasting of leadership skills for the high-tech economy

Relevance:



Not at all relevant (1)	4	1,5%
(2)	19	7,1%
(3)	43	16,0%
(4)	134	50,0%
Essentially relevant (5)	68	25,4%
Total	*268*	*100%*

N = 268 *σ = 0,9* *avg = 3,9*



World class best practices repository [1.3]

Best practice identification promotes learning from experience, offering approaches that can be useful in developing and assessing and refining strategies and programmes.

Best practices are typically defined as commercial or professional procedures that are accepted or prescribed as being correct or most effective. A best practice is a technique or methodology that, through experience and research, has been proven to reliably lead to a desired result. Best practice repositories of different type and in a multitude of domains have proven to be a successful means allowing others to learn from experience. These allow for the identification of a series of steps or practices that practitioners and interested parties can use in developing and assessing their strategies and programmes and further developing or refining them to become most effective.

Promising practice – Best practices on e-skills and leadership skills for digital and key enabling technologies

First best practice digital and leadership skills repositories have been developed with the support of the Commission. These include those on digital skills and e-skills (2013) (http://eskills-monitor2013.eu/results.html) but also on e-Leadership skills (2015) (http://eskills-lead.eu/documents/) related activities such as training, promotion etc. These could build a starting point for further Europe-wide or even global activities in this area.

However, these are not presented in an online repository, structured and presented in a way to allow for individual criteria-related and full-text searches to identify most suitable cases for a given situation and problem but as an integral part of Country Reports and thereby somewhat 'hidden' to interested stakeholders. Furthermore, these are not maintained and further developed and no initiative has been started to further expand on these.

Recommendations

Develop an online best practices platform for mutual learning:

Develop and regularly update an online platform for mutual learning of best practices on high-tech leadership skills and talent development. It should be linked with pledges as for instance made by stakeholders to the Digital Skills and Jobs Coalition which was launched in December 2016.

Ensure its broad dissemination throughout the European industry, social partners, education and training organisations and relevant policy developers in the EU Member States. It should also target relevant associations promoting it to their members and more broadly also to decision makers in enterprises and organisations.

Closely involve European institutions and their communication channels and publication formats including the CEDEFOP 'Skills Panorama' and 'Statistics in Focus' of Eurostat.

Target groups	Industry, education and training providers at all levels, national governments, key stakeholders and associations representing the above actors at European and national level
Leading (& other) relevant stakeholder groups	European Commission
Activities requiring dedicated budget	Pan-European project
Timeline	Design of a pan-European activity: 2 years
Target / Output / Success criteria	Operational innovation leadership best practices repository covering Europe and beyond (e.g. USA, Canada, Japan, China, South Korea etc.) with implemented mechanism for regular monitoring, updating and analysis reporting.

d. World-class best practices repository

Relevance:

Not at all relevant (1)		5	1,9%
(2)		10	3,7%
(3)		68	25,5%
(4)		125	46,8%
Essentially relevant (5)		59	22,1%
Total		*267*	*100%*
N = 267	*σ = 0,9*		*avg = 3,8*

European one-stop-shop to high-tech talent monitoring and benchmarking [1.4]

Data is already available on digital literacy, e-skills, e-leadership and KET skills from previous work conducted over the last decade, covering notably European and national demand and supply figures and forecasts. Those on high-tech leadership skills on which we provided some first quantifications and estimates need to be added and all should be made publicly available.

A one-stop-shop for hosting this information could provide extended time series analysis and monitoring and benchmarking that would allow stakeholders and policy makers to base their decisions on solid ground

Since around 2003 the Commission has regularly commissioned the development of European and national skills demand and supply figures and forecasting results, scoreboards and indices on digital literacy and skills, e-skills and e-Leadership and KET skills in a series of service contracts and studies. Most of these activities were carried out by DG GROW, others by DG CNECT and Eurostat. Partial involvement of DG EMPL and DG EAC took place, and CEDEFOP is also active in this area. From an organisational and policy support but also financial perspective it appears worthwhile to establish a one-stop-shop for hosting already available data, European and national demand and supply figures and forecasting results for the next 5-10 years, scoreboards and indices and the upcoming new complementary ones updating latest figures and results and allowing for an extended time series analysis, continuous monitoring and benchmarking allowing the Commission and national Member State governments to base their evidence-based policy development in these fields on more solid grounds.

Promising practice – Commission monitoring activities on digital skills, e-skills and digital leadership and KET skills

The Commission has initiated several such monitoring activities with the following showing examples from DG GROW and DG CNECT grouped according to themes and types of activities:

Scoreboard / Index
- Digital literacy 2009 - 2013
- Digital Skills 2015 – 2016 #
- Digital Agenda Scoreboard 2011 – 2015 ##
- e-Skills 2009 - 2016
- e-Leadership skills 2015 – 2016
- Digital entrepreneurship 2015 *
- Digital Entrepreneurship Monitor Scoreboard 2013 – 2016 **
- The Digital Economy & Society Index (DESI) 2015 – 2017 ***

Policies, initiatives and multi-stakeholder partnerships descriptions (including best practices)
- Digital literacy 2006 – 2009 - 2013
- e-Skills 2006 – 2009 - 2013
- e-Leadership skills 2013 – 2015 - 2016
- Digital entrepreneurship 2013 – 2015 – 2016
- KET skills 2015
- Case studies and best practice descriptions 2006 – 2009 – 2013 – 2015 - 2016

Policy activity index (for country benchmarking)
- Digital literacy 2009 - 2013
- e-Skills 2009 - 2013
- e-Leadership skills 2013
- Digital entrepreneurship 2013 *

Key:
= https://ec.europa.eu/digital-single-market/en/news/new-comprehensive-digital-skills-indicator
= https://ec.europa.eu/digital-single-market/en/digital-scoreboard
* = included in the e- leadership skills index
** = providing data in scoreboard format for the period 2008
*** = developed for DG CNECT 'Digital Single Market' initiative: https://ec.europa.eu/digital

Recommendations

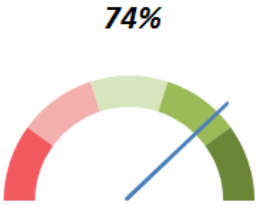
Implement a high-tech talent monitoring mechanism:

Regularly update presentations of the high-tech workforce development data and demand and supply figures on digital and key enabling technologies skills, as well as specifically leadership skills, and make regular forecasts for EU and individual Member States. Establish and operate a monitoring mechanism as a one-stop-shop for such data to support evidence-based policy making. It is recommended to use tried and tested approaches in its development and regular data updating such as those employed in the continuous updating of the Digital Economy & Society Index (DESI).

Target groups	European Commission, national governments, Eurostat, CEDEFOP
Leading (& other) relevant stakeholder groups	Industry, academia, industry and professional associations, wider public
Activities requiring dedicated budget	Pan-European project
Timeline	Design of a pan-European activity: continuous activity
Target / Output / Success criteria	Operational online European e-Skills and high-tech talent and leadership observatory mechanism accessible through a one-stop-shop gateway.

e. European observatory mechanism: one-stop-shop gateway to digital talent monitoring and benchmarking

Relevance:



Not at all relevant (1)		8	3,0%
(2)		19	7,1%
(3)		71	26,5%
(4)		118	44,0%
Essentially relevant (5)		52	19,4%
Total		*268*	*100%*
N = 268	*σ = 1*		*avg = 3,7*

3.6.2 Industry, education and training

Industry, education and training [2]

Universities for lifelong learning, new partnerships and players [2.1] [2.2]

With the current pace of innovation and the short life cycles of trends, speed matters. Education must respond swiftly to market needs, and education and training programmes must be tailored and not be too time-consuming for executive target groups. For example, EuroCIO has shortened its executive education programmes in accordance with demands from managers.

Universities and business schools must adapt their curricula too, or see their market stolen from them by the private sector. Examples include business schools like ISDI in Madrid or the courses offered by the New Bulgarian University. IT-vendor industry certifications could be further developed to become innovation leadership training and certification programmes.

Diversity should be a feature of all actions under the heading 'Industry, education and training'. The 'high-tech leadership' topic lends itself to roles for women in industry, since the focus is not purely on technology, which often deters women.

Human resources and career services need to adapt to the global nature of labour markets and the demand for horizontal skills. New educational actors, such as "Ecole 42" in France, are bringing value to existing systems. Widening the digital training catalogue with non-traditional curricula can help match unmet demand, and tightly focused shorter programs, especially in non-face-to-face training, offer interesting models for universities and business schools

As a general trend, it becomes more and more difficult to anticipate the needs for new competencies, in particular on the technical side. This affects the traditional methodologies for creating and running training plans based on gaps identification and transformation plans. 3 to 5 years plans seem to less and less appropriate for answering the need for more exploratory projects and smaller multidisciplinary teams. Companies use external suppliers and in particular create partnerships with start-ups, mixing those sources of high-tech competencies with their existing workforce both from the businesses and IT and KETs. Experts increasingly call for micro training modules that fit ad hoc needs.

Universities will have to accept changes in the curricula or their market is taken away by private institutions. But also HR and career services need to learn and adapt to the labour markets being global and horizontal skills being really needed.

Many new educational actors emerge and seem to bring value to the existing systems put in place, like Ecole 42 in France amongst others. Enlarging the catalogue of possible digital training seems to be a good way of matching the demand by allowing other curricula than the traditional ones. We see more and more the need of shorter programs, more focused, especially when it comes to non-face-to-face training. Both new players and universities and business school should take this into account.

Today we can observe the co-existence of different actors and approaches and a division of work in the education and training fields between

- Universities
- Business schools,
- Other training providers and consultants, and the emergence of
- New players and market entrants which show a much faster speed in programme development, programmes which are more aligned to industry needs.

With the appearance of new players existing boundaries are increasingly blurring and especially universities need to rethink their role and activities in a changing education and training market to remain attractive training providers.

There is consensus that a base level of education needs to be there, providing the foundations of the subject, the methods and the capability for continuous learning. The question then is how to structure ad hoc learning above that. In terms of "Unbundling of Higher Education" implying unbundling traditional programmes to offer students more flexible options, the best universities of the world (US Ivy league etc.) have de facto already broken up their model. These are also e.g. the universities behind the most important MOOC platforms. Other universities need to be pointed to these models.

The idea might be to break the existing degree models and develop and enlarge the programme offer with nano-degrees. A competing idea might be to provide the foundational education and rely on a life-long provision of ever new nano-degrees. However, this is not spelling the death of four-year programmes since

students go on to higher education for more than job training. For the latter nano-degrees could provide the better fit.

This is also reflected in the trend that there are more and more employees, in particular those from Gen Y, who get new competencies by themselves, without using the company academy centres and means. They focus on what interests them most and even engage external resources, cloud based, to develop and propose new functionalities or demonstrate the value of their ideas. They are less attached to a linear progression in their career and pay more attention to keeping up with new high tech solutions and concepts and take action.

Interesting developments in this area in the USA include the 'MicroMasters' made available on online platforms like edX which could also be seen as a means and pathway to e-leadership jobs. MicroMasters programs are a series of graduate level courses designed for career advancement at less cost than a normal Master's Degree.

In order to accelerate the adoption of KETs by other domains, it would be advisable to raise awareness on the opportunities offered by KETs among broader groups of STEM students (not limited to the ones studying explicitly KETs) and beyond. For that purpose, the curricula would need to incorporate courses/elements of courses that would ensure the exposure of students to the technical possibilities of KETs and their relevance to the core domain of their studies. An illustrative example of applying this approach to the architectural studies could imply integrating the following elements into the curriculum:

(1) architectural design in virtual/augmented reality combined with usage of wearables e.g. to demonstrate to the client the characteristics of newly created space;

(2) 3D printing for architectural applications;

(3) advanced digital tools for integrated design processes for built environment, including the analysis of the environmental impacts of materials and buildings (with LCA method), and especially the impacts related to climate change;

(4) modelling tools for simulations of energy efficiency and advanced building skins performance (climate responsive facades), building energy management systems (BEMS) and introduction of cognitive systems in buildings;

(5) phase change materials and nanomaterials applied for advanced insulation systems,

(6) micro-CHP (Micro combined heat and power) for buildings.

Promising practice - ISDI (INSTITUTO SUPERIOR DESARROLLO INTERNET)

ISDI is a Business School created by leading professionals for accelerating change towards a new, more competitive and more efficient business model, and to maximise the potential of individuals, professionals, companies and markets in Spain and Latin America. ISDI started from the observation that organizations need to develop their business in the digital ecosystem but do not have adequate profiles to do so. It is against this background that ISDI is offering training programmes to develop digital skills of different professional groups and business departments in companies including top level executives and (prospective) leaders. (http://www.isdi.education/en)

Promising practice – The Agile University Approach: a series of short e-Leadership courses by New Bulgarian University

New Bulgarian University is focussing on implementing a continuous process of curriculum improvement based very much on agile methodology of incremental innovation in sprints. This agility based curriculum development results in an increased flexibility and short-termism which is desperately needed by SMEs (and without doubt, large corporations would benefit from such a model as well). SMEs need flexibility in training specification and use which can be catered for if higher education institutions start following an agile development approach with rather or even extremely short sprint durations, lasting from a week (for weekend trainings) to a semester (for businesses that can afford months training). This process of sprint and review may go on continuously as the strategic goal will evolve. So a truly life-long learning approach can be addressed in close SME-university cooperation, with ever changing learning

outcomes but a rather stable process. As modules are accumulated, at some point it may result in a degree diploma under the Bologna convention to certify that a certain level of knowledge and skills was reached.

Promising practice – Engineers without Borders: Engineering for People Design Challenge

One way of improving KETs-related education and preparing students for the future workplace, is to replicate real-world situations in the classroom. This principle lies at the core of a 'challenge-driven' university model (see NESTA, 2016[18]), where students work on difficult problems and challenges for which there are no established answers. This approach allows engineering students to contextualise their theoretical learning in relation to how it would be useful in the world around them. Engineers Without Borders UK have been contributing to this way of educating students since 2011 through their 'Engineering for People Design Challenge'. This initiative is an inter-university design competition that encourages students to work in multidisciplinary teams, to address a real life, complex engineering challenge. The initiative helps students to develop the skills required to navigate complex situations in an environment where they can be guided and tutored by experienced academics. To date, more than 15,000 students in the UK and Ireland have engaged in the initiative. The evaluation so far indicates that it is facilitating their skills development in multiple ways. 94% of students surveyed in 2016 reported it had improved their skills related to the engineering design cycle and 91% stated it had helped to improve their creativity[19].

Universities and business schools to become lifelong-learning institutions and establish new (industry) partnerships and the emergence of new players:

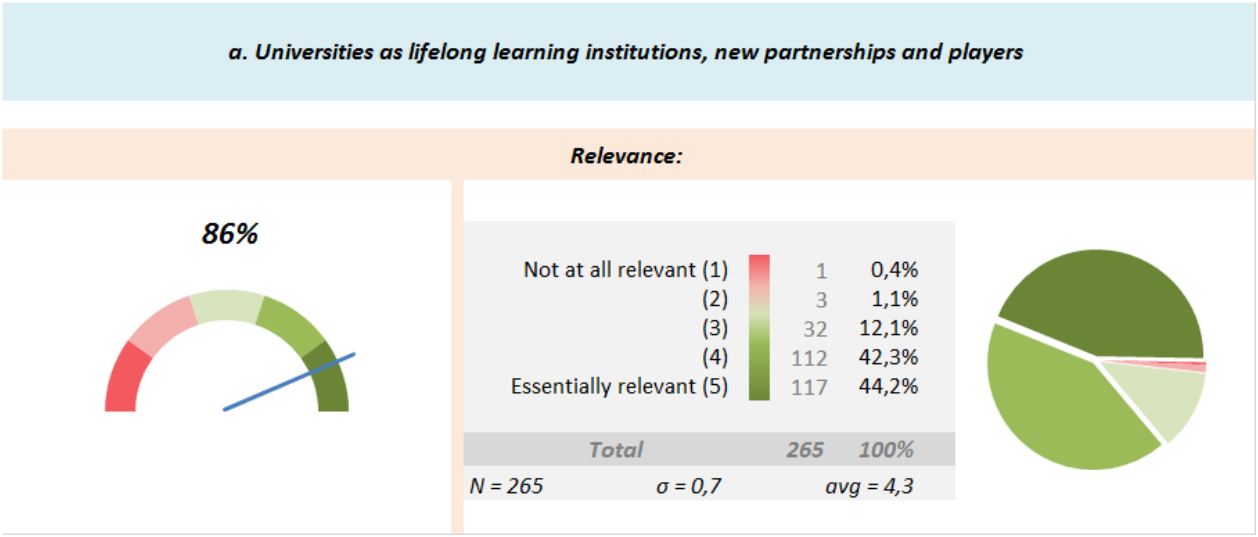
Technical universities and business schools should be more active in industry-related talent development, aligning curricula and programmes more closely with emerging skill requirements, and winning acceptance as training providers for professionals and executives in industry. For SMEs, curriculum improvement should be based on an agile methodology of incremental innovation. The traditional waterfall model of careers is inconsistent with the rapid change in skills requirements in the contemporary business world.

Pioneering universities and business schools have started to offer a mix of hands-on, technical and strategy-related courses that match the needs of SMEs. Focused high-tech leadership courses taken at appropriate points in time - as 'pills' or 'tapas' - can help create the future e-Leaders, and build national software industries in the Member States.

Target groups	Universities, business schools, further training institutions
Leading (& other) relevant stakeholder groups	Universities, business schools, further training institutions
Activities requiring dedicated budget	Development and implementation activities could apply for funding through national programmes or European programmes like Erasmus+
Timeline	Continuous activity
Target / Output / Success criteria	Start in 2017 with first results in 2018

[18] Mulgan G., Townsley O., Price A. (2016) "The challenge-driven university: how real-life problems can fuel learning", NESTA paper, available at: https://www.nesta.org.uk/sites/default/files/the_challenge-driven_university.pdf

[19] http://www.ewb-uk.org/complexproblemsineducation/



Guidance for rapid training programme adaptation and development:

The European Standardisation Committee (CEN) should support the development of standardised tools and guidance for rapid high-tech leadership skills programme development and adaptation, building on experiences such as the 'curriculum profile' approach used on the industry-led development of high-tech leadership skills curricula, including rapid light-weight certification or badges, to increase acceptability among training providers and industry clients. A new European Commission initiative focussing on curriculum development guidelines for KETs skills is planned to be launched in 2017.

Target groups	CEN, higher and executive education and training as well as other training providers, industry
Leading (& other) relevant stakeholder groups	CEN, European Commission
Activities requiring dedicated budget	CEN standardisation project
Timeline	2 years
Target / Output / Success criteria	Standardised tools and guidance for rapid e-leadership skills programme development and adaptation

'European Software Universities' for education, training and research in software-based innovation [2.3] [2.4]

Digital transformation needs leadership with deep competencies in software, as well as in new business models and smart industrial specialisation ecosystems. In 2011, in a famous article *"Why Software Is Eating the World",* Marc Andreessen warned that "every company needs to become a software company".

While software platform companies are prototypes of the business environment of the (digital) future, the traditional University structures offer little space for new approaches needed in education, training and research focusing on software. Software must become an important priority in Europe.

Software-based innovation should be promoted more aggressively alongside entrepreneurial approaches to business creation and development, so that decision makers recognise the increasingly fundamental role of

software and other emerging technologies for innovation and business success. There are simply not enough professionals at present with the necessary leadership skills, and related multidisciplinary training.

The crucial aspect of speed to implementation cannot emerge from old software developing principles, and must be replaced by new and more rapid prototyping and building businesses around prototypes with parallel and incremental further development of the software.

Several experts emphasised that software needs to be seen as a new "raw material" to create industries and businesses and that we need to get this understanding in Europe. Universities and business schools need to change their approaches to teaching and training and have to be much more open towards an interactive learning with customers and suppliers. In order to properly respond and move away from software 'use' to 'creation' there is a strong demand for a much closer connection and collaboration between research, design and production in Europe and are a strategic 'software agenda' for Europe.

This is in line with the recommendations for action of the DSM Sub-group on digital skills calling for strengthening the ongoing dialogue and closer cooperation between industry, education and government as well as social partners (i) to support mutual understanding of needs, (ii) for sharing information about companies' digital skills needs, (iii) to enable the development of up-to-date, labour market relevant curricula and (iv) to support closer cooperation in education and training.

Promising practice - IT University Copenhagen (ITU), Denmark

IT University Copenhagen (ITU) is a newly founded 'software' university and the youngest university in Denmark established in 1999. Based on its mission of contributing to making Denmark exceptionally good at creating value with IT the IT University strives to deliver internationally recognized and highly relevant research and education. The IT University Principle # 1 is described as "The essence of Information Technology is the creation, sharing and handling of mental constructions using digital technology." Study programmes (BSc, MSC and PhD) are provided in the areas described in the ITU triangle:

- Digital innovation and management
- Software development and technology
- Digital design and communication

The students come from very different backgrounds and many are internationals, offering new perspectives and approaches. The entrepreneurial spirit of both the University and its students is high as shown by the list of around 50 start-up companies founded by ITU students. http://en.itu.dk/

Promising practice - PROMPT – Professional master in software development

PROMPT at Mälardalen University, Sweden is an advanced education programme which aims at ensuring the supply of software experts to industry and to increase industrial competitiveness through customised, free education for engineers and developers. PROMPT has been launched, a national educational initiative in cooperation with several academic parties and a number of leading Swedish industrial companies and organisations. Together the parties develop academic courses on advanced level, adapted for professional engineers and software developers. The goal is to guarantee the supply of advanced software competencies and innovativeness to industry. The courses, all on master´s level, are developed to suit those gainfully employed and who need to be able to combine work and studies. The courses are produced in cooperation with the companies in need of the competence, and teaching has been adapted for those who are gainfully employed. The courses combine conventional studies with distance, web-based learning and teaching at the participating companies. The goal of the project is partly to implement an upgrading of skills that will significantly improve competitiveness in industry, and partly to support the development of new software based innovations. The participating companies get a head start when it comes to integrating new research in the area into their activities. PROMPT is an open initiative which welcomes additional companies and higher education institutions (HEIs). The PROMPT project has funding from the Swedish Knowledge Foundation's programme "Expertise for Innovation. http://www.promptedu.se

Recommendations

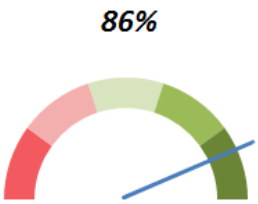
European Software Universities and programmes for education, training and research in software-based innovation:

Envisage the setting up a 'Software University' in every European country, along the recent experience of the IT University Copenhagen (ITU).
Foster the development and implementation of industry-university cooperation like PROMPT (Professional Master in Software Development) by Mälardalen University in Sweden aimed to increase the supply of software competencies and innovativeness in industry through customised education and training offers produced in cooperation with enterprises in need of such competencies.
Both software and hardware are important for the EU economy and their combination is crucial for developing applications. Governments should provide incentives to institutions attracting high intake of well-qualified students for multidisciplinary programmes developed in cooperation with industry and combining software and engineering skills and business and digital leadership competences. A functioning example is the Swedish Knowledge Foundation programme 'Expertise for Innovation' (through which PROMPT receives some funding).

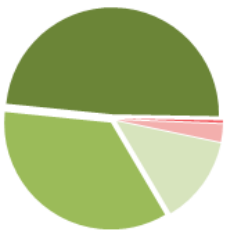
Target groups	National governments and universities, European Commission
Leading (& other) relevant stakeholder groups	National governments and universities
Activities requiring dedicated budget	National initiatives and projects in all EU Member States
Timeline	Design of national activities; 2-5 years
Target / Output / Success criteria	European universities and university programmes and courses of different type and size to teach high-tech leadership skills needed for successful digital transformation with deep competencies in technical issues, in particular in software as well as in business models and digital ecosystems. Emergence of successful European software platform companies.

b. New approaches and structures in education, training and research

Relevance:



Not at all relevant (1)		1	0,4%
	(2)	7	2,6%
	(3)	35	13,2%
	(4)	93	35,1%
Essentially relevant (5)		129	48,7%
	Total	*265*	*100%*
N = 265	*σ = 0,8*		*avg = 4,3*



Enhancing diverse types of mobility within and beyond KETs:

(Future) High-tech leaders' needs for wide expose to work experiences that simultaneously train technical, business and strategic skills can be met by mobility schemes.

Technical universities and other vocational and higher as well as executive education and training institutions should develop and implement mobility schemes:

- **between digital and key enabling technologies ('smart' team composition);**
- **along the KETs/Advanced Manufacturing value chain (integrating research and production in one facility, or innovation managers following an innovation along all TRLs) (AMT);**
- **between KETs/AMTs and application areas (partnering with enterprises from the application domain, or close interaction with end-users); and**
- **between academia and industry (creating open eco-systems where industry and academia work together on projects).**

Target groups	Industry
Leading (& other) relevant stakeholder groups	Industry, national governments and universities, European Commission
Activities requiring dedicated budget	National initiatives in the leading EU Member States (with an explicit strategic priority for KETs); EU-level mobility scheme for KETs workers
Timeline	Design of national activities and EU-level mobility scheme for KETs workers; 2-5 years
Target / Output / Success criteria	

Build ecosystems [2.5]

The highest level of innovation requires ecosystems that promote interaction among key actors active at different stages of the value chain - industry, research, education and training - and from technical and non-technical backgrounds. And for ecosystems to be replicable, so that Europe is widely covered, they need to be easy to understand and implement.

