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DEVELOPMENT AND IMPLEMENTATION OF A EUROPEAN FRAMEWORK FOR THE IT PROFESSION

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For more information about this paper, please contact:

European Commission, Directorate General Internal Market, Industry, Entrepreneurship and SMEs

Directorate Innovation and Advanced Manufacturing

Unit for KETs, Digital Manufacturing and Interoperability

E-mail: GROW-F3@ec.europa.eu

Project lead:

Niels van der Linden

Managing Consultant, Capgemini Consulting

E-mail: Niels.vander.linden@capgemini.com

This report was written and reviewed by: Niels van der Linden, Co Siebes, Karien Sneep (Capgemini Consulting), Francesca Bonazzoli, Marta Dimauro (EY), Gabriella Cattaneo, Marianne Kolding and Rosanna Lifonti (IDC).

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Executive summary

This interim-report is made up halfway the project's timeline. It presents a first comprehensive European Framework for the IT profession, and more: it initiates implementation actions that contribute to maturing the IT profession and in doing so aim to grow the supply of IT professionals, their mobility and to reduce mismatches that cause unnecessary unemployment. This summary explains:

- **why** the Framework for the IT profession plays a key role in further maturing the IT profession;
- **what** the forecasted shortage of IT professionals is in Europe, and Canada, Japan and USA;
- **how** the Framework for the IT profession establishes synergies for beneficiaries and users;
- **who** the early adopters of this Framework for the IT profession are that have already initiated simple, demand-driven, pragmatic, scalable and sustainable implementation actions;

Maturing the IT profession

Technology is changing our world. Nowadays, planes are being 3D printed[1] as are spine implants[2], big data analytics on cell phones helps to understand spread of diseases, Blockchain is to disrupt transactions as we know them now, crowdsourcing solutions are changing consumer goods manufacturing, military operations are impossible to imagine without drones and robots have taken over warehouses completely. We read about these developments on our mobile device after being triggered by our smart watch, wearing digital make-up[3] and while sitting behind the steer of our 'automated assist' car preparing ourselves for a run in a 'wearable' shirt that collects real-time exercise data. At the same time, deep-learning software is creating intelligent machines that might finally escape the pages of science fiction.

However, with the greater opportunities technology offers, comes a greater responsibility. The case of Volkswagen made this painfully clear, and there are more examples of immoral (even illegal) behaviour by IT practitioners. The extent to which IT is embedded in our lives is inevitably growing. The physical and digital world are blurring, imposing challenges on us as regards personal privacy, data security and even our personal relationships. If we fail to take steps to mature the IT profession, it is likely that the risks to society from IT will grow to unacceptable levels[4].

Trust is the key word here. **We must continue to nurture trust in IT professionals**. Continuous development of knowledge, skills and competences is vitally important to reach that goal. Professionalism is absolutely fundamental to the effective practice of IT. The IT profession is relatively young and maturing the profession will undoubtedly take time, but the time for engagement and action is now[5]. Obtaining the status of a profession requires professional bodies to set suitable standards of knowledge and codes of conduct.

Standardizing is a means to further mature a profession. This is also the direction that the European Commission and stakeholders are following: the European e-Competence Framework (e-CF) has become a standard recently and the ambition is to do more. A standard that includes not only competences, but also other essentials for any IT professional: knowledge, ethics, and education and certification.

This report presents a first comprehensive European Framework for the IT profession that consists of these pillars, and showcases implementation actions that contribute to achieving that end-goal of standardising.

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[1]   https://www.technologyreview.com/s/601268/airplanes-are-getting-lighter-thanks-to-3-d-printed-parts/#/set/id/601288/
[2]   https://www.weforum.org/agenda/2016/01/a-brief-guide-to-the-technologies-changing-world
[3]   http://mashable.com/2015/09/04/panasonic-magic-mirror/#WEP.qpz.egqa
[4]   IVI/CEPIS: "e-Skills and IT professionalism. Fostering the IT Profession in Europe", prepared for the European Commission, 2012
[5]   http://cepis.org/professionalism

Any organisation would want its IT staff to be professional in their practice, and to be recognised and accepted as being professionals. A Framework for the IT profession helps employers in providing a common language for professional development of IT professionals across Europe (and potentially beyond), while stimulating the mobility of employees and offering them tools to develop their careers. The benefits to organisations and society include practitioners having an adequate level of knowledge, providing a higher level of products and services, and abiding by professional standards and codes of ethics[6].

This challenge of maturing the IT profession is not unique to Europe. The project reflects parallel efforts in other parts of the world, such as driven by IPA in Japan, or ICTC[7] in Canada

Growing supply & reducing mismatches in Europe and Canada, Japan and USA

However, will there be sufficient staff? As it is clear that demand will outstrip the supply of IT professionals that can help organisations design, build, implement and manage new digital technologies. The gap in the skills demanded versus skills available will widen to reach 5.8% in 2020 which is more than double the gap seen in 2015, leaving approximately 515.000 vacancies unfilled across Europe.

We observe a similar trend outside Europe: in Canada, Japan and the USA. Our analysis shows that the UK will experience the strongest growth in the gap between demand and supply of IT professionals followed by Japan. Canada is the only country that will see the gap decrease over the period but at a very high level. The picture for the EU28 overall is of similar magnitude to the US and to France, while the gap in Germany will widen the least.

However, although the demand for skills can change quickly, the supply of skills is less volatile due to the time it takes for people to gain the necessary education, capabilities and experience to join the workforce "stock". The ability of education and training systems – from graduate and executive formal education to on-the-job and lifelong learning approaches – to flex with changing demand is increasingly important as the rate of technology changes and adaption is speeding up. And at the same time, private education is taking a leap across Europe showing students are looking beyond traditional options when deciding their future[8].

It is also important to bear in mind that the gap is not just about absolute numbers missing in the total IT workforce, but also very much about skills mismatch compared to market demand. This is where the Framework for the IT profession can play a critical role in providing the instruments, tools, standards that could contribute to reducing that mismatch and increasing transparency of the IT profession.

Establishing synergies for beneficiaries and users

The current state of play of the IT profession's building blocks shows a strong disparity in the level of maturity and adoption of the four pillars and, more in general, reflects the poor integration between them. Many initiatives have been launched so far to develop and promote (the pillars of) IT professionalism, but most of them address a single pillar, not the overall framework. Thus, a systemic approach is required to tackle main challenging and pressing issues concerning the IT profession.

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[6] Ridge, J., Australian Computer Society, Available online here:
http://press.anu.edu.au/apps/bookworm/view/Professionalism+in+the+Information+and+Communication+Technology+Industry/10791/ch02.xhtml

[7] See for instance: "Digital talent. The road to 2020 and beyond". A national strategy to develop Canada's talent in a global digital economy, Information and Communications Technology Council (ICTC) Canada, www.ictc-ctic.ca

[8] The Economist, 'Class apart. A growing number of European students are opting to pay for their education', 19 March 2016. Available online here: http://www.economist.com/news/europe/21695002-growing-number-european-students-are-opting-pay-their-education-class-apart

Managing the four pillars in a more integrated and complementary way is the key success factor for developing the European Framework as a unique point of reference for all beneficiaries and users dealing with IT professionalism. It will serve IT practitioners while orienting and planning their career as well as support Education providers, Professional Associations, Industry and Public sector, in creating the right conditions to mature and promote IT professionalism, and ultimately increase Europe's competitiveness.

The European Framework for IT Profession is designed to be more than the sum of its parts. The Framework is based on four building blocks essential to mature the IT profession: Bodies of Knowledge, Competences (e-CF), Education, Training & Certification, and Professional Ethics. The main strength of the proposed framework is the combination of stable components with a high degree of flexibility allowing to adapt to rapid IT changes and emerging market requirements. This report showcases examples of how these building blocks establish synergies for both the IT practitioners as well as for the many users that exist in Education, Government, Professional Associations, Certification providers and Employers.

The European Framework for IT Profession is user-centric and offers value in each stage of the IT professional's career path. Use cases are elaborated for: 'preparing to enter the IT profession', 'starting a career in IT', 'changing a career', and 'developing a career'. Each use case describes the challenges encountered in these stages of a career, and how the Framework instruments could help.

Clear value propositions are important to ensure the continued engagement of stakeholders in the further development and uptake of the framework. There currently is a general consensus among the stakeholders on the advantages deriving from the adoption of joint solutions at EU level to overcome the national fragmentation and to find a common ground for interaction. It does however require that stakeholders not only understand and agree on their role, but are also equipped with instructions and guidelines to fulfil that role. The Framework will also include such practical guidelines, and these will be part of the final report to be published early 2017.

Early adopters that initiate implementation of the Framework

Begin with the end in mind. In the long-term, the European Commission aims for recognition of the Framework as a standard that is used (implemented) by all European countries. Early adopters taking the first actions in that process of implementation will trigger others to follow, and eventually reach that long-term goal. This project, on the short-term, will identify these early adopters, select feasible actions that can be started during the course of this project and support the initial steps. Commitment of these early adopters is necessary to continue and monitor the actions initiated after this project has ended.

The support for this Framework and further maturing the IT profession is overwhelming. It is also a prerequisite to any successful implementation and therefore leaves us confident that – also after the project ends – there will be continuation of the actions initiated under this project as well as follow up on other important ideas raised in the first phase of this project. The ambition for this interim report was to have at least a clear view on possible interested countries and a longlist of solutions, with the aim of preparing the implementation during Phase 2 of the project, and starting the implementation during the last three months of the contract. At the moment, besides those goals, three initiatives are already starting up and various others are in the pipeline. This is very encouraging and positive signal for the second phase of the project. But more: it is a great step towards establishing an IT profession that is mature, transparent, and trustworthy.

Maturing the Professional Framework and the profession go hand in hand. This report provides a long-list of possible implementation actions all contributing to two sub-goals:
- The building blocks of the Framework should be further developed and reach a level that allows them to be recognised as standards – similar to the path of the e-CF;

- The Framework itself should be adopted by (professional organisations in) countries in Europe, and used in practice.

Three concrete implementation actions have already been initiated as these match the criteria (simple, demand-driven, pragmatic, scalable, and sustainable) very well and stakeholders involved have shown strong commitment to take the action. The three initiated actions are:

1. Development of European Ethical Guidelines, with the support of many stakeholders including CEPIS who have committed to a leading role, and various national professional associations;
2. A mapping of e-CF and SFIA, with great support of the SFIA Foundation and BCS, The chartered institute for IT, contributing to a global uniform language, increasing mobility for professionals and employers;
3. Adoption of the Framework for the IT profession by the ASL-BISL foundation – a Services Libraries or specific Body of Knowledge that represents a new and developing IT domain. With the aim of convincing other foundations (ITIL etc.) to follow the same path – and hence creating uniformity and a common language for each role in IT;

More actions are to be expected. Following these, Spain and Italy are very eager to also initiate implementation of the Framework. **Spain** has shared an impressive list of potential initiatives that they are keen on taking forward within a selected network of 70+ Spanish experts representing key stakeholders. Similar views for **Italy**, that was at the forefront of the recognition of the e-CF as a standard, and **Ireland**. Besides these countries, there are also very positive conversations with for instance the **Open Group**, that is a global consortium of more than 500 member organizations, spanning all sectors of the IT community — customers, systems and solutions suppliers, tool vendors, integrators and consultants, as well as academics and researchers.

Finally, a group of leading European experts from key stakeholders, government, academia and industry will be established to assist in the development and the implementation of the framework in Europe, coordinate actions and prevent fragmented initiatives. It is expected that in the future this initial core group of experts will become a larger and sustainable pan-European network.

This interim-report is made up halfway the project's timeline. The final report will be published early 2017, but you will have the chance to learn the insights during a **high-level Conference on 6 December 2016**, in Brussels. And more importantly, you can contribute to this project and help advancing the IT profession in Europe and beyond. For registration, questions and other: please contact us through www.ictprofessionalism.eu .

1   Introduction

1.1   A call for action

Technology has changed our world, and continues to do so. There are many examples across all industry sectors: from plains and spine implants[9] being 3D printed[10] to big data analytics on cell phones to understand spread of diseases. Blockchain is expected to disrupt transactions as we know them now, while crowdsourcing solutions are changing consumer goods manufacturing. Defence, healthcare, retail, finance, public sector: all are affected by digital transformations. And it affects us too: less and less citizens are remembering times without mobile devices, navigation tools, and social media (to name a few) nor that our working place consisted of a text writer and paper files.

However, with the greater opportunities technology offers comes a greater responsibility. The case of Volkswagen made this painfully clear. The more we're depending on technology, the more the physical and digital world are blurring, imposing challenges on us as regards personal privacy, data security and even our personal relationships. Failure to take steps to mature the profession would increase the potential risks of harming the society to unacceptable levels[11].

The European Union needs to ensure that the knowledge, skills, competence and creativity of the European workforce, including its IT practitioners, meet the highest global professional standard and are constantly involved in a process of effective lifelong learning for update. Developing and implementing a unique European Framework for the IT profession is the **way forward** to address the key structural challenges determined by the technological innovation and the fast growth of IT activity.

As underlined by the IVI/CEPIS Report in 2012, there are many reasons to foster the IT profession in Europe:
1. IT skills gaps and/or shortages, acting as a brake on European global competitiveness given IT's role as an enabler of business value;
2. Poor public image of the IT profession, impacting the numbers entering the profession and thus, its attractiveness towards new talented generations;
3. Low levels of IT expertise and/or siloed knowledge, hampering the view of the 'big picture' of IT, its interconnectedness, and its role in enabling organizational capability;
4. Impact of the 'IT black swans'*,* failed IT projects resulting in failure of the business or severe reputational damage.

To accommodate a sound and responsible increase of digitisation of our society there is a clear need to further mature the profession that is responsible for that digitisation.

According to Eurostat, nearly 8 million persons in the European Union (EU) were employed as Information and Communication Technology (IT) specialists, representing 3.7% of total employment. Over recent years, both the number and the share of IT specialists in total employment have continuously increased to better adapt to an ever digitalised world. Most recent Eurostat statistics on the size and composition of the IT workforce across Europe shape the context of the change and bring further evidence to support the adoption of a framework in Europe[12]:

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[9] https://www.weforum.org/agenda/2016/01/a-brief-guide-to-the-technologies-changing-world
[10] https://www.technologyreview.com/s/601268/airplanes-are-getting-lighter-thanks-to-3-d-printed-parts/#/set/id/601288/
[11] IVI/CEPIS: "e-Skills and IT professionalism. Fostering the IT Profession in Europe", prepared for the European Commission, 2012
[12] Eurostat, 21 January 2016, available online here: http://ec.europa.eu/eurostat/documents/2995521/7141198/4-21012016-AP-EN.pdf/f366dacf-bff5-467c-b8cd-ebfba6a44d5b

5. Almost all enterprises in many economic sectors, have experienced problems in employing, recruiting IT specialists and thus, the number of hard-to-fill vacancies for IT specialists has been high regardless of the specific economic activity;[13]

6. Within private sector companies, IT specialists are perceived an integral component of the business functioning and as a key factor for the effective use of IT into all the business processes and daily transactions;[14]

7. Broken down by gender, the majority of IT positions are held by men (82% of IT specialists)15 stressing the importance of addressing gender-related issues in the IT domain;

8. Looking at age and education, the majority of employees in this field are highly educated people (mainly tertiary education level) and aged over 35 confirming the ageing the IT market labour force and the limited attractiveness of the IT career for the younger generations.

As we will see in the forecast for the coming years (chapter 2 of this report) this could even further increase if not the correct measures are taken.

