



## High-Tech Leadership Skills for Europe»



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## Imprint

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### Foreword

Digital and key enabling technologies are generating new market opportunities and fostering new and sometimes disruptive business models. To fully exploit these technologies, enterprises of all sizes and in all sectors, require workers with high-tech skills – also and very importantly at the leadership team level. These skills are in high demand globally and the demand is not likely to be met by the current supply from education and training institutions.

The promotion of high-tech leadership skills and the provision of a large talent pool require long-term coherent and consistent efforts in many policy areas. It also requires the active contribution of numerous stakeholders and scalable public/private partnerships. To make this happen, a better understanding of the characteristics and the magnitude of the challenge as well as the corresponding solutions is needed.

This document provides a summary of the state-of-the-art of high-tech leadership skills in Europe, and it highlights concrete proposals for action and how best to implement an EU-wide agenda at Member State and European level. These proposals are based on the results of a consultation process in which experts shared their experiences and their visions on high-tech leadership skills towards 2020 and beyond.

Serious efforts must be made to increase Europe's talent pool and reduce skills gaps, mismatches and shortages. This will require a change of mind-set among politicians and stakeholders and, notably, the recognition that lifelong learning and upskilling are crucial to Europe's success, so national education and training systems must be able to respond and act accordingly.

This means more investments in high-tech leadership skills where people are at the centre. It is a shared responsibility of the private and public sector to make this an inclusive process. Without stakeholder commitment – at regional, national and EU level – we will not be able to meet Europe's need for high-tech skills. Now is the time for joint action!

*Slawomir Tokarski  
Director  
Innovation and Advanced Manufacturing  
DG Internal Market, Industry, Entrepreneurship and SMEs  
European Commission*



### The impact of high-tech 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 EU28 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<sup>1</sup>. 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 countries (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<sup>2</sup> 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.



**Saskia Van Uffelen**

CEO Ericsson BeLux,  
Digital Champion Belgium

*In 2020 65% of our current jobs will have changed due to technological developments. It is important that everyone develops the skills to remain competitive in the Digital Economy. European industry leaders in particular should acquire the technical, business and strategic leadership skills to initiate and achieve digital innovation.*

### Disruption through new technological, industrial and business trends

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.

1. 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>  
2. Boston Consulting Group: Transformation: Delivering and sustaining breakthrough performance, 2016: <http://media-publications.bcg.com/transformation-ebook/BCG-Transformation-Nov-2016.pdf>



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.



**Maria Laura Fornaci**

Senior Consultant  
Fondazione ISTUD

*The main features of the fourth industrial revolution now upon us are unprecedented speed, and pervasiveness that will change the rules of business and traditional value chains. We need new high-tech leaders who understand this and are able to grasp the opportunities it offers.*

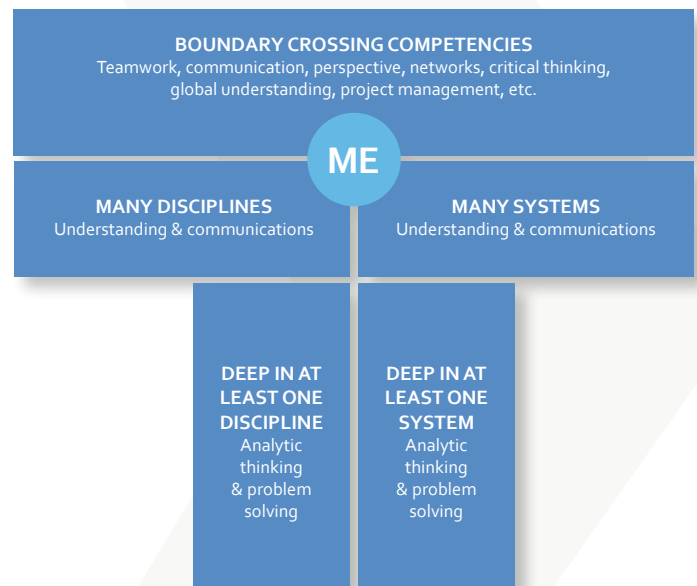
The innovative nature and technology profiles of these trends, particularly Big Data, the Internet of Things (IoT), advanced manufacturing technologies and other key enabling technologies, is very likely to create demand for genuinely new skills and, where business revenues increase, to the creation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