Promising practice – Digital Innovation Hubs and Competence Centres

Digital Innovation Hubs are based on competence centres located in technical universities or research organisations, providing companies, in particular SMEs, with access to facilities for experimenting and testing digital innovation. They will also supply advice on potential sources of financing and support industry in digital upskilling training. These are **ecosystems** that aim to create the best conditions for long-term business success for all involved. Competence centres are places where companies can go to with digital technologies. They offer access to technologies. The aim is to offer a one stop shop for any industry to get support in understanding digital technologies and support on how to finance/nurture the necessary investments. The Commission is already promoting various initiatives aimed at increasing training in digital skills for the workforce and for consumers; modernising education across the EU; harnessing digital technologies for learning and for the recognition and validation of skills; and anticipating and analysing skills needs.

Promising practice – IMEC and iMinds (merger in October 2016: https://www.iminds.be/en)

Imec is a world-leading research institution in nanoelectronics and delivers industry-relevant technology solutions. Imec is headquartered in Leuven, Belgium, and has offices in Belgium, the Netherlands, Taiwan, USA, China, India and Japan with about 2,500 researchers including almost 800 industrial residents and guest researchers.

Imec has been a global leader in the domain of nanoelectronics for more than 30 years, and has innovated applications in smart systems for the Internet of Things (IoT), Internet of Health, and Internet of Power. It has built an

extensive and worldwide partner network, as well as in Flanders, and has generated successful spin-offs. iMinds' activities span research domains such as the IoT, digital privacy and security, and the conversion of raw data into knowledge. Its software expertise is widely renowned and its entrepreneurship activities in Flanders are first-rate.

iMinds used to be the Flanders' digital research and entrepreneurship centre with some 1,000 researchers at five Flemish universities conducting strategic and applied research in areas such as Media, Health, Smart Cities and Manufacturing. Together with its research partners – enterprises, governments and non-profit organisations – iMinds translates digital know-how into concrete products and services. In addition, iMinds supports researchers and (start-up) entrepreneurs in the successful market introduction of their ideas.

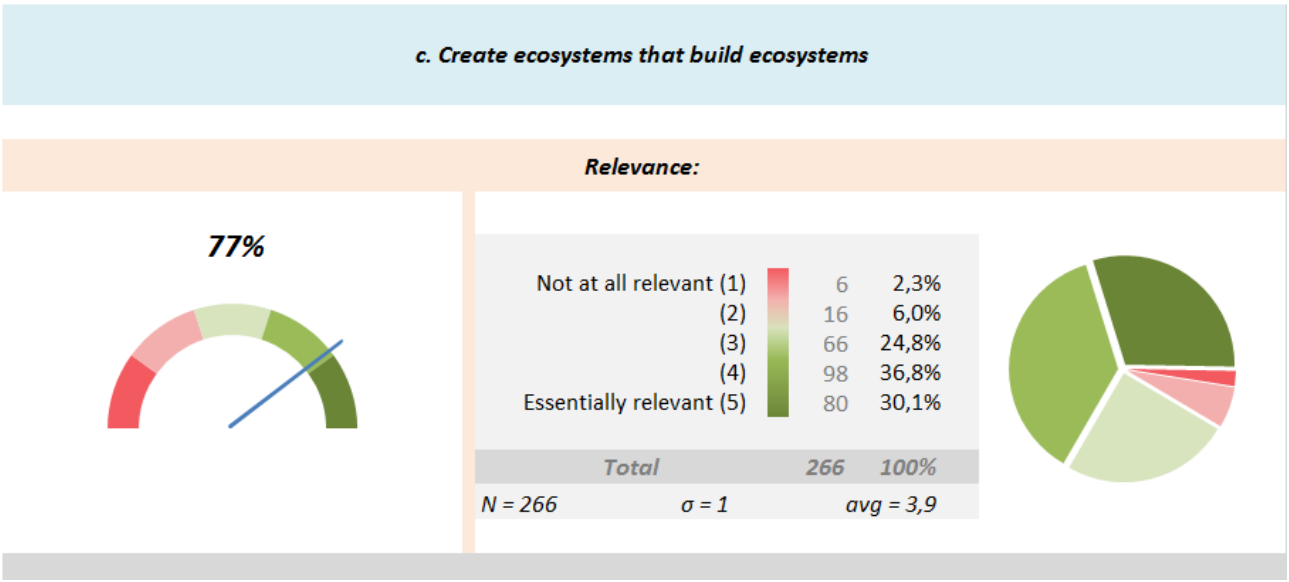
In October 2016 the nano-electronics research centre imec and the digital research and incubation centre iMinds merged into a high-tech R&D hub. Using the imec name, the combined entity is now creating a world-class, high-tech research centre for the digital economy combining longstanding leadership in microchip technology with in-depth expertise in software and IT.

Recommendations

Build ecosystems :

Exploit the Digital Innovation Hubs and Competence Centres active in advanced technologies to build ecosystems that create ecosystems in the form of innovation hubs and focal points in EU Member States, fostering local strengths such as telecommunications in the Nordic countries, finance in the UK, education in Finland or automotive in Germany. These should be open to new actors and other regions.

Target groups	Digital Innovation Hubs and competence centres in European regions.
Leading (& other) relevant stakeholder groups	Regional and national governments in EU countries; supported through European and national funding programmes.
Activities requiring dedicated budget	European Commission activity for raising awareness and motivation in European regions, Best practice award and competition followed by regional activities for implementation.
Timeline	2-3 years.
Target / Output / Success criteria	Dedicated regional / national ecosystems that create ecosystems along the regional strengths and specialities.



Workforce credentialing [2.6]

Workforce credentialing relates to the process of awarding individuals recognised verifiable indicators of a demonstrated qualification particularly for assessing workplace readiness. The credentials gauge knowledge, skills, and competencies applicable to work performance.

Various workforce credentialing initiatives aimed at prospective employees and employers help bring them closer together and provide clarity and understanding as well as quality standards.

It includes digital badging, which is increasingly important as a validated indicator of accomplishment, skill, quality, or interest earned in many learning environments.

The Bologna process in higher education developed a qualifications and certification framework introducing a three cycle system (Bachelor, Master, Doctorate) and at the same time strengthening quality assurance and easing recognition of qualifications throughout Europe (http://ec.europa.eu/education/policy/higher-education/bologna-process_en). While this is seen as an appropriate system for the above programmes and certifications and for making European universities more attractive, it is argued that it would be a too heavy-weight process to be applied to further programmes and courses universities are increasingly offering as part of their lifelong learning and further training related activities. As a consequence new programmes and courses often lack such type of formal certification and - as a consequence - recognition. Universities just offer their own certifications. Such non official degree programmes (e.g. named titulo propio in Spain) are offered next to the strongly regulated official Bachelor and Master degree studies. Typically these are non-official degrees not formally approved by the national ministry of education and taught as one year programmes.

Workforce Credentialing is the broader term used to address the process of awarding an individual some form of recognised verifiable indicator that an individual has demonstrated qualification in a subject area. The terminology is particularly prevalent when assessing workplace readiness and refers to credentials gauging knowledge, skills, and competencies applicable to work performance.

Workforce Credentials come in a variety of forms. They include academic degrees, state licenses, training certificates, continuing education or apprenticeship qualifications, board certifications or licenses, company internal qualifications, digital badges and micro-credentials indicating discrete learning accomplishments. With the broadening reach of the digital world and the rapid pace of innovation, some of these credentials have become increasingly important in today's world in order to measure current workplace readiness, especially internationally. With the increased significance of different kinds of credentials, higher and executive education and training institutions together with industry associations need to develop

workforce credentials but, unlike certification and licensure, there is still a lack of best practice and international standards and guidelines around these areas – thus their benefit as a reliable gauge of employability is currently limited. It is highly critical that these credentialing systems, such as badging and micro-credentials, gain the recognition that they need in order to become useful benchmarks, whilst ensuring that there is transparency around the differentiating factors of the various credentialing forms.

In essence there is a lack of:

- Clarity regarding the differences between types of credentials: certificates, certifications, degrees, badges, micro-credentials, and licenses.
- Information regarding credential quality. Quality can vary on a number of dimensions, including the value of the credential, the quality of the content standards that the credential measures.
- Quality of the assessments, which is largely dependent on the organisation providing the credential.

This has also been recognised outside Europe and there are various workforce credentialing initiatives aimed at prospective employees and employers – helping to bring them closer together and ensuring that there is clarity and understanding as well as quality standards around the credentials. Some international examples of these are:

- Credential Transparency Initiative: http://www.credentialtransparencyinitiative.org/
- Connecting Credentials: http://connectingcredentials.org/
- Employability Skills Framework: http://cte.ed.gov/employabilityskills/

An increasingly important component of Workforce Credentialing can be seen in Digital Badging. A digital badge is a validated indicator of accomplishment, skill, quality, or interest that can be earned in many learning environments. Open digital badging makes it easy for anyone to issue, earn, and display badges across the web—through an infrastructure that uses shared and open technical standards (http://openbadges.org).

Promising practice – Mozilla's Open Badge Project

Mozilla's Open Badge Project was announced in 2011 to develop an open technical standard called Open Badges to create and build a common system for the issuance, collection, and display of digital badges on multiple instructional sites. Mozilla and MacArthur Foundation engaged with over 300 non-profit organisations, government agencies and others about informal learning, breaking down education monopolies and fuelling individual motivation and in 2014 launched the Badge Alliance which sees itself as "a network of organisations and individuals working together to build and support an open badging ecosystem, with a focus on shared values including openness, learner agency and innovation" (http://www.badgealliance.org/).

Promising practice – The Badges for Lifelong Learning Competition

This is supported by the John D. and Catherine T. MacArthur Foundation, with additional support from the Gates Foundation and in partnership with Mozilla. The Competition is administered by co-located HASTAC teams based at the University of California Humanities Research Institute and John Hope Franklin Humanities Institute at Duke University (https://www.hastac.org).

Recommendations

Workforce credentialing:

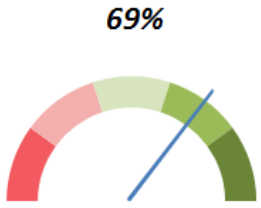
Higher and executive education and training institutions should work with industry associations to develop standards on workforce credentialing alternatives and quality badging formats for ad-hoc and short-term courses. Better balance and understanding are needed on the co-existence of formal certification and other forms of workforce credentialing, such as digital badging and micro-credentials. Creating working models, transparency, consistent standards and visibility to potential employees and employers will help.

Target groups	Higher and executive education and training institutions, industry associations

Leading (& other) relevant stakeholder groups	Association of Test Publishers
Activities requiring dedicated budget	Development of Workforce Credentialing Framework and Standards and linkage into e-CF Development and Rollout of Workforce Credentialing Guidelines and Development Models for above target audiences
Timeline	2 years
Target / Output / Success criteria	Increase in employability and workplace readiness of graduates

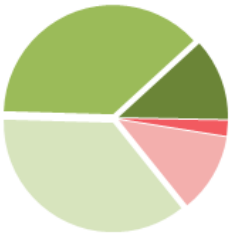
d. Workforce credentialing

Relevance:



Not at all relevant (1)	6	2,3%
(2)	31	11,7%
(3)	96	36,2%
(4)	100	37,7%
Essentially relevant (5)	32	12,1%
Total	*265*	*100%*

N = 265 *σ = 0,9* *avg = 3,5*



Embedding technical multi-disciplinarity in the curriculum [2.7]

The current educational system tends to produce graduates focused on one discipline - mechanics, electrics or systems engineering - while industry often needs people trained simultaneously in several disciplines and able to work at their points of intersection – such as in mechatronics. This multi-disciplinarity should become central in curricula for middle- and highly skilled workers.

Promising practice - Multi-Disciplinary Energy Studies at Aalto University

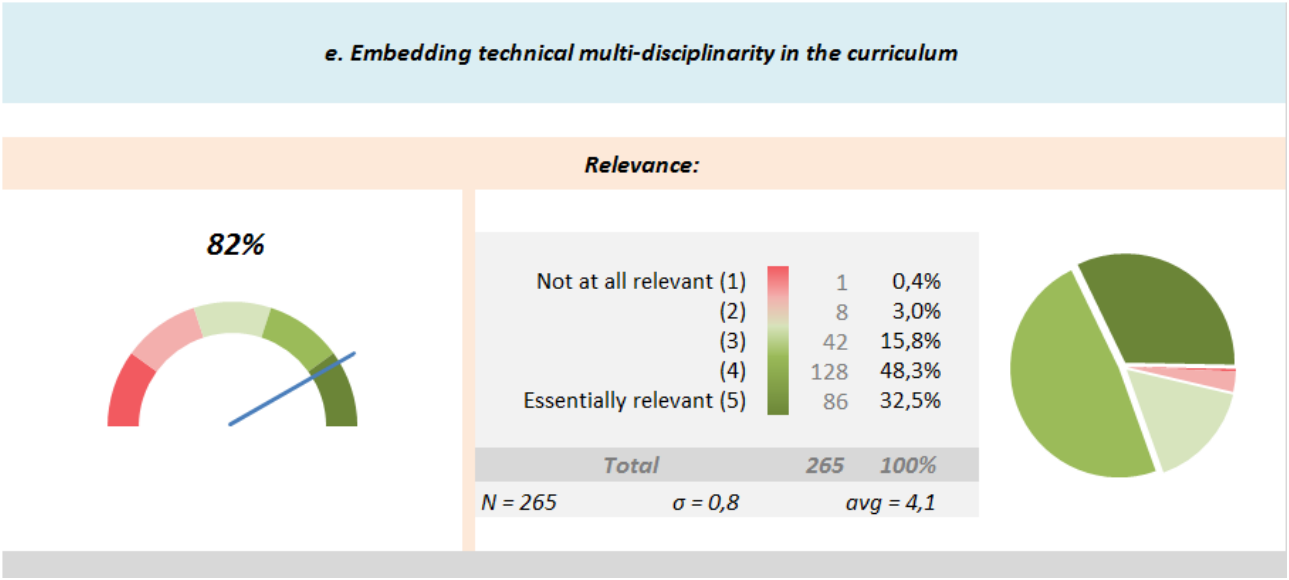
Aalto University offers a multi-disciplinary elective for master students interested in energy and society. It is a collaborative teaching effort between several disciplines taught at Aalto University, including system analysis, media, energy sciences, information technology, business, and economics. The goal of the elective is to educate multi-skilled students with both subject-specific know-how and integrative understanding across a range of energy issues. Owing to the multi-disciplinary approach, the university addresses key topical energy themes such as green-ICT, energy frugality, smart power and green innovations. By combining technical fields with other (related) sciences and business, the programme is an excellent example of integrating multi-disciplinarity in the curricula through a course-based approach. A similar approach could be adopted in technical curricula by combining different technical disciplines to address key societal topics, such as climate change.

Recommendations

Embedding technical multi-disciplinarity in the curriculum:

Higher and executive education and training institutions should increase multi-disciplinarity, training students in various disciplines simultaneously so that they can work 'at the crossroads' of those disciplines, such as mechatronics.

Target groups	Vocational education students, short-cycle tertiary education students, Bachelor students, Master students, PhD students.
Leading (& other) relevant stakeholder groups	Educators, national and European policy makers, industry
Activities requiring dedicated budget	• Pan-European projects to design adjustments in the curriculum for VET (pilot projects) • European and national funds for bringing these adjustments to practice • Pan-European projects to design adjustments in the curriculum for Bachelor/Master/PhD programmes (pilot projects) • European and national funds for bringing these adjustments to practice • Development and promotion of pan-European MOOCs training multi-disciplinarity in KETs • Development of European Multidisciplinary Master Programmes
Timeline	• Development: 2 years • Implementation (first pilots): 3 years • Gradual adoption on a massive scale: 5 years (after implementing first pilots)
Target / Output / Success criteria	At least 20% of the schools adopting the developed changes within 5 years after implementation of the first pilots.



Embedding non-technical courses in technical curricula [2.8]

It is a combination of technical and non-technical skills that drive the transformational capacity of people in digital and key enabling technologies, who display agility and the ability to solve complex problems. Successful operation requires competencies beyond the technical field, covering many non-technical and transversal areas including quality, risk and safety; management and entrepreneurship; communication; innovation-related competences; and emotional intelligence skills.

Educational institutions should offer dedicated modules to familiarise technical students with non-technical issues. One of the promising approaches implies mixing technical and non-technical students in joint project teams, where multidisciplinary expertise would be required. Besides the role of business schools in providing non-technical courses, an option could be to involve consultancy boutiques or SMEs to offer the non-technical courses for technical students. In addition, technical Universities could also provide both technical and non-technical courses themselves. Furthermore, business schools could offer (optional) technical courses that help non-technical students understand the possibilities of technology and the business opportunities that come along with it.

Promising practice – The Digital Manufacturing and Design Innovation Institute (DMDII)

This initiative from the United States set itself the goal to develop and demonstrate digital manufacturing technologies, and deploy and commercialise these technologies across key manufacturing industries. UI LABS, the managing organisation, has brought together more than 40 industry partners, and 30+ academic, government and community partners, and is supported by an additional 500+ companies and organisations. The initiative is funded by an initial 70 million USD in public funding, which is leveraged by an additional 250+ million USD in funds committed by partners from industry, academia, government and community. Although it is not purely an initiative that integrates non-technical courses in the curricula, it brings together the transformational capacity of business and academia. Working together on successful commercialisation requires all actors to combine different technical disciplines with a variety of non-technical skills, stimulating the development of entrepreneurial skills, innovation-related competences and emotional intelligence skills. By involving people in tertiary education, educational providers and industry, the initiative also aims to prepare the future manufacturing workforce for digital manufacturing technology, and facilitate the transition and insertion of digital manufacturing technology in the U.S. manufacturing base.

Recommendations

Embedding non-technical courses in technical curricula:

Higher and executive education and training institutions should ensure technical curricula include non-technical courses in quality, risk and safety; management and entrepreneurship; communication; innovation-related competences; and emotional intelligence skills. Cross-functional initiatives should be promoted and encouraged.

Target groups	Vocational education students, short-cycle tertiary education students, Bachelor students, Master students, PhD students
Leading (& other) relevant stakeholder groups	Educators, national and European policy makers
Activities requiring dedicated budget	• Pan-European project to collect and disseminate existing good practices. • European and national funds for upscaling these good practices.
Timeline	Adoption of good practice examples on large scale: 5-10 years
Target / Output / Success criteria	Fully operational higher and executive cross-functional education and training programmes embedding non-technical courses in technical courses and programmes throughout Europe

f. Embedding non-technical courses in technical curricula

Relevance:

Not at all relevant (1)	2	0,8%
(2)	9	3,4%
(3)	55	20,8%
(4)	117	44,3%
Essentially relevant (5)	81	30,7%
Total	*264*	*100%*
N = 264	*σ = 0,8*	*avg = 4*

Updating the skills of teachers/professors [2.9]

To ensure that education does not lag behind industry developments, teachers' skills need constant updating. Two-way exchanges between industry and the classroom can ensure insights into the latest developments.

Promising practice - Singapore Institute of Manufacturing Technology's Knowledge Transfer Office

SIMTech's KTO has been established to provide unique technology and case study-based training for manufacturing specialists, engineers, managers, as well as other industry professionals and executives. It brings together industry experts and teachers, ensuring that students are taught the relevant skills, that teachers are aware of the latest developments in industry, and that educators have access to state-of-the-art teaching facilities. All training courses, conducted in close collaboration with the Singapore Workforce Development Agency (WDA), draw extensively on the in-house cutting-edge manufacturing knowledge, established through years of industrial collaborations, industry experience and research, backed by state-of-the art manufacturing facilities.

Over the years, the KTO build many evidence-based case studies, which are integrated in their training programs. This allows its users to learn how technology is actually applied in practice. Its success is highlighted by the extensive client list of industry partners (220+), which make use of the programme to train their employees and executives.

Promising practice - The Festo Didactic "Transfer Factory" – Research and Teaching platform

Festo Didactic's Transfer Factory is a privately funded learning and research platform that provides training on state-of-the-art manufacturing infrastructure. Digitalisation in advanced manufacturing requires workers to develop a deep understanding of the structure and programming of digital facility networks. Such skills are best taught in a real-life controlled environment, to which education providers and companies typically do not have access to. The CP Factory learning and research platform responds to this challenge by providing higher education institutes and companies with access to the technology and applications of Industry 4.0.

The basis of the training platform is the MPS® Transfer Factory. The platform demonstrates the production of tomorrow in a locally controlled intelligent network and was developed for flexible training in a wide range of technologies and subjects. These subjects include facility networking, PLC programming, drive technology, sensor technology, safety technology, robotics, assembly, as well as value stream analysis and optimization. Festo Didactic also offers individual training courses in connection with the MPS® Transfer Factory, which address communication, robotics, simulation, image processing, PLC programming, fieldbus, RFID technology, plant simulation, and troubleshooting.

Recommendations

Updating the skills of teachers/professors:

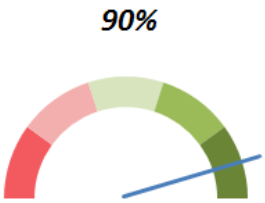
Higher and executive education and training institutions should ensure a good alignment of educational programmes with industry needs by having educational personnel visit enterprises to gain insights into the latest developments, while inviting executives and lead professionals from enterprises to regularly teach in the classroom to increase the (practical) relevance of education.

Target groups	Educational personnel from secondary schools, vocational education, short-cycle tertiary education, Bachelor programmes, Master programmes
Leading (& other) relevant stakeholder groups	Educators, industry, national and European policy makers.
Activities requiring dedicated budget	• Pan-European and national teacher exchange schemes. • Pan-European project to provide key educational institutions with state-of-the-art equipment: due to high costs related to acquiring such equipment, it

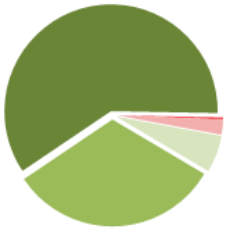
	could be placed only in some of the world-class European universities/educational institutions and then shared with educators and students across Europe.
Timeline	• Design of the pan-European scheme: 2 years • Implementation of the pan-European scheme: onwards (after design)
Target / Output / Success criteria	Fully operational higher and executive as well as vocational and secondary school education and training programmes with educational personnel visit companies to gain insights into the latest developments, while inviting executives and lead professionals from companies to regularly teach in the classroom to increase the (practical) relevance of education throughout Europe

g. Updating the skills of teachers/professors

Relevance:



Not at all relevant (1)		1	0,4%
	(2)	6	2,2%
	(3)	15	5,6%
	(4)	86	32,1%
Essentially relevant (5)		160	59,7%
Total		*268*	*100%*
N = 268	*σ = 0,7*		*avg = 4,5*



Reverse mentoring [2.10]

In digitisation, knowledge is often located low in the hierarchy of an organisation. 'Reverse mentoring', pairing older workers with younger ones to educate one another, can promote new ways of thinking, particularly in businesses that rely heavily on technology.

Recommendations

Build reverse mentoring programmes and instruments:

Enterprises should enable executives to be mentored by juniors on technology, social media and current trends, and should promote peer-to-peer learning.

Target groups	Executives and staff in European companies
Leading (& other) relevant stakeholder groups	European Commission

Activities requiring dedicated budget	European Commission project for the collection and presentation of best practices
Timeline	Continuous activity
Target / Output / Success criteria	European best practices repository of reverse mentoring programmes and instruments

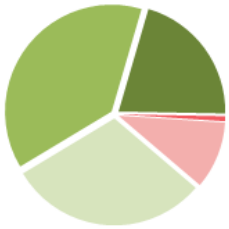
h. Reverse mentoring

Relevance:

74%

Not at all relevant (1)	2	0,8%
(2)	27	10,2%
(3)	80	30,2%
(4)	101	38,1%
Essentially relevant (5)	55	20,8%
Total	*265*	*100%*

N = 265 *σ = 0,9* *avg = 3,7*



3.6.3 Platform-based digital services for career support and recruitment

Platform-based digital services for career support and recruitment [3]

Platform-based digital services supporting diagnosis and self-assessment [3.1]

Personal career planning and employers' recruitment and appraisal processes can all benefit from digital services that support diagnosis and self-assessment of an individual's skills and competences. But these services are currently scattered and little known among those most in need of them.

Digital services supporting diagnosis and self-assessment of an individual's IT-related skills and competences can play a role in profiling oneself with respect to relevant skills and how these compare to those needed for a specific job or in the market, in the process of career planning but also for employers in recruitment, appraisal and career advancement processes. Over the past years several of such tools supporting diagnosis and self-assessment of an individual's IT-related skills and competences have been developed but are spread around widely and unknown among those most in need of them.