Other surveys show that salaries in IT are on the rise, and because of a chronic skills shortage this will make it very hard for companies that cannot offer these salaries to remain attractive for new employees and as a result will also have difficulties retaining their most talented workers[16]. As a consequence, the gap between high earners and low earners has widened substantially and new research[17] shows that a substantial part of the growth in this wage gap can be attributed to computer technology. New computer technologies require major new skills. Workers who learn these skills see their wages grow, but many workers have difficulty acquiring the new skills. And their wages have been stagnant, leading to a growing wage gap[18].

The complexity of the challenges illustrated above, suggests the limited value of any national-based strategy in driving the change in isolation as well as, the impossibility for the market to achieve an equilibrium based on self-regulation. At the same time, there are growing public concerns about the possibility to control or at least to keep up with the path of change. Maturing the IT profession is still an imperative to keep Europe competitive on a global scale but a joint and coordinated effort is needed from all the actors at EU and national level.

This report introduces a comprehensive European framework for the IT profession, as a value-driven and up-to-date tool to address the challenges ahead by providing a common language that covers competences, knowledge, education and training and certification, and ethics to all the economic sectors.

This challenge of maturing the IT profession is not unique to Europe. This project also reflects on parallel efforts in other parts of the world, such as driven by IPA[19] in Japan, ITIF[20] in the United States, or ICTC[21] in

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[13] From a geographical perspective, across the EU-28 some Member States have encountered more difficulties (e.g. Czech Republic, Luxembourg and Austria) compared to the average percentage of enterprises at EU level (38%).

[14] In 2015 the 20% of EU-28 enterprises employed IT/IT specialists with highest percentages in Ireland (30%), Belgium and Netherlands (28%) followed at a short distance by Greece and Cyprus (26%). Broken down by size, the average at EU level was mirrored in the SMEs (19%) while IT specialists in medium and large enterprises accounted for 43% and 77% of respectively across the EU-28.

[15] The sharpest gender disparities could be found in Luxembourg, Cyprus and the Netherlands where men in the IT-specialist workforce were more than 8 out of 10 in 2014. On the contrary, some countries such as Bulgaria, Estonia and Romania recorded the top female percentages (around 30% of the total IT-specialist workforce).

[16] Brand-E, *UK faces deep tech skills shortage*, January 2016. Available online here: http://www.brand-e.biz/uk-faces-deep-tech-skills-shortage_36859.html .

[17] Bessen, J., *How computer automation affects occupations: technology, jobs, and skills*. Boston University School of Law, 2016 Available online here: http://www.researchoninnovation.org/research-summary.html

[18] Bessen, J., Computers don't kill jobs but do increase inequality, Harvard Business Review, March 2016. Available online here: https://hbr.org/2016/03/computers-dont-kill-jobs-but-do-increase-inequality

[19] Information technology Promotion Agency (IPA), see for instance the aim to protect and nurture the IT society: https://www.ipa.go.jp/english/about/about.html

[20] Information Technology & Innovation Foundation (ITIF), see: https://itif.org/about

[21] See for instance: "Digital talent. The road to 2020 and beyond", A national strategy to develop Canada's talent in a global digital economy, Information and Communications Technology Council (ICTC) Canada, www.ictc-ctic.ca

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Canada, and even more important initiated collaboration with key stakeholders in those countries to exchange knowledge and experiences on these issues that are global.

1.2   Project objectives

This project is commissioned by the European Commission, Directorate General Internal Market, Industry, Entrepreneurship and SMEs and aims to achieve three objectives:

1. **The update of key indicators and progress on the situation concerning the IT profession** based the latest data, trends and developments, regarding:

- The evolution of the supply and demand of IT professionals in Europe (2014-2016) and new updated forecasts for 2020, building on previous work on the topic;
- The evolution of the situation concerning IT industry training and certifications and progress related to the development of a governance model based on multi-stakeholder partnership, the mapping of IT industry based certifications to the European e-Competence Framework and the provision of related online self-assessment tools.
- The evolution at international level building on previous work of the European Commission and the Organisation for Economic Co-operation and Development (OECD) on the topic, including a detailed analysis and comparison of the situation for Canada, Japan, USA, Germany, France and UK.

2. **The development and the implementation of the four foundational building blocks for a first comprehensive European Framework for the IT profession**. These four building blocks have already been defined in the report on "e-Skills and IT professionalism: Fostering the IT profession in Europe" (2012) as:

- Body of knowledge: a method of establishing a profession is to define an appropriate body of knowledge6, which may be used to set standards and certification processes.
- Education and Training: certifications, qualifications, non-formal learning and informal learning are mutually supportive components of a professional's career development and they attest to an individual's competences and skills.
- Competences: an understanding of the capability and competency needs of individuals7 working in various roles is essential for organizations to effectively recruit and develop suitable employees.
- Professional Ethics: a defining aspect of any profession involves adhering to professional ethical conduct.

Building on state-of-the-art achievements, best international practices and relevant on-going activities, the main goal will be to propose concrete solutions which could start to be implemented in the short term in at least three EU Member States before the end of the service contract.

3. **Establishment of a group of leading European experts** (with a "core group" of 20 experts) in this field from key stakeholders, government, academia and industry to assist in the development and the implementation of the framework in Europe, coordinate actions and prevent fragmented initiatives. It will deal with the indicators, the building blocks and the articulation between qualifications and certifications vs. skills and competences. It will also facilitate progress during the implementation stage and follow-up activities.

It is expected that in the future this initial core group of experts will become a larger and sustainable pan-European network. It will be important to take this expectation into account when selecting the experts and formulating concrete recommendations for the future.

1.3   Project approach

An old African proverb says that '*if you want to go fast, go alone. If you want to go far, go together'*. Establishing the profession will take many years and proposals for its development will need to be flexible and open to change and adaptation. The end-goal is just as important as the road towards that goal. It is hence vitally important to bring together relevant stakeholders across Europe – and in other parts of the world - to discuss the current state of IT professionalism and how it must be developed for the common good.

This interim report concludes the first phase of this project. This phase could be best described as 'building phase' that follows a consultative approach to engage key stakeholders in the design and implementation of the Framework already in an early stage. This is also essential to work towards demand-driven framework and consequent implementation actions; obviously fundamental to ensure sustainability. It consisted of broad desk research, over 50 interviews with key experts in and outside of Europe, two interactive workshops with over 25 participants, and will be complemented by an online survey on expectations of the framework in general and suggested implementation actions in particular. These activities created the knowledge base that feeds into the work to achieve the three aforementioned objectives of this service contract. For each objective we will now shortly explain what has been achieved in the first phase of this project, and consequently in paragraph 1.3.2 what is planned for in the second phase of the project.

1.3.1   Phase 1 (September 2015 – April 2016) – completed steps

For each objective a short overview of activities and deliverables is presented below, with reference to the chapters where more details can be found.

1. The update of key indicators and progress on the situation concerning the IT profession based on the latest data, trends and developments is captured in **chapter 2** of this report and includes:
   - The measurement of key indicators on the supply and demand of IT professionals in Europe for the period 2014-2016, building on the previous work carried out on the topic, with the estimate of gaps, excess demand, and mismatches.
   - The forecast of the main indicators to 2020, based on the update and revision of the forecast scenarios.
   - A detailed comparative analysis of the key indicators for Europe (with a specific focus on France, Germany and the UK) versus the US, Canada and Japan.

2. The overall process of development of the Framework and implementation of the proposed actions has completed the first stage (of three) of which the results are presented in **chapters 3, 4 and 5**:
   - The first stage (BUILD) delivered an analysis of the current state-of-play of IT professionalism in Europe, European countries and Japan, USA, Canada and also as regards the status of the pillars of the Framework for the IT profession. This was completed taking into account stakeholders' views and expectations. The description of the Framework also includes a series of use cases that reflect different stages of a career in IT (orienting on a job, entering profession, changing career, developing career). This ensures a user-centric approach in the design of the Framework. Furthermore the Framework is described in terms of synergies as to provide an understanding of the possible value it can have for both IT professionals and for key stakeholders in the Skills ecology.

Two more stages follow in the second phase of the project (May 2016 – January 2017) – of which **chapter 6** already presents the latest as regards implementation activities:

- The second stage (REFINE) will focus on further refining the framework through various stakeholder consultations (see next paragraph on 'steps planned for').
- The third stage (RUN) concerns initiating at least 3 implementation activities of simple, demand-driven, pragmatic, scalable and sustainable solutions that bring clear added value at EU and international level. A longlist of solutions has been gathered from the knowledge base activities and these will be further evaluated. **At the moment, we have already started up three activities and a few more are in the making**. This will ensure a broad support that contributes to sustainability of the Framework and increased take-up across Europe. The activities concerning implementation are described in **chapter 6**.

3. As regards the establishment of a group of leading European experts:
- A list has been proposed to the Commission, and this list will be further expanded during the second phase of the project.
- Spain, by input of the CCII, has produced a stakeholder map of 75 key experts in Spain that will contribute to further implementation actions and sustainability of these actions. Following this example, the second phase of the project will see to draft similar maps for other countries or on specific topics (e.g. on Ethics).

1.3.2   Phase 2 (May 2016 – January 2017) – steps planned for

This paragraph provides a short overview of planned for steps in the second phase of the project.

1. The update of key indicators and progress on the situation of the IT profession will furthermore see to:

- Updating the method for producing key indicators on supply and demand
- Validation efforts with key experts in Europe to align on proposed method
- Validation efforts with key experts in Canada, Japan and USA on proposed method and updates as regards the international comparisons
- Consolidation

2. The development of the Framework and implementation will take on the following activities:
- The second stage (REFINE) will focus on further refining the framework through various stakeholder consultations such as the CEN IT Skills workshop, continuous conversations with stakeholders in the field, two project-workshops and another large scale online survey.
- The third stage (RUN) will seek to:
    - o Initiate even more implementation activities of simple, demand-driven, pragmatic, scalable and sustainable solutions that bring clear added value at EU and international level. A longlist of solutions has been gathered from the knowledge base activities and these will be evaluated a) by committed countries and organisations willing to contribute and b) by a wide audience of IT professionals and stakeholders via an online survey.
    - o Derive a roadmap for implementation and/or action plans that can be used as examples/templates for other countries/organisations to take-up (parts of) the Framework.

- Support the planned for implementation actions and derive learnings and recommendations as input for the final report, and also to serve as input to:
- Develop practical guidelines and instructions on how to use the Framework and its instruments.
- Draft clear proposals for each stakeholder group as regards their role in sustaining the Framework and increasing take-up.

3. As regards the establishment of a group of leading European experts:
- Besides refining and validating a network of experts, the final report will also seek to provide recommendations as regards the governance of the Framework (building on previous work done[22])

1.4 Reading guide

This chapter presents the call for action and project objectives, approach and planning.

The rest of the report is constructed as follows:
- Part A concerns key indicators for the IT profession on the supply and demand of IT practitioners:
  - In Chapter 2 the current state-of-play in Europe, USA, Canada and Japan concerning the IT profession is described, as well as a section on gender;
- Part B concerns the European Framework for the IT profession, and specifically sets out:
  - In Chapter 3 the rationale for this Framework is explained as well as insights into current policy developments at EU, national and international level, and the relationship with topics e-Leadership and KETs;
  - In Chapter 4 the state-of-play of each of the pillars of the Framework and its synergies;
  - In Chapter 5 the target audience of the Framework and its users;
- Part C concerns implementation of the European Framework for the IT profession:
  - Chapter 6 describes end goal and challenges in getting there, the approach towards implementation, a long list of suggested initiatives and three already initiated implementation actions;
- Chapter 7 concludes the report with some recommendations concerning sustainability.

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[22] IVI/Nui Maynooth, "Governance framework for IT professionalism. Proposal", December 2013. Available online here: http://eskills-monitor2013.eu/fileadmin/monitor2013/images/monitor_ictprofessionalism_finalreport_final.pdf

2   State-of-play in Europe, USA, Canada and Japan

This section will show what trends are driving the demand for IT skills. It also answers the question: will there be sufficient and well qualified staff for organisations to take full advantage of the opportunities that technology offers? And how does Europe compare in this regard to leading economies such as Canada, Japan and the United States of America? This chapter provides a burning platform that a Framework for the IT profession should aim to extinguish (as will be part of the next chapters in this report).

2.1   Technology & business trends driving the demand for IT professionals

This section describes the main technology and business trends that are driving the demand for IT skills[23].

2.1.1   Technology Driven Business Transformation

It is widely considered that adoption of new advanced technologies will transform dramatically every-day life, businesses, and the global economy. This trend already started in the beginning of the 2000s, and most analysts believe that this technology-driven business transformation – often termed digital transformation – will be evident in the upcoming years will lead to disruption in the industry landscape and the way modern industries work, produce, and deliver. There are already several examples of this happening (Netflix in movie rental, Uber in taxi services and Airbnb in accommodation booking to mention a few well know examples).

The main structural characteristics of digitally transformed industries will be:

- **Integration and very structured organisations.** Digital transformation will drive an unprecedented reorganisation of production processes, of value creation and of industry structures. Digital platforms and social connections may help achieving scales previously attainable only by large organisations, so that the size of the business may not be as relevant as it was in the past since even the smallest company can achieve global reach. The emergence of industry platforms will create new products and services, and modify and integrate the supply chain: more integration but also more flexibility will be a characteristic of the future production processes. Industry platforms will allow personalisation of products both in B2B and B2C relationships, which were previously inconceivable without high costs. A new generation of organisational concepts and work skills are going to be necessary; new work skills will come from game design, neuroscience, and happiness psychology.

- **A globally connected world.** The past couple of decades have witnessed both increasing globalisation of products and services and increasing globalisation of the production system. Nowadays, availability of computing power, memory, connectivity, and high-speed networks are increasing the ability to connect factories and businesses, much more than was possible just a few years ago. This connection capacity is changing the way manufacturers interact with customers and with their suppliers, and is modifying the traditional relationships and exchanges along the supply chain. Previously, economic theories and analysis were based on the idea that large companies could take advantage of scale factors around cost and supply-chain efficiencies. With the digital factory, we need to re-think production processes, competitive advantages, and stakeholders' relationships.

- **Automation driven by artificial intelligence transforming work.** Digital innovation is progressively increasing the activities that can be automated. The magnitude of the automation benefits seems to

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be very relevant and they can provide unexpected competitive advantages. Sometimes we can hear that automation is a threat for the employment. Nevertheless, it is not known whether the net effect on employment is positive thanks to the competitive advantage provided by automation. Automation will transform the vast majority of occupations which will require a redefinition and a transformation of business processes. The benefits will not only affect cost savings aspects but they may extend beyond that and require a profound re-organisation of business processes. This will create new social and economic challenges and require a change in the governance of the labour market.

2.1.2   Underlying Technology Trends

In IDC's vision, the IT industry is in the midst of a "once every 20–25 years" shift to a new technology platform for growth and innovation (the 3rd IT Platform), expected to dominate the market by 2020 (see Figure X). This platform is characterised by the disruptive combination of the following technologies:

- The widespread adoption of cloud computing, a disruptive delivery model of IT software and services, based on flexible and on-demand business models;
- The rapid penetration of mobile devices and technologies, including mobile apps and M2M, machine to machine connectivity through billions of sensors (the Internet of Things);
- The emergence of Big Data analytics, driven by the huge increase of data generated by mobile devices and the Internet;
- The adoption of social technologies, migrating from the personal to the business environment will be affecting profoundly business and social interactions within enterprises and in supply chains.

In addition, it is necessary to consider another, horizontal transformational trend, that is:

- IT security: affected by the new technology environment, shaped by emerging cyber threats and the evolution of regulation, this trend requires specific attention and influences the mix of skills required to deal with these new challenges.