## The importance of high-tech leadership skills

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 T-shaped professional metaphor <sup>3</sup>

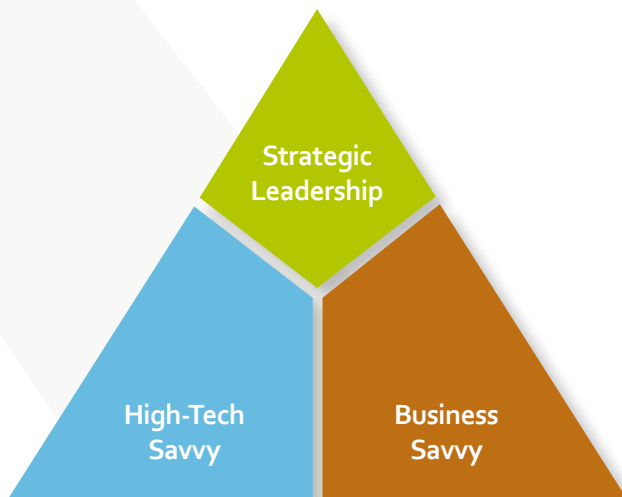


3. Adopted from the following source: T Summit 2016 Event: <http://tsummit.org/t>





## High-tech Leadership Skills Triangle



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
- >> **High-tech Savviness:** to envision and drive change to improve business performance, exploiting the innovation opportunities in high-tech trends.



**Nicolas Schmit**

Minister of Labour, Employment and the Social and Solidarity Economy, Luxembourg

*Today's leaders need to navigate the complexities of a fast changing environment. High-tech leadership skills mean being able to identify risks and opportunities that innovations pose for people, organisations, and society as a whole.*

## Actions taken

Since its Communication on „e-Skills for the 21st Century“ (2007) the European Commission has been helping improve digital skills and to create a larger talent pool of IT professionals that the EU must have to be innovative and competitive in the global market. In 2012, the European Commission adopted a “European strategy for Key Enabling Technologies – A bridge to growth and jobs”<sup>4</sup>, outlining the strategy to boost the deployment of KETs in Europe. Several Member States launched major national initiatives, especially Germany<sup>5</sup>, France<sup>6</sup> and Italy<sup>7</sup>.

The European Commission’s Communication for a “European Industrial Renaissance”<sup>8</sup> (2014) emphasised that digital technologies are essential to increase productivity through redefining business models and creating new products and services. Through the Strategic Policy Forum on Digital Entrepreneurship<sup>9</sup> (created by the European Commission in 2014), multiple reports have been delivered including “Accelerating the digital transformation of European industry and enterprises” (March 2016) and “Upskilling European industry: New operational tools wanted” (July 2016).

4. [https://ec.europa.eu/growth/industry/key-enabling-technologies/european-strategy\\_en](https://ec.europa.eu/growth/industry/key-enabling-technologies/european-strategy_en)  
5. <http://www.hightech-strategie.de/de/The-new-High-Tech-Strategy-390.php>  
6. [http://www.economie.gouv.fr/files/files/PDF/pk\\_industry-of-future.pdf](http://www.economie.gouv.fr/files/files/PDF/pk_industry-of-future.pdf)  
7. <http://www.fabbricadelfuturo-fdf.it/?lang=en>  
8. [https://ec.europa.eu/growth/industry/policy/renaissance\\_en](https://ec.europa.eu/growth/industry/policy/renaissance_en)  
9. [http://ec.europa.eu/growth/sectors/digital-economy/entrepreneurship/strategic-policy-forum\\_en](http://ec.europa.eu/growth/sectors/digital-economy/entrepreneurship/strategic-policy-forum_en)



These activities are well known and recognised in expert circles. In 2016 an expert survey from empirica confirmed that these analyses and initiatives were acknowledged as highly relevant for addressing the challenges from digital disruption and industrial modernisation, and for creating the talent pools that can be needed to unleash the opportunities of new technology developments and trends.