Promising practice – e-Competence-quality online assessment tool

Online self-assessment tool allowing the different target groups to profile themselves, their demand for or supply of digital skills and compare the current skills and competence profiles with those required in a set of ICT-related occupational profiles and showing how skills gaps can be met by e-skills training and certification. The tool offers direct paths to such certifications and is using the e-CF which has become a European standard and can be seen as a durable framework, neutral and free of use (http://www.e-Competence-quality.com)

Promising practice – e-CF profiling tool

http://profiletool.ecompetences.eu/

Promising practice – CEPIS e-Competence Benchmark

CEPIS (Council of European Professional Informatics Societies) has created the e-Competence Benchmark, where users can measure their ICT competences - find out today if you have the digital skills you need to get hired (http://cepisecompetencebenchmark.org)

Promising practice - Berufsnavigator

Berufsnavigator (occupation navigator) from the German employment agency linking career advancement to training and thereby demonstrating short and long-term effects of training activities: https://ben.arbeitsagentur.de/

Promising practice - diagnostic tools which reflect the e-Leadership skill requirements

LMSA online in Northern Ireland with its Leadership and Management Skills Assessment Tool and Business Diagnostic Tool at http://www.nibusinessinfo.co.uk

Entrepreneurial Skills Check of the ECN Network in Austria: http://www.ecnetwork.at/Portal/c.php?c=skillscheck

Promising practice – ICT Talentcenter (The Netherlands)

In the Netherlands an **ICT Talentcenter** has been developed in 2015. This Talentcenter forms an independent platform for the demand and supply side of the ICT market based on the e-CF (European e-Competence Framework). ICT professionals can profile themselves and find vacancies matching their competencies. In the back office of this platform vacancies - coming in through Jobfeed (http://www.jobfeed.com/home.php) - are "translated" to a common language by TextKernel semantic search. Currently NGI-NGN is looking at combining their websites around e-CF, e-CF advies en e-CF Forum, assessment tools developed and supported by Exin, with the platform Talentcenter and AG-Connect, the editor of the NGI-NGN publications. This combination can provide one independent platform where e-skills professionals can find jobs, opportunities, knowledge, access to assessment tools, education, contact and forum opportunities. Employers find an independent platform that can bring them in contact with their target group and entrance in general into the e-skills community and related markets. All information, demand, is or can be converted through e-CF in understandable supply, like skilled people or training programmes. (https://www.caict-talentcenter.nl)

Promising practice – Academy Cube

Academy Cube combines e-learnings with the job hunt. It has been developed by leading global companies to strengthen tomorrow's workforce and to open the door to new opportunities in the international labour market for motivated talents. Academy Cube connects students, graduates and professionals with companies through an online platform. Its USP is a matching system that proposes courses based on a job-seekers' self-assessment to teach the specific qualifications required by a job profile. Through this approach, Academy Cube offers practical course content with proven relevance for companies.

Recommendations

Platform-based ecosystem of digital services supporting diagnosis and self-assessment:

Support the development of a quality-assured online repository of services supporting diagnosis and self-assessment in recruitment as well as appraisal and career advancement processes. These should take account of individuals' 'development potential' as well as of certificates. An online ecosystem of tools, constantly refined by customer feedback through a one-stop-shop gateway, could help align national systems with Europe-wide initiatives.

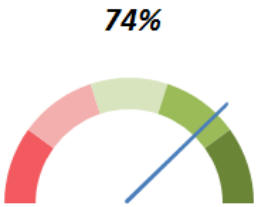
Participating platforms and tools should use European standards like ESCO and the European e-Competence Framework (e-CF), and be distinguished with the slogan 'e-CF inside' or 'powered by e-CF' as form of branding. Platforms should remain open, in a collaborative spirit like Wikipedia, allowing further development and maintenance through the community, with a light-weight overall 'umbrella' organisation.

Target groups	Employers and employees throughout Europe and the world
Leading (& other) relevant	Service providers of digital services supporting diagnosis

stakeholder groups	and self-assessment
Activities requiring dedicated budget	Prototype development and feasibility study
Timeline	2 years
Target / Output / Success criteria	Operational online platform supporting diagnosis and self-assessment

a. Platform-based digital services supporting diagnosis, self-assessment, learning and job search

Relevance:



Not at all relevant (1)	8	3,0%
(2)	17	6,3%
(3)	75	28,0%
(4)	118	44,0%
Essentially relevant (5)	50	18,7%
Total	*268*	*100%*

N = 268 *σ = 0,9* *avg = 3,7*

3.6.4 Better coordination

Better coordination and funding [4]

Better information about and more strategic use of available funding [4.1]

Experts argue that policy makers at all levels in Europe – European and national – have not yet established the policy and funding framework conditions in the skills and talent area to achieve the necessary increase in innovation and competitiveness of European industry and businesses.

According to them and to successfully achieve the necessary digital transformation in industry and in our knowledge society this should include the move away from 'use' to 'creation' of software in Europe with the establishment of the prerequisites to make it happen. Foremost these need to tackle the education and training area, include activities for setting the right incentives and the development of suitable funding concepts.

Policy makers at European and national level in the EU should re-consider existing funding concepts and programmes which are often dating back to the late 1980s. While the past was characterised by funding legacy including large national IT giants in Member States (see for instance the Commission programmes ESPRIT, RACE, ACTS in the 1980s and 90s) new concepts need to address and support digital disruption as a topic.

The European Social Fund (ESF) constitutes Europe's main instrument to support job creation and will invest EUR 80b in human capital related initiatives between 2014 and 2020. However, a report from empirica (Gareis et al., 2014) revealed that policy development and funding focussing on e-skills and e-leadership skills differ significantly across Europe and are at rather poor level in many countries. The Commission Erasmus+ programme has started activities to address the e-skills and e-leadership skills topic through funding respective knowledge alliances and sector skills alliances. An evaluation of these activities will have to reveal its appropriateness and suitability for moving towards and reaching the set goals.

Promising practice – Erasmus+ funding of e-skills and e-Leadership skills Knowledge Alliances

Le@d 3.0 Academy is an example of a Knowledge alliance funded by the Erasmus+ programme. Le@d3.0 Academy intends to create a knowledge alliance between Academy and Industry to widely spread the use of Web3.0 and OER by trainers to develop those strategic e-Leadership skills (Se-Ls) that are required by the labour market in the Digital Age. The project works around two important operational objectives. The first one is the identification of the emerging strategic e-Leadership skills portfolio (taxonomy) and the analysis of the related skill gaps as perceived by managers, trainers and students. The taxonomy and the gap analysis were the foundation for approaching the second objective, being to develop the trainers' capacity to embed Web3.0 and OERs into their training practices for e-Leadership education & training. This will be done by offering trainers both a capacity building programme and a Community of practice (CoP) to work on the methodological approach to online and blended learning and a virtual platform equipped with already developed OERs and training paths for students and managers to develop the desired strategic e-Leadership skills.

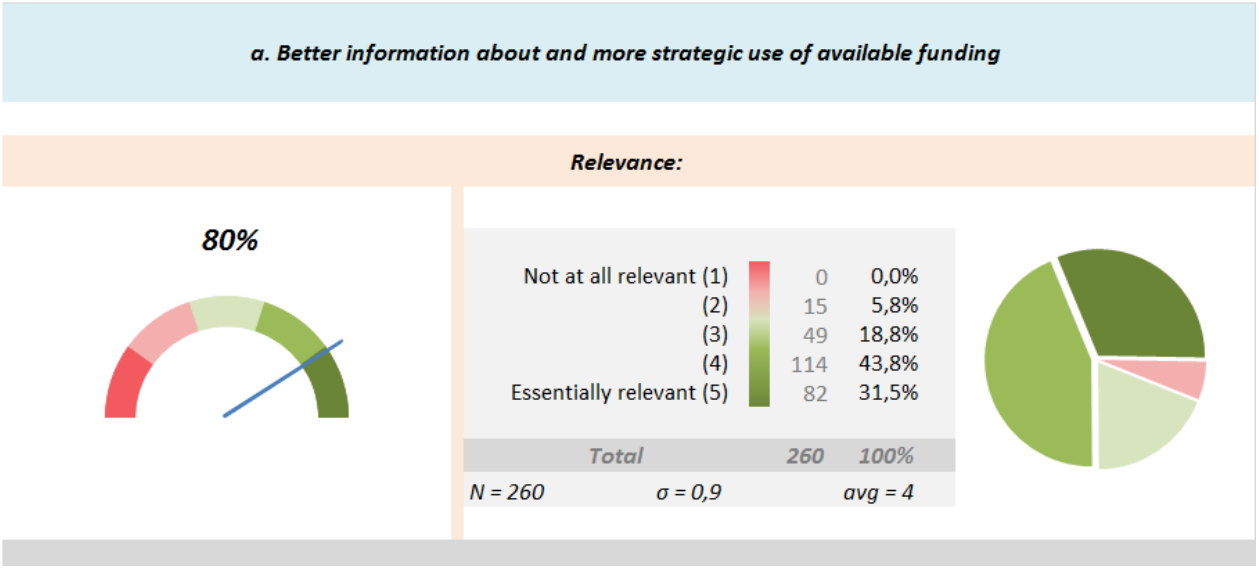
Recommendations

Setting new framework conditions and developing new funding schemes supporting digital disruption and industrial modernisation:

Policy makers need fuller understanding of the high-tech economy and society, so that Europe can boost innovation. Because innovation and disruption often come from creative outsiders without track record or organisational and financial stability, small short-term funds should be available to help this volatile community to produce mock-ups of concepts and business models that would support applications for venture capital or other funding for further development.

The European Social Fund (ESF) offers funding opportunities in many skills-related areas, and those responsible for allocating funding (via Operational Programmes in the Member States) need to develop an understanding of the related issues and present and future requirements if they are to take due account of it in their plans.

Target groups	EU funding programmes
Leading (& other) relevant stakeholder groups	European Commission and national governments
Activities requiring dedicated budget	Impact analysis studies
Timeline	2 years
Target / Output / Success criteria	Framework conditions and funding programmes in Europe better addressing and supporting digital and technological disruption



Government-driven public procurement of innovation [4.2]

Actors in start-up and initial entrepreneurship and business development phases today can expect support mainly only from incubators and accelerators, despite the importance of their role in building innovation. They have the opportunity to receive some funding from EU research and innovation programmes through the SME Instrument and the Fast Track to Innovation (FTI) pilot which is a bottom-up measure in Horizon 2020 to promote close-to-the-market innovation activities. These programmes are heavily oversubscribed. Securing finance for the 'proof of business model phase' and the 'growth phase' of young enterprises remains a problem in European Member States.

What is even less well developed in Europe compared to the US is state-driven public procurement of innovation which can actively shape and create markets thereby enabling the state to take an active role in fostering long-run innovation led economic growth. In her book 'The entrepreneurial state. Debunking public vs. private sector myths' published in 2015 Marina Mazzucato reveals that every technology that makes the iPhone so 'smart' was government funded through such schemes: the Internet, GPS, its touch-screen display and the voice-activated Siri.

Promising practice – DARPA model - prototype development with innovative public procurement

The Defence Advanced Research Projects Agency (DARPA) in the United States funds the purchasing of advanced prototypes that embody breakthrough technologies, in a tender process. It is a small agency, with 140 technical project managers in charge of a USD 3 bn. budget. It may be described as a form of "innovative public procurement", typical of the "Entrepreneurial State".[20]

Recommendations

Government-driven public procurement of innovation:

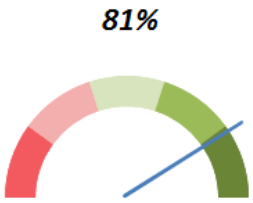
The European Commission has been active in bootstrapping the process of public procurement but EU Member States should now become active and intensify activities towards government-driven public procurement of innovation which can actively shape and create markets thereby enabling the state to take an active role in fostering long-run innovation led economic growth and at the same time support innovative start-ups and SMEs.

[20] IndustriAll: Strategic study on anticipation of changes in the European ICT sector. September 2016

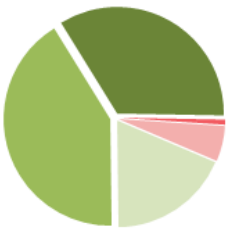
They could selectively support investment enterprises active at the seed capital stage, to create a sustainable economic model, and fund the purchase of breakthrough prototypes via a tender process, such as in the US DARPA model, open to all applicants. Here, DoD, NASA and other public bodies are obliged to spend a fixed percentage of their external budget with innovative start-ups and SMEs.	
Target groups	European Commission
Leading (& other) relevant stakeholder groups	European Commission and EU national governments
Activities requiring dedicated budget	Exploration and demonstration and testing studies
Timeline	2 years
Target / Output / Success criteria	Demonstrator funding schemes operating in a one-year experimentation phase

b. Funding schemes addressing the 'proof of business model phase' and 'growth' phase of start-ups and SMEs

Relevance:



Not at all relevant (1)		2	0,8%
(2)		14	5,4%
(3)		48	18,4%
(4)		108	41,4%
Essentially relevant (5)		89	34,1%
Total		*261*	*100%*
N = 261	*σ = 0,9*		*avg = 4*



Incentivise individuals [4.3]

Individuals are themselves responsible for their skills development throughout their working lives, so funding could include support for individuals to follow education and further training, such as through voucher systems or tax breaks for individuals and employers.

Promising practice – voucher systems and tax breaks used in different countries

In the United Kingdom, the apprenticeship levy is to be paid by all enterprises above a certain payroll threshold. It can be claimed back to the extent that the firm invests in apprenticeships. Such an approach might be adopted for life-long-learning as well.

Training vouchers have already been used and continue to be used in the implementation of the Bulgarian Human Resources Development Operational Programme. Also France has a tax credit system relating to organisations who train their staff as well as for training suppliers.

Finally, in Malaysia as another example, tax income is held back to be used for lifelong learning.

Promising practice – 'Financial and fiscal incentives for e-skills in Europe'

Already in 2009 and as part of the long-term e-skills agenda for Europe the Commission published a report on 'Financial and fiscal incentives for e-skills in Europe' to promote different types of schemes and best practices in this area. The goal was to investigate appropriate financial and fiscal incentives, in full respect of State aid rules, related to

e-skills training, especially for SMEs, and studying the potential of a human capital investment tax credit for individuals.

Recommendations

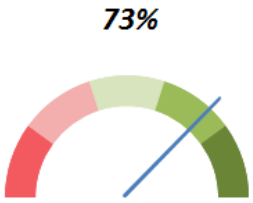
Promote voucher systems and tax breaks for individuals and companies to support life-long-learning:

Financial and fiscal incentives for high-tech leadership skills in Europe should be evaluated and refocused to take account of new innovative and tested approaches to funding individuals to obtain such skills through life-long-learning. Typical examples include for instance training vouchers or ILAs (Individual Learning Accounts). These types of financial training support can be offered to reduce overall cost of the training and provided for individuals and also for SMEs.

Target groups	European Commission and national EU governments
Leading (& other) relevant stakeholder groups	European Commission and national EU governments
Activities requiring dedicated budget	European Commission service contract on 'Financial and fiscal incentives for innovation leadership skills in Europe'
Timeline	2 years
Target / Output / Success criteria	Overview of 'Financial and fiscal incentives for innovation leadership skills' in all EU Member States.

c. Fund 'individuals'

Relevance:



Not at all relevant (1)	7	2,7%
(2)	25	9,7%
(3)	79	30,5%
(4)	91	35,1%
Essentially relevant (5)	57	22,0%
Total	*259*	*100%*

N = 259 *σ = 1* *avg = 3,6*

European quality level leap of worldwide recognition in high-tech leadership education and training [4.4]

Not only does Europe lack high-tech professionals in general; it also lacks innovation leaders with technology savviness, management and leadership excellence. Joint university/industry training programmes like the Software Campus initiated in Germany would need to be scaled up and implemented throughout Europe. Experts and policy makers at the IT summit in Germany in November 2016 urged bolder large-scale joint activities involving industry, education and training institutions and policy makers.

Recommendations

European quality level leap joint industry / university innovation leadership skills education and training programme:

The European Commission should initiate and provide co-funding for a European joint training programme of universities and industry and of worldwide recognition for the creation of a larger pool of high-tech and innovation leaders, comparable to other ambitious programmes such as Airbus or CERN. Creating and implementation of such a joint industry / university innovation should build on the experiences of the European Institute of Innovation & Technology (EIT) which was set up in 2008 to spur innovation and entrepreneurship across Europe to overcome some of its greatest challenges.

Target groups	European Commission, national EU governments, education and training institutions, industry
Leading (& other) relevant stakeholder groups	European Commission and national EU governments jointly with industry and universities
Activities requiring dedicated budget	Establishment and operation of a European programme and funding scheme co-funded by the Commission, national government and industry.
Timeline	2 years
Target / Output / Success criteria	European programme and funding scheme co-funded by the Commission, national government and industry similar to the CERN and Airbus projects in terms of ambition and volume.

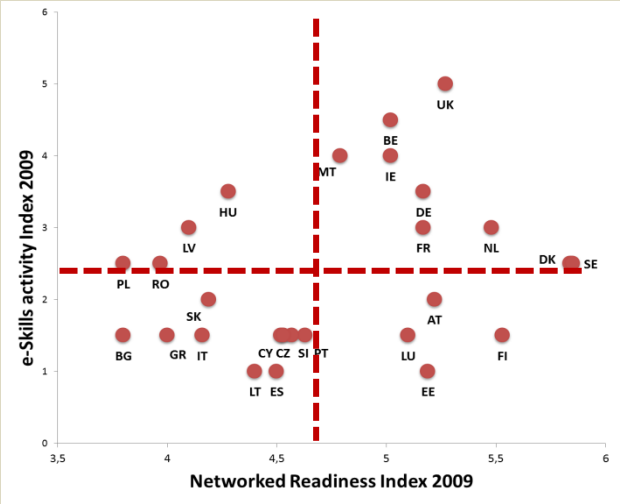
3.6.5 National digital and high-tech skills strategies: longer-term policy commitment and action

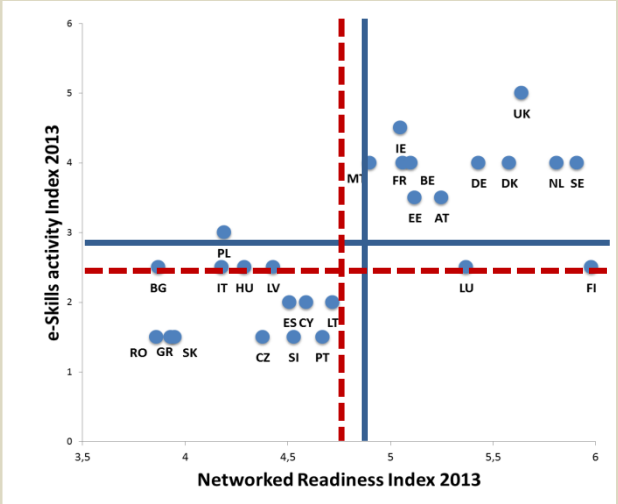
National digital and high-tech skills strategies [5]

Longer-term policy commitment and concrete action plans [5.1]

Wide divergences exist across Europe in national policies and initiatives relating to high-tech skills for the high-tech economy. For example, in the past the e-skills policy activity index based on data from 2009 and 2013 illustrated improvements, but also revealed significant disparities from country to country.

Governments need to adopt a long-term commitment to developing and implementing high-tech and leadership skills, which are crucial for the future of all Member States.





Source: *Gareis, K. Et al.: E-SKILLS FOR JOBS IN EUROPE: MEASURING PROGRESS AND MOVING AHEAD. FINAL REPORT Feb 2014*

Promising practice - Grand Coalition for Digital Jobs

The Grand Coalition for Digital Jobs is leading a multi-stakeholder partnership to tackle the lack of digital skills in Europe and the thousands of unfilled ICT-related vacancies across all industry sectors. Launched in March 2013 the multi-stakeholder partnership endeavours to facilitate collaboration among business and education providers, public and private actors and to create national coalitions of all these actors to help close the skills gap.

Promising practice – Digital Skills and Jobs Grand Coalition

The 'shared concept' for a digital skills strategy presented at the launch of the Digital Skills and Jobs Coalition in December 2016 could provide a good inspiration and initial platform for cooperation.

Promising practice - Festo Didactic "Transfer Factory" – Research and Teaching platform

Digitalisation in advanced manufacturing requires workers to develop a deep understanding of the structure and programming of digital facility networks. The CP Factory learning and research platform - a privately funded initiative from Festo Didactive - responds to this challenge by providing higher education institutes and companies with access to the technology and applications of Industry 4.0. The platform demonstrates the production of tomorrow in a locally controlled intelligent network and was developed for flexible training in a wide range of technologies and subjects. These subjects include facility networking, PLC programming, drive technology, sensor technology, safety technology, robotics, assembly, as well as value stream analysis and optimization. Festo Didactic also offers individual training courses in connection with the MPS® Transfer Factory, which address communication, robotics, simulation, image processing, PLC programming, fieldbus, RFID technology, plant simulation, and troubleshooting.

Recommendations

Longer-term policy commitment and concrete action plans on high-tech leadership skills development:

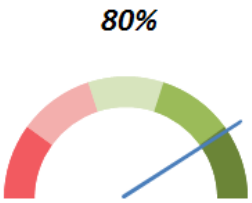
The EU should motivate long-term policy commitment by Member States to establish high-tech competence centres in all major regions, to foster smart specialisation, build on existing research and competence-centres and innovation hubs, and to provide well equipped infrastructures for 'high-tech leadership' training and career promotion. Existing industry activities should be integrated and national governments should ideally put a single Ministry in charge of coordinating all activities related to 'innovation leadership skills'.

The 'shared concept' for a digital skills strategy presented at the launch of the Digital Skills and Jobs Coalition in December 2016[21] could provide a good inspiration and initial platform for cooperation.

Target groups	EU member state governments
Leading (& other) relevant stakeholder groups	European Commission and EU member state governments
Activities requiring dedicated budget	To be agreed on between the European Commission and national governments in EU
Timeline	3 years
Target / Output / Success criteria	Longer-term national policy commitment and concrete action plans on high-tech talent and leadership skills development in EU member states National government restructuring allocating responsibility for 'digital' and 'high-tech leadership talent and skills' in a single ministry.

a. Longer-term policy commitment and concrete action plans

Relevance:



Not at all relevant (1)		3	1,1%
	(2)	8	3,0%
	(3)	52	19,8%
	(4)	120	45,6%
Essentially relevant (5)		80	30,4%
	Total	*263*	*100%*
N = 263	*σ = 0,9*		*avg = 4*

[21] https://ec.europa.eu/digital-single-market/en/news/launching-digital-skills-and-jobs-coalition-boosting-europes-digital-skills

National advisory boards for informed policy development [5.2]

If national governments and associated authorities are to act effectively to boost innovation, competitiveness and growth, they require information and advice to understand the emerging developments in innovation leadership and skills requirements in a high-tech economy. Advisory boards could provide this service, in line with the precedent of government advisory organisations on economic affairs, social welfare, education, or science.

Recommendations

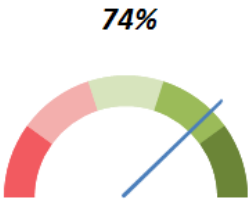
Invest in national advisory boards for informed policy development:

The EU should support the establishment of national advisory boards on innovation leadership skills in each Member State to promote informed policy development in liaison with the new Digital Skills and Jobs Coalition. Governments should invite industry and academia who can bring expertise in areas where economy, society and new technologies overlap, such as in cyber security and digital forensics, e-government, digital social innovation or combining hardware and software solutions.

Target groups	National governments in EU Member States
Leading (& other) relevant stakeholder groups	European Commission and national governments in the EU Member States
Activities requiring dedicated budget	To be agreed on between the European Commission and EU member state governments
Timeline	2 years
Target / Output / Success criteria	Successful installation and operation of an old instrument (advisory boards) for a new topic (high-tech talent and leadership skills) to support policy development in EU member states.

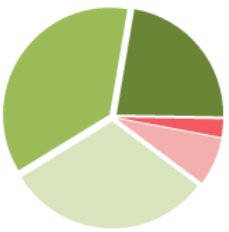
b. National Advisory Boards

Relevance:



Not at all relevant (1)	7	2,7%
(2)	19	7,3%
(3)	81	31,0%
(4)	95	36,4%
Essentially relevant (5)	59	22,6%
Total	*261*	*100%*

N = 261 *σ = 1* *avg = 3,7*



3.6.6 Promotion and awareness raising

Promotion and awareness raising for leadership skills for the high-tech economy [6]

European promotion of multi-stakeholder partnerships and campaigns on leadership skills for the high-tech economy [6.1]

Awareness-raising is essential if relevant stakeholders are to recognise the importance for society of taking action on an important topic such as 'leadership skills for the high-tech economy'. This can take the form of conferences and workshops, competitions and awards, best practice / success story promotion, newsletters, web-portals, video, webinars, blogs or social media communication.

Promising practice – European Commission 'e-Skills for Jobs Campaign' 2015 and 2016

The aim of the **e-Skills for Jobs Campaign** was to raise awareness of the opportunities that digital skills offer for employment and employability. The focus is on e-skills. The campaign has been launched under the Commission's Grand Coalition for Digital Jobs, a multi-stakeholder partnership to address the shortfall in e-Skills among Europeans and encourage people to fully exploit the potential employment opportunities that ICT provides, while also ensuring that women are able to partake equally in the opportunities offered by the digital economy (http://eskills4jobs.ec.europa.eu/).