These core technologies have already built momentum, but they are now becoming the "building base" for an additional wave of technologies – called innovation accelerators by IDC – which will radically change and expand the possibilities and opportunities that IT can bring in terms of innovation and value creation. The additional innovation accelerators that IDC assesses will have a major impact in Europe out to 2020 are:

- **The Internet of Things (**IoT) which 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:** Technology that allows immersive visual experience that removes or complements external visual input and follows the user's head movement;
- **Wearables:** At the broadest level, wearable computing devices include any wearable device with a microprocessor. "Wearable" implies that the device operates in a hands-free fashion and the user can readily put it on and take it off. "Computing" means that it is capable of digitally processing data.
- **3D printing of all kinds:** Materializing all sorts of physical things from digital blueprints — from food to clothing to eventually even living tissue and organs.
- **Cognitive systems and robotics:** Systems that observe, learn, analyse, offer suggestions, and even create new ideas — dramatically reshaping every services industry. Includes artificial intelligence (AI), machine learning, cognitive computing, and robotic process automation.

Source: IDC, 2016

2.2   Supply and demand of IT professionals in Europe

Since 2009, IDC and empirica has worked together to develop estimations of IT skills demand and supply and provided forecasts of development for the coming years to enable for a continuous monitoring and benchmarking of developments in precursor service contracts for the European Commission. The approach taken in this study follows the same methodology and approach. The figure below provides a simplified outline of the baseline supply-demand model.

IT Workers Demand and Supply Model, Simplified Outline
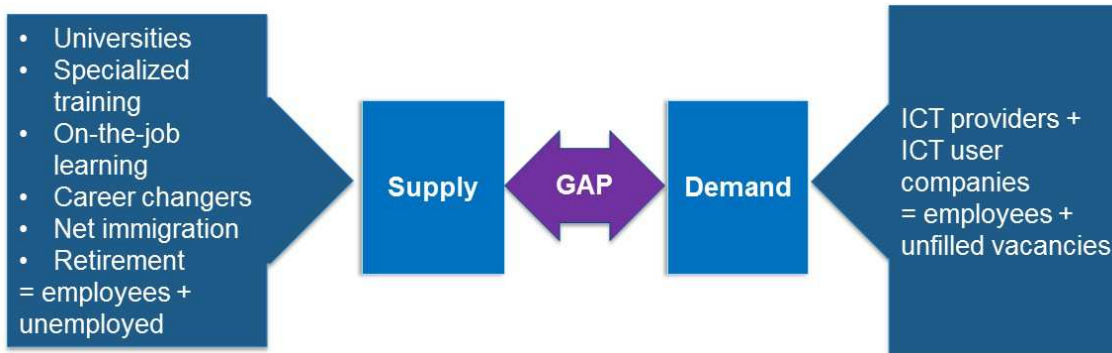
Source: IDC and empirica, 2016

Essentially, the supply side of the model in the base year (in this case 2015) includes individuals in IT practitioner positions and unemployed IT practitioners. The movements in the supply stock arise from new entrants, such as new graduates, net career changers and net immigration. On the demand side in the base year (again 2015), the model measures the size of the IT practitioner workforce that the market would absorb

given a set wage level. Limitations, such as the availability of skills in general and at the wage level that employers are willing to pay can result in unfilled vacancies. Movements in the demand will be influenced by factors such as IT investment patterns and efficiency improvements including through new IT delivery models. It should be considered that the model does not compute the mobility flows of IT workers between EU MS (for lack of good quality data) and the results are a snapshot of a constantly evolving labour market.

The concept is further being elaborated, also with countries outside of Europe (Japan, Canada, and USA). We would like to ensure that the ISCO-08 occupations that we are considering as part of this project are as complete and relevant as possible. We would also like to ensure that they resonate with regions and countries, where ISCO-08 is not generally used as the standard occupational classification. For this purpose the second phase of the project will organise a workshop with the aim to further discuss the definitions used and to make sure they reflect general opinions as good as possible.

2.2.1 Forecasting supply and demand to 2020

Applying the approach briefly described above, the overall supply and demand forecast for the EU has been developed for the period 2015 to 2020 and is shown in the table below. Detailed breakouts for demand and supply of IT professionals in France, Germany and the UK will be provided later in the chapter.

TOTAL EU28 Skills Demand and Supply Forecast

	2015	2016	2017	2018	2019	2020	15-20 CAGR
Demand	8,052,000	8,231,000	8,424,000	8,616,000	8,795,000	8,945,000	2.1%
Supply	7,837,000	7,959,000	8,075,000	8,193,000	8,310,000	8,430,000	1.5%
Gap	215,000	272,000	349,000	423,000	485,000	515,000	19.1%
Gap %	**2.7%**	**3.3%**	**4.1%**	**4.9%**	**5.5%**	**5.8%**	

Source: IDC and empirica, 2016

The demand will grow by a compound annual growth rate (CAGR) in the period 2015-2020 of 2.1% from 8.1 million in 2015 to 8.9 million in 2020. Over the same period, the available supply will grow at a slower CAGR of 1.5% from 7.8 million in 2015 to 8.4 million in 2020. Consequently, the gap in the skills demanded versus skills available will widen to reach 5.8% in 2020 which is more than double the gap seen in 2015. Historically, the unemployment rate of IT workers in Europe has always been considerably lower than the general unemployment rate (2% on average in the years 2006-2010 vs 8 to 10% general unemployment rate)[24]. This reinforces the model results about a persisting imbalance between supply and demand of IT professionals and not simply a consequence of mismatches and inefficiencies of the labour market: there is a genuine lack of IT professionals, rather than a difficulty to match demand and supply.

Key Messages

The acceleration in demand, while not excessively strong, is outgrowing the increase in the supply stock of IT practitioners in the EU. A key reason for this is that the investments in new digital technologies is taking off strongly across most European countries – and in many cases faster than was expected a few years' ago. IDC is now estimating that, on a global basis, IT investments in the 3rd Platform technologies (see above) will outstrip

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[24]   OECD (2012), "IT Skills and Employment: New Competences and Jobs for a Greener and Smarter Economy", OECD Digital Economy Papers, No. 198, OECD Publishing. http://dx.doi.org/10.1787/5k994f3prlr5-en

investment in 2nd Platform technologies (essentially technologies centred on client server architecture) already this year. Since 3rd Platform technology spending is also dramatically outgrowing 2nd Platform technologies (12.7% CAGR in the 2015-20 period compared to -5.1% CAGR), this creates significant future demand for new skills. While this is global data, this shift is also seen in Europe – and will become stronger as the large SME sector in Europe also embrace the digital trend as demonstrated from some of the commentary in the stakeholder interviews undertaken for this project:

"Digital transformation is a strong and rapidly developing trend in Denmark. There are especially two groups that are digitalizing: the public sector and the large companies." (Bo Sejer Frandsen, CEO, IT Forum, Denmark)

"Digital transformation is a trend throughout Europe but the rate of change varies across countries.... [but] it is not yet reaching SMEs as it should." (Fabrizio Gagliardi, Chair ACM Europe)

However, although the demand for skills can change quickly, the supply of skills is less volatile due to the time it takes for people to gain the necessary education, capabilities and experience to join the workforce "stock". Consequently, the development in skills supply is relatively stable over the forecast period. The ability of education and training systems – from graduate and executive formal education to on-the-job and lifelong learning approaches – to flex with changing demand is increasingly important as the rate of technology changes and adaption is speeding up. This issue of how the education and training system keeps up with the changing demand was discussed by many of the stakeholders interviewed for this project. Although there are many ideas and approaches to what can be done, there are few threads running through most opinions: make the education systems provide a strong holistic education that will provide strong grounding and understanding of what is needed from the future employers. And then use boot camps, MOOCs, shorter courses etc. to teach on specific new technologies. In addition, since the rate of change is so rapid, it is important to stimulate and encourage on-going or life-long learning. But underlying all of this is to ensure that graduates have the ability – and hunger – to learn. Said Brenda Byers, Chair, Canada's Association of IT Professionals – CIPS: "Graduate attributes should be evaluated, not in terms of specific technology knowledge, but on their ability to stay updated, to maintain their professional attributes rather than the specific technology skills. Soft skills are fundamental. Some of the specific attributes qualified graduates need to provide are the problem solving, leadership, project management, data analysis skills."

2.2.2 IT professionals in France

Just as can be seen in other countries, the trend towards using new digital technologies to transform businesses is strong in France alongside the application of IT to increase the efficiency of the business. According to a survey of European organisations conducted by IDC in February and March 2016[25], the main strategic IT priorities over the next two years is for 30% of French organisations to make the business more cost effective and for 26% to drive non-cost related business improvements (such as supporting top-line revenue growth). These strategies will be fulfilled by adopting new technologies, in particular cloud (46% of respondents) and Big Data/Analytics (24%). These future plans will have a strong impact on the skills that French organisations will be demanding. The same survey also found that French organisations will try to address these issues through a range of different approaches, including re-skilling existing staff and developing internship/apprenticeship programmes for new graduates.

Specific Assumptions for France

Despite the high unemployment rate in France over the past several years (at around 10%) and subdued growth in IT spending, driven by a weakened economy, France has still been experiencing a lack of professionals with relevant IT skills. This has been largely due to skills mismatches (i.e. the right types or levels

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[25]   IDC European Enterprise Services Survey, March 2016

of capabilities not being available in the market) combined with the fact that French organisations have been less open to pursuing other avenues to resource IT projects and operations for example through outsourcing. However, looking forwards some of these dynamics are changing and are taken into account in the specific assumptions for the development of the supply and demand balance presented below for France:

- IT spending in France will increase by a CAGR of 3.7% between 2015 to 2020, including internal IT spending from dedicated IT as well as Line of Business budgets. This data is based on forecast by IDC.
- GDP growth in the model has been aligned to the GDP forecast published by the IMF.
- The number of computer science graduates will grow by 1% each year and 95% of these will enter the IT workforce while graduates from other STEM education will be relatively stable with only 10% entering the IT workforce.
- There will be a net migration into France of mainly intra-EU people entering the workforce.

Supply and Demand Balance

The supply and demand forecast for France showed a gap of 20,000 in 2015. This represented 2.1% of the total demand. The gap is expected to increase to 3.7% in 2016 and continue to increase to 2019 after which it will tail off in 2020. By then, it is forecast that there will be a gap of 56,000 or 5.3% as shown in the table below.

	2015	2016	2017	2018	2019	2020	15-20 CAGR
Demanded	935,000	956,000	983,000	1,010,000	1,038,000	1,058,000	2.5%
Supplied	915,000	921,000	940,000	960,000	981,000	1,002,000	1.8%
Gap	20,000	35,000	43,000	50,000	57,000	56,000	22.9%
Gap %	**2.1%**	**3.7%**	**4.4%**	**5.0%**	**5.5%**	**5.3%**	

Source: IDC and empirica, 2016

Key Messages

The demand and supply mismatch or gap in France will grow strongly over the forecast period, driven by strong pent-up demand for technology refresh and application of new digital technologies to address business improvement issues. French organisations have been quite reluctant to embrace the use of outsourcing and especially offshoring to resource IT activities and operations. However, this is changing – and the Indian offshore companies (such as Tata Consultancy Services and Infosys) are now more often than not asked to bid in Request for Proposal (RfP) situations in large French organisations. In addition, Atos and Capgemini (the largest French-based IT services providers) are also building out their offshore capabilities to service their customers – including their domestic market.

However, the demand for new IT skills will not only come from the large companies. As stated during one of the stakeholder interviews for this study:

"…..the digital economy is going to get more and more important, that digital processes will involve all industries and all business dimensions and all industries: professionals, SMEs, and large enterprises into all industries. Businesses will have to digitalise their processes, otherwise they will not survive." (Francis Behr, Consultant, Syntec Numerique)

2.2.3   IT professionals in Germany

The German economy has generally performed at a much more stable level than much of the rest of Europe. This has also been reflected in IT investments in the country which has been relatively stable. German

organisations are looking at how to adopt new technologies to drive revenue growth initiatives and improving customer engagements. According to IDC's European Enterprise Services Survey mentioned above half of German organisations see driving growth in existing markets as a key driver for digital transformation, while almost 40% is looking to expand into new markets (multiple answers allowed). Having said this, there is still a strong focus also to drive efficiencies in the organisation (48% of respondents). All in all, the need for new technologies is clear in driving the change necessary in German organisations. And just like their French counterparts, German organisations are prioritising investments in Big Data/Analytics and cloud to help achieve these strategic goals – with the resulting impact on demand for new IT skills that can help lift these projects.

According to the same survey, German organisations are planning two main strands of activities to ensure that they have the right skills in place: hiring people with the right experience into the organisation (51%) and reskilling/retraining the existing workforce (49% - multiple answers allowed). However, the question is how easy it will be to use the former approach considering the current skills demand and supply balance in Germany.

Specific Assumptions for Germany

The much more stable environment in Germany – booth in terms of the economy and in terms of IT investments – has resulted in Germany facing a higher skills gap over the last few years than many other European countries. With the stronger focus towards adoption of digital technologies to grow top line revenues, this is set to continue over the forecast period. Similar to France, German organisations have been more reluctant to embrace outsourcing and offshoring than many other European countries -–but again similar to France, this is also changing even if still not reaching deep into the all-important Mittelstand.

These are some of the specific assumptions behind the development of the supply and demand forecast for Germany:

- IT spending in Germany will increase by a CAGR of 2.1% between 2015 to 2020, including internal IT spending from dedicated IT as well as Line of Business budgets. This data is based on forecast by IDC. This growth rate reflects the fact that we have seen steady IT investments since 2008 and hence are seeing less pent-up demand being released.
- GDP growth in the model has been aligned to the GDP forecast published by the IMF.
- The number of computer science graduates will grow by 1% each year and 95% of these will enter the IT workforce while graduates from other STEM education will be relatively stable with only 10% entering the IT workforce.
- There will be a net migration into Germany of mainly intra-EU people entering the workforce.

Supply and Demand Balance

The supply and demand forecast for Germany showed a gap of 56,000 in 2015. This represented 4.3% of the total demand. The gap is expected to increase to 6.9% in 2018 after which it will tail off over the period to 2020. By then, it is forecast that there will be a gap of 92,000 or 6.4% as shown in the table below.

	2015	2016	2017	2018	2019	2020	15-20 CAGR
Demanded	1,301,000	1,336,000	1,369,000	1,397,000	1,420,000	1,440,000	2.1%
Supplied	1,245,000	1,257,000	1,278,000	1,301,000	1,325,000	1,348,000	1.6%
Gap	56,000	79,000	91,000	96,000	95,000	92,000	10.4%
Gap %	**4.3%**	**5.9%**	**6.6%**	**6.9%**	**6.7%**	**6.4%**	

Source: IDC and empirica, 2016

Germany is facing quite a significant gap in IT skills over the forecast period. Based on the IDC survey data presented above, many German organisations are hoping that they can hire people with the relevant experience to fill their needs. However, considering that there will be close to 100,000 extra IT practitioners needed, this would seem to be a difficult approach – and an expensive one at that as salary levels are likely to increase. As mentioned, some of the gap could be closed by using offshore resources – but this is currently most often considered by large, private organisations and the trend towards digital transformation and the accompanying skills need affect all types of organisations. As stated by one of the interviewees for this study:

"Digital transformation is a dominant trend in Germany, and there is high recognition at policy level by associations about the relevance of this trend. In some branches this trend is very fast; it is the case of automotive, financial services, industry machines, IoT (which accelerate a lot this trend)… The digital transformation is affecting SMEs as well as large enterprises, in Germany (Stephan Pfisterer, Bitkom, Germany).