It is time to integrate digital and key enabling technologies related skills activities under an overarching high-tech skills agenda. The latest developments in these areas reveal that multidisciplinary skills are crucial for industrial modernisation, competitiveness and as a consequence job creation and retention in the EU.

## Europe needs 50,000 additional high-tech leaders per year

Cross-disciplinary leadership skills that exploit new digital and key enabling technologies 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 EU28**.

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.



### Nacho de Pinedo

CEO of ISDI - Institute for Internet Development

*The development of digitisation is not an era of changes, but a change of an era. Therefore, people need to adapt their talent, skills and attitude to the new way of thinking, interpreting, acting and relating in this new ecosystem if they want to remain competitive and survive in this new professional environment.*

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 missing out on innovation opportunities and leaving them to be taken up by its competitors.

## Importance of leaders for driving innovation at all levels

The population of high-tech leaders is highly diverse, and consists of leaders that can be found at different company levels. Besides C-level executives (such as CEOs, CTOs, CIOs etc.) forming the top of companies, there is also a broader layer of 'mid-level leaders'. Those include leaders of business divisions, departments, project teams and other sub-groups.

10. Harvard Business School (2013) "Danger in the middle: Why midlevel managers aren't ready to lead" Harvard Business publishing; available at: [http://www.harvardbusiness.org/sites/default/files/PDF/17807\\_CL\\_MiddleManagers\\_White\\_Paper\\_March2013.pdf](http://www.harvardbusiness.org/sites/default/files/PDF/17807_CL_MiddleManagers_White_Paper_March2013.pdf)  
11. Alexander S. (2016) "Key to Sustainable Success: Developing Middle Managers", published on Everwise on 20 May 2016, available at: <https://www.geteverwise.com/talent-development/key-to-sustainable-success-developing-middle-managers/>  
12. Ibid.





Mid-level leaders are key to the successful execution of business strategy and ongoing organisational transformation. They often represent visionaries and innovation drivers, with motivation, capabilities and high potential.

While the importance of mid-level leaders is growing, their skills often do not stand up to the market requirements<sup>10</sup>. For organisations willing to compete and thrive, there is a clear need to invest sufficient resources in the development of their mid-level leaders<sup>11</sup>. Successful leadership development builds on the blending of experiential on-the-job learning, coaching, and feedback with formal training. Good practice programs keep the learning as close as possible to a leader's day-to-day work<sup>12</sup>.

Most organisations do not have developmental programs in place for mid-level leaders. Possible alternative measures to boost their development include seeking out a coach, becoming mentors themselves for other growing individuals, establishing self-awareness of own talents and development points, seeking opportunities that force one to step out of comfort zone, and making time to think outside the box. Stakeholders would welcome an EU-level support for performing an inventory of relevant available initiatives in this field and/or developing a blueprint for mid-level leader development program for high-tech domains.

### Need for a new generation of leaders

A multidisciplinary and rapidly evolving nature of KETs and their highly competitive and difficult-to-predict market environment require a new generation of leaders especially in the field of KETs, able to spot, create and serve fundamentally new markets. That has direct implications for the skill requirements for these leaders. Below we address some of the key skills that the new generation of KETs leaders needs to possess:

- >> **Learning-to-learn skills**, including primarily the ability to absorb and constantly update knowledge, as well as to create new knowledge on top of the existing one.
- >> **Alertness** referring to the ability to constantly monitor internal and external (i.e. economic, social, cultural, political, technological etc.) developments, thereby gaining awareness of the latest trends, as well as the ability to act upon them rapidly.
- >> **Adaptability** which implies being open to change (positive or negative) and to considerable variety in the workplace; the ability to accept, prepare for and handle change.



#### Rudy Lauwereins

Vice President, IMEC (R&D organisation combining microchip technology with expertise in software and ICT)

*There is insufficient attention to retraining people in highly capital-intensive environments. Hands-on training on the expensive equipment is highly challenging. New educational methods need to be developed for such environments.*

- >> **Continuous experimentation and ability to build on failures** with the acceptance of potential failures and the ability to turn those into a valuable learning experience, and preferably into a winning situation.
- >> **Multidisciplinarity and integration skills**, including the ability to use and integrate various fields into joint solutions to complex problems is best achieved at the collective level (i.e. working in teams). Integration skills go hand in hand with design mind-set, disruptive thinking and complex problem solving skills.