Promising practice – European Commission e-Leadership initiative 2013 - 2016

The Commission started the **European e-Leadership Initiative** in 2013 and expanded it in 2014 to also address SMEs. Within this initiative 17 Regional Cluster Events were organised throughout Europe and two large European conferences held. More than 1000 experts participated in stakeholder dialogue out of a number of more than 3500 stakeholders involved in total.

Recommendations

European promotion campaign and awareness raising:

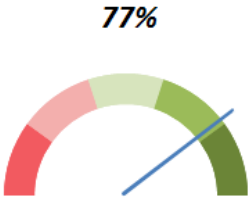
The EU should support awareness raising activities about high-tech leadership skills throughout Europe, at all level of education. Easy-to-understand messages should excite opinion-formers and audiences. Role models (see following recommendation) could reinforce the impact through TED talks, piggy-backing promotion activities on major high-tech related European and national events, and participation on TV shows etc.

Target groups	European Commission, EU member state governments. A large range of further relevant stakeholders (see previous promotion campaigns)
Leading (& other) relevant stakeholder groups	Ditto.
Activities requiring dedicated budget	European promotion campaign
Timeline	2018-2020
Target / Output / Success criteria	Successful operation of European multi-stakeholder partnerships and promotion campaigns

6. Promotion and awareness raising for leadership skills for the high-tech economy

a. European promotion campaign on leadership skills for the high-tech economy

Relevance:



Not at all relevant (1)		7	2,6%
(2)		14	5,3%
(3)		60	22,6%
(4)		109	41,1%
Essentially relevant (5)		75	28,3%
Total		*265*	*100%*
N = 265	*σ = 1*		*avg = 3,9*

Role models and success stories [6.2]

The importance of high-tech leadership needs to be promoted widely especially for SMEs and traditional sectors. Many are lagging behind regarding the adoption of new digital and key enabling technologies and are lacking the capability to adapt and transform themselves successfully. They would be the most affected by technological disruptions. To help them, it would be useful to promote concrete career path descriptions and publicity about role models, demonstrating the opportunities – in particular for women – in the new economy, geared to attracting students and employees.

Promising practice – Pasc@line Observatory Report: What are the competences needed for tomorrow's e- leaders?

The aim of the **Pasc@line Observatory Report** was to identify the competences e-leaders will need to develop in order to gain leverage on every dimension of the real economy and of business operations, starting out from the traditional foundation of every engineer's training: the mastery of technology, and digital technology in particular. The report includes several biographies and portraits of e-leaders which provide an insight in the type of skills and experience needed from a real-life perspective. For more information:

http://www.assopascaline.fr/offres/doc_inline_src/650/e-leadership%2BPasc40line%2Breport%2BA5%2BUK.pdf

Recommendations

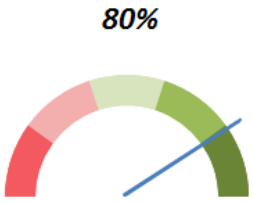
High-tech leadership skills role models and success stories:

The EU should develop and promote awareness of role models, business cases and success stories of leaders in the high-tech economy as pathways to success and an opportunity also and especially for women. These could be made available online to schools to motivate students from an early age.

Target groups	European workforce, students, pupils, citizens
Leading (& other) relevant stakeholder groups	European Commission
Activities requiring dedicated budget	Development of a Europe-wide repository of high-tech leadership role models and success stories embedded in a European promotion campaign (see above)
Timeline	2018-2020
Target / Output / Success criteria	Successful development and promotion of role models and success stories, continuously further developed and maintained role model and success story repository

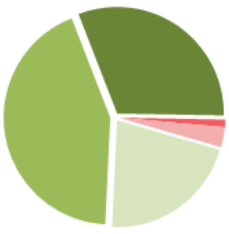
b. Role models and success stories.

Relevance:



Not at all relevant (1)	3	1,1%
(2)	8	3,0%
(3)	56	21,3%
(4)	114	43,3%
Essentially relevant (5)	82	31,2%
Total	*263*	*100%*

N = 263 *σ = 0,9* *avg = 4*



3.7 Summary overview of recommendations and time table

The following tables provide a tabular overview of the strategic priorities, recommendations and actions for inclusion in a European agenda on 'High-tech Leadership Skills for Europe – Towards an Agenda for 2020 and Beyond' in an overview format.

Overview of the recommendations and suggested time table

Recommendation			2017	2018	2019	2020-2025
Monitoring, benchmarking and forecasting						
1	1.1	Engage widely with stakeholder groups to sharpen definitions, segmentations and classifications regarding high-tech leadership skills	Preparation	Implementation & First Results		
2	1.2	Regularly update a high-tech leadership scoreboard and index	Preparation & Implementation	First Results		
3	1.3	Develop robust methodologies for the measurement and quantification of workforce demand and supply, and forecasting of high-tech leadership skills	Preparation	Implementation & First Results		
4	1.4	Develop an online Best Practices platform for mutual learning	Preparation & Implementation	First Results		
5	1.5	Implement a high-tech talent monitoring mechanism	Preparation & Implementation	First Results		
Industry, education and training						
6	2.1	Universities and business schools to become lifelong-learning institutions and establish new (industry) partnerships and the emergence of new players	Preparation	Implementation	First Results	
7	2.2	Guidance for rapid training programme adaptation and development	Preparation	Implementation	First Results	
8	2.3	'European Software Universities' and programmes for education, training and research in software-based innovation		Preparation	Implementation	First Results
9	2.4	Enhancing diverse types of mobility within and beyond advanced technologies	Preparation	Implementation	First Results	
10	2.5	Build ecosystems		Preparation	Implementation	First Results
11	2.6	Workforce credentialing	Preparation	Implementation	First Results	

Recommendation			2017	2018	2019	2020-2025
12	2.7	Embedding technical multi-disciplinarity in the curriculum	Preparation	Implementation	First Results	
13	2.8	Embedding non-technical multi-disciplinarity in technical curricula	Preparation	Implementation	Preparation	
14	2.9	Updating the skills of teachers/professors	Preparation	Implementation	First Results	
15	2.9	Build reverse mentoring programmes and instruments	Preparation	Implementation	First Results	
Platform-based digital services for career support and recruitment						
16	3.1	Platform-based ecosystem of digital services supporting diagnosis and self-assessment	Preparation & Implementation	First Results		
Better coordination and funding						
17	4.1	Setting framework conditions and developing new funding schemes supporting digital disruption and industrial modernisation	Preparation	Preparation	Implementation	First Results
18	4.2	Government-driven public procurement of innovation	Preparation	Implementation	First Results	
19	4.3	Promote voucher systems and tax breaks for individuals and companies to support life-Long-learning	Preparation	Implementation & First Results		
20	4.4	European quality level leap joint industry / university innovation leadership skills education and training programme	Preparation	Preparation	Implementation	First Results
National digital and high-tech skills strategies						
21	5.1	Longer-term policy commitment and concrete action plans on high-tech leadership skills development	Preparation	Implementation	First Results	
22	5.2	Invest in national advisory boards for informed policy development	Preparation	Implementation & First Results		
Promotion and awareness raising for leadership skills for the high-tech economy						
23	6.1	European promotion of multi-stakeholder partnerships and campaigns on leadership skills for the high-tech economy	Preparation	Implementation & First Results		
24	6.2	High-tech leadership skills role models, business cases and success stories	Preparation	Implementation & First Results		

Strategic Priority	Recommendation	Recommendation / Action	Target groups	Leading (& other) relevant stakeholder groups	Activities requiring dedicated budget	Timeline	Target / Output / Success criteria
Monitoring, benchmarking and forecasting [1]	**Engage widely with stakeholder groups to further sharpen definitions, segmentations and classifications regarding high-tech leadership skills [1.1]**	Engage widely with stakeholder groups to sharpen definitions and metrics for high-tech leadership skills to include digital as well as key enabling technologies skills. Refine and re-define the IT workforce and profession in light of developments and trends in technology, industry and business. The same holds true for the skills of workers and leaders in the key enabling technologies domain, with newly emerging jobs being created. Elaborate classification and competence frameworks such as ISCO, ESCO and e-CF and develop EU professional profiles within the relevant CEN Workshop on ICT Skills.	National employment agencies and governments, industry, education and training institutions including higher and executive, vocational and secondary education levels throughout Europe, CEN	Commission, CEN, include new players and actors already active in the field	Pan-European project	Design of a pan-European scheme: 2 years	Clear and agreed definitions and metrics for measuring high-tech leadership skills and their implications on innovative job profiles.
	Regularly update a high-tech leadership scoreboard and index [1.2]	It should be expanded beyond 'digital' to include progressively key enabling technologies, and especially domains of European strengths such as photonics, nano-electronics and robotics. Develop related scoreboards and an index Europe-wide and beyond, involving relevant stakeholders and regularly reporting results. These activities should build on and extend already running ones in this area including those of the Commission relating to the Digital Economy & Society Index (DESI).	European and national governments, policy makers and key stakeholders throughout Europe and beyond	European Commission	European initiative to develop indicator, scoreboard and index updates differentiating between high-tech leadership accomplishment and preparedness for the future	Annual activity	Annual publication of scoreboard and analysis report published on European Commission web portal
	Develop robust methodologies for the measurement and quantification of workforce demand and	Develop robust and trusted methodologies, indicators, algorithms and covering the full spectrum of high-tech leadership skills, and forecast figures on workforce, (excess) demand, and supply including also based on vacancy data. Provide reliable estimates and data by category and group of workers, differentiated by skills levels and skill sets, permitting detailed analysis	European Commission, national employment agencies and governments, Eurostat, research and	European Commission, providers of multilingual CV parsing and semantic search in big data sources,	Pan-European or even global project	Design of a pan-European / global activity: 2 years	Monitoring mechanism regularly and continuously offering up-to-date and differentiated demand, supply

Strategic Priority	Recommendation	Recommendation / Action	Target groups	Leading (& other) relevant stakeholder groups	Activities requiring dedicated budget	Timeline	Target / Output / Success criteria
	supply, and forecasting of high-tech leadership skills [1.3]	and identification of structural changes in the workforce. We recommend to favour 'clusters of competences' instead of 'occupations', and develop future-oriented approaches to defining 'sets/bundles of competences and skills'. Link findings to human resource departments in enterprises and use them in teaching and training for higher, executive and VET levels. Present results differentiated and disaggregated by gender where possible. Seek cooperation with the online vacancy data market.	consulting organisations, industry	matching tools and labour market statistics to accelerate and improve the process of matching demand and supply in the job market, experienced research and consulting organisations in this area, global business-oriented social networking service operators (e.g. LinkedIn)			and forecasting information, data and statistics on high-tech leadership
	Develop an online best practices platform for mutual learning [1.4]	Develop and regularly update an online platform for mutual learning of best practices on high-tech leadership skills and talent development. It should be linked with pledges as for instance made by stakeholders to the Digital Skills and Jobs Coalition which was launched in December 2016. Ensure its broad dissemination throughout the	Industry, education and training providers at all levels, national governments, key stakeholders	European Commission	Pan-European project	Design of a pan-European activity: 2 years	Operational high-tech leadership best practices repository covering Europe and beyond (e.g. USA, Canada,

Strategic Priority	Recommendation	Recommendation / Action	Target groups	Leading (& other) relevant stakeholder groups	Activities requiring dedicated budget	Timeline	Target / Output / Success criteria
		European industry, social partners, education and training organisations and relevant policy developers in the EU Member States. It should also target relevant associations promoting it to their members and more broadly also to decision makers in enterprises and organisations. Closely involve European institutions and their communication channels and publication formats including the CEDEFOP 'Skills Panorama' and 'Statistics in Focus' of Eurostat.	and associations representing the above actors at European and national level				Japan, China, South Korea etc.) with regular monitoring, updating and analysis reporting.
	Implement a high-tech talent monitoring mechanism [1.5]	Regularly update presentations of the high-tech workforce development data and demand and supply figures on digital and key enabling technologies skills, as well as specifically leadership skills, and make regular forecasts for EU and individual Member States. Establish and operate a monitoring mechanism as a one-stop-shop for such data to support evidence-based policy making. It is recommended to use tried and tested approaches in its development and regular data updating such as those employed in the continuous updating of the Digital Economy & Society Index (DESI).	European Commission, national governments, Eurostat, CEDEFOP	Industry, academia, industry and professional associations, wider public	Pan-European project	Regular activity	Operational observatory mechanism accessible through a one-stop-shop gateway.
Industry, education and training [2]	**Universities and business schools to become lifelong-learning institutions and establish new (industry) partnerships and the emergence of new players [2.1]**	Technical universities and business schools should be more active in industry-related talent development, aligning curricula and programmes more closely with emerging skill requirements, and winning acceptance as training providers for professionals and executives in industry. For SMEs, curriculum improvement should be based on an agile methodology of incremental innovation. The traditional waterfall model of careers is inconsistent with the rapid change in	Universities, business schools, further training institutions	Universities, business schools, further training institutions	Development and implementation activities could apply for funding through national programmes or European programmes like Erasmus+	Regular activity	National plans and reforms in EU Member States

Strategic Priority	Recommendation	Recommendation / Action	Target groups	Leading (& other) relevant stakeholder groups	Activities requiring dedicated budget	Timeline	Target / Output / Success criteria
		skills requirements in the contemporary business world. Pioneering universities and business schools have started to offer a mix of hands-on, technical and strategy-related courses that match the needs of SMEs. Focused high-tech leadership courses taken at appropriate points in time - as 'pills' or 'tapas' - can help create the future e-Leaders, and build national software industries in the Member States.					
	Guidance for rapid training programme adaptation and development [2.2]	The European Standardisation Committee (CEN) should support the development of standardised tools and guidance for rapid high-tech leadership skills programme development and adaptation, building on experiences such as the 'curriculum profile' approach used on the industry-led development of e-leadership skills curricula, including rapid light-weight certification or badges, to increase acceptability among training providers and industry clients.	CEN, higher and executive education and training as well as other training providers, industry	CEN, European Commission	CEN standardisation project	2 years	Standardised tools and guidance for rapid high-tech leadership skills programme development and adaptation
	European Software Universities and programmes for education, training and research in software-based innovation [2.3]	Envisage the setting up a 'Software University' in every European country, along the recent experience of the IT University Copenhagen (ITU). Foster the development and implementation of industry-university cooperation like PROMPT (Professional Master in Software Development) by Mälardalen University in Sweden aimed to increase the supply of software competencies and innovativeness in industry through customised education and training offers produced in cooperation with enterprises in need of such competencies. Both software and hardware are important for the	National governments and universities, European Commission	National governments and universities	National initiatives and projects in all EU Member States	Design of national activities; 2-5 years	European universities and university programmes and courses of different type and size to teach high-tech leadership skills needed for successful digital transformation with deep

Strategic Priority	Recommendation	Recommendation / Action	Target groups	Leading (& other) relevant stakeholder groups	Activities requiring dedicated budget	Timeline	Target / Output / Success criteria
		EU economy and their combination is crucial for developing applications. Governments should provide incentives to institutions attracting high intake of well-qualified students for multidisciplinary programmes developed in cooperation with industry and combining software and engineering skills and business and digital leadership competences. A functioning example is the Swedish Knowledge Foundation programme 'Expertise for Innovation' (through which PROMPT receives some funding).					competencies in technical issues, in particular in software as well as in business models and digital ecosystems. Emergence of successful European software platform companies.
	Enhancing diverse types of mobility within and beyond KETs [2.4]	(Future) High-tech leaders' needs for wide expose to work experiences that simultaneously train technical, business and strategic skills can be met by mobility schemes. Technical universities and other vocational and higher as well as executive education and training institutions should develop and implement mobility schemes: • between digital and key enabling technologies ('smart' team composition); • along the KETs/Advanced Manufacturing value chain (integrating research and production in one facility, or innovation managers following an innovation along all TRLs) (AMT); • between KETs/AMTs and application areas (partnering with enterprises from the application domain, or close interaction with end-users); and	Industry	Industry, national governments and universities, European Commission	National initiatives in the leading EU Member States (with an explicit strategic priority for KETs); EU-level mobility scheme for KETs workers	Design of national activities and EU-level mobility scheme for KETs workers; 2-5 years	European universities and university programmes and courses of different type and size to teach high-tech leadership skills.

Strategic Priority	Recommendation	Recommendation / Action	Target groups	Leading (& other) relevant stakeholder groups	Activities requiring dedicated budget	Timeline	Target / Output / Success criteria
		• between academia and industry (creating open eco-systems where industry and academia work together on projects).					
	Build ecosystems [2.5]	Exploit the Digital Innovation Hubs and Competence Centres active in advanced technologies to build ecosystems that create ecosystems in the form of innovation hubs and focal points in EU Member States, fostering local strengths such as telecommunications in the Nordic countries, finance in the UK, education in Finland or automotive in Germany. These should be open to new actors and other regions.	Digital Innovation Hubs and competence centres in European regions.	Regional and national governments in EU Member States; supported through European and national funding programmes.	European Commission activity for raising awareness and motivation in European regions, Best practice award and competition followed by regional activities for implementation.	Regular activities	Regional ecosystems and smart specialisation
	Workforce Credentialing [2.6]	Higher and executive education and training institutions should work with industry associations to develop standards on workforce credentialing alternatives and quality badging formats for ad-hoc and short-term courses. Better balance and understanding are needed on the co-existence of formal certification and other forms of workforce credentialing, such as digital badging and micro-credentials. Creating working models, transparency, consistent standards and visibility to potential employees and employers will help.	Higher and executive education and training institutions, industry associations	Association of Test Publishers	Development of Workforce Credentialing Framework and Standards and linkage into e-CF Development and Rollout of Workforce Credentialing Guidelines and Development Models for above target audiences	2 years	Increase in employability and workplace readiness of graduates
	Embedding technical multi-disciplinarity in	**Higher and executive education and training institutions should increase multi-disciplinarity, training students in various disciplines**	Vocational education students, short-	Educators, national and European	Pan-European projects to design adjustments in the	Development : 2 years Implementati	At least 20% of the schools adopting the

Strategic Priority	Recommendation	Recommendation / Action	Target groups	Leading (& other) relevant stakeholder groups	Activities requiring dedicated budget	Timeline	Target / Output / Success criteria
	the curriculum [2.7]	**simultaneously so that they can work 'at the crossroads' of those disciplines, such as mechatronics.**	cycle tertiary education students, Bachelor students, Master students, PhD students.	policy makers, industry	curriculum for VET (pilot projects) European and national funds for bringing these adjustments to practice Pan-European projects to design adjustments in the curriculum for Bachelor/Master/PhD programmes (pilot projects) European and national funds for bringing these adjustments to practice Development and promotion of pan-European MOOCs training multi-disciplinarity in KETs Development of European Multidisciplinary Master Programmes	on (first pilots): 3 years Gradual adoption on a massive scale: 5 years (after implementing first pilots)	developed changes within 5 years after implementation of the first pilots.
	Embedding non-technical courses in technical curricula [2.8]	Higher and executive education and training institutions should ensure technical curricula include non-technical courses in quality, risk and safety; management and entrepreneurship; communication; innovation-related competences;	Vocational education students, short-cycle tertiary education	Educators, national and European policy makers	• Pan-European project to collect and disseminate existing good practices.	Adoption of good practice examples on a massive scale: 5-10	Fully operational higher and executive cross-functional education and

Strategic Priority	Recommendation	Recommendation / Action	Target groups	Leading (& other) relevant stakeholder groups	Activities requiring dedicated budget	Timeline	Target / Output / Success criteria
		and emotional intelligence skills. Cross-functional initiatives should be promoted and encouraged.	students, Bachelor students, Master students, PhD students		• European and national funds for upscaling these good practices.	years	training programmes embedding non-technical courses in technical courses and programmes throughout Europe
	Updating the skills of teachers/professors [2.9]	Higher and executive education and training institutions should ensure a good alignment of educational programmes with industry needs by having educational personnel visit enterprises to gain insights into the latest developments, while inviting executives and lead professionals from enterprises to regularly teach in the classroom to increase the (practical) relevance of education.	Educational personnel from secondary schools, vocational education, short-cycle tertiary education, Bachelor programmes, Master programmes	Educators, industry, national and European policy makers.	• Pan-European and national teacher exchange schemes. • Pan-European project to provide key educational institutions with state-of-the-art equipment: due to high costs related to acquiring such equipment, it could be placed only in some of the world-class European universities/educational institutions and then shared with educators and students across Europe.	• Design of the pan-European scheme: 2 years • Implementation of the pan-European scheme: onwards (after design)	Fully operational higher and executive as well as vocational and secondary school education and training programmes with educational personnel visit companies to gain insights into the latest developments, while inviting executives and lead professionals from companies to regularly teach in the classroom to increase the (practical) relevance of

Strategic Priority	Recommendation	Recommendation / Action	Target groups	Leading (& other) relevant stakeholder groups	Activities requiring dedicated budget	Timeline	Target / Output / Success criteria
							education throughout Europe
	Build reverse mentoring programmes and instruments	Enterprises should enable executives to be mentored by juniors on technology, social media and current trends, and should promote peer-to-peer learning.	Executives and staff in European companies	European Commission	European Commission project for the collection and presentation of best practices	2-3 years	European best practices repository of reverse mentoring programmes and instruments
Platform-based digital services for career support and recruitment [3]	**Platform-based ecosystem of digital services supporting diagnosis and self-assessment [3.1]**	Support the development of a quality-assured online repository of services supporting diagnosis and self-assessment in recruitment as well as appraisal and career advancement processes. These should take account of individuals' 'development potential' as well as of certificates. An online ecosystem of tools, constantly refined by customer feedback through a one-stop-shop gateway, could help align national systems with Europe-wide initiatives. Participating platforms and tools should use European standards like ESCO and the European e-Competence Framework (e-CF), and be distinguished with the slogan 'e-CF inside' or 'powered by e-CF' as form of branding. Platforms should remain open, in a collaborative spirit like Wikipedia, allowing further development and maintenance through the community, with a light-weight overall 'umbrella' organisation.	Employers and employees throughout Europe and the world	Service providers of digital services supporting diagnosis and self-assessment	Prototype development and feasibility study	2 years	Operational and self-maintained online platform of an ecosystem of digital services supporting diagnosis and self-assessment
Better coordination and funding [4]	**Setting new framework conditions and developing new**	Policy makers need fuller understanding of the high-tech economy and society, so that Europe can boost innovation. Because innovation and disruption often come from creative outsiders	European Commission funding programmes	European Commission and national governments	Impact analysis studies	2 years	Framework conditions and funding programmes in

Strategic Priority	Recommendation	Recommendation / Action	Target groups	Leading (& other) relevant stakeholder groups	Activities requiring dedicated budget	Timeline	Target / Output / Success criteria
	funding schemes supporting digital disruption and industrial modernisation [4.1]	without track record or organisational and financial stability, small short-term funds should be available to help this volatile community to produce mock-ups of concepts and business models that would support applications for venture capital or other funding for further development. The European Social Fund (ESF) offers funding opportunities in many skills-related areas, and those responsible for allocating funding (via Operational Programmes in the Member States) need to develop an understanding of the related issues and present and future requirements if they are to take due account of it in their plans. The Erasmus+ programme to support actions in the fields of Education, Training, Youth and Sport for the period 2014-2020 is providing funding for knowledge and sectoral skills alliances.					Europe better addressing and supporting digital and technological disruption
	Government-driven public procurement of innovation [4.2]	The Commission has been active in bootstrapping the process of public procurement but EU Member States should now become active and intensify activities towards government-driven public procurement of innovation which can actively shape and create markets thereby enabling the state to take an active role in fostering long-run innovation led economic growth and at the same time support innovative start-ups and SMEs. They could selectively support investment enterprises active at the seed capital stage, to create a sustainable economic model, and fund the purchase of breakthrough prototypes via a tender process, such as in the US DARPA model,	European Commission	European Commission and EU national governments	Exploration, demonstration and testing	2 years	Demonstrator schemes operating in a one-year experimentation phase