2.2.4   IT professionals in the UK

The UK economy has seen a steady return to growth over the past two years and with this also more stable IT budgets. Adoption of some of the new digital technologies, such as cloud, has taken off faster in the UK than in many other parts of Europe. In addition, the UK has been open to outsourcing and offshoring for a long time, which has created IT skills dynamics that different from e.g. Germany and France in that most UK organisations – even the public sector – are open to look at alternative approaches to resource IT projects and operations. Nevertheless, the trend towards business transformation through the use of new digital technologies continues to drive much of the new IT spending, from the IT department as well as from IT.

IDC's European Enterprise Services Survey mentioned above showed that almost half of UK respondents are currently undergoing digital transformation with another 45% planning on embarking on this in the next two years. It is especially the need to meet or exceed new customer expectations that are driving these projects (50% of respondents) followed by a continued eye on organisational agility and efficiencies (44% - multiple answers allowed). The use of cloud, Big Data/Analytics and social media technologies are important in achieving these goals. This echoes the findings from the stakeholder surveys undertaken from this study. Said Margaret Sambel, Head of Strategy for The Tech Partnership:

"Big data, cloud computing, e-commerce, and cyber security are the leading technologies and the most relevant for the new IT skills. The skills gap can definitely damage the competitiveness of the European industry. "

Specific Assumptions for the UK

While, as mentioned, UK organisations are happy to explore alternative strategies for finding the right skills needed, the strong growth in adoption of new technologies is expected to outstrip the renewed interest in STEM and specifically computing degrees seen in the latest enrolment data in the UK. In addition, there is expected to be a large outflow from the workforce due to retirement and other replacement demands with a large number leaving the workforce annually.

These are some of the specific assumptions behind the development of the supply and demand forecast for the UK:

- IT spending in Germany will increase by a CAGR of 2.2% between 2015 to 2020, including internal IT spending from dedicated IT as well as Line of Business budgets. This data is based on forecast by IDC.
- GDP growth in the model has been aligned to the GDP forecast published by the IMF.

- The number of computer science graduates will grow by 1% each year and 95% of these will enter the IT workforce while graduates from other STEM education will be relatively stable with only 10% entering the IT workforce.
- Exits from the IT workforce includes 2.5% of practitioners and 3.5% of managers that will leave the workforce annually
- There will be a net migration into the UK of mainly intra-EU people entering the workforce.

Supply and Demand Balance

The supply and demand forecast for the UK showed a gap of 49,000 in 2015. This represented 2.9% of the total demand. The gap is expected to continue to increase over the forecast period to reach 9.8% in 2020, representing a gap of 185,000 as shown in the table below.

	2015	2016	2017	2018	2019	2020	15-20 CAGR
Demanded	1,715,000	1,748,000	1,786,000	1,825,000	1,861,000	1,891,000	2.0%
Supplied	1,666,000	1,692,000	1,696,000	1,698,000	1,702,000	1,706,000	0.5%
Gap	49,000	56,000	90,000	127,000	159,000	185,000	30.4%
Gap %	**2.9%**	**3.2%**	**5.0%**	**7.0%**	**8.5%**	**9.8%**	

Source: IDC and empirica, 2016

Key Messages

The demand for IT skills in the UK will strongly outstrip the supply over the forecast period. However, a few recent trends may have a positive impact on the gap over the coming years and may result in a restatement of the forecast. These includes statistics just reported that computing courses are outperforming general enrolment rates. There have been several initiatives announced that would help to address re-skilling/re-training of people from other careers into IT, such as the British Council and Tata Consultancy Services announcing a partnership focused on training 1,000 new graduates between 2016 and 2020. Another example is Capgemini announcing its intention to create 100 highly skilled jobs over the next three years at a new application delivery centre in South Wales over five years backed by Welsh Government Business Finance Funding. While the numbers are small on an annual basis, the frequency with which such initiatives are announced is increasing.

Nevertheless, the gap should be a major concern. It is widely accepted that the ability to adopt new technologies for transforming businesses is a key competitive factor. The UK economy could face a major challenge if it cannot address this skills issue.

2.2.5   The On-going Gender Issue

Despite the topic having been discussed for several years, the ability to attract women into the IT profession remains difficult. Recent EUROSTAT statistics on the size and composition of the IT workforce across Europe[26] show that the majority of IT positions are held by men (82% of IT specialists)[27]. There are several studies that have looked at this issue in great detail[28] and there is significant focus on this also from an EC perspective[29].

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[26]   The presented statistics are the result of a survey on IT usage and e-commerce in enterprises carried out by EUROSTAT in 2015 but only 148 800 out of 1.5 million enterprises with at least 10 employees in the EU-28 were surveyed.

[27]   The sharpest gender disparities could be found in Luxembourg, Cyprus and the Netherlands where men in the IT-specialist workforce were more than 8 out of 10 in 2014. On the contrary, some countries such as Bulgaria, Estonia and Romania recorded the top female percentages (around 30% of the total IT-specialist workforce).

[28]   The Women in IT Scorecard, 2015 – The Tech Partnership and BCS

As a starting point, it is necessary to attract girls onto the relevant educational tracks first of all, such as the STEM courses – and then inspiring them to pursue careers in IT. However, there is perhaps a bit of a catch-22 in this: without strong female role models for girls to follow into IT, it is hard to get girls to join and then to become role models for others.

This is an issue that resonates across Europe. From discussing the issues with the stakeholders as part of the research process, it is on everyone's agenda to address. And there are several initiatives that are aimed at attracting females, such as The TechFuture Girls school club that the Tech Partnership is running. Professional and scientific societies, such as ACM and IEEE, have very successful initiatives that have the benefit of supporting the entire IT community and forging linkages to educational institutions. The IEEE Computer Society in collaboration with Intel offers an annual Prize to the best female led software development team in the Game Sig College Competition. This is designed to encourage more females to take a leadership role in the profession. However, the common feeling is that there are a lot of competing initiatives without a central coordination that is needed to ensure effective and concrete results, unless the issue is addressed.

However, it is very clear that this is an issue that needs addressing in order for the IT sector to benefit from the skills and competences that women can bring to the profession. At Stanford University, Computer science is now the most popular major for female students[30]. Let's hope this example will become more common.

2.3 IT professionals – an international comparison

The skills demand and supply mismatch is a common issue amongst most developed countries across the globe. As part of this project, a comparison of the skills demand and supply forecast for France, Germany and the UK has been made to the US, Canada and Japan. This chapter provides a short profile of each of the latter three countries, the general trends in the market and the underlying assumptions behind the data before providing the forecasts and the key messages to be drawn. These assumptions and messages draw strongly upon stakeholder interviews as part of this project as well as desk research undertaken.

Finally, the chapter will conclude by presenting a comparison of the six countries and highlight the key takeaway points from this analysis.

As mentioned above, the concept is further being elaborated, also with countries outside of Europe (Japan, Canada, and USA). For this purpose the second phase of the project will organise a workshop with the aim to further discuss the definitions used and to make sure they reflect general opinions as good as possible.

2.3.1 IT professionals in Canada

Similar to what is observed in European countries, Canadian organisations are facing a lack of critical IT skills – especially for new technologies – that can hamper technology adoption and ultimately competitiveness of Canadian enterprises in the global economy. And the impact can be dramatic: The Canadian Information and Communications Technology Council (ICTC) assert that a 1% increase in labour productivity as the result of adopting advanced technologies would yield $8 billion to the Canadian economy[i31].

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29   CONNECT: https://ec.europa.eu/digital-single-market/en/blog/women-digital-gap-and-opportunity
30   "Computer science now most popular major for female students at Stanford", Online available here:
     http://www.bizjournals.com/sanjose/news/2015/10/12/computer-science-nowmost-popular-major-for-female.html
31   "The Smart Economy Reshaping Canada's Workforce: Labour Market Outlook 2015-2019"; ICTC 2015

Specific Assumptions for Canada

As is seen in Europe, IT spending for Canadian organisations is driven by the digital transformation wave underpinned by technologies, such as cloud, mobility, Big Data and social – not to mention security and IoT. And digital is also in Canada a board room topic. All of this drives demand for strong specific technology skills – but also for people that can bridge between technology and business. As stated by Meenakshi Gupta, Senior Director, Policy and Research for Information and Communications Technology Council (ICTC): *"In Canada, Job growth in IT outpaced the overall economy by over 4 to 1 in recent years, and among the fastest growing IT careers is cyber security. The digital trend is very much reaching SMEs as well. About 30% of SMEs have adopted these technologies."*

In terms of specific assumptions for the development of the supply and demand balance presented below, the following has been applied:

- IT spending in Canada will increase by a CAGR of 5.5% between 2015 to 2020, including internal IT spending from dedicated IT as well as Line of Business budgets. This data is based on forecast by IDC.
- GDP growth in the model has been aligned to the GDP forecast published by the IMF.
- Overall, enrolment in postsecondary programmes have increased by between 2-3% a year in the period from 2009-2013. The supply forecast assumes a similar growth rate in enrolment going forward and 3 years for students to join the job market. For Mathematics, Computer Science and Statistics, growth in enrolment has been even higher at a CAGR over the period at 4.5% and this is also assumed for the forecast period. This is data issued by Statistics Canada.

Supply and Demand Balance

The supply and demand forecast for Canada showed a gap of 59,000 in 2015. This represented 6.6% of the total demand. The gap is expected to increase to 7.5% in 2016 and then slowly decrease towards 2020. However, by then there will still be a gap of 70,000 or 6.2% as shown in the table below.

	2015	2016	2017	2018	2019	2020	15-20 CAGR
Demanded	890,000	946,000	992,000	1,039,000	1,092,000	1,130,000	4.9%
Supplied	831,000	875,000	920,000	965,000	1,012,000	1,060,000	5.0%
Gap	59,000	71,000	72,000	74,000	80,000	70,000	3.5%
Gap %	**6.6%**	**7.5%**	**7.3%**	**7.1%**	**7.3%**	**6.2%**	

Source: IDC, 2016

Key Messages

The impact of not having enough of the right resources is significant and can hold back Canadian businesses' ability to respond, can reduce productivity and inhibit innovation in corporate Canada. According to research by IDC Canada, the Canadian IT skills gaps is a major contributor to the use of offshoring, which has led to over 70,000 positions moving to lower wage countries over the past decade.

Canada faces a skills gap that is not only about the lack of absolute numbers of IT professionals but also about having access to the right skills. According to the ICTC: "Collaborative focus needs to shift to "right skilling" of the workforce, as an appropriate skills strategy that is aligned with economic and digital strategies is crucial for Canada's competitive strength".

2.3.2   IT professionals in Japan

Trends in IT spending in Japan – and therefore the trends related to the IT skills needed to design, develop, implement and run IT – are in some ways different from the other countries included in this study. While most of Europe, Canada and the US are seeing a strong shift in IT spending growth going towards the new digital technologies, spending on "traditional" technologies will still constitute by far the largest part of spending by 2020. However, Japan is like the other countries also seeing the most acute lack of skills for the new digital technologies. For traditional skills, Japan is a strong user of offshore resources to fill the need.

Specific Assumptions for Japan

However, Japan – like the other countries studied – face a real risk that the lack of skills for new digital technologies can hold back adoption and thereby also business opportunities and economic growth. As stated by the IPA (Japan's Information Technology Promotion Agency): *"The high risk is a loss of business opportunities [brought about] by the skills shortage. It is also considered that businesses' [ability] to take advantage of these technologies is insufficient."*

Specific assumptions for the development of the supply and demand balance presented below include:
- GDP growth over the forecast period expected to grow by an average of 1.7% (based on Japan's statistical office)
- Total IT spending is expected to increase by a 2.8% CAGR over the forecast period including internal IT spending from dedicated IT as well as Line of Business budgets. This data is based on forecast by IDC.
- According to statistics on enrolment in higher education from Japan government statistics, the number of new students has been declining between 2010 and 2012 (-1% from 2010-11 and by -1.9% from 2011-12). It is assumed that this trend will continue in the forecast period with an annual decline of 1.5%. Science studies fared even worse with declines of 11% and 14% respectively in the 2010-12 period. Enrolment in Engineering meanwhile increased by 3.7% and 2.7% in the years.
- The forecast model was calibrated to be in line with existing statistical information on IT workers employed in 2012, 2013 and 2014 as supplied by IPA.

Supply and Demand Balance

The supply and demand forecast for Japan showed a small gap of only 19,000 in 2015 or 1.6% of total demand. However, due to factors relating both to supply (decreasing addition of students with relevant background) and the increasing shift towards spending on new digital technologies on the demand side, the gap is expected to increase strongly throughout the forecast period to 7% in 2020. This will represent a gap of 93,000 – or almost 19 times the gap in 2014.

	2015	2016	2017	2018	2019	2020	15-20 CAGR
Demand	1,178,000	1,204,000	1,231,000	1,259,000	1,292,000	1,325,000	2.4%
Supply	1,159,000	1,171,000	1,185,000	1,200,000	1,214,000	1,232,000	1.2%
Gap	19,000	33,000	46,000	59,000	78,000	93,000	37.4%
Gap %	**1.6%**	**2.7%**	**3.7%**	**4.7%**	**6.0%**	**7.0%**	

Source: IDC, 2016

While Japan is currently not seeing a large gap in skills, this is about to change over the forecast period. The country faces a significant skills gap unless underlying conditions improve. It is quite clear that the technology shift is unlikely to abate – and nor is it desirable for this to happen since digital technology adoption is at the heart of innovation in most industries. So, the obvious area to address is how to improve the supply trends.

There is a strong focus on promoting the IT profession in Japan by the Ministry of Economy, Trade and Industry (METI) and the Ministry of Internal Affairs and Communications, led by IPA taking action in collaboration with the IT sector and IT user companies. Part of what is needed is to improve the profile and attractiveness of IT. If IT is not seen as providing interesting job prospects and the IT department is not recognised as a valuable and highly strategic part businesses this can be difficult.

2.3.3   IT professionals in USA

The US economy continues to improve overall but in a fairly volatile manner. The past seven years have caused organizations to keep a strong cost and efficiency focus in any investment plans, including IT budgets. However, changing customer demands and a need to start seeing growth on the revenue line, means that organizations are looking for ways to free up funds for transformation - and new digital technologies play a crucial role in this.

Specific assumptions for the USA

However, many of these developments are still only taking shape – and so are the skills needed to take full advantage of the technologies. In the words of Dr John Keppler from the IEEE Computer Society: *"It is important to keep in mind that these new IT technologies are still evolving and far from being mature. More and more new skills will evolve and develop as Big Data, Cloud Computing, Mobile, Social Media, and IoT, evolve and develop."*

Specific assumptions underlying the skills demand and supply forecast for the US includes:
- IT demand overall is growing by a CAGR of 3.9% but there is a much stronger adoption of e.g. cloud in the US than in many other countries, which – with its economy of scale – should have lower requirements for number of skilled people. This data is based on IDC forecast.
- The US has a strong heritance in driving IT innovation which has continued to drive interest into IT as a career. While overall enrolment in higher education increased by between 2-3% from 2010-2013, enrolment in mathematics, computer and information science increased by 3-6% per annum according to information from the National Center for Education Statistics.