## High-tech leadership skills 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 and 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.

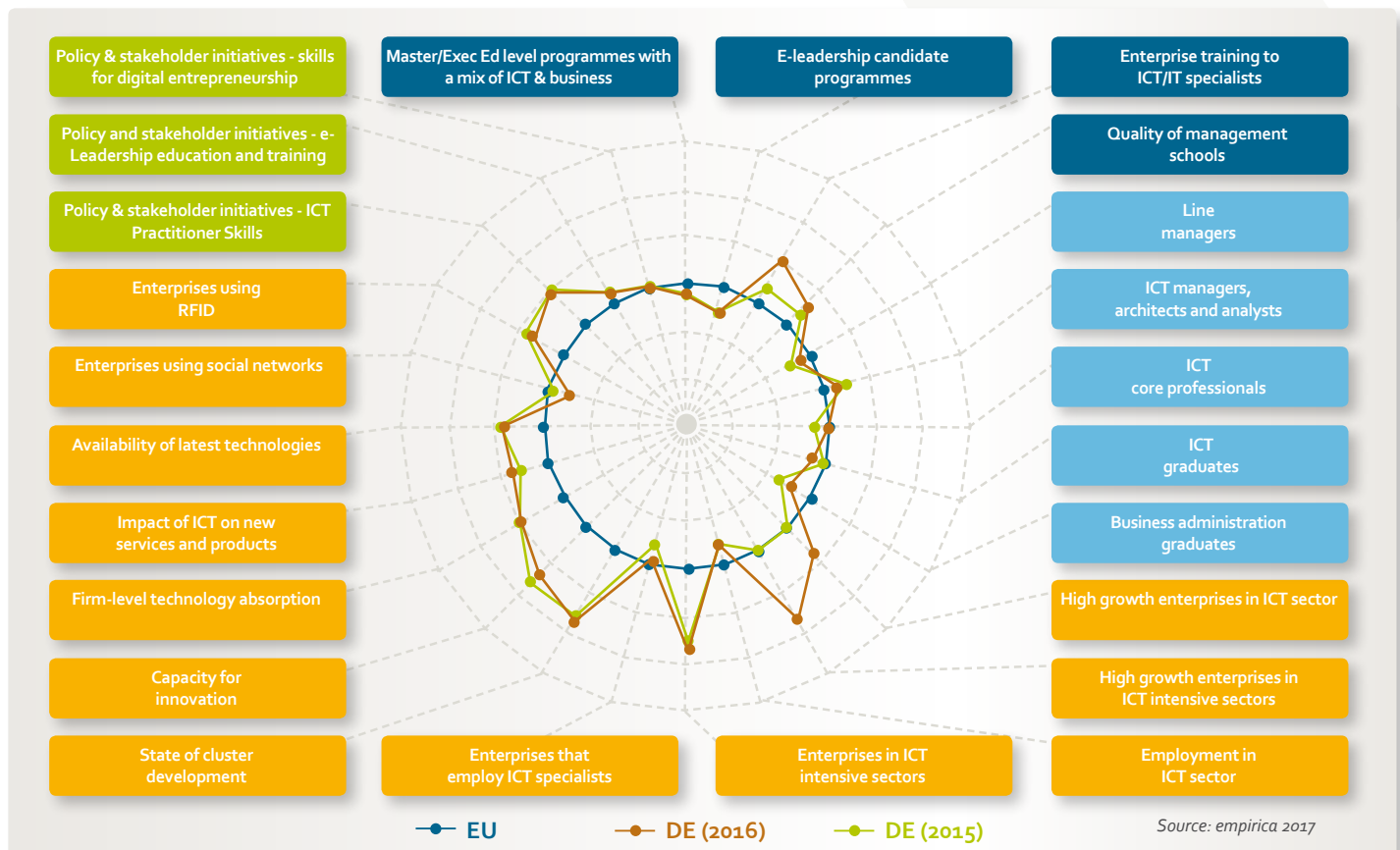
It is composed of domains such as:

- >> 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.

e-Leadership performance per indicator



## High-tech leadership Benchmarking Index

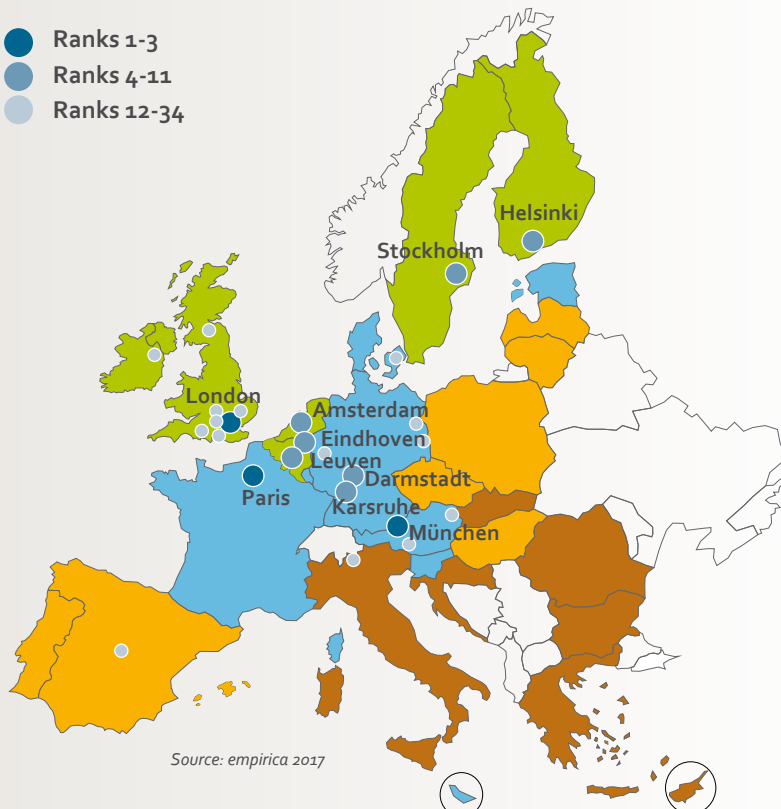
The experimental index combines each of the different dimensions of the e-leadership scoreboard to benchmark EU Member States policies in this field. The index combines indicators on the business and policy climate, infrastructure, and related outcomes on e-leadership. It locates Member States in four 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.

### European Map of e-Leadership Index quartiles

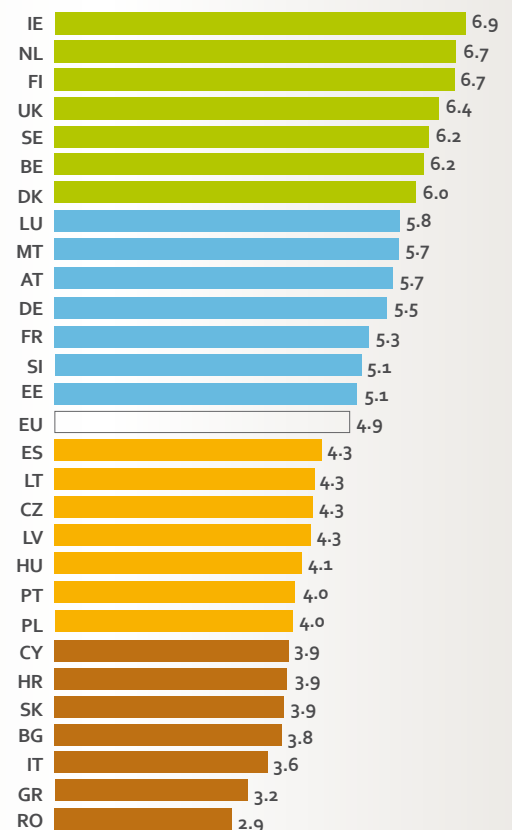
European ICT Poles of Excellence Rank in EU  
"ICT Pole of Excellence", IRC (2014)