Strategic Priority	Recommendation	Recommendation / Action	Target groups	Leading (& other) relevant stakeholder groups	Activities requiring dedicated budget	Timeline	Target / Output / Success criteria
		open to all applicants. Here, DoD, NASA and other public bodies are obliged to spend a fixed percentage of their external budget with innovative start-ups and SMEs.					
	Incentivise individuals [4.3]	Financial and fiscal incentives for high-tech leadership skills in Europe should be evaluated and refocused to take account of new innovative and tested approaches to funding individuals to obtain such skills through life-long-learning. Typical examples include for instance training vouchers or ILAs (Individual Learning Accounts). These types of financial training support can be offered to reduce overall cost of the training and provided for individuals and also for SMEs.	European Commission and national EU governments	European Commission and EU Member States	European Commission service contract on 'Financial and fiscal incentives for innovation leadership skills in Europe'	2 years	Updated overview of 'Financial and fiscal incentives for innovation leadership skills in Europe' in all EU Member States.
	European quality level leap joint industry / university innovation leadership skills education and training programme [4.4]	The Commission should initiate and provide co-funding for a European joint training programme of universities and industry and of worldwide recognition for the creation of a larger pool of high-tech and innovation leaders, comparable to other ambitious programmes such as Airbus or CERN. Creating and implementation of such a joint industry / university innovation should build on the experiences of the European Institute of Innovation & Technology (EIT) which was set up in 2008 to spur innovation and entrepreneurship across Europe to overcome some of its greatest challenges.	European Commission, national EU governments, education and training institutions, industry	European Commission and EU Member States with industry and universities	Establishment and operation of a European programme and funding scheme co-funded by the Commission, national government and industry.	2 years	European programme and funding scheme co-funded by the Commission, national government and industry similar to the CERN and Airbus projects in terms of ambition and volume.
National digital and high-tech skills strategies [5]	**Longer-term policy commitment and concrete action plans [5.1]**	The EU should motivate long-term policy commitment by Member States to establish high-tech competence centres in all major regions, to foster smart specialisation, build on existing research and competence-centres and innovation hubs, and to provide well equipped	EU member state governments	European Commission and EU member state governments	To be agreed on between the European Commission and EU Member States	3 years	Longer-term national policy commitment and concrete action plans on high-tech leadership

Strategic Priority	Recommendation	Recommendation / Action	Target groups	Leading (& other) relevant stakeholder groups	Activities requiring dedicated budget	Timeline	Target / Output / Success criteria
		infrastructures for 'high-tech leadership' training and career promotion. Existing industry activities should be integrated and national governments should ideally put a single Ministry in charge of coordinating all activities related to 'innovation leadership skills'. The 'shared concept' for a digital skills strategy presented at the launch of the Digital Skills and Jobs Coalition in December 2016 could provide a good inspiration and initial platform for cooperation.					skills development in EU member states National government restructuring allocating responsibility for 'digital' and 'high-tech leadership skills' in a single ministry
	Invest in national advisory boards for informed policy development [5.2]	The EU should support the establishment of national advisory boards on innovation leadership skills in each Member State to promote informed policy development in liaison with the new Digital Skills and Jobs Coalition. Governments should invite industry and academia who can bring expertise in areas where economy, society and new technologies overlap, such as in cyber security and digital forensics, e-government, digital social innovation or combining hardware and software solutions.	National governments in EU Member States	European Commission and national governments in the EU Member States	To be agreed on between the European Commission and EU member state governments	2 years	Successful installation and operation of an old instrument (advisory boards) for a new topic (high-tech leadership skills) to support policy development in EU member states.
Promotion and awareness raising for leadership skills for the high-tech	**European promotion of multi-stakeholder partnerships and campaigns on leadership skills for the high-tech**	The EU should support awareness raising activities about high-tech leadership skills throughout Europe, at all level of education. Easy-to-understand messages should excite opinion-formers and audiences. Role models (see following recommendation) could reinforce the impact through TED talks, piggy-backing	European Commission, EU member state governments. A large range of further relevant stakeholders	Ditto.	European promotion campaign	3 years	Successful operation of European multi-stakeholder partnerships and promotion campaigns

Strategic Priority	Recommendation	Recommendation / Action	Target groups	Leading (& other) relevant stakeholder groups	Activities requiring dedicated budget	Timeline	Target / Output / Success criteria
economy [6]	**economy [6.1]**	promotion activities on major high-tech related European and national events, and participation on TV shows etc.	(see previous promotion campaigns)				
	High-tech leadership role models & success stories [6.2]	The EU should develop and promote awareness of role models, business cases and success stories of leaders in the high-tech economy as pathways to success and an opportunity also and especially for women. These could be made available online to schools to motivate students from an early age.	European workforce, students, pupils, citizens	European Commission	Development of a Europe-wide repository of high-tech leadership role models and success stories embedded in a European promotion campaign (see above)	3 years	Successful development and promotion of role models and success stories, continuously further developed and maintained role model and success story repository

3.8 Enhancing leadership skills for liberal professions

Rapid technology development, expanding stakeholder expectations, changing regulation and governance, and globalisation all have major implications for the liberal professions, including the required leadership skills. Below we indicate the key directions for action for each of the liberal professions individually, namely accountants, architects, civil engineers, lawyers, notaries and doctors. Due to their highly specific nature, 'one size fits all' approach would not be appropriate here.

Accountants

Existing evidence suggests that the accountancy profession is currently undergoing a fundamental evolutionary change. Besides strong technical, ethical and digital expertise, the new generation accountant must possess an additional set of skills historically not so closely associated with the accountancy professions, namely creativity, strategic vision and emotional intelligence.

Although the leading accountancy firms report to be aware of the changes that digital transformation and other global challenges pose to the accountancy profession, new skills development is reported to be relatively limited. Discussions take place between (international) accountancy boards, industry representatives and educational institutions, but an explicit focus on new skills development has not yet found its way into the majority of the curricula. Moreover, new skills training in the sector is mostly left up to industry.

Two key directions for action refer to the advancements of educational processes for students before they enter the labour market, and on-the-job training.

Specific proposed initiatives for the advancement of educational processes for students before they enter the labour market include the following:

- ***Teaching advanced managerial accounting and controlling***: besides financial accounting, students need to be well familiar with the essence of managerial accounting. Financial accounting implies providing information to shareholders, government agencies, creditors, and other external stakeholders in the form of annual report. Managerial accounting, in contrast, is intended primarily to supply knowledge to decision makers within an organisation, to provide managers with information about the financial position of their organisation, to help them make strategic decisions and maintain effective and real control over company's resources[22].

- ***Teaching advanced digital skills***: recent digital advancements (e.g. blockchain technology) led to the emergence of the new directions in accounting. Students need to be provided with the most up-to-date knowledge related to these developments[23]. Initial pilot educational projects could be supported at the EU level, and need to be developed in close collaboration with the accountancy industry, regulators, software experts and other relevant stakeholder groups.

  At the same time, due to a rapid development of digital technologies, digital training needs to be continued also after graduation.

- ***Embedding creativity in the educational process***: the curricula for future accountants need to incorporate elements that stimulate creative thinking. That implies focus on more qualitative assignments (besides numbers), with increased attention to conceptualisation, interpretation and

[22] Orban I. et al. (2016) "Future challenges of accounting education at the university of Debrecen", SHS Web of Conferences, 26, 01022 (2016), available at: http://www.shs-conferences.org/articles/shsconf/pdf/2016/04/shsconf_erpa2016_01022.pdf

[23] *Ibid*.

understanding of the strategic application of the analysed information. Initial pilot educational projects could be supported at the EU level.

The measures related to on-the-job training include the following:

- ***Offering emotional intelligence training***: Besides regular advancement of technical skills, accountants, and especially the ones that already are leaders or are aspiring to become ones, need to be offered an opportunity to further develop their emotional intelligence. This training could take an online form. An example of a good practice refers to "Search Inside Yourself leadership Institute"[24], an online training project of Google. This training is now available to the public. The development of similar pilot projects in Europe could be supported at the EU level.

- ***Training strategic thinking through experience***: accountants, and especially the ones that already are leaders or are aspiring to become ones, in their work experience, need to be exposed to situations that would stimulate their strategic thinking. That could be done by expanding employee responsibilities, stretching the focus of assignments, and engaging employees in the client assignments in new roles (as strategic advisers)[25].

In addition, industry welcomes a clear mapping of the skills needs for the accountancy profession of the future, including an estimate of demand and supply of these skills over time. Such a mapping would enable policy makers and industry to monitor skills demand and supply in the profession, highlighting the important areas that require action.

Architects

Nowadays, architects are crossing boundaries, taking up new roles and experimenting with new approaches, such as design beyond buildings and green revolution. With expanding expectations of the stakeholders, architects must evolve to stay relevant. It becomes increasingly recognised that the architecture profession does not rely only on technical skills[26], and students also need to understand the development and meaning of architecture in a broader sense, and its place in culture, values and nature. That, in turn, puts central the notions of multi-disciplinarity and integrated design, and has a fundamental impact on the (future) leadership skills.

Specific proposed initiatives for the advancement of leadership skills of the current and future European architects include the following:

- ***Creating online EU platforms for training advanced technical and non-technical skills for architectures*** (e.g. automation, coding, and data mining), offering state-of-the-art online courses (see, for example, the US initiatives of EdX[27] and Udemy[28]) and software. Such a platform, could, for example, contain results from (public) research, a repository of (open-source) tools and relevant applications of digitalisation strategies in architectural companies.

    - Specifically for *integrated design*, a good practice example refers to the IDES-EDU initiative[29] (supported by the Commission through the Intelligent Energy Europe Programme[30]), aimed at

[24] https://siyli.org/

[25] http://www.accountingweb.com/practice/team/accountants-lack-opportunities-to-hone-strategic-thinking-skills

[26] "Recession coming to an end" for British architects", dezeen magazine, 18 November 2013, available at: http://www.dezeen.com/2013/11/18/increase-in-british-architects-workloads-suggests-recession-could-be-coming-to-an-end/

[27] https://www.edx.org/

[28] https://www.udemy.com/

[29] https://ec.europa.eu/energy/intelligent/projects/en/projects/ides-edu

providing training for architects and engineers on integrated multidisciplinary building design. IDES-EDU developed advanced curricula and training programs, promoted exchanges between students and professionals, accelerated the certification and accreditation of the courses at national level, as well as provided a framework for European certification. The project delivered a multimedia teaching portal to make the educational packages available to graduate students and building professionals in Europe[31]. IDES-EDU represents a joint effort of 15 EU educational institutions.

- ***Developing training aiming specifically at leadership skills of the new generation architects:*** such training should focus on the aspects of stakeholder engagement and understanding, multidisciplinary team leadership, complex problem solving, vision and strategic thinking. An example of European good practice refers to RIBA (Royal Institute of British Architects) Future Leaders Programme[32].

- ***Ensuring better alignment of architects' curricula with market needs (e.g. embedding multi-disciplinarity):*** for example, RIBA (Royal Institute of British Architects) collaborates with multiple architects' practices in specific student mentoring schemes at Central St Martins, London South Bank University and the University of Westminster[33]. An EU equivalent of such schemes could be a useful pilot for the wider implementation of such models in the future.

- ***Ensuring large-scale promotion and dissemination of existing tools and materials addressing the (e-) leadership skills needs for architects:*** particular attention needs to be paid to the awareness raising of the results of the EU and national-level initiatives addressing the abovementioned challenges. Each of such initiatives needs to have a clear communication strategy defining target groups, key messages and key communication channels. In addition, an overall overview of relevant initiatives on one platform/portal would also allow for greater awareness of and easier access to the results of specific initiatives.

Civil engineers

Specific recommendations for enhancing leadership skills of civil engineers include the following:

- Taking into account the generational differences, ***an EU-wide initiative on "Generational Learning" could be considered to stimulate knowledge transfer and skills development across the generations***. Pairing up younger professionals with more experienced professionals may teach the younger generation valuable lessons from practice, may facilitate e-skills development of the older generation, and may stimulate innovation in the profession by opening experienced professionals up for new ideas.
- Stimulating the use of innovative tools in public procurement, e.g. by taking into account the benefits of using such tools in the quality criteria.
- Stimulating digitalisation of public administration, allowing civil engineering companies to handle and file all administrative paper work (e.g. permits) digitally.

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30 https://ec.europa.eu/energy/intelligent/

31 http://www.ides-edu.eu/

32 https://www.architecture.com/RIBA/Professionalsupport/Professionalcommunities/FutureLeaders2016.aspx

33 www.bdonline.co.uk/the-future-of-architectural-education-%E2%80%93-can-it-work-in-practice?/5078346.article

Lawyers

Specific recommendations for enhancing leadership skills of lawyers include the following:

- Government-funded programmes are sometimes met with scepticism of industry, especially of the larger firms. To this end, stakeholders suggested focussing attention on the advancement of executive level courses at prestigious universities. It could therefore be explored to what extent such universities can offer short executive programmes and/or courses that train digital awareness and digital transformation at executive level specifically for the legal industry.
- Identifying the level of proficiency of (e-) skills required in the future of the profession and ensuring that law school support the development of knowledge and skills required in an increasingly more digitally oriented legal profession[34].
- Disseminating information on best-practices of firms (e.g. business models, service offerings) who are digitally transforming their legal practice.

Notaries

Specific recommendations for enhancing leadership skills of notaries include the following:

- Identifying the legislative acts at Member State level that prevent or slow down the rate of digitalisation of the profession, and convincing legislators to adopt legislation that allows for further digitalisation.
- Although digital skills were generally considered adequate, awareness of existing e-leadership initiatives could be raised further in the profession, to ensure that they become aware of the training opportunities.

Doctors

Specific recommendations for enhancing leadership skills of doctors include the following:

- Raising awareness of business opportunities that eHealth brings to the medical profession, as well as the benefits it brings for increasing the quality, effectiveness and sustainability of healthcare in Europe.
- Identifying the minimum proficiency of e-skills for both the providers and users of eHealth services separately and ensuring that training is adequately embedded in the curricula to ensure this level of proficiency.
- Continuing collaboration of all relevant stakeholders to map common e-skills on which eHealth services rely, and identify future skills needs on the basis of this common framework[35].

[34] NYSBA, (2011). Report of the Task Force on the Future of the Legal Profession. New York State Bar Association, Task Force on the Future of the Legal Profession.

[35] *De Raeve, P. (2014). eHealth Stakeholder Group Report. Report for the e-Skills and Health Workforce, final version, 10 November 2014.*

4 Annexes

4.1 Annex 1: Experimental Scoreboard and Index 2015 and 2016: data sources

Indicator	Definition and scope	Latest data available	Source
e-leadership skilling			
Number of Master's or Exec Ed level programmes with a mix of ICT and business	**Definition**: combination programmes that have as target group specialist or junior / middle management are professional-oriented and have a mix of business and IT. Either at regular consecutive MSc level, or are aimed at specialist subjects only (e.g. new media, marketing, logistics, communications, e-health etc. **Measure:** per 100,000 population aged 20-59	2013	empirica
E-leadership candidate programmes	**Definition**: E-leadership candidate programmes - programmes that are clearly aimed at experienced professionals with leadership roles, which usually already expect a high level of IT skills and significant business experience. **Measure**: per 100,000 of workforce with potential e-leadership skills	2014	empirica
Enterprises that provided training to ICT/IT specialists to develop/upgrade their ICT skills	**Definition**: Enterprises who provided training to develop/upgrade ICT skills of their personnel: for ICT/IT specialists (NACE Rev. 2). **Measure:** % of enterprises	2015	Eurostat Information society statistics Code: isoc_ske_ittn2
Quality of management schools	**Definition**: In your country, how would you assess the quality of business schools **Measure**: [1 = extremely poor—among the worst in the world; 7 = excellent—among the 2012–13 weighted average	2016	World Economic Forum, Executive Opinion Survey
e-leadership skilled professionals			
Line managers	**Definition**: ISCO-08 (1211, 1213,1219, 1221, 1222, 1223) **Measure**: as % of total workforce	2015	LFS

Indicator	Definition and scope	Latest data available	Source
ICT managers, architects and analysts	**Definition**: ISCO-08 (1330, 2421, 2511) **Measure**: as % of total workforce	2015	LFS
e-leadership pipeline			
e-Leadership pipeline 1:ICT practitioners - professional level	**Definition**:ISCO-08 (2152, 2153, 5356, 2434, 5212, 2513, 2514, 2519, 2512, 2522, 2523, 2529) **Measure**: as % of total workforce	2015	LFS
e-Leadership pipeline 2-1: ICT graduates	**Definition**: Count of first degrees in ISCED 5A and first qualifications in 5B. The number of students entering the labour force in a given year does not equal but is approximated by this number of graduates, as many will go on to second or further degrees (master, PhD). **Measure**: per 1,000 population aged 20-24	2014	Eurostat Code: [educ_grad5]
e-Leadership pipeline 2-2: Business administration graduates	**Definition**: Count of first degrees in ISCED 5A and first qualifications in 5B in business and administration. **Measure**: per 1000 population aged 20-24	2014	Eurostat Code: [educ_grad5]
Business environment			
High growth enterprises n ICT sector	**Definition**: High growth enterprises (growth by 10% or more) and related employment by NACE Rev. 2 sectors: Information and communication (J). **Measure**: Number of high growth enterprises measured in employment (growth by 10% or more)	2014	Eurostat Code: [bd_9pm_r2]
High growth enterprises in ICT intensive sectors	**Definition**: High growth enterprises (growth by 10% or more) and related employment by NACE Rev. 2 sectors: Manufacture of computer, electronic and optical products (C26), Manufacture of electrical equipment (C27), Manufacture of machinery and equipment n.e.c. (C28), Manufacture of motor vehicles, trailers and semi-trailers (C29), Manufacture of other transport equipment (C30), Professional, scientific and technical activities (M). **Measure**: Number of high growth enterprises measured in employment	2014	Eurostat Code: [bd_9pm_r2]

Indicator	Definition and scope	Latest data available	Source
	(growth by 10% or more)		
Employment in ICT sector4	**Definition**: Number of persons employed in the following NACE Rev. 2 sectors: Manufacture of computer, electronic and optical products (C26), Information and communication (J). **Measure**: as % of total employment	2013	Eurostat
Employment in ICT intensive sectors	**Definition**: Number of persons employed in the following NACE Rev. 2 sectors: Manufacture of electrical equipment (C27), Manufacture of machinery and equipment n.e.c. (C28), Manufacture of motor vehicles, trailers and semi-trailers (C29), Manufacture of other transport equipment (C30), Professional, scientific and technical activities (M). **Measure**: as % of total employment	2013	Eurostat
Enterprises that employed ICT/IT specialists	**Definition:** Enterprises that employed ICT/IT specialists (NACE Rev. 2) **Measure**: % of enterprises	2015	Eurostat Code: [isoc_ske_itspen2]
Innovation opportunities			
State of cluster development	**Definition**: In your country, how widespread are well-developed and deep clusters (geographic concentrations of firms, suppliers, producers of related specialized institutions in a particular field)? **Measure**: [1 = nonexistent; 7 = widespread in many fields] | 2012–13 weighted average	2014	World Economic Forum, Executive Opinion Survey
Capacity for innovation	**Definition**: In your country, to what extent do companies have the capacity to innovate? **Measure:** [1 = not at all; 7 = to a great extent] |	2014	World Economic Forum, Executive Opinion Survey
Firm-level technology absorption	**Definition:** In your country, to what extent do businesses adopt new technology? **Measure:** [1 = not at all; 7 = adopt extensively] | 2012–13 weighted average	2014	World Economic Forum, Executive Opinion Survey
Impact of ICT on new services and products	**Definition**: In your country, to what extent do ICTs enable new business models? **Measure:** [1 = not at all; 7 = to a great extent] | 2013–2014 weighted	2014	World Economic Forum, Executive Opinion Survey

Indicator	Definition and scope	Latest data available	Source
	average		
Technology trends			
Availability of latest technologies	**Definition**: In your country, to what extent are the latest technologies available? **Measure**: [1 = not available at all; 7 = widely available] | 2012–13 weighted average Availability of latest technologies	2014	World Economic Forum, Executive Opinion Survey
Enterprises using social networks	**Definition**: Use social networks (e.g. Facebook, LinkedIn, Xing, Viadeo, Yammer, etc.) **Measure**: % of enterprises	2015	Eurostat Code: [isoc_cismt]
Enterprises using RFID technologies	**Definition:** Enterprises using Radio Frequency Identification (RFID) technologies **Measure**: % of enterprises	2014	Eurostat Code: [isoc_ci_cd_en2]
National policy and stakeholder initiatives			
ICT Practitioner Skills	**Definition**: Level of national policy and stakeholder activity on ICT Practitioner Skills **Measure:** 1 - 5 (1 = "No relevant policy or stake-holder activities of significant scope and size have been identified."; 5 = "A master strategy is in place.)	2013	empirica
e-Leadership education and training	**Definition**: Level of national policy and stakeholder activity on e-Leadership education and training **Measure:** 1 - 5 (1 = "No relevant policy or stake-holder activities of significant scope and size have been identified."; 5 = "A master strategy is in place.)	2014	empirica
Skills for digital entrepreneurship	**Definition**: Level of national policy and stakeholder activity on Skills for digital entrepreneurship **Measure:** 1 - 5 (1 = "No relevant policy or stake-holder activities of significant scope and size have been identified."; 5 = "A master strategy is in place.)	2014	empirica

4.2 Annex 2: Experimental Scoreboard and Index 2015 and 2016: methodology

A country's e-leadership performance is attempted to be captured into a scoreboard and into a composite indicator (e-leadership index). A number of challenges related to the quality of the data selected and to their combination into a single indicator arise.

4.2.1 Challenges and steps taken

A number of steps were taken to assure the quality of the data and the reliability of the e-leadership index. The challenges and steps followed are explained in more details below:

Step 1: Identifying and addressing outliers

Mean and standard deviations have been calculated for all indicators among all countries included in the scoreboard. Outliers have been identified as the absolute z-values larger than 3. Relative to the case, the values distorting the variable distribution (positive/negative outliers) have been replaced by maximum/minimum values observed in each single indicator. Beforehand, some indicators have been standardized using population data in order to avoid any country-size effects in the dataset sample.

Step 2: Setting reference year

A reference year is set depending on the data availability of each indicator for each of the countries considered. Overall, for most of the indicators the reference year is lagging 1-3 years behind the timing the e-leadership scoreboard refers to. In this case, the reference year for most of the indicators of the 2014 e-leadership scoreboard will be lying between years 2011 to 2013.

Step 3: Treatment of missing data

When dealing with the missing values, we distinguish among two different cases which influence data imputation procedure:

- Missing at random: If data is not available for a year-in-between, we replace data using the value for the previous year / latest year available.
- Missing completely: For countries which data is completely missing for the entire time series, no imputation effort is carried out. In these cases the indicator is left empty, marked as not available (N/A), and not considered in the calculation of the county scores.

Step 4: Calculating re-scaled scores

Min-max normalisation method was adopted to adjust for differences in terms of units of measurement and ranges of variation. All variables have been normalised into the [0-10] range, with higher scores representing better performance for the indicators.

The following normalisation formula has been applied:

$$X_{i,0\ to\ 10} = 10 \times \frac{(X_i - X_{Min})}{(X_{Max} - X_{Min})}$$

Where:

X_i = country score

X_{Min} = sample minimum

X_{Max} = sample maximum

$X_{i,\ 0\ to\ 10}$ = the data point i normalized between 0 and 10

For comparability between years, the min and max of the most recent year have been applied backwards. The result of this is naturally that index values published in a previous year (t) based on the min max in that year (t) cannot be compared to the index values of that year (t) but published one year later (t+1) for comparison with t+1.

Step 5: Calculating the composite e-leadership index - methodology

The stepwise process followed towards developing e-leadership index is detailed below:

S1: Selection of indicators – Conceptual consistency

As also mentioned above, candidate indicators were selected for their relevance to a specific dimension / building block and on the basis of the literature review, expert opinions, country coverage, timelines, etc. To avoid country-size effects as well as to represent a fair picture of country differences, some indicators (as appropriate) were standardised using population data.

S2: Treatment of indicators and data checks

The quality and accuracy of a composite indicator as well as the reliability of the messages it aims at delivering depends not only on the methodology its composition builds upon but primarily on the quality of the framework and the data used.[36] The previous section summarizes the selection criteria considered to identify candidate indicators. Proxy indicators have been utilised in cases when desired data have not been available. Considerations have also been given to the data quality assessment for the selected variables as well as to the treatment of outliers, approaches used for the imputation of missing data, normalisation method used, and so on.

S3: Statistical coherence

A principal component analysis has been conducted to validate the extent to which the statistical approach confirms the conceptual framework. From the analysis it came out that none of the selected variables should be excluded. Overall, the selected principal components explain almost 80% of the total variance.

S4: Calculating composite scores

Prior to calculating a composite index, one may decide on calculating an un-weighted average of the variables included or assigning different weights to their scores. Lacking clear theoretical guidelines in assigning weights to the individual elements, we outline four different weighting scenarios assessing differences among achieved results.

4.2.2 Assessing different weighting approaches

The e-Leadership composite indicator has been obtained from a weighted aggregation of 24 indicators used for assessing e-leadership environment among Member States. Several weighting methods were tested, such as:

Equally weighted indicators

This weighting approach considers each indicator of the e-leadership scoreboard to equally contribute to the index score, hence each of them being equally weighted.

Equally weighted building blocks

Here, we assign equal weights to each of the building blocks by equally distributing weights to each individual indicator in the building block, based on:

- The number of indicators available in each building block
- Data availability for each indicator individually and for each country

[36] Handbook on constructing composite indicators: methodology and user guide – ISBN 978-92-64-04345-9 - © OECD 2008

Equally weighted dimensions

The approach of equally weighted dimensions distributes equal weights to each of the four dimensions of the scoreboard. A sensitivity analysis showed that some differences appear, yet no fundamental change of results.

Approach chosen: Weighted building blocks

Based on the overall results, each of the Member States falls into one of the following four groups:

- Countries with an overall performance score of 120% or more of the EU average fall into 'Group 4' group.
- 'Group 3' countries have a score of between 120% and 100% of EU average.
- Countries in 'Group 2' have a score between 80% and 100% of the EU average.
- 'Group 4' includes countries with scores below 80% of the EU average.