Supply and demand balance

The US is expected to see a gradual increase in the skills gap over the period to 2020 from 2.9% in 2015 to 5.2% in 2020. This means that the gap will increase from just under 116,000 in 3015 to 221,000 in 2020. The main reason for this growth is the speed of change in customer demands, in the competitive forces that drive change and in availability and adoption of new technologies. Underlying the numbers presented in the table below is a skills mismatch. As stated by Professor William Agresti from Johns Hopkins Carey Business School as part of the research for this study: *"Big data, and especially predictive analytics, combined with IoT, will place the greatest demands for new IT skills."*

	2015	2016	2017	2018	2019	2020	15-20 CAGR
Demand	3,963,700	4,015,200	4,073,900	4,138,200	4,209,000	4,285,000	1.6%
Supply	3,848,000	3,895,000	3,935,000	3,978,000	4,021,000	4,064,000	1.1%
Gap	115,700	120,200	138,900	160,200	188,000	221,000	13.8%
Gap %	**2.9%**	**3.0%**	**3.4%**	**3.9%**	**4.5%**	**5.2%**	

Source: IDC, 2016

Key messages

Demand will increasingly outstrip the IT skills that are available in the market. The US is in an interesting position in that the country dominates in terms of IT innovation overall. It furthermore has a tradition for supporting new innovative start-ups through venture capital funding, which means that from a perspective of positioning IT as a career, it is probably further ahead than many. However, not all IT professionals will become millionaire entrepreneurs – many still have to take on the more mundane tasks internally in IT departments. So also in the US is there a need for promoting the career. As Dr Keppler stated: *"We need to be more proactive in communicating to young candidates about the importance of IT and describing the potential IT careers available to them as early as possible, highlighting that these careers are good prospects for entrepreneurship and offer high wages."*

2.3.4   International comparisons of main trends

Most of the key trends that are influencing the demand for IT skills are the same whether looking at the UK, Germany and France or further afield at the US, Canada and Japan. However, scratching under the surface as we have seen there are different dynamics affecting the overall skills demand and supply balance – mostly relating to the supply side issues.

The Figure below presents the skills gap for the six countries discussed above as well as the EU28.
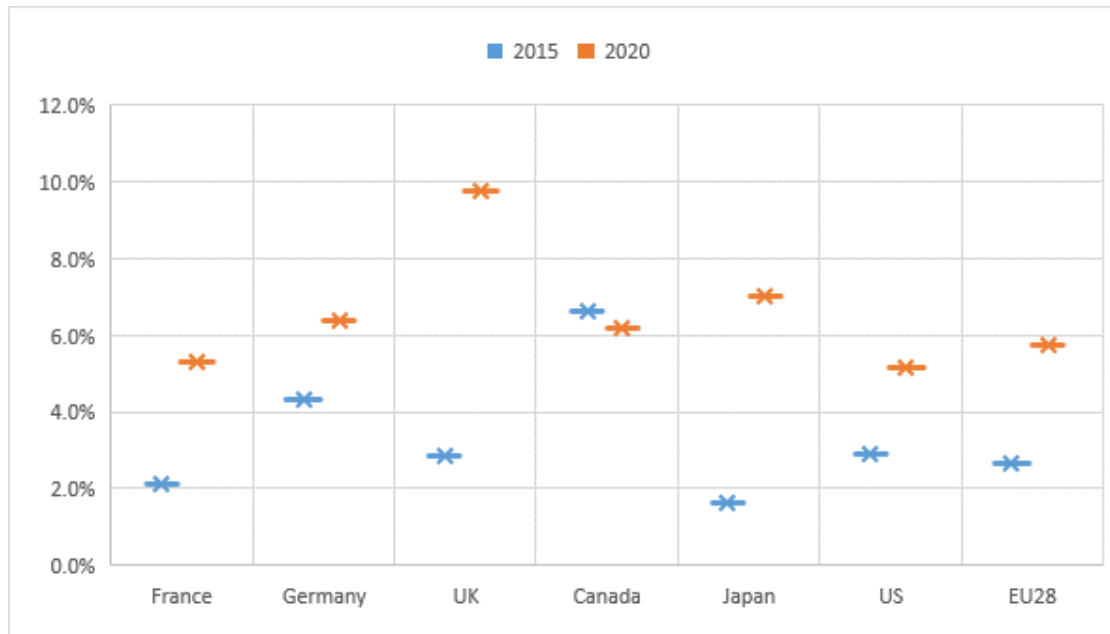
Source: IDC and empirica, 2016

This analysis shows that the UK will experience the strongest growth in the gap between demand and supply of IT skills followed by Japan. Canada is the only country that will see the gap decrease over the period but at a very high level.

The picture for the EU28 overall is of similar magnitude to the US and to France, while the gap in Germany will widen the least.

2.4   IT training and certification in Europe, Canada, USA and Japan

< PLACEHOLDER: section will be finalised based on expected inputs from a.o. global certification providers >

2.5   Summary Conclusions

The trend towards adoption of digital technologies is strong across all countries included in this study. There are variations in the levels of adoption of these – and the main strategies driving the adoption. However, it is clear that demand will outstrip the supply of IT professionals that can help organisations design, build, implement and manage new digital technologies, such as cloud and Big Data as well as the all-important security technologies to protect organisations, their customers and their employees.

Considering the general acceptance that the inability of organisations to adopt new technologies to improve efficiencies, grow new and existing revenue streams and service their customers better – and indeed innovate to ensure that they are not overrun by emerging competitors, this is a major concern and could influence the economic recovery, which is still fragile in many countries.

Although the lack of IT professionals has been debated and considered for a long time, the fact is that the speed of change on the supply side is relatively slow and it takes a while for new initiatives to be embedded and to show results. However, it is important to bear in mind that the gap is not just about absolute numbers missing in the total IT workforce. It is also about the actual skills and levels of experiences that people are missing. This is also very much about skills mismatch compared to market demand – and about how easy it is to assess which skills the individual IT person possess. This is where the Framework for the IT profession can play a critical role.

The lack of women in the IT profession is also an issue that needs addressing. Interestingly, this is not just an issue that affects Europe: also in Canada, Japan and the US is there a need to make the IT profession more attractive to women. Initiatives to get more women to join needs to start early targeting young girls – and even targeting parents so that they will consider that IT is a suitable profession for their daughters. Perhaps the emergence of many of the new technologies may help on this? While it may still be difficult to attract women to e.g. hardcore network technology jobs, many new jobs will require more "hybrid" skills such as business/technology (e.g. data scientists), design/technology (e.g. customer experience and user interface development). The technology development itself may finally be what attracts females to IT.

3 Rationale for a European Framework for the IT profession

> "*The digital economy merges with the real economy*.
>
> *We need leadership and investment in digital technologies in areas like*
>
> *advanced manufacturing, smart energy, automated driving or e-health*"
>
> Elżbieta **Bieńkowska**
>
> Commissioner for Internal Market, Industry, Entrepreneurship and SMEs

Europe is strongly depending on sufficient skills to further boost the Digital Economy. The previous section made clear that demand will outstrip the supply of IT skills that can help organisations design, build, implement and manage new digital technologies. This section provides an overview of policy initiatives concerning IT professionalism at European level and within some of its Member States, as well as what is happening at a global stage. It also puts this project on IT professionalism in the context of developments concerning e-Leadership skills and Key Enabling Technology (KET) skills. The next chapter 4 will elaborate on what the Framework for the IT profession encompasses and provides the current state-of-play.

3.1 IT professionalism is key for boosting the digital economy in Europe

As we have seen in the previous chapter, almost 515,000 unfilled IT-related vacancies are estimated to be reached in Europe by 2020. Closing the gap between the number of job seekers in Europe and the number of unfilled digital jobs has been the main priority of the European economy for nearly a decade.

In September 2007, the European Commission adopted a Communication on "e-Skills for the 21st Century: Fostering Competitiveness, Growth and Jobs" which included a long term EU e-skills agenda for Europe. Two evaluations of its implementation for the period 2007-2010 and for the period 2010-2013 concluded that good progress has been made and that efforts should be intensified. The following developments in particular should be mentioned:

- E-skills activities have been included in the "Digital Agenda for Europe" (2010)[32];
- The Communication "Towards a Job-rich Recovery" (2012)3 presents key actions for the promotion of IT employment and e-skills[33];
- The President of the European Commission together with four Commissioners launched a "Grand Coalition for Digital Jobs" at the conference on "e-Skills and Education for Digital Jobs" on 4th March 2013 in Brussels[34].

As part of this long-term effort to align the European economy to the digital market trends started with the EU e-skills strategy and the 'Grand Coalition for Digital Jobs', the European Commission launched a EU-wide 'e-Skills for Jobs' campaign.[35] The aim of the campaign is to raise awareness of the opportunities that digital skills offer for employment and employability. Targeting young people, unemployed people, IT practitioners, enterprises (in particular SMEs) as well as business leaders and policy makers, the campaign provides a response to the unmet demand for IT-skilled professionals across all industry sectors.

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[32] See: http://ec.europa.eu/digital-agenda/
[33] See: http://europa.eu/rapid/press-release_IP-12-380_en.htm
[34] See: https://ec.europa.eu/digital-single-market/en/grand-coalition-digital-jobs
[35] Further information is available on: http://eskills4jobs.ec.europa.eu/

Delivering on its Strategy to create a Digital Single Market, the European Commission recently[36] unveiled its first industry-related package with plans to help European industry, SMEs, researchers and public authorities make the most of new technologies. A set of measures to support and link up national initiatives for the digitisation of industry and related services across all sectors and to boost investment through strategic partnerships and networks was presented. Important element of this package is **an EU skills agenda** that will help give people the skills needed for jobs in the digital age – to be released in May 2016.

The recommendations of DIGITALEUROPE[37] will provide important input for the new EU skills strategy. It addresses seven topics:

1. Foster digital skills training programmes
2. Harness industry-led education
3. Accelerate the encouragement of Labour mobility for digital jobs
4. Bolster National Coalitions for Digital Jobs
5. Raise awareness of the role played by technology in the EU's digital single market and the digital career opportunities available
6. Ensure availability of EU funding dedicated to upskilling initiatives and training platforms at EU level
7. Inspire girls to pursue IT studies and careers and encourage better gender balance by promoting a stronger role of women

The last version of the e-Skills Manifesto[38] states that "digital technologies are a major engine for growth, fuelled by the ideas of **highly skilled IT professionals** and business leaders – or e-Leaders". The European Commission will support Member States in their efforts for the recognition of digital skills and qualifications and raise Europe's level of IT professionalism. The adoption of a European framework for IT professionalism would help achieve this goal.

At European level various projects have been undertaken that have proven to be important milestones in the further development of IT professionalism.

The relevant documents and initiatives are:

- "E-Skills and IT Professionalism: Fostering the IT profession in Europe" (2012)
- "Towards European Quality Labels for the IT Industry Training and Certification" (2013)
- "European e-Competence Framework 3.0" (2013)
- "e-Skills for Competitiveness and Innovation: Vision, Roadmap and Foresight Scenarios,"(2013)
- "European Foundational IT Body of Knowledge" (version 1.0): a first point of reference for anyone interested in working in IT (2014)
- "e-Skills in Europe: Measuring Progress and Moving Ahead" (2014)
- "The International Dimension and the Impact of Globalisation on e-Skills" (2014)

Short overviews of these reports are included in *annex C*. The next paragraph will inform about ongoing initiatives and how they interrelate.

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[36] On 19 April 2016 the following press release was published: http://europa.eu/rapid/press-release_IP-16-1407_en.htm
[37] DIGITALEUROPE and the EC's Skills Strategy 2016, Recommendations from DIGITALEUROPE: "Boosting the skills for the future of Europe". 13 January 2016. Available online here: http://www.digitaleurope.org/DesktopModules/Bring2mind/DMX/Download.aspx?Command=Core_Download&EntryId=1089&PortalId=0&TabId=353
[38] The e-Skills Manifesto, 2015

3.2   Triangulation of IT professionalism, e-Leadership and KET skills

Current initiatives at EU level are focusing on IT professionalism, but also on the development of skills to apply Digital and Key Enabling Technologies (KETs) which are at the heart of the EU's industrial policy for growth, competitiveness and jobs, and on the promotion of e-leadership skills to provide Europe with a larger talent pool of highly-skilled entrepreneurs, managers and professionals (e-Leadership)[39].

These initiatives cannot be seen separately, and coordination is important to ensure consistency of approaches and terminologies. A feedback loop between these initiatives is essential. This paragraph describes how these topics are interrelated to provide a proper understanding of ongoing initiatives.

Figure 3.1 The e-Skills pyramid[40]
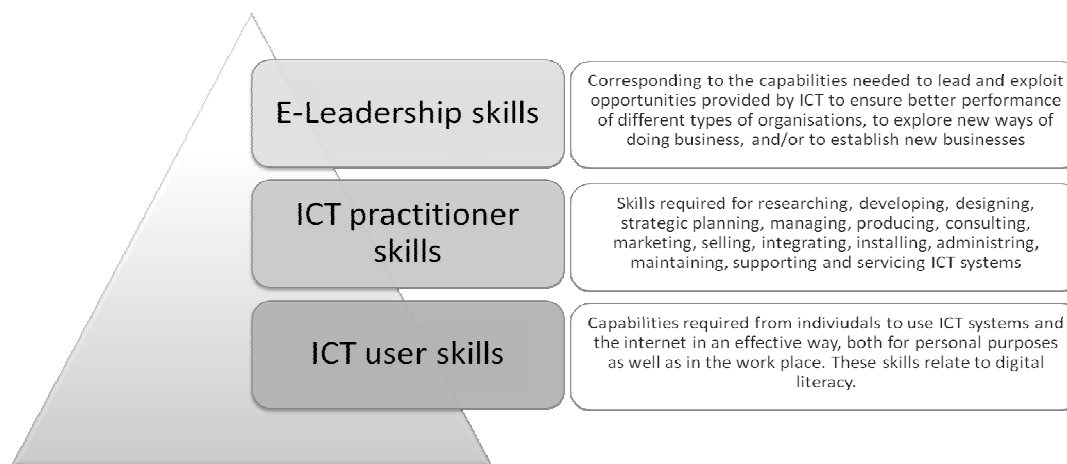
The e-Skills landscape usually distinguishes three segments of skills, as is shown and explained in figure 3.1. Obviously there is a natural flow of people from 'IT practitioner' to 'e-Leader'. These are professionals that advance their career and reach to senior level positions that require these e-Leadership skills. Of course, not every management role in IT is considered as an e-Leader role, and it is also true that not every e-Leader necessarily has a background as IT practitioner. Nevertheless the relationship is obvious and follows a recognised career path.

The Framework for the IT profession consists of four pillars; each one is shown in figure 3.2. The e-CF also includes job profiles such as CIO that are close to what is defined as an e-Leader. The Foundational Body of Knowledge indicates IT Strategy & Governance as one of the knowledge areas of the IT spectrum. This visual also lists some of the deliverables of the e-Leadership projects, such as new curricula for e-Leadership skills and Quality labels for these new curricula. Obviously the skills these curricula describe should be aligned with, or even part of, these pillars of the Framework for the IT profession. It makes sense if e-Leadership curricula educate professionals in competences and knowledge that are described in job profiles for CIO's and are similar to the knowledge items included in the Foundational Body of Knowledge for IT Strategy & Governance. Or, the other way around: the curricula provide input for updating these instruments according to the latest insights.

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[39]   In the areas of e-Leadership and KET skills several studies have been completed as well.
See: e-Leadership: http://eskills-guide.eu/documents/ and http://eskills-scale.eu/home/ and KETs: http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=8764&lang=en&title=Final-report%3A-Skills-for-Key-Enabling-Technologies-in-Europe

[40]   Based on the e-skills definition of the European e-Skills Forum, 2004.