- Ranks 1-3
- Ranks 4-11
- Ranks 12-34



- Group 1: more than 20% below EU average
- Group 2: less than 20% below EU average

- Group 3: less than 20% above EU average
- Group 4: more than 20% above EU average





**Freddy Van den Wyngaert**  
CIO, Agfa ICS

*At AGFA we need executives to drive our innovation forward. Over decades we have invested in the digital transformation of our activities in the graphic industry and the healthcare sector. Although we are a global and innovative player, finding people with the right executive education remains difficult. This initiative is just in time to start delivering a new generation of leaders capable of capitalising on new IT competences.*

Ireland had the top performance 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.

### 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

**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/>



**Roger De Keersmaecker**

Executive Advisor, IMEC

*Bold high-tech entrepreneurs are important for the digitising economy, but leadership at work is broader and deeper, and means strengthening the high-tech leadership skills of the workforce to foster successful innovation in the future.*

### BEST PRACTICE EXAMPLE

#### 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

#### PROMPT – Professional master in software development, 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 up-grading 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/>



#### Malin Rosqvist

Project leader for the PROMPT project,  
School of Innovation, Design & Engineering,  
Mälardalen University

*The PROMPT initiative builds on successful research in cooperation between academia and industry. The motivation for researchers is that they get to work with their research partners in a new way; by training professionals, and in return they get information on industrial challenges and ways of working.*

### BEST PRACTICE EXAMPLE

#### 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

#### 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>



#### Silvia Leal

IT Programmes Academic Director, IE Business School

*Digital innovation has become a key to economic growth, but many leading enterprises are failing to maintain their leadership as innovators. They need professionals who e-Lead and catalyse the digital skills of their teams so that they produce profitable ideas.*



## BEST PRACTICE EXAMPLE

### 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](http://www.festo-didactic.com)



### Marius Rieger

Referent für Bildungspolitik im ZVEI - Zentralverband Elektrotechnik- und Elektronik-industrie e. V.

*Without Education 4.0, Industrie 4.0 will not succeed. Digital Industry will rely on employees' digital skills and on domain expertise, so digital transformation depends on appropriate education and training.*

## BEST PRACTICE EXAMPLE

### 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>



### Bruno Lanvin

Executive Director for Global Indices, INSEAD, Board member of ICANN and GovTech

*Innovation rests on talent. Commercially successful innovation requires talent and leadership reflecting the digital age: the ability to lead and inspire virtual and multi-cultural teams, to adapt to changing environments, and readiness to adopt new ways to do business. The work of the European Commission on e-Leadership and high-tech leadership skills is of critical importance for all governments, enterprises, organisations and individuals trying to turn technological innovations into opportunities.*



### Christian Pagel

Head of Information Technology Management/CIO, ThyssenKrupp Industrial Solutions

*It is high time for industry and administration to push dual thinking on education and tactical skill development as a factor in entrepreneurial success. Organisations that ignore the necessity for digital skills will be beaten by the digitalisation of economies.*

## BEST PRACTICE EXAMPLE

### 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 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 startup projects.  
<http://www.startupestonia.ee>

## Proposal for a European high-tech leadership skills agenda

Our recommendations are designed to help ensuring that Europe has sufficient talent pool of high-tech leaders in the future. They result from expert consultations in workshops, surveys and interviews.

More than 700 experts were involved in a survey and in interviews. Around 100 experts expressed interest in contributing to developing the agenda and around 50 made specific proposals.

The recommendations and 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:



The recommendations provide a roadmap for action at all levels in Europe, for industry, academia, government and other national stakeholders and the European Union institutions. They are proposed below with a timeline for key actions.



### Strategic Priority 1 – Monitoring, benchmarking and forecasting

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

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.



**Werner B. Korte**

Director, empirica GmbH

*With a favourable political and business environment and a flourishing digital and high-tech ecosystem at European and Member State level, increased investments in innovation and equipping the workforce with innovation leadership and relevant digital skills, there is strong potential for Europe to become leaders in the global economy and to produce higher-value goods and services for successful global trade.*

**Recommended action 1.1** 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.

#### 1.2 Scoreboard and index and new ways for measurements and quantification

To overcome the lack of existing official statistics on the demand for high-tech leadership skills, a recent European 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-tech 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.