The following approach is the one chosen after discussions at workshops and as the result of e-mail consultation with all workshop participants after workshop 3.

This approach distributes different weights to each of the building blocks, based on the results obtained from a regression analysis which assesses relationships between each building block (independent variable) and estimated number of e-leaders for each 28 Member States (dependent variable). The rationale behind this analysis is to explore whether the overall strength of indicators in a building blocks is positively linked to the presence of e-Leaders. Results from each performed regression analysis are shown below:

Building block	R(sqr)	Weight
Education and training	0.537165	12%
e-leadership skilled professionals	0.852037	18%
e-leadership pipeline	0.819715	18%
Business environment	0.819048	18%
Innovation opportunities	0.692116	15%
Technology trends	0.546241	12%
National policy and stakeholder initiatives	0.363288	8%

4.2.3 Data

	e-leadership skilling				e-leadership skilled professionals		e-leadership pipeline			Business environment					Innovation opportunities				Technology trends			National policy & stakeholder initiatives		
	level programmes with a mix of ICT and business per 100,000	E-leadership candidate programmes per 100,000 of workforce	Enterprises that provided training to ICT/IT specialists	Quality of management schools	Line managers (as % of total workforce)	ICT managers, architects and analysts (as % of total workforce)	ICT practitioners - professional level (as % of total workforce)	ICT graduates (per 1000 population aged 20-24)	Business administration graduates (per 1000 population aged 20-24)	% share of ICT sector High growth enterprises	% share of High ICT intensity sectors High growth enterprises	Employment in ICT sector (as % of total employment)	Employment in ICT intensive sectors (as % of total employment)	Percentage of enterprises that employed ICT/IT specialists	State of cluster development	Capacity for innovation	Firm-level technology absorption	Impact of ICT on new services and products	% of enterprises using social networks	% of enterprises using RFID technologies	Availability of latest technologies	ICT Practitioner Skills	e-Leadership education and training	Skills for digital entrepreneurship
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
AT	1.4	0%	33%	4.88	1.76%	0.82%	2.06%	4.61	22.08	4.6%	16.0%	2.9%	16.9%	24%	4.9	5.4	5.7	4.9	39%	18%	6.1	3.5	1.5	2.5
BE	0.3	163%	32%	6.05	2.19%	1.54%	2.33%	1.83	13.02	6.2%	13.1%	3.9%	15.4%	28%	4.7	5.3	5.6	5	42%	17%	6.2	4	3	3
BG	0.2	0%	8%	3.56	1.05%	0.57%	1.34%	2.65	23.86	4.9%	8.2%	3.4%	10.4%	20%	3.0	3.8	4.4	3.9	30%	17%	4.6	2.5	2.5	3
CY	0.2	0%	23%	4.75	0.83%	0.33%	1.04%	2.83	20.06	1.4%	17.1%	3.3%	11.7%	26%	4.0	3.7	5.1	4.3	56%	8%	5.2	2	1	2
CZ	0.5	0%	22%	4.29	1.53%	0.39%	1.52%	4.14	21.20	4.6%	15.6%	2.7%	20.7%	19%	4.1	4.8	5.0	4.3	23%	6%	5.6	1.5	1	1.5
DE	0.4	9%	30%	5.21	1.17%	1.04%	1.92%	3.17	16.00	6.6%	19.9%	3.0%	21.0%	21%	5.5	5.6	5.7	5.3	33%	14%	6.2	4	2.5	2.5
DK	0.9	0%	29%	5.35	0.62%	1.04%	2.49%	5.35	33.69	7.7%	17.6%	5.3%	19.1%	24%	4.3	5.3	5.7	4.9	53%	11%	6.0	4	3.5	2.5
EE	0.5	0%	14%	4.74	2.27%	1.30%	2.47%	4.33	16.03	4.4%	9.8%	3.7%	13.2%	15%	3.7	4.7	5.4	5.5	31%	8%	5.8	3.5	2	3
ES	0.2	96%	22%	5.75	0.90%	0.44%	1.08%	5.93	19.45	4.1%	13.6%	2.8%	13.5%	25%	4.0	4.1	4.9	5.1	38%	11%	5.5	2	3	2.5
FI	0.4	0%	37%	5.44	1.06%	2.01%	4.40%	3.38	17.87	7.9%	15.4%	4.1%	17.8%	25%	5.1	5.6	5.8	5.8	47%	21%	6.6	2.5	2.5	4
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*

	e-leadership skilling				e-leadership skilled professionals		e-leadership pipeline			Business environment					Innovation opportunities				Technology trends			National policy & stakeholder initiatives		
FR	0.3	12%	21%	5.54	2.01%	0.71%	1.74%	3.06	35.28	5.7%	18.2%	3.7%	16.4%	16%	4.3	5.1	5.5	5.2	28%	7%	6.0	4	2	2
GR	0.1	170%	15%	3.92	0.33%	0.25%	0.67%	3.80	14.91	:	:	1.8%	12.7%	26%	3.0	3.5	4.5	3.5	33%	4%	5.0	1.5	1.5	1.5
HR	:	0%	25%	4.02	0.70%	0.40%	1.00%	2.79	21.84	3.7%	13.7%	2.5%	14.1%	22%	3.2	3.3	4.6	4.5	33%	12%	5.0	:	2	3
HU	0.3	80%	16%	4.07	0.97%	0.26%	2.03%	2.77	23.58	3.5%	14.5%	3.6%	19.6%	26%	3.5	3.1	4.7	4.5	27%	7%	5.1	2.5	1	2
IE	1.6	230%	30%	5.41	2.57%	0.70%	2.41%	8.05	29.96	7.0%	14.2%	3.7%	13.4%	30%	4.8	5.2	5.6	5.4	62%	6%	6.1	4.5	4.5	4
IT	0.2	39%	12%	5.11	0.15%	0.39%	0.89%	0.79	8.76	4.8%	13.5%	3.1%	16.0%	17%	5.6	4.5	4.2	3.8	35%	11%	5.1	2.5	3.5	2
LT	0.9	0%	11%	4.36	2.58%	0.50%	1.22%	2.48	29.67	2.8%	7.8%	2.4%	9.4%	15%	3.5	4.6	5.4	5	36%	11%	5.8	2	2	2
LU	1.0	0%	25%	4.86	0.68%	2.14%	3.34%	0.71	6.91	7.1%	15.7%	5.7%	15.6%	25%	4.9	5.4	6.0	5.6	37%	15%	6.2	2.5	2	2.5
LV	0.4	0%	12%	4.55	2.49%	0.97%	1.11%	3.91	23.84	3.3%	6.8%	3.4%	10.0%	19%	3.5	4.0	5.0	4.4	25%	8%	5.8	2.5	1	1.5
MT	0.4	0%	25%	4.70	2.11%	0.76%	1.62%	11.04	13.83	8.2%	15.6%	2.4%	11.3%	26%	4.0	3.9	5.2	5.1	71%	15%	5.4	4	3	4
NL	0.4	127%	18%	5.70	1.36%	2.19%	3.44%	3.61	18.66	8.0%	17.6%	3.9%	16.6%	28%	5.3	5.2	5.6	5.5	61%	12%	6.3	4	3	2.5
PL	0.4	52%	12%	4.06	1.38%	0.47%	1.60%	4.62	33.84	3.0%	11.4%	2.7%	13.8%	12%	3.5	3.9	4.2	3.9	20%	6%	4.6	3	2	2
PT	0.4	123%	22%	5.19	0.69%	0.47%	1.54%	1.13	13.07	4.1%	10.4%	2.3%	11.4%	20%	4.2	4.5	5.6	5.1	37%	14%	6.1	1.5	2	1.5
RO	0.5	0%	5%	3.86	0.23%	0.31%	1.13%	1.22	13.52	5.6%	11.5%	2.9%	14.0%	13%	3.8	4.0	4.4	3.9	23%	8%	4.6	1.5	1	1.5
SE	0.6	0%	26%	5.36	1.65%	1.96%	3.39%	2.88	9.80	7.0%	17.0%	5.0%	19.6%	19%	4.7	5.7	6.0	5.7	51%	9%	6.5	4	2.5	2
SI	0.9	0%	28%	4.50	1.96%	0.70%	2.13%	5.34	22.26	4.7%	16.9%	3.2%	19.3%	20%	3.4	4.4	4.9	4.4	41%	13%	5.5	1.5	1	1.5
SK	0.2	0%	19%	3.83	0.81%	0.20%	1.30%	2.85	14.99	3.7%	14.9%	3.1%	19.2%	19%	3.8	3.8	4.8	4.2	29%	12%	5.5	1.5	2.5	2.5
UK	0.5	23%	27%	5.93	2.12%	1.33%	3.46%	4.50	15.21	6%	18%	4.6%	17.4%	22%	5.2	5.4	5.7	5.6	52%	6%	6.5	5	4	4

4.3 Annex 3: High-tech leadership skills best practice descriptions

Entrepreneurship Centre Network (ECN) [AT-01SCA]			
Country	Austria	***Scope***	National
Target	Austria	***Duration***	April 2013 – ongoing
e-leadership aspects addressed	• Strategic leadership • Business savviness • Digital savviness	***Main driver / initiator***	University
Managing organisation	Entrepreneurship Centre Network (ECN)		
Main focus / objective	Education, training & networking		
Target group	• Students • Universities • Young Entrepreneurs		
Short description	ECN is a collaborative platform for promotion of entrepreneurship in the university sector, initiated by the Institute for Entrepreneurship & Innovation of the Vienna University of Economics and Business and set up jointly by six Viennese universities. It is supported by Vienna Business Agency (start-up initiative of the City of Vienna), the Austrian Research Promotion Agency (FFG) the Austrian Economic Chambers (WKO), Tecnet (Early Stage Fund), and Festo (a major German manufacturer of factory and process automation). Its main goal is to boost start-up activity at universities in the region, with a strong focus on equipping entrepreneurs with the skills needed for successful practice. ECN runs the ”Entrepreneurship Avenue”, a unique event series designed to inspire, encourage and support young people to start their own business; provides online resources like the “ECN Founders TV” or "Entrepreneurial Skills Check" and access to online tools for entrepreneurs such as start-up apps, databases of financial support schemes, business plan software etc.; and of course access to entrepreneurship education programmes at universities in Austria: • Entrepreneurship Avenue, a unique event series “designed to inspire, encourage and support young people to start their own business”. In the course of four workshops and a final conference day, participants can gain insights into entrepreneurial life from various start-ups and can experience first-hand what working on a business idea is like. Participants can attend the entire event series or register for the conference individually. Participation is free. In spring 2016, more than 1,500 students from 50 different universities joined this year’s program. • An online "Entrepreneurial Skills Check", a self-evaluation survey that gives feedback on the roles a person is capable to take in a start-up as well as the additional competences required. The Skills Check is structured into 8 areas of relevance to entrepreneurship. Taking the survey lasts about 20 minutes. The result is not an overall fitness score or such, but a personal entrepreneurial profile. • “Werkstatt”, i.e. links to tools for entrepreneurs such as start-up apps, databases of financial support schemes, business plan software etc.; • “Founders TV”, i.e. multimedia content such as video presentations of successful entrepreneurs; the videos are produced by students; • Access to entrepreneurship courses, i.e. relevant education programmes at universities in Vienna.		
Synergies with e-Leadership	The initiative focuses mainly on awareness building, cross-disciplinary networking and team building, and the development of entrepreneurship skills through a series of events designed to inspire, encourage and support young people to join the startup scene. However, digital awareness is not explicitly targeted. Moreover, the initiative is not targeted at executive and management level, focusing mainly on promotion of		

Entrepreneurship Centre Network (ECN) [AT-01SCA]			
	entrepreneurship at the university level.		
Impact	ECN's main mission is raising awareness of the career path "starting your own business" and the importance of interdisciplinary collaboration among students. Thus, the number of participants in our events and programs is the most important performance indicator. Since the foundation of the ECN in April 2013, approx. 5,000 students have joined our events. That's almost 3% of the total student population in Vienna. ECN facilitated the setup of approx. 150 student start-up projects over the past three years. Approx. 20-25%% of the teams actually started a company. A quarter of those got successfully admitted to acceleration/incubation programs and/or received private seed financing. On the average, there have been approx. 5 innovative growth oriented start-ups a year that can be regarded highly successful.		
Scalability and transferability	Given the track record of ECN's flagship program, "Entrepreneurship Avenue", where the number of attendees, mentors and speakers increased threefold from 2014-2016, and mounting requests from international partners from Europe and overseas (e.g. Canada, New Zealand) we trust that our initiatives do have the potential to scale-up and can be successfully applied in other regions as well. We are currently in the process of inviting all other Austrian universities in joining the ECN.		
Innovativeness	1) Inter-disciplinary/cross-university approach 2) Focus on very early stage support (awareness) 3) Low-barrier entry/extra-curricular, open programs		
Contact person	Rudolf Dömötör	**Web link**	www.ecn.ac.at

IMEC INTERNATIONAL – merger of imec and iMinds created a world-leading high-tech research centre driving the digital economy, Belgium [BE-01SCA]			
Country	Belgium	**Scope**	National / Regional
Target	Belgium	**Duration**	2016 – ongoing (in the revised format: IMEC International)
e-leadership aspects addressed	• Digital savviness • Business savviness • Strategic leadership	**Main driver / initiator**	Universities, Industry, Government
Managing organisation	iMinds (now merged with IMEC to IMEC International)		
Main focus / objective	iMinds: Training/Coaching/Research - Digital research and entrepreneurship IMEC: performs world-leading research in nanoelectronics and delivers industry-relevant technology solutions		
Target group	Tech entrepreneurs / Academic researchers / Industry executive/managers / Product developers / Investors /Policymakers		
Short description	In late 2016 the nano-electronics research centre IMEC and the digital research and incubation centre iMinds merged into a high-tech R&D hub. Using the IMEC International name, the combined entity is now creating a world-class, high-tech research centre for the digital economy combining longstanding leadership in microchip technology with in-depth expertise in software and IT. IMEC performs world-leading research in nanoelectronics and delivers industry-relevant technology solutions. Imec is headquartered in Leuven, Belgium, and has offices in Belgium, the Netherlands, Taiwan, USA, China, India and Japan with about		

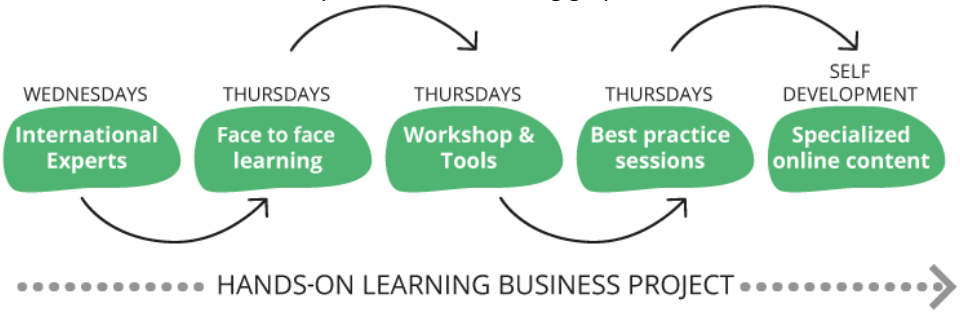
IMEC INTERNATIONAL – merger of imec and iMinds created a world-leading high-tech research centre driving the digital economy, Belgium *[BE-01SCA]*	
	2,500 researchers including almost 800 industrial residents and guest researchers. IMEC has been a global leader in the domain of nanoelectronics for more than 30 years, and has innovated applications in smart systems for the Internet of Things (IoT), Internet of Health, and Internet of Power. It has built an extensive and worldwide partner network, as well as in Flanders, and has generated successful spin-offs. iMinds' activities span research domains such as the IoT, digital privacy and security, and the conversion of raw data into knowledge. Its software expertise is widely renowned and its entrepreneurship activities in Flanders are first-rate. iMinds used to be the Flanders' digital research and entrepreneurship centre with some 1,000 researchers at five Flemish universities conducting strategic and applied research in areas such as Media, Health, Smart Cities and Manufacturing. Together with its research partners – enterprises, governments and non-profit organisations – iMinds translates digital know-how into concrete products and services. In addition, iMinds supports researchers and (start-up) entrepreneurs in the successful market introduction of their ideas. Previously iMinds was an independent research institute aimed to "inspire, train and coach the next generation of ICT entrepreneurs". They offer Training/Coaching, Acceleration and Incubation for everyone with entrepreneurial ambitions in the field of ICT. In 2004, iMinds was founded by the Flemish Government as a demand-driven and independent research institute to stimulate ICT innovation, with particular emphasis on entrepreneurs. In this perspective, iMinds brought together companies, authorities, and non-profit organizations to join forces on research projects. iMinds started supporting interdisciplinary research for innovative ICT services and applications within five application domains: Culture & Media, Healthy Society, Green ICT, Sustainable Mobility and Social & Secure ICT. In 2011, supported by an active ecosystem of entrepreneurs, financial organisations, industrial partners and research departments in the region, the Institute also started to focus more on entrepreneurship in general by offering programmes to inspire, train and coach the next generation of ICT entrepreneurs in Flanders (for example via its 'Entrepreneurship and Valorisation' program). Some of the activities in this area include programmes designed specifically for student entrepreneurs, workshops on "Opportunity Recognition" and boot camps for training and coaching. Next to this, iMinds also focuses on incubation, acceleration and internationalisation. iMinds targets its research and entrepreneurship activities on markets that face important challenges and have great innovation potential such as: ICT, Media, Health, Smart Cities and Manufacturing. iMinds collaborates with research partners to convert digital knowhow into real-life products and services that change people's lives for the better. Their key asset is their agile, open research mind set and proven methodology. As a business incubator, iMinds also guides researchers, young entrepreneurs and start-ups in the successful market introduction of their ideas.
Synergies with e-Leadership	This initiative is an ideal example of an e-leadership skills development initiative in which people are trained and coached to turn their innovative ideas into successful businesses. A series of courses is offered to its research community and IT professionals covering all aspects of e-leadership, such as: tailor-made program for the research community to strengthen their skills and competences in setting up and executing cooperative research projects; blended courses created by renowned industry experts and academics for the IT professional to help them stay up-to-date with the latest trends, tools and techniques in the field of IoT; training in leadership

IMEC INTERNATIONAL – merger of imec and iMinds created a world-leading high-tech research centre driving the digital economy, Belgium *[BE-01SCA]*			
	for experienced digital researchers; professional trainings in development of personal skills; etc. iMinds offers coaching and support through every step of the way towards exciting new high-tech ICT companies for Flanders and beyond. The main goal is to inject digital innovation in (new) companies, or translate these innovations into products and services that improve and enrich the lives of people, young and old.		
Impact	The impact on e-leadership skills development is considered **high**, as the scope and focus of the iMinds is to bring together universities with industry and SMEs in cooperative research projects to turn digital know-how into future-proof products and services. With its incubation programs: with more than 300 full-time jobs created and a total turnover of over 16 million euro, the iMinds start-ups make for a vibrant community. iMinds Digital Innovation Fosters Economic Growth through its: 380+ local and European research projects; 75+ start-up projects originating from the iMinds business incubation program; and 1100+ research partners (commercial and social-profit organizations, governments)		
Scalability and transferability	• Scalability is considered to be **high** as the initiative has a high potential of attracting more and more actors and achieving bigger coverage. iMinds helps tech entrepreneurs start and grow their digital businesses in local and global markets. • Scalability is considered to be high in case both research and industry and finance (VC) networks can be activated in EU and non-EU context (e.g. ENOLL – European network of Living Labs, EIT Digital Schools, …) • Transferability is considered to be **high**. The model could be transferable to other regions in the world provided if similar types of funding and incentive structures are available (universities, funding agencies, industry commitment, …) • Transferability is considered to be high in case Open Innovation (e.g. < IPR) and inter-disciplinarity are part of the ecosystems' culture and values		
Innovativeness	Innovativeness can be considered as **high**. Through its various programmes it covers different disciplines and offers development opportunities for experienced researchers, IT professionals and tech entrepreneurs putting a strong focus on digital innovation. The iMinds Living Labs offers researchers and entrepreneurs the chance to test and co-develop their innovative solutions thoroughly with their target audience. Products, services and business models are developed, tested and validated by panels of test users to ensure products and services are better and have every chance of success on the market. The incubation and entrepreneurship programs connect (future) entrepreneurs and researchers, enabling them to join forces and achieve stronger market potential with their ventures. For instance, iMinds' iStart business incubation programme is considered to be very successful in helping entrepreneurs successfully launch their business. It supports tech start-ups with pre-seed funding, expert coaching and counselling from experienced entrepreneurs, workshops, and access to iMinds' network and co-working spaces. After the end of the programme, iMinds helps the start-up company to acquire follow-up funding by third-party investors in Belgium and internationally.		
Contact person	Hans de Canck	***Web link***	http://www.iminds.be/

Start-up Estonia [EE-01LEA]			
Country	Estonia	**Scope**	National
Target	Estonia	**Duration**	2011 - ongoing
e-leadership aspects addressed	Mainly digital savviness and digital entrepreneurship	**Main driver / initiator**	Government
Managing organisation	Estonian Development Fund / KredEx Foundation		
Main focus / objective	Support the emergence and development of start-up companies through different training activities		
Target group	• Entrepreneur • Startup employees		
Short description	The Estonian government initiated Start-up Estonia in late 2011, a programme for the promotion of business start-ups in high-growth areas with a strong role of ICT. Start-up Estonia is an initiative to support start-ups in digital entrepreneurship by helping local students and researchers to develop business incentive in the area of ICT. Start-up Estonia brings mentors from around the world in order to share their knowledge with local entrepreneurs, organises workshops, open lectures and networking events to help collaboration and mutually beneficial information sharing. As part of the initiative, study trips to Silicon Valley and an annual international start-up conference Latitude59 are supported. The programme is managed by the Estonian Development Fund since 2014, when it took over from Enterprise Estonia. From Q3 2016, the programme will be managed by Foundation KredEx. The program focuses on the development of technology based start-up entrepreneurship in the smart specialisation areas. Startup Estonia divides its activities into 4 categories: • Developing the Estonian start-up ecosystem – uniting and building the community through different events and activities, creating and executing unified marketing and branding strategies; • Working on educating the start-up founders and employees in areas they currently lack certain knowledge of that keeps them from achieving their (international) business goals; cooperating with higher education institutions to bring quality entrepreneurial education to a wider audience; and developing niche start-up areas in Estonia, such as clean-tech, health-tech and cyber-tech; • Working on educating the local investors to help them invest more and smarter, as well as attracting foreign investors to Estonia; • Working on eliminating regulative issues and barriers that are complicating the process of operating a start-up, investing or raising funding in Estonia. Startup Estonia's program is financed from the European Regional Development Fund with 7 million euros.		
Synergies with e-Leadership	In the new funding programming period (2014-2020) the activities of Start-up Estonia are directly linked to the development of e-leadership skills and digital entrepreneurship through various initiatives which fall into two main groups: training programs contributing to building strong teams and launch new startup companies; activities concentrating at helping startups grow and attain readiness to attract investments to finance them. All initiatives follow a particular order – initial team – team development with product and client development – business conception – investment readiness. During the period 2014-2015 various programmes have been piloted focussing on individuals, early teams and students to test their performance, structure, partners, and cooperation as well as helping start-ups with initial investment get to the next financing round.		