Figure 3.2 Interrelation of e-Leadership projects and the Framework for the IT profession
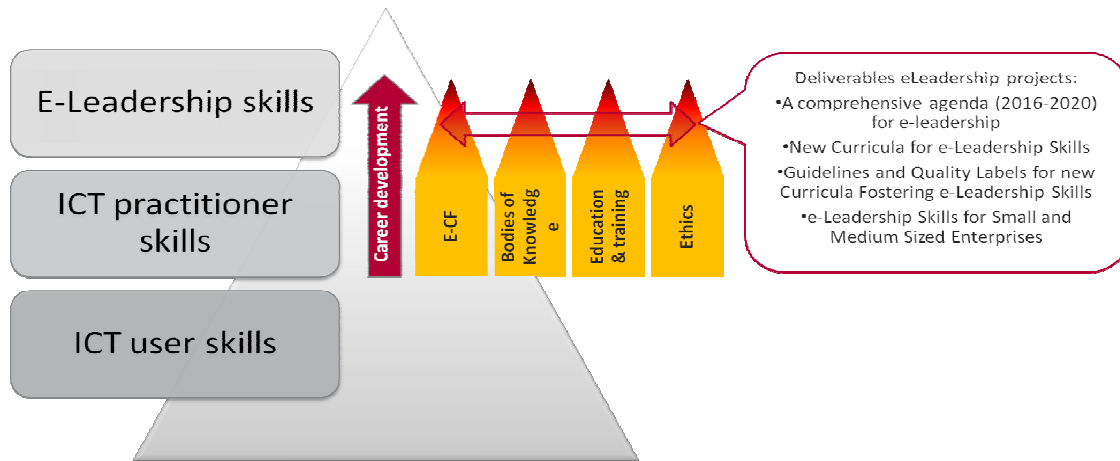
The relationship between IT professionals and developments around KET stems from the fact that both IT practitioners and KET workers are (partially) recruited from STEM graduates. Both are Key industrial competences determining Europe's global competitiveness[41]. And both address the need to further align industry needs with educational programmes, the need for regular re-training/re-skilling as well as improving the image to attract more people to enter these fields. For instance, the KETs Skills Vision Report[42] indicates the need to train students in 'collective problem solving' and 'entrepreneurial adaptability'. These relate to the skills that are required from dual thinkers that the IT industry is asking for: both required from practitioners as well as leaders. Obviously these overlaps need to be well coordinated to avoid different and/or incomplete messages are sent to educational providers that would reduce the efficiency and effectiveness of these initiatives, and the overall Skills strategy.

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[41] Key industrial competences determining Europe's global competitiveness as per definition of the Horizon 2020 Framework Programme for Research and Innovation. Not mentioned in this figure, but distinguished in this programme besides KET and IT is 'Space'. Source available online here: https://ec.europa.eu/programmemes/horizon2020/en/h2020-section/leadership-enabling-and-industrial-technologies

[42] Skills for Key Enabling Technologies in Europe: "Vision for the Development of Skills for Key Enabling Technologies (KETs)", PwC, March 2016. Available online here: http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=8764&lang=en&title=Final-report%3A-Skills-for-Key-Enabling-Technologies-in-Europe

Figure 3.3 interrelation of KET skills projects and the Framework for the IT profession
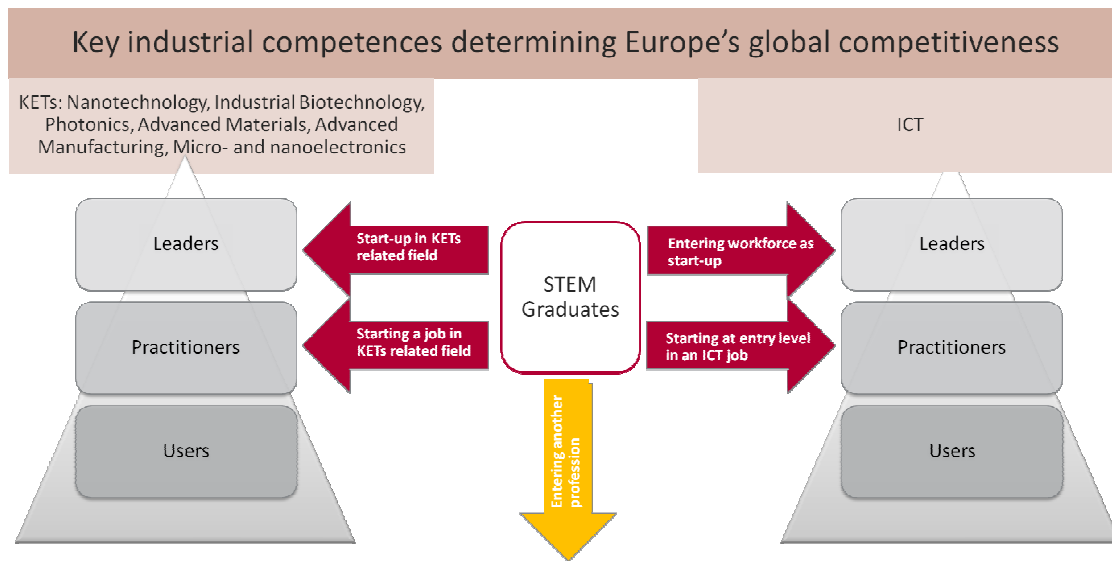
Concluding, triangulation of these three topics will lead to optimal impact. The idea is that one can be more confident with a result if different methods lead to the same result.

3.3 IT professionalism in European countries

This paragraph presents an overview of the European countries that have, already in the first phase of this project, shown commitment as regards taking-up the Framework for the IT profession. This is a very positive sign and we believe their interest will trigger other countries to join as well.

3.3.1 IT professionalism in the United Kingdom

The U.K. is usually considered a worldwide benchmark for policies regarding the promotion of e-skills and for multi-stakeholder partnerships in the IT domain. The country's initiatives related to e-skills development remain a point of reference for policy intervention and supporting activities in the area. They refer to both the development of digital literacy targeting the entire population and the IT practitioner skills.

As a starting point, the Information Economy Strategy of June 2013 underlined the fact that a lack of sufficiently skilled people was one of the biggest barriers to UK leadership and to reap the economic and social benefits in the global information economy. Two markets for skills development were identified: a publicly funded market built around qualifications, and a privately funded training market addressing business needs. Those markets did not align sufficiently. The ambition was to make the UK a global leader for cutting edge technologies. Therefore, the strategy supported long-term Industrial Partnerships through the Employer Ownership of Skills initiative[43] to enable businesses to take end to end responsibility for skills development.

In the last decade, the UK's approach has been characterised by a strong financial engagement by the state **and industry in IT-related policies despite the critic current economic environment. An overview of current**

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[43] Further details are available at: https://www.gov.uk/government/uploads/system/ uploads/attachment_data/file/305746/employer-ownership-of-skills-web-vision-report-final2.pdf

initiatives in the IT field is necessary to understand the national Digital Skills Strategy developed by the Information Economy Council (IEC) Skills Working Group.[44]

The **Tech Partnership**, recognised by the British government as the 'Industrial Partnership for the Digital Economy' and the skills, tackles the market failure in the supply of digital skills. It takes forward the work of the 'e-skills UK' and it involves the government, education providers and stakeholders across the economy in a joint effort to maximise the impacts of the action taken. The Tech Partnership is a growing network of employers collaborating to boost growth in the global digital economy. The primary objective is to increase young generations' interest in technology to orientate the flow of young and talented people with different backgrounds into technology careers. In the development of this 'world class pipeline of new talent' for technology careers, a particular focus is put on attracting more females.[45] It is also intended to help companies develop their technological skills and competences necessary for the future. This partnership sets standards for skills and development, and brings coherence by embracing all able to contribute to its strategic objectives. As a consequence, it aims at influencing school curriculum and providing support to teachers. This would help the development of industry-backed or focused degree programmes and conversion courses.

According to the most recent data, many positive results and impacts of the Tech Partnership have been reported indicating a change in the skills landscape in the UK towards more coherence. With regards to skills development, a breakthrough has been achieved in setting skills standards. The Partnership has shift from 50 companies to over 550, two thirds of which are SMEs and it goes beyond the original ambition (total 400 companies). In close cooperation with professional bodies including *BCS, the Chartered Institute for IT* and IISP (for cyber security), a strong effort has been made to develop a unified framework for standards and professional progression. Since June 2014, over 180 private, public and third sector organisations have joined the Tech Partnership Stakeholder Alliance bringing more cohesion in the field.[46]

As highlighted in the report, the ambition of the Tech Partnership is to deliver the skills for a million new digital jobs over the coming decade. This would lead to growth for businesses across the economy, and to a fundamental change to the capabilities developed in schools, colleges and universities across the UK.[47]

Graduate entry is not the only route in to the profession for those at the start of their career. Apprenticeships are increasing in the UK. From March 2017 an apprenticeship levy will be introduced which any company with a salary bill of £3 million or more will be required to pay[48]. The money this generates will be used to fund further apprenticeships. It is widely anticipated that this will lead to an increase in the take-up of apprenticeships in all sectors, including IT.

The *BCS, the Chartered Institute for IT* has already triggered an important action concerning the Framework for the IT profession. A workshop was organised as part of this project to take an important step towards closer alignment of two major IT competency models that have similar goals in providing a common language to describe the requirements of IT professionals, and hence meeting private and public needs around the globe. The ambition of both the SFIA Foundation and the European Commission is to bring these frameworks closer together. This initiative is described in more details in the chapter that deals with implementation of the Framework (please see 6.5.2).

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[44] Additional information is available at: https://www.techuk.org/
[45] The Information Economy Council Digital Skills Strategy, July 2014. Available online here: https://www.thetechpartnership.com/globalassets/pdfs/research-2014/informationeconomydigitalskillsstrategy_oct14.pdf
[46] The Tech partnership Progress update Report (April 2014 – March 2015).
[47] Ibid.
[48] More information can be found here: https://www.gov.uk/government/publications/apprenticeship-levy/apprenticeship-levy

3.3.2 IT Professionalism in Spain

The *Consejo General de Colegios Profesionales de Ingeniería Informática* (CCII) was set up in 2010 by a specific agreement of the Spanish Parliament. CCII has among its duties:

- Representation of the Spanish informatics engineering professionals on the national and international level;
- Organisation and regulation of the professional practice;
- Ensuring proper standards and promoting an ethical practice and contribution of informatics engineering to general interest;
- Disciplinary proceedings / notification of sanctions or disqualification proceedings for the professional practice;
- Deontological control of the professional and its values in good practice;

CCII is interested in the scope of the IT Professional Framework, and specially the least-developed fields as Ethics and Certifications and implementing Quality Labels.

Since 2014, CCII is involved in CEN PC 428 e-Competences and IT Professionalism, whose main goal has been producing the upcoming EN 16234 (European Norm about IT Profession Competences by the European Committee for Standardisation - CEN). The President of CCII is also the President of the corresponding Spanish national subcommittee in the Spanish standardisation national entity (AENOR) and since June 2015 CCII is participating in CEN IT Skills Workshop.

CCII has provided a national implementation approach presented in workshop 1 "Towards a European Framework for the IT Profession", developed and improved later with several documents and virtual meetings to draft an action plan for implementation of IT Professional Framework in Spain, being the first basic action the presentation of IT Professional Framework in Spain, in the Digital Enterprise Show 2016, 24th May in Madrid, taking advantage of this event to call and promote the support and participation of Spanish IT sector agents and organisations in implementation of IT Professional Framework in Spain.

At the moment, a workshop is planned for where Spanish experts and project team will discuss and improve the action plan and provide a wide roadmap for further implementation of the Framework. An initial list of possible actions can be found in Appendix D.

3.3.3 IT Professionalism in Italy

In Italy, the Osservatorio of Digital Competences 2015, promoted by the AgiD (Agenzia per l'Italia Digitale), has been published in March 2016. The Osservatorio shows that Companies and Government entities are highly aware (80-90% of respondents) about the impact of the "digital transformation" and the need to adapt the digital skills especially in light of the new trends (mobile, digitization of flows and processes, business analytics, IoT, cloud computing, Web developments, electronic payments). In particular, main findings from the research provide a clear overview on the IT professionalism:

- The skill level of coverage (defined on the basis of the European system e-Competence Framework - e-CF), measured as the simultaneous presence of all the necessary components, ranging from 73% of the IT companies to 67% of in-house company of the Regions and Autonomous provinces 48% of business users, before falling to 41% in Central PA and 37% in local PA.
- The main recruitment channels for IT profiles are: professional network (around 70% of companies surveyed), company's research and selection (more than 50% of user organizations)

- The growth of internal expertise is based mainly on the on the job training (over 90% of the centralised units, 75% of those premises, 80% of business users, 87% of IT companies).
- The most required degrees are Informatics / Computer Science, together with other Engineering addresses. Both at the companies in the IT sector at the demand, in fact, are the degrees that are better adapted to the diverse challenges that the digital evolution implies. The appreciation is around 80% of respondents. For 80% of IT companies is also a key technical skills certification system.

In Italy, the most requested IT professions in 2014 were high qualified, managerial (70%), whilst technical professions decreased to around 24%. (Excelsior –IT sector 2014», in *Osservatorio Competenze Digitali* 2014). In 2013, at least 22% of recruiting took more than four month, because of IT skills mismatch (Modis Italia White Paper 2013). e-Skills Vision study (Empirica) highlights that the mismatch between demand/offer will increase and in 2020 Italy will record a lack of 100.000/200.000 IT professionals.

Since summer 2012, the main stakeholders' representatives, namely the five most important employer associations in Italy, Confindustria Digitale, Assintel (Confcommercio), CNA and Unimatica-Confapi, with the scientific support from Fondazione Politecnico di Milano, set up a precompetitive network "Rete Competenze per l'economia digitale" (Grand Coalition for Digital Jobs Pledger, http://www.linkedpolicies.eu/pledge/), aimed at fostering IT professionalism in Italy .

The main topics of interest were: which kinds of competences are required by the IT market, how to develop them both in the school system and in continuing VET, how to build a recognised IT profession identity.

A very interesting tool already available on the market was the e-CF, developed in the CEN IT Skills Workshop context. The e-CF was the first European framework for IT competences mainly required by IT end-user companies, i.e. a common reference speaking a shared language, useful for comparisons and evaluations. Such stakeholders considered this tool as a concrete starting point around which building awareness and mutual understanding on e-competences needed to be competitive.

Several workshops had been organised in Milano and Roma addressing stakeholders from private and public sectors to present the e-CF and the relevance of e-competences for competitiveness.

The e-CF became the new reference for the local qualitative and quantitative surveys on the issue, carried out yearly by some employer associations such as Assintel.

The first concrete action was to make this framework a national standard, becoming Italy the first country with the e-CF as an official norm: UNI 11506:2013.

Meanwhile, a free of charge job-matching tool (JobICT) for enterprises and IT professionals, based on the e-CF, was developed by social partners (UilTucs, one of the main Italian trade Unions with the support of ASSINTEL) and IWA Italia with contributions from FPM (http://www.jobict.it/).

The National Agency for Digital Italy adopted the e-CF as the reference for the national guidelines on *Training, Competences and the Digital Culture*, to align the VET offer against the Public Administration's and IT SMEs' needs (http://www.agid.gov.it/agenda-digitale/competenze-digitali) .

Several e-CF-based training initiatives to develop new job profiles are being designed even within Ministerial projects, such as the forthcoming Ambient Assisted Living new professional profiles (Design4All CTN01_00128_297089).

For such stakeholders, a step ahead would be now to integrate the forthcoming European Foundational IT Body of Knowledge with the e-CF both in the VET programmes and in the above mentioned job matching tool; to align the local emerging VET programmes to the European training guidelines within the IT Professionalism framework. In such a way, a clearer and clearer IT professionalism picture for the Italian context can be depicted as well.

3.3.4   IT professionalism in Ireland

The commitment of the Irish Computer Society (ICS) to driving professionalism in IT is well illustrated by the association's website[49]. It presents the Framework and its pillars in a consequent manner, explaining the added value and referring to relevant instruments and tools where available.