**Jean-Marc Guiol**

HR Operations and EuroCIO - European CIO Association

*EuroCIO has redesigned some of their courses to better fit the requirements of industry. All courses today are shortened, sometimes from nine modules to three, and typically a course takes only one semester, to fit into change programs in enterprises.*

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.

## **Recommended action 1.2 Regularly update a high-tech leadership scoreboard and index**

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 European Commission relating to the Digital Economy & Society Index (DESI).

## **Recommended action 1.3 Develop robust methodologies for the measurement and quantification of workforce demand and supply, and forecasting of high-tech leadership skills**

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 and 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. >>

## **1.3 Mutual learning from world-class best practices**

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

## **Recommended actions 1.4 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.

14. <http://eskills-lead.eu>; e-Leadership Skills for SMEs: European Guidelines and Quality Labels for new Curricula Fostering e-Leadership Skills: <http://eskills-guide.eu>





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

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.



#### Klaas Brongers

Advisory Board, KNVI (National association of informatics professionals in the Netherlands)

*KNVI, the Royal Dutch Association of Information technology professionals, endorses the European Commission's initiatives emphasising e-leadership that show the importance of IT understanding at all levels as a key element for a sustainable economic growth in Europe.*

### Recommended action 1.5 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).

## Strategic Priority 2 – Industry, education and training

### 2.1 Universities for lifelong learning, new partnerships and players

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.



**Olle Vogel**

Programme Coordinator, KK Stiftelsen  
(Knowledge Foundation), Stockholm

*The pace of new knowledge emerging on digital skills and e-leadership requires education systems to keep course content up to date and relevant, matching results from research with needs in industry. Collaborative methods for course development should include both researchers and industry experts, and courses must be e-based and flexible to enable studies combined with work.*

## **Recommended action 2.1 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 high-tech Leaders, and build national software industries in the Member States.

## **Recommended action 2.2 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 e-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 start later in 2017.



### 2.2 'European Software Universities' for education, training and research in software-based innovation

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 strategic 'software agenda' for Europe.



**Emir Demircan**

Manager EU Public Affairs  
at CECIMO

*Advanced manufacturers need to go step by step in digitisation, which is evolutionary rather than revolutionary. One element in this transformation is investing in the hybrid skill-set that merges IT, data analytics and production technologies.*

### Recommended action 2.3 European Software Universities and programmes for education, training and research in software-based innovation

Envisage 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) 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).



## Barbara Widera

PhD Architect, Wrocław University of Science and Technology

*Over the next 10 years, the building industry will experience a green revolution requiring architects to become innovation leaders who can lead integrated design processes.*

### Recommended actions 2.4 Enhancing diverse types of mobility within and beyond advanced technologies

(Future) High-tech leaders' needs for wide exposure 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).

### 2.3 Build ecosystems

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. For ecosystems to be replicable, so that Europe is widely covered, they need to be easy to understand and implement.



## Prof. Dr. Dr. h.c. Manfred Broy

Zentrum Digitalisierung (Centre for Digitalisation), Bayern (Germany)

*Digital transformation needs leadership with deep competencies in technical issues, in software as well as in business models and digital ecosystems.*

### Recommended actions 2.5 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 European countries, 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.

### 2.4 Workforce credentialing

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.

### Recommended actions 2.6 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.

### 2.5 Embedding technical multidisciplinary in the curriculum

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 mechatronic. This multidisciplinary should become central in curricula for middle- and highly skilled workers.

### Recommended actions 2.7 Embedding technical multidisciplinary in the curriculum

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

### 2.6 Embedding non-technical courses in technical curricula

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.



**Carm Cachia**

CEO / Executive Coordinator,  
eSkills Malta Foundation

*High-tech leadership curricula can link industry and education at an executive and strategic level, to take advantage of the digital economy. The EU should form a group of thought leaders in high-tech leadership to help EU countries achieve this single market goal.*



**Dr. Kristina Dervojeda**

Senior Manager Innovation & Development, PwC

*The high-tech economy needs a new generation of leaders who can spot, create and serve new markets. Redesigned curricula need to stimulate the necessary multidisciplinary and entrepreneurial agility.*

## Recommended actions 2.8 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.

## 2.7 Updating the skills of teachers/professors

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.