Start-up Estonia [EE-01LEA]			
Impact	The expected impact of the 2014-2020 programme is offering training to 1000 existing or aspiring start-up entrepreneurs. Of this, roughly 1/5 or 200 is achieved to date. Other expected results include the proven ability of 5 impacted start-ups to raise capital internationally. Practical results include impact on changes in the Alien Act. Feedback from start-ups has helped to carve regulations on start-up visas and living permits, which will be effective from Q4 this year.		
Scalability and transferability	• In terms of scalability, Start-up Estonia seems to have reached what can be expected from an initiative of this type • Transferability is considered to be rather high. The Start-up Estonia model is highly transferable to different contexts and regions.		
Innovativeness	Since 2014, the initiative has been tightly knit with funding organisations (as opposed to 'regular' and 'soft' entrepreneurship support organisations): Estonian Development Fund has run investments via SmartCap and Foundation KredEx is the national organization for offering loans, guarantees and fund-of-fund initiatives to projects with high growth and export potential. Startup Estonia acts as a facilitator of deal flow for these financing opportunities. This reflects the difference between startups and more traditional SMEs – growth-orientation comes along with a need for capital, due to which startups initiatives should be developed along with the (risk) capital market. Also, the initiative is aimed at developing the ability of other market players (e.g. financing the emergence of new accelerators) to offer startup training, instead of offering direct support (grants) to startups. Hopefully the need for Startup Estonia will become obsolete by 2020 and the market will itself create the deal flow and startup projects. What is more, we are also tackling key regulative issues that have been raised by the startup community and have been able to solve some of those issues (e.g. startup visa regulation is being updated currently) and have found possible solutions to others. Finally, you could also say that Startup Estonia is a startup in its own right – the team is pivoting and changing its project portfolio, given the changing realities that startups face in Estonia.		
Contact person	Viljar Lubi, Deputy Secretary General for Economic Development, Ministry of Economic Affairs and Communications Mikk Vainik, Ministry of Economic Affairs and Communications, contact to Startup Estonia and KredEx	**Web link**	http://www.startupestonia.ee

DiTex – Digital Talent Executive Program [ES-01SCA]			
Country	Spain	**Scope**	National
Target	Spain and beyond	**Duration**	2016 - ongoing
e-leadership aspects addressed	• Digital savviness • Strategic leadership • Business savviness	**Main driver / initiator**	ISDI Institute for Internet Development

DiTex – Digital Talent Executive Program *[ES-01SCA]*	
Managing organisation	ISDI Institute for Internet Development
Main focus / objective	The DiTex – Digital Talent Executive Program is addressed to HR directors, talent managers and management specialists as well as training and development managers who have to lead the digital agenda of the business and talent transformation.
Target group	• Executives • HR directors • Digital talent managers
Short description	The DiTex – Digital Talent Executive Program is addressed to HR directors, talent managers and management specialists as well as training and development managers who have to lead the digital agenda of the business and talent transformation. Objectives: • Teach and learn knowledge of digital business in order to lead the company's talent transformation from HR. • Teach and learn skills for managing Digital Talent. • Become familiar with digital tools to manage new HR KPIs. Modules: In DITEX students learn to handle digital tools to manage new HR KPIs. The program consists of 8 on-campus modules + a core project: Module 1. Digital Ecosystem Module 2. Digital business strategy Module 3. Digital talent Module 4. Digital Image Reputation & Employer Branding Module 5. Recruitment & New map of digital professions Module 6. Digital Talent Management Module 7. Digital Talent Analytics Module 8. E-Leadership and Digital Culture Methodology: The program combines theory with the development of a core project, from the beginning to the end of the course as depicted in the following graphic:  The ISDI teachers are recognized digital working professionals and specialist experts in the areas they teach. The program has first been run in Madrid from 7th April to 21st June 2016 for 125 hours, with face-to-face lectures every Thursday, 70% in Spanish, 30% in English and at a cost of EUR 8,750. Its execution includes best practice sessions, workshops tools, webinars and a tutored Core Project for students.
Synergies with e-Leadership	The program addresses all aspects of e-leadership with one module explicitly addressing the topic of e-leadership as a key issue for building a digital company culture with the right type of talent to be recruited.

DiTex – Digital Talent Executive Program *[ES-01SCA]*			
Impact	The program was first run in 2016. An evaluation of its impact is still to be done.		
Scalability and transferability	• Scalability is considered to be **high** since – should the initial phase of teaching the programme in the Spanish market be successful, it will be applied and taught in the ISDI branch offices in Latin America and the USA. • Transferability is considered to be **high** for the same reasons and its universal applicability in all European markets and economies where comparable challenges and skills gaps in industry need to be tackled.		
Innovativeness	To our knowledge DiTex is probably one of a few programs of this type which is very market / industry oriented and offered by a new entrant on the dedicated 'digital' and 'digital transformation' training market addressed to executives with digital working practitioners and specialists instead of academics and professors as teachers, which can easily and rapidly be adopted to changing market needs.		
Contact person	Nacho de Pinedo, CEO; Fátima Gallo, Talent Manager	***Web link***	http://www.isdi.education/ditex

Le@d3.0 Academy – Knowledge Alliance			
Country	Italy and Europe	***Scope***	National/European/International
Target	National/European/International	***Duration***	2015 - ongoing
e-leadership aspects addressed	• Digital savviness • Strategic e-leadership	***Main driver / initiator***	Trainers, Industry, Universities
Managing organisation	ISTUD Foundation as lead partner Members of the Consortium: Muenster University, Coventry University, EFMD, OIC Poland, Advancis, Gruppo Pragma, Groupe Auchan, Unicredit Group.		
Main focus / objective	• Identifying **new leaders' needs for strategic e-leadership skills (SeLs)**, and designing how they can be developed making use of innovative learning methods • Identifying **trainers' lacking competencies** and developing learning programmes and approaches, in **teaching strategic skills based on Web3.0 and OERs** • Shaping, testing and implementing an **open virtual environment** and an **educational toolkit** for trainers enabling a learning process for e-Leaders. • Setting up a **learning community of practice of trainers** to use Web3.0 and OERs in strategic e-skills education & training		
Target group	**Primary Target Group:** Trainers from Higher Education Institutions, Business schools, Consultancies and Corporate Academies **Secondary Target Groups**: Students, Entrepreneurs, Managers from large corporations and SMEs **Stakeholders:** • Academic institutions (business schools and Higher Education Institutions) • Training providers (adult education actors, vocational training providers, training centres, corporate academies, HR departments, etc.) • Companies (large corporations; SMEs; entrepreneurs) • Academic associations and networks • Corporate associations and networks		
Short description	Le@d3.0 Academy intends to create a knowledge alliance between Academy and Industry		

Le@d3.0 Academy – Knowledge Alliance	
	to widely spread the use of Web3.0 and OER by trainers to develop those Strategic e-Leadership skills (Se-Ls) that are required by the labour market in the Digital Age. The project works around two important operational objectives. The first one is the identification of the **emerging strategic e-leadership skills portfolio** (taxonomy) and the analysis of the related **skill gaps** as perceived by managers, trainers and students. The taxonomy and the gap analysis were the foundation for approaching the second objective, being to develop the trainers' capacity to embed Web3.0 and OERs into their training practices for e-leadership education & training. This will be done by offering trainers both a capacity building programme and a Community of practice (CoP) to work on the methodological approach to online and blended learning and a virtual platform equipped with already developed OERs and training paths for students and managers to develop the desired strategic e-leadership skills. Le@d3.0 intends to offer to its primary target group (trainers): • a virtual environment (CoP) to share and further develop knowledge on Web3.0 enhanced learning methods and to co-design new OERs related to e-skills • a delivery platform and a repository of pre-selected OERs (Le@d Academy) for shaping their customised training paths to develop strategic e-leadership skills in students and managers. The secondary target group (students and managers), besides being the main actors of the gap analysis phase, will benefit from access to the Le@d3.0 Academy platform in order to improve their e-leadership profile.
Synergies with e-Leadership	e-Leadership is the main focus of the Le@d3.0 Academy project, which intends to raise the awareness and the capacity of trainers to align their training design, both for HEIs and VET curricula, to the emerging market needs for e-leadership skills. Although the Le@d Academy is not a research project and does not aim at advancing the existing knowledge in the e-leadership field, we carried out a gap analysis to understand to which extent managers and students feel confident in performing certain strategic e-leadership skills and to what extent they perceive a need for some training for raising such skills. Furthermore, we analysed if and how trainers are currently addressing the need for such e-leadership skills and if they are willing to review their training design and practice in order to be consistent with the emerging market needs. The analysis phase allows our project to focus on a selected set of strategic e-leadership skills for deploying our virtual Academy (repository of OERs and delivery platform) which will be offered to trainers for shaping customised blended training offers on e-leadership for managers and students.
Impact	Although the project is still in the design phase of its Academy, the research phase allowed us to reach more than 2.000 final users (trainers, students and managers) and to assess the willingness and interest of trainers (60% of the sample showed a strong interest) in reviewing and updating their training programmes related to leadership and their practices (moving toward a blended delivery model). The Capacity Building Sessions planned for fall 2016 will involve 100 trainers while 300 will participate in the CoP. 70 students from Universities and Business Schools and 30 managers from Corporations will participate in the Pilot Programme of the Le@d3.0 Academy.
Scalability and transferability	• From an initial partnership formed only by the consortium members, the project will be opened to a wider formal partnership of academic, business organisations and individuals (trainers). This will be achieved by setting up a European Association having the mission to facilitate the transformation of the members (teachers and trainers) into facilitators, in order to allow them to design, co-develop and run effective and efficient e-Leadership development programmes in digital environments. • The project foresees to sign a Memorandum of Understanding with at least 10 organisations interested to join the Academy after the end of the EU funding. The

Le@d3.0 Academy – Knowledge Alliance			
	exploitation plan is under development and sets much higher targets for the Association. • As far as *transferability* is concerned, even if the project's focus is on SeLS, its approach and methodologies are readily transferable to other skill areas, within or outside the e-Leadership framework.		
Innovativeness	The project represents an innovation at four different levels related to its: - **organisational model** (Knowledge Alliance between Industry and Academy): putting together Universities, Business Schools and Corporate Schools helping to establish a new collaborative practice to respond to an emerging and critical need, due to the advent of the digital revolution. So the project is an example of an innovative way to collaborate by putting together institutions and organisations that have a prominent role in training and developing the future and the existing industry leaders. - **methodological and technological approach**: the partners will not only share their experience and know-how, but through the project they all will be asked to get involved in the ideation, design, and implementation and testing of an innovative learning environment based on Web3.0 approach. This will be a good example of learning by design and learning by teaching and training. - **digital strategy**: the pedagogy underpinning the Le@d3.0 Academy is giving a new role to social media and social networks as means to foster knowledge co-creation and sharing. - **market focus**: the project will address primarily **trainers,** considering them as key agents of change to foster a deeper penetration into existing curricula of both the e-leadership related topics and innovative teaching strategies based on Web3.0.		
Contact person	Maria Laura Fornaci, Project Manager, ISTUD Foundation	***Web link***	http://www.eleaderacademy.eu/

PROMPT – Professional master in software development [SE-01SCA]			
Country	Sweden	***Scope***	National
Target	Sweden Europe	***Duration***	2013 (-2019): ongoing
e-leadership aspects addressed	Mainly digital savviness, others only peripherally	***Main driver / initiator***	Universities, Industry
Managing organisation	Mälardalen University		
Main focus / objective	Guarantee the supply of advanced software competencies and innovativeness in Swedish Industry through customised education offers.		
Target group	• Professional engineers and software developers • Students		
Short description	The advanced education programme PROMPT aims at ensuring the supply of software experts to industry and to increase industrial competitiveness through customised, free university courses for engineers and developers. PROMPT has been launched as a national educational initiative in cooperation with several academic parties and a number of leading Swedish industrial companies and organisations. Together the parties develop academic courses on advanced level, adapted for professional engineers and software developers. The goal is to guarantee the supply of advanced software competencies and innovativeness to industry. The courses, all on master´s level, are developed to suit those already employed and who want to combine work and studies. The courses are produced in cooperation with the companies in need of the competence, and teaching has been adapted for professionals		

PROMPT – Professional master in software development [SE-01SCA]

combining studies with work. The courses combine conventional studies with distance, web-based learning and teaching at the participating companies.

The goal of the project is partly to implement an upgrading of skills that will significantly improve competitiveness in industry, and partly to support the development of new software based innovations. The participating companies get a head start when it comes to integrating new research in the area into their activities.

PROMPT is an open initiative which welcomes additional companies and higher education institutions (HEIs). The PROMPT project has funding from the Swedish Knowledge Foundation's programme "Expertise for Innovation", and also from the participating HEIs and companies.

Synergies with e-Leadership

The initiative trains digital savviness and is as such relevant for one of the e-Leadership aspects. Offered courses mainly focus on development of software skills and talent generation for the digital transformation of businesses. The initiative does not have an explicit focus on (strategic) leadership and business savviness. Both the project management and students in the PROMPT courses see the need for higher management in companies to improve their knowledge about software development to develop business opportunities deriving from software development.

Impact

Brand new courses for professionals

PROMPT is up-grading the Swedish academic landscape through offering university courses with relevant content for professional software developers in industry. Autumn 2016 PROMPT has 10 courses, 2017 there will be +20 course (in total 135 credits).

Research and technical transfer through courses

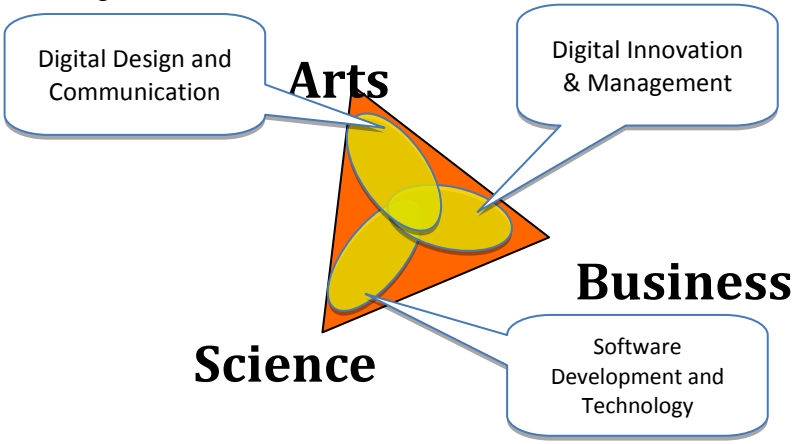
PROMPT teachers are all skilled researchers; the content in the courses is a direct result of the research they are performing, which gives companies and students immediate access to the recent research results and findings.

Improved ways of working in industry

Students state that they can implement what they learn in the courses in their everyday working life. Managers stress the importance of investments in education:

- "Even though there is great knowledge in our companies, skill is a moving target; it's important not to become complacent."
- "Swedish industry's tools for facing competition are to invest in skills and innovations based on software. "
- "Constant continuing professional development is vital for Swedish companies

PROMPT – Professional master in software development [SE-01SCA]			
	since software is such a big product. Sweden has of course traditionally been successful with innovations, but it's important to continue investing in a favourable development climate." **Development and up-grading of regular education/courses** Also campus students benefit from the improved forms of performing education. Course material is re-used in regular campus education. **Modernisation of universities through on-line web-based training** To meet needs from employers in both industry and public sector, universities need to modernise themselves. PROMPT is one example of how to bring education up-to-date in the software development area, both when it comes to content and pedagogical formats. PROMPT develops the skills in didactics and pedagogy for web-based training of participating organisation. **Availability across Europe** PROMPT courses are available free-of-charge for practitioners within EES and Switzerland; all courses are taught in English. Hence, a company can send employees from different sites to the same course, at the same time.		
Scalability and transferability	• Scalability is considered to be **high** as the model has proven to be able to scale-up quickly. • Transferability is considered to be **high** as it is universally applicable in all European markets and economies where comparable challenges and skill gaps in industry need to be tackled. • Scalability of the initiative itself is considered to be **high**, since more courses, HEIs´, companies and industrial experts can add on to the concept and the content. • Web-based courses have the potential to take on more students than regular courses. • Web-based courses make it possible for more students to succeed with the combination of work and studies, since they are flexible in time and place. • PROMPT works actively to learn from others in the area of web-based education, and also to transfer knowledge from the own project to others (local, national and international). • The concept can be transferred to other domains.		
Innovativeness	Speedy technology transfer from academia/research to industry/professionals; an innovative way to disseminate research results. Through PROMPT, the participating HEI´s reclaim the position as a competence provider for industry and professionals. The process of developing the courses is itself innovative and renews ways of working within academia. Web-based training utilising the latest didactic and pedagogical advances, tailored to working professionals. Advanced-level academic courses adapted for professionals in partnership between academia and industry.		
Contact person	Malin Rosqvist & Hans Hansson, Leader of the PROMPT project, Mälardalen University	***Web link***	http://www.promptedu.se/

IT University Copenhagen *[DK-01SCA]*			
Country	Denmark	***Scope***	National
Target	Denmark and beyond (globally oriented)	***Duration***	1999 - ongoing
e-leadership aspects addressed	• Positive non-conformers • Broad-minded graduates with a deep insight into IT. • Value creation with IT	***Main driver / initiator***	Government, University, Industry
Managing organisation	IT University of Copenhagen		
Main focus / objective	Follow a cross-disciplinary approach to the study of information technology approaching IT from a variety of perspectives: natural sciences (traditional computer science), software engineering, Science and Technology Studies (STS), CSCW, the design and use of IT, e-business, computer games studies, and the social, cultural and aesthetic aspects of IT.		
Target group	• (First time) Students (BSC, MSc, PhD) • Employees interested in further training • Private and public partners in research • Entrepreneurial students		
Short description	The IT University of Copenhagen is a Danish globally oriented, independent university established in Copenhagen, Denmark in 1999. The IT University is **a mono-faculty university with a cross-disciplinary approach**. The IT University is the youngest university in Denmark with around 2000 students. Based on its mission of contributing to making Denmark exceptionally good at creating value with IT the IT University strives to deliver internationally recognized and highly relevant research and education. The IT University Principle # 1 is described as "The essence of Information Technology is the creation, sharing and handling of mental constructions using digital technology." Study programmes (BSc, MSC and PhD) are provided in the areas described in the ITU triangle below:  The IT University of Copenhagen offers 3 BSc programmes, 4 MSc programmes and an extensive PhD programme as well as professional Masters Degrees and a Diploma programme, including interdisciplinary studies within the Sciences, the Humanities, Design and Business. The students come from very different backgrounds and many are internationals, offering new perspectives and approaches. The entrepreneurial spirit of both the University and its students is high as shown by the list of around 50 start-up companies founded by ITU students: https://docs.google.com/spreadsheets/d/1ViJx3LulRDZ_fOSmjV2A9OJiOq8FUd7oj1ytHaEqJ3w/edit#gid=0 http://en.itu.dk/ The stated objective of the university's research is to strengthen Denmark's ability to create value with IT. The research aims to provide new insight that could be the foundation for new		

IT University Copenhagen [DK-01SCA]			
	types of interaction, new breakthroughs in digital culture, better resource optimization, technological innovation and much more. An important part of the research is the PhD program. Each year, the IT University enrols PhD students from all over the world. These students work closely with the faculty on their research projects in order to develop their research skills and their international network.		
Synergies with e-Leadership	The different programmes of IT University Copenhagen teach topics which are of crucial importance and relevance for innovation and the creation of value with IT in companies now and in the future with a cross-disciplinary approach as described in the ITU triangle and a strong representation of software and data analytics in research and education at ITU.		
Impact	At present admission of full-time students is at 637 with a number of applicants which is significantly higher and at 2590. In 2015, the IT University alone graduated 405 MSc graduates in IT, which is more than three times the 1999 output from Computer Science Programmes from the universities that existed back when the IT University started. The creation of the university created internal competition among universities on scaling up IT programmes and the other universities in Denmark too have grown their IT programmes significantly during that period of increased competition.		
Scalability and transferability	• Scalability heavily depends on the 'quality' of applicants. Applying strict quality criteria has led to the admission just 637 applicants in the last year out of 2590 applicants. At present scalability can therefore be seen as 'difficult' and at maximum be considered as **medium** as long as quality criteria are not diluted. • Transferability of the ITU model can be considered as **'not so easy'** as it requires a strong political will and substantial and continuous investments over a long period of time at government level. ITU was founded as a new university in 1999 since at that time the existing universities showed no interest in following the approach set out by government. It can be assumed that the situation will be similar in the other EU Member States.		
Innovativeness	Strong focus on 'software' following a cross-disciplinary approach as described in the ITU triangle and a strong representation of software and data analytics in research and education at ITU.		
Contact person	Mads Tofte, Vice Chancellor	**Web link**	http://en.itu.dk/

Womentor [SE-03LEA]			
Country	Sweden	**Scope**	National
Target	Sweden	**Duration**	2006 - ongoing
e-leadership aspects addressed	• Strategic leadership • Business savviness • Digital savviness	**Main driver / initiator**	Industry, Government
Managing organisation	IT och Telekomföretagen (association for the Swedish IT and telecoms industry)		
Main focus / objective	Reduce inequality by supporting the increase of the proportion of female managers in IT and telecommunications industry		
Target group	• ICT Professionals (women)		
Short description	Womentor is a mentor program run by IT och Telekomföretagen (association for the Swedish IT and telecoms industry) to support companies in the industry that wish to work systematically to increase the proportion of female managers and take greater advantage of and develop women's skills as future leaders. The initiative is		

Womentor [SE-03LEA]			
	supported by all major ICT companies in the country. In 2006, 30 major Swedish ICT companies came together to launch this mentoring programme with the objective to raise Sweden's competitiveness through getting more women into leadership positions in the ICT and media sector. The programme is for companies seeking to develop and utilize women's skills in order to secure their future supply of managers and their future competitiveness. Official launch of the programme was preceded by a pilot project commissioned in 2006 by the then Minster of Industry Ulrica Messing. More than 30 companies participated in the pilot project led by the National Post and Telecom Agency (PTS) and supported by a steering committee composed of high level representatives (mostly CEOs) from the ICT industry in Sweden, the trade association and government institutions. Mentoring expertise was provided by a subcontractor, Ardida. The pilot project was scientifically evaluated and shown to have been very successful. Subsequently the Trade Association for the Swedish ICT sector, IT&Telekomföretagen, decided that the ICT sector itself should take over ownership of the programme and thereby ensure its continuation. This year 2016, we celebrate our 10th anniversary.		
Synergies with e-Leadership	The initiative trains components of e-leadership through experience and knowledge sharing aiming at fostering professional and personal development of competent women in IT and telecommunications industry.		
Impact	Since 2007, over 50 companies and more than 400 female managers have participated in consecutive rounds of the programme. 2006 we had 25% of female managers in the Swedish ICT sector. 2015 we have 28%. An increase but with slow speed. Among the participating companies we have several companies who have reached 35-40% of female managers.		
Scalability and transferability	• Scalability is considered to be **high**. The initiative has the potential of attracting more and more actors and achieving bigger coverage and replication on a larger scale. • Transferability is considered to be **high**. The model could be transferable to other regions in the world provided its similar types of incentive structures are available.		
Innovativeness	Womentor is a one-year leadership development and mentoring programme for women leaders in companies who have taken their first steps as managers and want to move on. Mentors are expected to have at least ten years of experience as managers and have a willingness to share their experiences. Mentees work together on a joint project during the year, mainly to strengthen network ties through collaborative work but also for participating companies to benefit from the outcome. The availability of bigger share of mentors than mentees ensures that mentees match up with a suitable mentor from other companies. Womentor is also a change programme for the participating companies as they set their own goals for their equality work, coaching is provided for them how to reach their goals. The employer's organisation, IT & Telecom företagen, has set a goal that 40% are female managers within the ICT sector by 2025. The programme includes a total of six full days and ongoing mentor calls each month. The mentees should have or have had at least one post as first line manager. Furthermore, they should wish to continue the managerial career and have a potential to achieve a higher management position.		
Contact person	Tuija Kivistö & Sofia Yngwe, Kommunikationschef, ALMEGA - the Employers' Organisation for the	***Web link***	http://www.womentor.se/

Womentor [SE-03LEA]			
	Swedish Service Sector		

Cornell College of Business (CCB) [US-03SCA]			
Country	USA	**Scope**	International
Target	International	**Duration**	2016/17 – ongoing
e-leadership aspects addressed	• Digital savviness (main focus) • Strategic leadership • Business savviness	**Main driver / initiator**	Cornell University
Managing organisation	Cornell University Business Schools: School of Hotel Administration, Charles H. Dyson School of Applied Economics and Management, and Samuel Curtis Johnson Graduate School of Management.		
Main focus / objective	Cornell University is in the planning stages for the creation of a College of Business that will comprise the university's three accredited business schools: the School of Hotel Administration, the Charles H. Dyson School of Applied Economics and Management, and the Samuel Curtis Johnson Graduate School of Management. The plan for the new college is being developed with broad input from faculty, students, staff, and alumni. The College of Business is supposed to benefit faculty and students by bringing together the excellence and breadth of Cornell's undergraduate, graduate, and professional business programs to create a more collaborative and comprehensive business management program, while preserving the individual excellence of the three schools. The new college is anticipated to launch during the 2016-17 academic year. The aim is to become a world-class center of teaching and research for business management and entrepreneurship.		
Target group	• Workers and professionals • Industry • Higher and executive education institutions • National governments		
Short description	The Cornell College of Business is supposed to create more diverse and rigorous learning and research opportunities for both students and faculty to help strengthen entrepreneurship, business and finance, technology, globalization, and management education. The aim is to bring together the excellence and breadth of Cornell's leading undergraduate, graduate, and specialized professional programs to create a more collaborative and comprehensive business management program for students. Students will gain exposure to a wider array of faculty and learning opportunities across disciplines, including at Cornell Tech and through our partnerships with institutions around the world, and be able to collaborate with a broader assembly of students at the undergraduate, graduate and professional levels. A greater integration among programs across the three business schools is supposed to create more diverse and rigorous learning and research opportunities for both students and faculty to strengthen entrepreneurship, business, real estate and management education at Cornell. Soumitra Doutta, Dean of the College of Business (5 May 2016): "For example, Cornell Tech, which has a strong relationship with Johnson, has been developing some unique relationships with leading firms from the technology sector. Many hospitality companies might be interested in working with these firms to better understand the impact of technology transformation. It will be a win-win-win, for students, the companies and the university."		