The ICS is establishing a core group of experts that will further promote the IT Professional Framework and its specific components in order to increase awareness amongst the various stakeholder groups in Ireland, and eventually take-up. The ICS has listed several possible actions for IT Professionalism Framework implementation in Ireland (please find an overview in Appendix D).

One of these tools is a new career progression pathway for Ireland's IT professionals: Continuous Professional Development (CPD)[50], developed by the Irish Computer Society. CPD allows professionals to take ownership of their career development, to record CPD activities for verification and to track and review CPD progress.

The Irish Computer Society has developed for its members a free-to-use, online system to support their tracking of their professional development. I announced a new career progression pathway for Ireland's IT professionals that is:

- Inspired by the work of the Council of European Professional Informatics Societies (CEPIS), in particular its landmark study prepared for the European Commission, e-Skills and IT professionalism: Fostering the IT Profession in Europe.
- The result of lengthy consultations with industry experts, academics and other stakeholders about what IT professionals need from CPD, and what Ireland's innovative economy needs from IT professionals.
- Facilitated and administered by the Irish Computer Society, in partnership with other members of its six-society professional network in the fields of IT architecture, data protection, IT service management, business analysis and health informatics.

In addition, the Irish Computer Society has developed for its members a free-to-use, online system to support their recording, tracking and sharing of their professional development.

In a visually appealing way, the ICS explains the benefits for professionals and organisations as well as how it contributes to the profession as a whole. It also explains that CPD is a unique journey and that depending on where a professional is in his/her career, a different need as regards education ways arise. It distinguishes between IT students, IT professionals, and IT leaders.

Finally, it also includes the opportunity to track 'contributions' of the professional. The idea is that members should be recognised for their efforts to support the profession, their colleagues and aspiring IT professionals. This includes for instance signing up to the ICS code of conduct, but could also encompass research & publishing or volunteering.

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[49]   See: https://www.ics.ie/professional/it-professionalism.php
[50]   More information online here: https://www.ics.ie/certification

Figure 3.4 Continuous Professional Development by the Irish Computer Society[51]

Ireland also has a good example of a short-term solution to 'train the trainers' with an out of field training[52].

Ireland's *2012 IT Action Plan*, 2011 *National Strategy for Higher Education 2030* and *Action Plan for Jobs 2013* all include elements affecting teacher training in Ireland and form the basis for on-going reforms to the Irish educational system. While the teacher training curriculum in Ireland is not being reformed in its entirety, the Irish government has enacted a number of policies of direct relevance to IT in education.

The Irish IT Action Plan includes a target of improving the retention rates in the university sector by 7% and by 9% in Institute of Technology sector by 2014, and notes that one of the key factors in the high dropout rates is an inadequate level of maths proficiency. Against this background, one policy initiative is of particular

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[51] More information online here: https://www.ics.ie/cpd
[52] Source: http://epistem.ie/

relevance in the context of IT, namely the ongoing roll-out of "Project Maths" This includes the establishment of a new continual professional development Postgraduate Qualification for teachers of mathematics. The approach taken by the Irish government focuses not solely on basic IT training for teachers but rather on an increase in both volume and quality of mathematics teaching across Irish schools to allow pupils to pursue higher mathematics at a later stage as well as provide teachers with the necessary skills to teach mathematics at a high level.

Furthermore, the Irish National Strategy for Higher Education 2030 stressed the need to build on the centrality of mathematics and science. The strategy argues that mathematical concepts, models and techniques are central to working in all sectors of employment and the proficiency level of students in mathematics is a key factor influencing the domestic supply of graduates for sectors with growth potential such as IT, as identified by the Irish Expert Group on Future Skills Needs. Therefore the need to equip teachers with the right skills to teach mathematics is of central importance.

A key deliverable of this initiative was the establishment of a Postgraduate Qualification for "out of field" teachers of mathematics. The course is a blended learning programme based on a two-year part-time university accredited diploma; it is delivered locally and through online modules. The course was introduced in 2012 with 390 places and is available nationwide free of charge, with specific provision for teachers in Irish-medium schools. The first cohort of teachers completed the programme in September 2014. The programme is funded by the Irish Department of Education and Skills as part of the national strategy to support the implementation of Project Maths and improve standards in mathematics education in post-primary schools by up-skilling out-of-field teachers of mathematics.

3.3.5   IT professionalism in the Netherlands

Since 2011 the Dutch central government aims at empowering commissioning of IT, development of IT professionals in public service (keeping professionals up to date and flexible and mobile between government units) and on enhancing IT user skills and e-Skills. The Dutch central government has adapted the e-CF in her approach to HR as standard and sets up all occupations following the e-CF. It brings great transparency and uniformity. As the central government organises this for all ministries and agencies at a national level this is quite a challenge. They developed a 'Quality Framework IV' that bridges from generic occupations within the national government to specific IT profiles and competences. It is grouped in Quality profiles that define results, and is mapped on SAME (2007).

Figure 3.5 The Netherlands Quality Framework
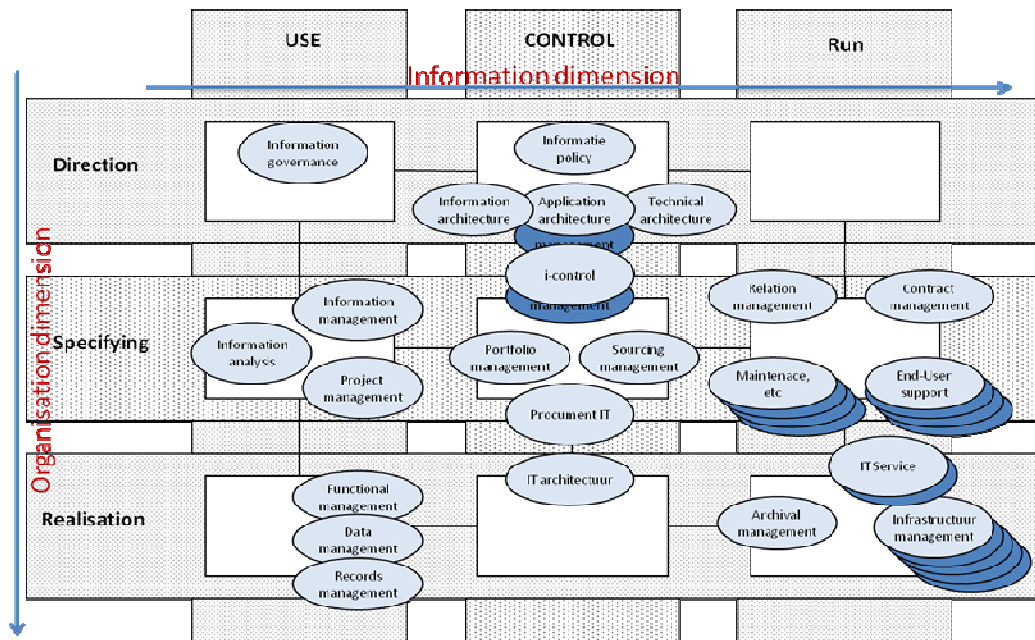
The Dutch government has started a project team to integrate the Foundational Body of Knowledge into their Quality Framework IV. The Quality Framework itself could very well be applied in the context of other countries that face similar challenges. The Dutch government is positive about sharing their knowledge with others and learning. The Quality Framework will also be leading for public procurement processes in the near future.

Besides being a user of e-CF, the Dutch government is also very keen on promoting IT professionalism and e-skills in general. The Ministry of Economic Affairs is leading in this and relies on the ECP for implementation of an vision for the information society. ECP stands for 'Platform for the Information Society' and is an independent platform where government, business and civil society work together and share knowledge with a view to the application of information and communication technologies in Dutch society.

The work of ECP also closely relates to the work and interests of the Dutch IT trade association ('Netherlands IT'). *Netherlands IT* represents more than 550 IT companies in the Netherlands with the mission of deploying all existing knowledge and expertise to provide market incentives, act as a powerful representation in transcending business interests, offer personalised services in the field of legal, financial issues and HR, and facilitate a large network.

On the side of associations, the Ngi-NGN, the Dutch professional association for IT professionals and managers. It is an independent platform where members deepen their knowledge and network maintenance. The Ngi-NGN has been around since 1959. The Ngi-NGN provides the perfect opportunity to keep well with all the developments in IT, to increase knowledge and maintain your network. Members of the Ngi-NGN access content events, such as lectures, seminars and conferences. With this organisation we are a.o. exploring the option of publishing a peer-review assessment tool based on both e-CF as well as the other pillars of the Professional Framework (Ethics, Knowledge).

In this regard also the Dutch Association for Computer Scientists Registry (VRI) needs to be mentioned. Each IT professional registered with VRI abides by a Code of Ethics and is thus visible as a professional of high integrity. At the moment, the VRI, together with Ngi-NGN, EXIN Foundation and several industry and education partners, have initiated the start of an e-CF register. This is a voluntary register aimed at providing

transparency in achieved competences of IT professionals while at the same time providing IT professionals with an opportunity of personal branding. The register is developed based on ISO standards (17024:2012) for certification. The register will start from the current VRI-register of informatics, but is aimed at all Dutch IT professionals. Registration will be based on self-assessment and/or a personal assessment. The launch of this initiative took place on 27 May 2016 and is fresh. More details will follow for the final report. By that time, more insights can be given on organisations adopting it and the governance approach.

Figure 3.6 A voluntary e-CF register for IT professionals in the Netherlands
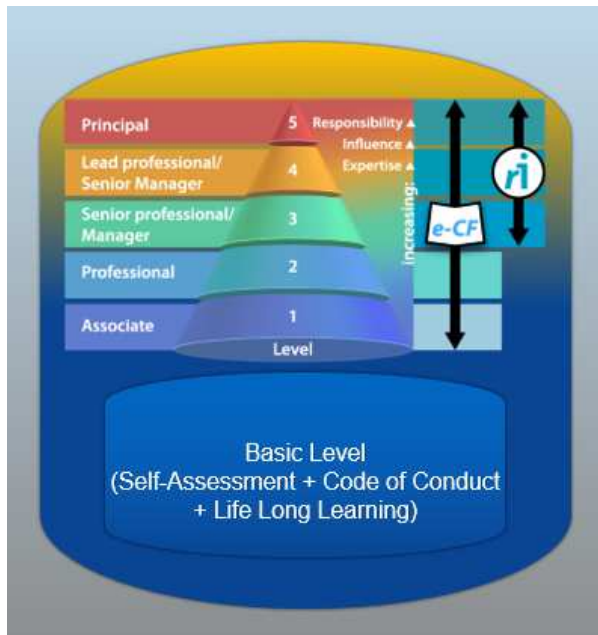
3.4   Similar initiatives outside Europe

This challenge of maturing the IT profession is not unique to Europe. This project also reflects on parallel efforts in other parts of the world, such as driven by IPA[53] in Japan, ITIF[54] in the United States, or ICTC[55] in Canada, and even more importantly we initiated collaboration with key stakeholders in those countries to exchange knowledge and experiences. Policies and initiatives led at national, EU or international level may differ depending on local context, but there are common priorities addressed and this is essential in moving the IT profession forward. The section below summarises key elements of the strategies these non-EU countries take as regards Skills. The final report will see to add some more details about key success factors in these countries.

The World Economic Forum has taken on a multi-year initiative – New Vision for Education-and it is trying to identify and define the 16 most critical "21st-century skills" in primary and secondary education for today's innovation-driven economy. In particular, IT literacy is included among the foundational literacies which will constitute the basis of a 'technology-enabled closed-loop instructional system'[56].

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[53]   Information technology Promotion Agency (IPA), see for instance the aim to protect and nurture the IT society: https://www.ipa.go.jp/english/about/about.html
[54]   Information Technology & Innovation Foundation (ITIF), see: https://itif.org/about
[55]   See for instance: Digital talent. "The road to 2020 and beyond: A national strategy to develop Canada's talent in a global digital economy", Information and Communications Technology Council (ICTC) Canada, www.ictc-ctic.ca
[56]   Further information is available at: http://widgets.weforum.org/nve-2015/#summary

The following paragraphs include the most recent information on policies and initiatives for the promotion of the IT profession in Japan, Canada, and the USA.

3.4.1   Canada: developing talent in a global digital economy

Due to its favourable political and business environment and a vibrant digital ecosystem, Canada is likely to become a leader in the global digital economy. However, in order to achieve this, problems such as talent shortages, skills gaps, and the slow pace of digital adoption first need to be overcome[57].

The gap between the aging current IT workforce and not enough youth entering the IT labour market could lead to jeopardizing Canada's future competitiveness. Under a baseline scenario, it is expected that by 2019, over 84,000 new IT jobs will have been created in Canada. Due to both replacement demand and retirements and other exits, the availability of home grown IT talent is expected not to be able to meet the demand resulting in a supply shortage of over 182,000 IT professionals over the next five years[58].

Therefore, in 2015, the Canadian Information and Communication Information Council published the strategy 'Digital Talent: Road to 2020 and beyond' to 'contextualise Canada's digital landscape and labour market needs by 2020'. The paper puts forward a series of recommendations to be implemented by all stakeholders: industry, government, media and individual citizens.

The strategy focuses on 7 areas to help Canada become a leader in the global digital economy, namely:
1) Nurturing a strong youth talent pipeline;
2) Leveraging Canada's diverse talent;
3) Supporting workforce upskilling to enhance digital adoption;
4) Attracting and retaining global digital talent;
5) Strengthening digital literacy and digital skills for Canadians;
6) Fostering digital entrepreneurship; and
7) Building labour mobility pathways to fill high demand occupations.

These 7 areas were then grouped into three areas: industry growth, education and skills, and diversity and inclusion. These three areas also formed the taskforces needed to develop an action plan with critical milestones to guide the strategy.

It is expected that if Canadian stakeholders successfully implement the above recommendations, it will be ensured that SMEs and other Canadian businesses as well as Canadian citizens will be better prepared and equipped to respond to the rapidly evolving global economy[59].

3.4.2   USA: incentivising public-private partnerships and strengthen STEM

Also the US is faced with a significant supply and demand gap in the IT sector. The main workforce issues could be attributed to: outsourcing, government resources, and role of government in industry's workforce initiatives, skills and training[60]. In terms of demographics, only 12 percent of US innovators are women; 46 percent are immigrants or the children of immigrants; less than 8 percent of US born innovators are minorities;

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[57] Digital Talent: Road to 2020 and Beyond: http://www.ictc-ctic.ca/wp-content/uploads/2016/03/ICTC_DigitalTalent2020_ENGLISH_FINAL_March2016.pdf
[58] Labour Market Outlook 2015—2019: http://www.digcompass.ca/labour-market-outlook-2015-2019/
[59] Digital Talent: Road to 2020 and Beyond: http://www.ictc-ctic.ca/wp-content/uploads/2016/03/ICTC_DigitalTalent2020_ENGLISH_FINAL_March2016.pdf
[60] US Department of Labor: https://www.doleta.gov/BRG/IndProf/IT_profile.cfm

innovators are highly educated, especially in STEM fields; most foreign-born innovators are from Asia and Europe; and the median age for an innovator in the US is 47[61].

Over the last decade, new IT jobs were responsible for a 36% increase compared to just a 3% increase in the overall US job market. Although high wages and employment rates derive from high demand for IT workers, still around half a million jobs are yet to be filled with adequately skilled workers. An important factor for this imbalance could be attributed to primary and secondary schools having failed for the most part to adapt and teach in-demand computer concepts[62].

Where many universities have taken steps to limit the number of students in CS courses, a new generation of non-profit organizations and advocacy groups, learning programmes and courses has emerged. Several NGOs focus on seeking to democratise access to CS education across gender lines and socioeconomic divides; introducing CS to students at a younger age; training more teachers; and putting CS into more schools.