## Recommended actions 2.9 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.

## 2.8 Reverse mentoring

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.

## Recommended actions 2.10 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.

## Strategic Priority 3 – Platform-based digital services for career support and recruitment

### 3.1 Platform-based digital services supporting diagnosis and self-assessment

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.





### Fiona Fanning

Secretary General, CEPIS - Council of European Professional Informatics Societies

*The Council of European Professional Informatics Societies (CEPIS) and its IT Professionalism Europe (ITPE) initiative aim to foster IT professionalism in Europe, to ensure Europe benefits from the digital revolution. The continued development of the European e-Competence Framework, incorporating e-Leadership skills requirements, is vital to closing the digital skills gap and addressing the shortages experienced in Europe today, as well as generating a workforce with the skills and competences that employers need tomorrow.*

#### Recommended actions 3.1 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<sup>16</sup> 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.

## Strategic Priority 4 – Better coordination and funding

### 4.1 Better information about and more strategic use of available funding

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.

#### Recommended actions 4.1 Setting 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 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 and a new 'Blueprint for sectoral cooperation on skills' will be piloted in six sectors in 2017. Allocations need a significant size and the scope of the activity broadened to other sectors to have an impact on the high-tech skills gaps in Europe.

16. ESCO – European Skills, Competences, Qualifications and Occupations: <https://ec.europa.eu/esco/portal/home?resetLanguage=true&newLanguage=en>; e-CF: <http://www.ecompetences.eu/>



### 4.2 Government-driven public procurement of innovation

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 European Commission 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 countries.

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.

#### **Recommended actions 4.2 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.

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.

### 4.3 Incentivise individuals

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.

#### **Recommended actions 4.3 Promote voucher systems and tax breaks for individuals and enterprises 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.



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

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.



#### Dr. Dirk Werth

Managing & Scientific Director, AWS-Institute for Digital Products and Processes

*Digital leadership is the ability to use new methods and instruments in order to transform a company towards digital organisation principles. The systematic fostering of those collective and individual skills is vital for substantial growth in Europe. It needs a common action plan from the EU, the Member States and the big corporate players to be set up as soon as possible.*

### Recommended actions 4.4 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.

## Strategic Priority 5 – National digital and high-tech skills strategies

### 5.1 Longer-term policy commitment and concrete action plans

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.



#### John Higgins CBE

Director General,  
DIGITALEUROPE

*Europe needs people who can successfully plan and lead the digital transformation of our enterprises and public services, and exploit the opportunities of key enabling technologies. We need to be able to draw on a wide variety of digital talent to make this happen. Digital is transforming the way Europeans live and work; we need more great leaders to make sure this transformation is a success.*



## Recommended actions 5.1 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<sup>17</sup> could provide a good inspiration and initial platform for cooperation.



**Chris Decubber**

Technical Director, EFFRA (European Factories of the Future Research Association)

*Connectivity is inherent to the development of the future workplace. Future knowledge workers should interact dynamically and share tasks with smart manufacturing technology. In this context, manufacturing education and re-skilling has a key role in preparing humans for new approaches to knowledge communication, skill and competence development, and advanced training.*

## 5.2 National advisory boards for informed policy development

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.

### Recommended actions 5.2: 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.

## Strategic Priority 6 – Promotion and awareness raising for leadership skills for the high-tech economy

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

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.

17. <https://ec.europa.eu/digital-single-market/en/news/launching-digital-skills-and-jobs-coalition-boosting-europes-digital-skills>



### Recommended actions 6.1 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.

### 6.2 Role models and success stories

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.



**Eva Fabry**

Director, European Centre for Women and Technology

*ECWT is committed to lead coordinated actions for gender-parity in high-tech leadership as a key to digital transformations and economic growth in Europe.*

### Recommended actions 6.2 High-tech leadership skills role models, business cases 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.



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