Cornell College of Business (CCB) [US-03SCA]			
	(http://news.cornell.edu/stories/2016/05/dutta-planning-college-business-track)		
Synergies with e-Leadership	The activities have a strong relationship to e-leadership skills development since they aim to implement and operate the CCB to become a world-class center of teaching and research for business management and entrepreneurship.		
Impact	Through the integration of three accredited business schools the CCB has the potential to become a strong institution for of e-leadership skills training in higher and executive education. The approach seems to have similarities to Aalto University which started on 1 January 2010 as a merger of the Helsinki School of Economics, Helsinki University of Technology and the University of Art and Design Helsinki. Aalto University was established as a priority project in the Finnish university renewal. The idea was to create a new innovative university merging science and technology, design and art, and business and economics.		
Scalability and transferability	• Scalability is not an issue since the initiative has not yet started and will only be operational as of the academic year 2016/2017. • Transferability is considered to be **high** but heavily depends on the political will of key actors in such a process to merge previously independent institutions.		
Innovativeness	Merging previously independent higher and executive education institutions to become a world-class center of teaching and research for business management and entrepreneurship and thereby creating the leadership skills for the high-tech economies of the future can be considered as a **highly** innovative activity.		
Contact person	Soumitra Dutta, the Anne and Elmer Lindseth Dean of the Samuel Curtis Johnson Graduate School of Management, Dean of the College of Business	**Web link**	http://business.cornell.edu/

e-Leadership MBA Curriculum – University College Algebra and IGBS, Zagreb [HR-01SCA]			
Country	Croatia	**Scope**	National
Target	Croatia and beyond	**Duration**	2016 – ongoing
e-leadership aspects addressed	• Strategic leadership • Business savviness • Digital savviness	**Main driver / initiator**	University College Algebra, Zagreb, successor of IGBS – International Graduate Business School, Zagreb, with faculty members of Kelley School of Business at Indiana University
Managing organisation	University College Algebra		
Main focus / objective	MBA curriculum and program dedicated to e-leadership skills development responding to market requirements, where organizations increasingly rely on Information and Communications Technology to operate their business processes in order to enhance productivity and competitiveness. As they invest more in business operations and technologies, it is expected that ICT leaders are more oriented toward business, and business leaders toward ICT. Organizations need a new type of leaders who will accomplish business objectives using technology. e-leadership is therefore seen as accomplishment of business goals, relaying on strategic leadership, management of human resources and usage of ICT.		
Target group	There are two target group types:		

***e-Leadership MBA Curriculum – University College Algebra and IGBS, Zagreb** [HR-01SCA]*	
	• Professionals with relevant business experience and tight business and personal schedule; executives, i.e. leaders in various industry fields or top corporate management members (e.g. founders, CEOs, CFOs, CIOs, CTOs etc.); EMBA delivery version • Higher educational graduates and professionals without relevant enough business experience; MBA delivery version Minimum entry requirements: • Bachelor's or university/professional degree (min. 180 ECTS) • entrance exam or evidence of competence in written and spoken English • depending on the delivery track, relevant business experience
Short description	  The e-Leadership MBA program is designed for professionals who wish to develop MBA skills and knowledge in order to leverage digital technology to support and develop business. It runs over a period of two years with up to 50 participants per academic year. There are 18 modules that consist of 40 contact hours each spread over the total of 18 months, while additional time (last semester) is reserved for preparation of the final master thesis. It includes lectures, classroom exercises, case studies, and project work. Students will receive 120 ECTS as credits. The program has clearly spelled out learning outcomes which are mapped to the skills and competences of the e-CF (European e-Competence Framework). This program is the successor of the highly successful MBA program at the International Graduate Business School (http://www.igbs.hr/en/programs/igbs-mba.html), which was set up and executed in cooperation with the Kelley School of Business. There are two versions of the program: MBA and EMBA. Because of its nature/delivery, MBA is suitable for students and professionals without relevant business experience. Program is delivered during the weekdays' afternoons. Because of its nature/delivery EMBA is suitable for professionals with relevant business experience, and tight business and personal schedule. The delivery of contact hours is designed in the modular style for students who have the opportunity to study on weekends. It means that each course will be delivered in two consecutive weekends in the form of the module. One of the most significant additional values of the EMBA program is valuable networking with students from different industries and countries. Program (in both versions) is excluded of VAT as accredited higher educational program. In both versions of the program price can vary depending on payment

e-Leadership MBA Curriculum – University College Algebra and IGBS, Zagreb [HR-01SCA]			
	method and potential scholarship available to promising students. The e-Leadership MBA program includes modules, as follows: • MBA requirements and value • Managerial economics • Strategic management • Operations management • Financial management • Critical thinking and creativity • Marketing management • Financial and managerial accounting • Quantitative methods • Project management • Entrepreneurship and innovation • Strategic management of technology and innovation • Business process modelling • Information systems in modern organisations • Managing information risk and security • IT service management • Managing human resources in a global environment • New products management		
Synergies with e-Leadership	The program based on this curriculum is a fully-fledged e-leadership MBA program and it complies with all e-leadership requirements.		
Impact	The program will run in 2016 for the first time. So far no evaluation results have been published.		
Scalability and transferability	• Scalability is considered to be **high** should the initial phase of teaching the program in the Croatian market be successful. • Transferability is considered to be **high** as it is universally applicable in all European markets and economies where comparable challenges and skill gaps in industry need to be tackled.		
Innovativeness	Fully-fledged e-leadership curriculum for program development with a very large set of modules and use of top faculties from one of the five best evaluated business schools in US.		
Contact person	Robert Kopal, Ph.D., Algebra University College Professor, Vice Dean for Research and Development	***Web link***	http://eleadership.mba/eleadership-mba/mba-program/

Software Campus – an innovative e-leadership programme for excellence [DE-01LEA]			
Country	Germany	***Scope***	National
Target	Germany	***Duration***	2011 - ongoing
e-leadership aspects addressed	• Strategic leadership • Business savviness • Digital savviness	***Main driver / initiator***	Industry, Universities, Government

Software Campus – an innovative e-leadership programme for excellence *[DE-01LEA]*	
Managing organisation	EIT ICT Labs Germany GmbH for the German Federal Ministry for Education and Research (BMBF)
Main focus / objective	Cooperative excellence programme between industry and universities for the education and training of future e-leaders with some funding from the national government
Target group	• Large industrial companies, mostly multi-nationals • Technical universities and research institutes • Ministry of Education and Research
Short description	Software Campus is a unique cooperation between government, education and industry that supports young researchers in ICT. Each participant works on an academic project, which is funded by Software Campus. After the participants are selected, the grants are required with the Ministry of Education and Research. Apart from that, the candidates receive high quality leadership training by the participating industry partners. Therefore, they collaborate with a partner company, where they are mentored by an experienced manager and contribute with their research. Software Campus was originated from the idea to create a new generation of managers with an advanced ICT background since the new leaders have to have both economic competences and excellent ICT skills. A total of 19 stakeholders, consisting of universities, research institutions and companies, contribute to the multi-stakeholder partnership. Industry partners include major names such as DPDHL, Siemens and SAP. It was a major priority to include companies from different economic sectors and foster a platform for precompetitive work. The first steps for Software Campus were taken at the German National IT Summit in 2010. Industry, universities and the Federal Government have set up Software Campus in order to promote the development potential of young talents and to help create a new generation of managers with an advanced ICT background. Software Campus is aimed at outstanding PhD students of information technology and young professionals from other disciplines with the relevant IT knowledge. Software Campus seeks to bring together the most successful leadership trainings provided by the industry partners involved. The concept of Software Campus rests on five closely interlinked pillars: 1. Participants are given the task of realizing ICT projects of their own. They are in charge of personally managing the entire process of their IT projects with the assistance of partners from research and industry: from project planning to the application for funds to management and team coordination all the way to the conclusion of the project. Every project is funded by the German Federal Ministry of Education and Research for a maximum project term of two years, with the bestowal of grants up to €100,000. 2. Participants are given the opportunity to further develop their leadership skills, methodology expertise, social skills and personal skills within the scope of a six-module program in the Executive training programs. Software Campus' industry partners are contributing their most successful executive training methods to the programme to systematically and strategically enhance the participants' inherently existing potential. 3. All participants are personally supported by an executive of their partner from the industry within the scope of a confidential and protected relationship. This Mentoring provides the participants with insights into the everyday work life of senior IT executives. That way, they learn management skills from the industry's top decision makers, including strategy development; technology, innovation and patent management; or human resource management. In addition to the mentoring, the participants are also entrusted into the capable hands of professional experts. 4. During the internship phase of Software Campus participants get the opportunity to gain practical experience by exploring the application aspects of their research

Software Campus – an innovative e-leadership programme for excellence *[DE-01LEA]*			
	projects while obtaining valuable insights into the in-company processes of their industry partners. Moreover, they get the chance to personally build up their networks at the company by brushing up existing contacts and establishing new contacts. 5. Every participant immediately becomes part of an active network of current and future IT executives, founders of leading German IT companies and renowned experts from science and research. The alumni of Software Campus will establish a future network of their own, and they are the future holders of responsible positions. A first target was to include around 100 ICT PhD students from ICT-related disciplines into the programme by the end of 2012. By 2014 a total of 159 PhD students had entered the Software Campus. Until today (2016) 212 students have entered the programme, 83 graduated already. The total budget amounts to €10 million, funded by the Federal Ministry of Education and Research in addition to the mostly in kind contributions of the industry partners amounting to about the same budget. Industry partners include major names such as DATEV eG, DPDHL Group, Deutsche Telekom AG, Robert Bosch GmbH, SAP SE, Siemens AG, Software AG, Scheer Holding and Holtzbrinck Publishing Group. Academic partners are TU Berlin, TU Darmstadt, Karlsruher Institute für Technologie, TU München, Universität des Saarlands, Deutsches Forschungszentrum für Künstliche Intelligenz, Fraunhofer IuK-Verbund, Max-Planck-Institut für Informatik.		
Synergies with e-Leadership	This initiative is an ideal example in which relevant key players from industry (top German industrial organizations mostly multi-nationals), higher education and training institutions (top technical universities and research centres in Germany) and the relevant national government ministry (BMBF) join forces for establishing and funding an e-leadership skills excellence initiative with a longer-term perspective.		
Impact	The impact on e-leadership skills development is considered **high**, as the scope and focus of the Software Campus is bringing together national top players in this field and fully targeting the e-leadership skills topic. With the present shared funding model is can be considered to be **highly sustainable**.		
Scalability and transferability	• Scalability is considered to be **high**. The initiative is considered to be highly scalable towards an involvement of further industrial companies including larger SMEs, the public sector and further higher and executive education and training institutions (reaching beyond the top technical universities) and possibly also not only addressed to PhD but also Master students, should this be desired by its founders and operators, to attract more actors and achieve larger coverage. Replication on a larger scale requires rather high investments should this model be replicated 1:1. • Transferability is considered to be rather **high**. The model offered by the initiative is highly transferable to different contexts. The strong dependence on a cooperation model of the above actors and the necessity of rather substantial funding could make it challenging to transfer to other geographical regions. However, replication of the Software Campus in other European regions may also be feasible with less investment and funding.		
Innovativeness	It is one of the very few (if not the only) e-leadership skills development excellence initiative funded through a combination of private and public sources, integrating industry and higher education and training, with a strong link to practice and mentoring, gaining work experience in a company and practical problem solving through carrying out and leading a project dealing with an issue of relevance for the company and as such rather unique in Europe and probably the world.		
Contact person	Erik Neumann, EIT ICT Labs	***Web link***	http://www.softwarecampus.de/en/home/

Software Campus – an innovative e-leadership programme for excellence *[DE-01LEA]*			
	Germany GmbH		

Demola – co-creation platform [FI-05LEA]			
Country	Finland	***Scope***	International
Target	National / International	***Duration***	2008 - ongoing
e-leadership aspects addressed	• Digital savviness • Business savviness • Strategic leadership	***Main driver / initiator***	Industry, Universities, Government
Managing organisation	Demola Network		
Main focus / objective	• Boost multidisciplinary agile innovation culture and encourage entrepreneurship. • Increase change capabilities of businesses and talents on the interfaces of the universities. • Validate problems, create new innovations and enable further development decisions by offering professionally facilitated co-creation process.		
Target group	Students, universities, local SMEs, international companies, public organisations		
Short description	Demola offers new ways and practices for collaboration between businesses, students and universities. For companies and other organisations, Demola offers an opportunity to test and co-create innovative solutions with multidisciplinary university student teams and researchers. The Demola was launched in Tampere, Finland in 2008 and has subsequently expanded to 11 countries in Europe, Latin America and Africa. Projects and challenges are developed jointly by companies and universities. Multidisciplinary teams are formed from students from multiple universities and participating staff from partner companies and organisations. Demola process is part of students' degree programmes. A typical local Demola site carries out about 50-100 projects per year with variety of students and project partners. Demola's roots lay in Tampere and was initiated by major industry partners such as Nokia, local universities and government authorities. Part of the development was enabled by ERDF funding. The idea generated from a shortcoming identified by decision-makers in industry, namely the impression that more practical and multidisciplinary innovation environments are needed and that the previous ones were too inward-looking. In response, leading international innovation centres were studied and the Demola concept developed with the goal to deliver concrete results in more customer focused, down-to-earth, agile, cost-efficient and effective way, making best use of innovative methods of collaboration between talented students, companies and universities. Companies and other organisations operating as partners benefit from fresh ideas and approaches to challenge their current perspectives as well as from access to a pool of young talents eager to collaborate in real-life projects for developing solutions to challenges defined with the partner. University students benefit from the opportunity to add real-life work experience into the conventional path towards a career and from opportunities to establish their start-ups based on Demola project results. Demola sites are run by local partners together with global network with extensive experience in supporting innovation processes and start-up creation. In 2012, the Demola Network received the Baltic Sea Region Innovation Award.		
Synergies with	Demola provides students and companies with a collaborative and multidisciplinary		

Demola – co-creation platform [FI-05LEA]			
e-Leadership	innovation environment where students from three regional universities create demonstrations of novel service and product concepts coming from companies and other organisations. Demola gives multidisciplinary student teams the opportunity to develop demo products and services based on company concepts. Companies ranging from local SMEs to international large-scale enterprises as well as public organisations collaborate with the teams. In order to increase synergies with education, Demola has been integrated into the core university course structures and university-business cooperation models. These include offering dedicated Demola courses, integrated into the curriculum, thus offering students from all local universities the chance to work in multi-disciplinary teams with support from professors and industry professional.		
Impact	The key results of Demola highlight the engagement of more than 600 partner companies and more than 70% of the results claimed for business use and further development. In addition, new jobs and new companies have been created. Demola sites have had significant impact on creating new culture of cooperation between experts from multiple knowledge areas as well as supported university business cooperation. Also several corporate partners have developed internal innovation processes based on their learnings from Demola cooperation.		
Scalability and transferability	• Scalability is considered to be **high**. The initiative is considered to be highly scalable towards an involvement of further industrial companies including SMEs larger corporations, the public sector and further higher and executive education and training institutions. Replication on a larger scale requires rather high investments should this model be replicated 1:1. • The Demola project approach is highly transferrable to other industry-university settings. The key features that should be considered are the neutral location (not in the university, not in a business), the approach to ownership of results balancing industry and student perspectives and the staffing of the facility.		
Innovativeness	Demola operates on a region-wide basis and opens new opportunities via international ecosystem. The model was developed in Tampere, Finland where all three universities and City of Tampere were engaged in the project. The project also operates on a limited budget enhancing the overall value of the achievements and impacts. The role of the project partners and students are central to the success of the programme. Project partners are actively supported to design suitable challenges and to learn best practices around co-creation. Students are responsible for team working, problem-solving and creating demonstrable solutions with the support of Demola staff and participating university researchers. The students are given the opportunity to contribute real-life innovations with end-users and globally connected organisations. Moreover, they have the possibility to start own business based on IPR created in the demo project. The establishment of Demola as a neutral ground location, not dependent on any one partner or university, has allowed flexibility in growth and has given confidence to potential new partners when joining. Running in a cost-efficient and agile manner has allowed quick reactions to changing environments and events. Focusing on producing concrete demo results has helped to lead a change in the mind-set of innovation thinking in local environments		
Contact person	Ville Kairamo, Head of Demola Network	***Web link***	http://www.demola.net

UK Futures Programme – Skills for innovation in manufacturing			
Country	United Kingdom	***Scope***	National/Sectoral
Targeted KET/AMT	AMT	***Duration***	Dec. 2015 – Mar. 2018 (27 months)
e-leadership aspects addressed	• Strategic leadership • Business savviness	***Main driver / initiator***	Government
Managing organisation	The UK Commission for Employment and Skills (UKCES)		
Main focus / objective	Education & training		
Target group	• Education providers • Employers		
Short description	The UK Futures Programme is a series of learning programmes that target specific emerging or persistent workforce development problems. Stakeholders are invited to submit proposals for funding on specific topics. In the "Skills for innovation in manufacturing" competition round, stakeholders from business and academia were invited to submit proposals for projects that focus on skills development to manage the innovation process and exploit innovative products or services for commercial value. The awarded projects will run until summer 2016. Each will test skills development in their workplaces, resulting in a series of learning programmes aiming to address specific workplace skills needs. They will receive co-investment from UKCES up to £150,000 per project. Organisations that submitted successful proposals include a leading UK manufacturer, an employer representative body and UK universities. The projects are based in Belfast, Cardiff, Glasgow, Swansea and Lancaster.		
Synergies with e-leadership	There is **medium** synergy with e-Leadership. The initiative is particularly relevant for stimulating strategic leadership skills with relevance to advanced manufacturing and for creating awareness of innovative (digital) solutions among leadership in AMT. However, it lacks focus on digital skills development (i.e. digital savviness) for leadership.		
Impact	Although the initiative is still on-going and yet to be evaluated, the impact is expected to be **medium.** Only five organisations were selected and relatively little funds were distributed to the projects. Nevertheless, the selected projects are expected to yield valuable learning that can be shared across the sector to improve innovation and productivity.		
Scalability and transferability	• Scalability is **medium**. Although the initiative has potential of attracting more actors through its round-based approach, it is strongly dependent on government funding. • The conceptual approach is **highly transferable** to other regions, as it does not require large-scale investments in its current form nor does it require specific expertise that is only available on-site at the current initiative.		
Innovativeness	The initiative is unique in its kind, as no other initiative in Europe was identified that focuses on skills development for managing the innovation process and exploiting innovative products and services in advanced manufacturing.		

Contact person	Paul McKelvie OBE	***Web link***	www.gov.uk[37]

Singapore Institute of Manufacturing Technology-Knowledge Transfer Office			
Country	Singapore	***Scope***	National / Sectoral
Targeted KET/AMT	AMT	***Duration***	2009-*ongoing*
e-leadership aspects addressed	• Strategic leadership • Digital savviness • Business savviness	***Main driver / initiator***	Government
Managing organisation	Singapore Institute of Manufacturing Technology (SIMTech)		
Main focus / objective	Education & training		
Target group	Manufacturing specialists, engineers, managers, as well as other industry professionals and executives.		
Short description	SIMTech's Knowledge Transfer Office (KTO) has been established to provide unique **technology and case study-based training for manufacturing specialists, engineers, managers, as well as other industry professionals and executives.** All training courses, conducted in close collaboration with the Singapore Workforce Development Agency (WDA), draw extensively on the in-house cutting-edge manufacturing knowledge, established through years of industrial collaborations, industry experience and research, backed by state-of-the art manufacturing facilities. In recognition of their outstanding contribution to the development and expansion of the Singapore's Workforce Skills Qualifications (WSQ) system, the WDA has awarded SIMTech with the WSQ Distinguished Partner Accolade.		
Synergies with e-Leadership	Although broader in scope than e-Leadership, the initiative is **highly relevant** for e-Leadership skills development. A variety of offered courses have particular relevance to digital and business savviness, as well as to strategic leadership within AMTs, some of which are specifically targeted at the executive level. Relevant courses that are offered include "Manufacturing Data Mining Techniques", "Innovation Management", and "Strategic Technology".		
Impact	**Impact is considered to be high**. Over the years, the KTO build many evidence-based case studies, which are integrated in their training programs. This allows its users to learn how technology is actually applied in practice. Its success is highlighted by the extensive client list of industry partners (220+), which make use of the programme to train their employees and executives. The **sustainability of the initiative is considered high**, as many key stakeholders are involved and the as the initiative is based on diversified funding from government agencies, industry associations, industrial partners.		
Scalability and transferability	• Scalability if considered to be **medium/high.** Although the potential is high, up-scaling of such an initiative beyond Singapore would entail establishing workforce training sites throughout Member States, and granting them access to cutting-edge facilities and well-versed trainers that are experts in their technology fields. This may best be implemented in tandem with regional smart specialisations strategies and technology clusters, as these often offer the required facilities and experts in a specific technology field.		

[37] See e.g. https://www.gov.uk/government/organisations/uk-commission-for-employment-and-skills *and* https://www.gov.uk/government/publications/ukces-futures-programme-skills-for-innovation-in-manufacturing-competition-brief

	• Transferability is **high**, as the courses offered by the initiative are highly transferable to different contexts. Conceptually it could also be transferred to the EU, although it should be taken into account that sector-specific workforce development programmes in Europe are typically organised at national and regional level. A centralised initiative that is relevant for both AMT and e-Leadership, such as SIMTech's KTO, may help to introduce e-Leadership aspects into these development programmes.		
Innovativeness	The initiative is **highly innovative**, as it is among the very few ones in the world combining all skills training aspects of e-Leadership for AMT. The offered modules utilise a unique approach of real industrial case-studies and on-site training to equip students at all levels (i.e. ranging from engineers to managers and executives) with the latest industrial knowhow.		
Contact person	Dr. Zeng Xianting	***Web link***	http://kto.simtech.a-star.edu.sg/

Festo Didactic "Transfer Factory" – Research and Teaching platform			
Country	Germany	***Scope***	National/Sectoral
Target	Europe	***Duration***	2015-ongoing
e-leadership aspects addressed	Digital savviness	***Main driver / initiator***	Industry
Managing organisation	Festo Didactic		
Main focus / objective	Education & training		
Target group	• Education providers • Employers		
Short description	Digitalisation in advanced manufacturing requires workers to develop a deep understanding of the structure and programming of digital facility networks. Such skills are best taught in a real-life controlled environment, to which education providers and companies typically do not have access to. The CP Factory learning and research platform - a privately funded initiative from Festo Didactive - responds to this challenge by **providing higher education institutes and companies with access to the technology and applications of Industry 4.0**. The basis of the training platform is the MPS® Transfer Factory. The platform demonstrates the production of tomorrow in a locally controlled intelligent network and was developed for flexible training in a wide range of technologies and subjects. These subjects include facility networking, PLC programming, drive technology, sensor technology, safety technology, robotics, assembly, as well as value stream analysis and optimization. Festo Didactic also offers individual training courses in connection with the MPS® Transfer Factory, which address communication, robotics, simulation, image processing, PLC programming, fieldbus, RFID technology, plant simulation, and troubleshooting.		
Synergies with e-Leadership	The initiative trains digital savviness within Industry 4.0 and is as such relevant for one of the e-Leadership aspects. However, it lacks explicit focus on (strategic) leadership and digital awareness. Moreover, the initiative is not targeted at executive and management level.		
Impact	The impact on digital savviness in the industry is considered high, as the learning factory is used worldwide by industrial companies, universities and technical colleges. Due to the scope and focus of the initiative it is unlikely that initiative has a significant impact on strategic leadership and/or digital awareness at executive level. The initiative is considered to be highly sustainable, provided that is already privately funded and that the results produced by this initiative are likely to be		

Festo Didactic "Transfer Factory" – Research and Teaching platform			
	usable in a broad context for years to come.		
Scalability and transferability	• Scalability is considered to be **medium**. Although the initiative has a high potential of attracting more and more actors and achieving bigger coverage, replication on a larger scale requires high investments in state-of-the-art training facilities. • Transferability is considered to be **medium**. The courses offered by the initiative are highly transferable to different contexts. However strong dependence on a state-of-the-art training facility makes it difficult to transfer to other geographical regions due to the high investment costs.		
Innovativeness	It is one of the few privately funded training initiatives for digitalisation in advanced manufacturing and as such unique in the world. Moreover, the state-of-the-art training facilities are unique in Europe.		
Contact person	Heike Haarmann	***Web link***	www.festo-didactic.com

4.4 Annex 4: Summary overview of service contract deliverables

ID	Deliverable / event	Title	Date
D1	Inception Report		Sep 2015
	Workshop no. 1 minutes and conclusions	Workshop Report No. 1	Apr 2016
	Report	Business, Industrial and Technological Trends Analysis and Impact on e-Leadership Skills	Dec 2015
	Report	Digitalisation, Jobs and Convergence in Europe: Strategies for Closing the Skills Gap	Jan 2016
D2	Working Document: Guidelines	European Guidelines for Curriculum Development for e-Leadership Skills: proposal for further development and adoption by the 'CEN ICT Skills Workshop'	Jan 2016
D3	Interim Report	Leadership Skills for Digital and Key Enabling Technologies	Jan 2016
	Workshop no. 2 minutes and conclusions	Workshop Report No. 2	May 2016
	Workshop no. 3 minutes and conclusions	Workshop Report No. 3	Sep 2016
D4	Working Document: High-Tech Leadership Agenda	High-Tech Leadership Skills for Europe (see 'Final Report')	Mar 2017
	Workshop no. 4 minutes and conclusions	Workshop Report No. 4	Nov 2016
	Brochure	High-Tech Leadership Skills for Europe	Mar 2017
	Conference Report	Conference Report	Jan 2017
D5	Final Report	High-Tech Leadership Skills for Europe	Mar 2017