Furthermore, most innovations in the US happen in very large or very small companies; small companies often rely on government funding to innovate; public-private partnerships are key to innovation; and 28 percent of innovations face barriers to commercialisation.

Therefore, the Information Technology & Innovation Foundation[63] has called upon US innovation policymakers to:
1. Strengthen the STEM immigration pipeline;
2. Improve STEM education and empower students of all backgrounds to pursue these fields;
3. Incentivise collaborations between public and private entities; and
4. Expand government funding for innovation.

In early 2015 the White House announced a new initiative called TechHire which 'coordinates the efforts of the federal government, cities, corporations and schools to train workers for the thousands of current job openings in the tech sector'. In this initiative, a focus is put on coding schools like Galvanize, Flatiron School and Hack Reactor, which offer accelerated training in digital skills as a way to "rapidly train workers for a well-paying job." With most students being in their 20s and 30s, it was estimated that the USA with about 16,000 graduates in 2015 would therefore be responsible for about one-third of the estimated number of computer science graduates from American universities[64].

3.4.3   Japan: discovering Young IT talent

In 2015 Japan's GDP growth rate was about 2%, making it the third largest worldwide after the US and China. An important reason for the rather low growth could be attributed to Japan's population decrease which will have an even bigger impact on the IT labour market as also in Japan there is a growing need for IT skilled professionals, especially with the Tokyo Olympic Games and Paralympics 2016 coming up. A specific growth rate is expected in cloud computing, big data, mobility, social media and the new business areas such as Internet of things. Where the Japanese IT sector used to be focused on system integration, IT is now increasingly used for new business development and new market creation. Moreover, due to a clear mismatch in required skills, Japan is losing business opportunities[65].

In order to increase digital skills within the Japanese workforce, the Japanese governmental Information Technology Promotion Agency (IPA)[66] is developing human resources within businesses and across the new

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[61] ITIF: https://itif.org/publications/2016/02/24/demographics-innovation-united-states#.Vt2EM_dQ8o4.mailto
[62] The e-Skills Manifesto, 2015 – chapter 5: http://eskills4jobs.ec.europa.eu/c/document_library/get_file?uuid=b69ba1d7-6db4-415d-82e4-ac4d700a38b8&groupId=2293353
[63] ITIF: https://itif.org/publications/2016/02/24/demographics-innovation-united-states#.Vt2EM_dQ8o4.mailto
[64] New York Times: http://www.nytimes.com/2015/07/29/technology/code-academy-as-career-game-changer.html?ref=technology
[65] The e-Skills Manifesto, 2015 – chapter 6: http://eskills4jobs.ec.europa.eu/c/document_library/get_file?uuid=b69ba1d7-6db4-415d-82e4-ac4d700a38b8&groupId=2293353
[66] The IPA promotes the various activities of the IT industry under the umbrella of the Japanese Ministry of Economy, Trade and Industry.

hire base; developing the employment of female workers; and outsourcing from overseas. It is expected that both business growth and young entrepreneurs and start-up companies will lead be leading factors in this shift[67].

To tackle these issues, the IPA has taken the following steps to secure Japan's leading position:
1. Human resources development;
2. Qualifications in IT;
3. Digital skills framework;
4. 'MITOH' project (supporting the discovery of young IT talents); and
5. Information security human resources and security camp;

Furthermore, to strategically promote IT human resource development policies in these rapidly changing times, the Japanese IPA developed an 'I Competency Dictionary' to make it possible for companies involved in the training of IT professionals to flexibly combine and apply the Skill Standards for IT Professionals. Future objectives are to further enrich the contents of the Task Dictionary and Skill Dictionary; share examples of applications; and coordinate with the training programmes and qualifying/certifying examinations provided by educational institutions. It is meant to also provide an application system to support the use and application of the I Competency Dictionary by companies, organizations, and IT engineers involved in human resource development[68].

3.4.4   Israel: inspired by innovation

Israel has been long known for being on the cutting edge of research and development in advanced technologies. History and geography have made Israelis experts at identifying market needs, finding creative solutions, and shortening the development process to turn them into commercial products. Thousands of start-ups have been created in Israel over the years, making it second only to the US in this sector.

The Israeli entrepreneurship spirit combines original thinking, excellence in science and technology education, strong business drive and the ability to dare. All these factors join to create the "start-up nation": a deep and buzzing eco-system of strong networks between industry, government, academia, private investors and young companies.

Accordingly, over 50% of Israel's industrial exports stem from high-tech and life science industries, and almost 4.1% of GDP is spent on R&D – the highest rate among OECD countries[69].

The gap in Israel is not so big because of sufficient supply. Computer science has been taught in almost every school for almost 30 years. It's part of the culture in Israel and it started with teachers. After overcoming resistance in the early years, in particular to ensure teachers understood what they were expected to teach, the community of teachers and the curricula are now key testimony to the successes achieved.

Language is important. In the words of Mr Avi Cohen, Inspector-in-chief Computer Science & information technology of the Ministry of Education in Israel: '*I refer to computer science as the 'language of technology' to illustrate to people and to convince investments are required to keep on matching demand. Computer science is the language of technology, and mathematics is the language of computer science*.'

Education trends in Israel consist of three key tracks:
- Computer software engineering
- Telecommunications

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67   The e-Skills Manifesto 2015 – chapter 6: http://eskills4jobs.ec.europa.eu/c/document_library/get_file?uuid=b69ba1d7-6db4-415d-82e4-ac4d700a38b8&groupId=2293353
68   I Competency Dictionary: http://www.ipa.go.jp/english/humandev/icd.html
69   Reuters, *Insight Israel's high-tech boom is double edged sword*, 19 January 2015.. Available online here: http://www.reuters.com/article/israel-tech-ma-idUSL6N0UR1GO20150119

- Cyber knowledge management – for managers, (and thus entangled with the topic of e-Leadership)

However, this might be changing. While many entrepreneurs and investors made good money from Israeli start-ups over the past two decades, increasingly firms acquired by foreign buyers are then either shut down, with their intellectual property moving abroad, or turned into R&D centres for the parent company. Israel's successful high tech industry attracts major global players who have been eager to snap up local start-ups. This could obviously affect the demand for jobs in Israel. In the words of Karin Mayer Rubinstein, head of the Israel Advanced Technology Industry association: 'the Israeli government might need a long-term plan for incentives and support rather than simply early-stage aid'[70].

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[70]   Idem

4 Defining the European Framework for the IT profession

The year 2013 marked the 40th anniversary of the very first piece of literature paving the way for IT professionalism. In this foundational book famous book "Social Issues in Computing[71]" published in 1973, Calvin Carl Gotlieb and Allan Borodin tackled, among others, the topic of "professionalization and responsibility," whereby they addressed notions such as education, professional development, ethics, etc. Their work paved the way for a European Framework for the IT Profession.

Since the publishing of this book significant development has been made in the IT sector regarding professionalism, in- and outside of Europe. Many stakeholders and governments have invested time and means to further mature the IT profession at both national and international level.

This chapter sets out the current state-of-play of the IT profession in Europe, following the 4 proposed pillars of the Framework for the IT profession – as constructed by the Innovation Value Institute (IVI) and the Council of European Professional Informatics Societies (CEPIS) in 2012: competences, knowledge, education and training and certification, and ethics.

4.1 The four pillars of the EU framework for the IT profession

In Europe, there is no coherent perception of the "IT Profession" or common understanding of the possible career opportunities it offers. Thus, it is important to clarify the concept of IT professionalism.

A first definition of IT professionals was developed by the Innovation Value Institute (IVI) and the Council of European Professional Informatics Societies (CEPIS) in 2012 and widely accepted by the CEPIS Task Force on IT Professionalism, and CEPIS Council members.[72] As recalled in the CEPIS final report on e-skills and IT professionalism (CEPIS, 2012; EC, 2015), IT professionals:

– *Possess a comprehensive and up-to-date understanding of a relevant body of knowledge[73]*

– *Demonstrate ongoing commitment to professional development[74] via an appropriate combination of qualifications, certifications, work experience, non-formal and/or informal education*

– *Adhere to an agreed code of ethics/conduct[75] and/or applicable regulatory practices and*

– *Through competent practice[76] deliver value for stakeholders.*

In an era of rapid digital transformation where the IT literacy is embedded in society and has extensively penetrated the labour market, the development of a comprehensive framework at EU level is key to spread more consciousness of the IT professionalism.

The fundamental elements of the definition of IT professionals introduced above, are reflected in the key components of the framework explained in the CEPIS report and recalled in this study.

The whole architecture of the **IT framework** pivots on its fundamental elements, also called *building blocks* common to most of the professions: Bodies of Knowledge; Education and Training; Competences and Ethics.

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[71] Calvin Carl Gotlieb and Allan Borodin, Social Issues in Computing, Academic Press, 1973 - 284 pages
[72] CEPIS Council is the governing body of the Council of European Professional Informatics Societies (CEPIS).
[73] The term relevant body of knowledge refers to a broad and up-to-date knowledge base encompassing both a foundational IT body of knowledge and specialist knowledge and skills.
[74] Professional development implies the improvement of competences and both technical and non-technical skills towards better individual performance and career progression.
[75] Professionals are kept accountable to themselves, the IT Profession and society, through agreed code of ethics/conduct or regulatory practices.
[76] Competent practice refers to products and services' quality delivered by practitioners.

As an overarching theoretical structure, the European framework is intended to both systematise and synthesise the corpus of concepts developed and the lessons learned from the experiences in the IT domain without imposing a one-stop-shop solution but rather, providing a basis for future developments in the field.

In essence, this framework is not developed to crystallise the IT profession into static blocks but rather, to evolve dynamically with the surrounding tech eco-system reacting to a wide range of internal and external stimulus.

During the last decades, concrete steps have been made in each of the four building blocks both at EU and national level. As part of our research, the framework builds on the legacy from past policy strategies and initiatives and it paves the way to a new approach for people willing to start an IT career.

As part of our research, an overview of the four pillars is provided below. For each pillar, the report describes its origin and the progress made so far, the current state of play as well as the value for its users and the steps needed to advance.

4.1.1   Competences: the e-CF

According to an agreed definition within the IT community, a "competence is a demonstrated ability to apply knowledge, skills and attitudes to achieving observable results".[77]

History

A debate on the type of competences and digital skills needed by the IT workforce to adapt to a fast changing tech environment and to meet the highest-level international standards, has aroused in recent years. Many lists of IT competences have been dressed by individual European firms and different national-based frameworks have been adopted by Member States. The risk for IT professionals' cross-border mobility and recognition of qualification was high. From this perspective, the adoption of a unique EU framework on IT competences (e-CF) represented a cost-saving solution to meet the requirements of the IT labour market.

The first version of the e-CF (CEN e-CF 1.0) was issued in 2008 under the guidance of the CEN Workshop on IT Skills involving approximately 100 entities and also members from AITTS, CIGREF and SFIA in the project. It was stated that the "The e-CF is a component of the European union's strategy for e-Skills in the 21st Century supported by the European Commission and The Council of Ministers".[78] Published as a "Workshop Agreement", the document gathered the consensus of the members of the CEN Workshop on IT Skills. Based on the inputs provided from a wide range of stakeholders and experts from different countries, the first version of the e-CF comprised 36 IT competences and five proficiency levels. It uses a common language to describe the competences of IT professionals that are important to the business sector and other relevant organisations as well as informing the policy-makers about the needs and priorities for e-skills related strategies and initiatives both at regional and national level.

The second version of the e-CF was released in 2010 and in parallel other CEN projects, dealing with its application to IT professional profiles, certification offerings and the specific realm of SMEs, were run. In detail, a set of typical 23 European IT Professional Profiles has been developed by the CEN Workshop on IT Skills to complement the e-CF and to provide a starting point for future profiles.[79]

An updated version of the e-competence framework (e-CF 3.0) was issued in 2014 after a 8 years multi-stakeholder dialogue within the e e-CF user community [80] and as a result of the CEN IT skills Workshop Project "e-CF support and maintenance – towards e-CF version 3.0" (from May 2012 to December 2013). The e-CF 3.0

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77 User guide for the application of the European e-Competence Framework 3.0. CWA 16234:2014 Part 2.
78 A common European Framework for IT Professionals in all industry sectors (2009) www.ecompetences.eu/ Retrieved March 2016
79 CWA 16458:2012
80 European e-Competence Framework 3.0. A common European Framework for IT Professionals in all industry sectors. CWA 16234:2014

reviews the principles and contents of the previous versions building the results on a structured feedback mechanism (December 2013 by CEN Workshop Agreement).

Similarly to the previous versions, it provides a common language to use for competences, skills and proficiency levels across Europe.[81] The e-CF represents a sector-specific application of the European Qualifications Framework (EQF) which made existing qualifications more readable and comparable across the EU by linking together different national qualifications systems and frameworks in a common European reference thus serving the twofold objective of promoting citizens' mobility and supporting lifelong learning.[82] There is a "rational and consistent relationship" between the EQF learning levels of the e-CF competence levels to allow a coherent interpretation of both of them.[83]

Strongly endorsed by the European Commission and by European large companies, the development of a **European e-Competence Framework (e-CF)** has represented a response to facilitate the IT professionals' recruitment and assessment within any IT company or organisation.[84] In line with the European Union's strategy for e-Skills in the 21st century[85] led by the European Commission and the Council of Ministers, the e-CF has been seen as an instrument to attain the key policy objectives of the Grand Coalition for digital Jobs[86] targeting a wide user community.

With the introduction of version 3.0 in 2014 the CEN started the process to make the e-CF a European standard and in early 2016 the European e-Competence Framework has been formally published as a European standard.

At the time of the report, discussion for a new version (e-CF 4.0) is taking place within the EU institutions. This is due to the need to strike a balance between stability of the adopted references for users and the obligation to constantly update the framework to maintain its value.

After ten years of growth and development and three released versions, the European framework of IT competences is going to become standard for Europe.[87]

The e-CF has become the basis for the work of CEN TC 428, the new CEN technical committee set up with the contributions of National Standard Bodies from several countries. The aim of the CEN TC 428 is to turn the e-CF into a European Norm (EN). In February 2015, the new standard was approved by the TC and the process of formal approval by the National Standards Bodies of Europe began.

Current state of the play

The e-CF 3.0 clearly defines a competence in a holistic fashion as "a demonstrated ability to apply knowledge, skills and attitudes for achieving observable results"[88]. As recalled in the guiding principles, the e-CF is an *enabler* aimed at empowering users and a *neutral* and *durable* tool which requires an update every three years to keep its relevance as reference. In regard to the content, the e-CF comprises a set of 40 competences which are deemed essential and desirable within the IT workplace for IT Professionals including both practitioners and managers. E-competences are structured into four dimensions presenting the organisational perspective as opposed to the individual one and in relation to the European Qualifications Framework (EQF) bridging with the individual competences.[89]

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81 Further information is available on the website: http://www.ecompetences.eu/
82 European Communities (2008). The European Qualifications Framework for Lifelong Learning (EQF), Brochure.
83 CWA 16234:2014
84 Building the e-CF – methodology documentation, e-CF 2.0 CWA Part III, 09/2010 www.ecompetences.eu
85 COM(2007) 496 final
86 The 'Grand Coalition for Digital Jobs' is a multi-stakeholder partnership launched by the European Commission in March 2013 to find solutions to solve the problem of the digital skills gap in Europe and the IT-related vacancies surplus in all industry sectors.
87 For further information please visit: http://www.digitalsme.eu/the-e-competence-framework-is-coming-of-age/
88 Ibid.
89 A detailed description of the e-CF 3.0 is introduced on the website: http://www.ecompetences.eu/

Therefore, an IT professional has to exhibit certain characteristics to be considered "*professionally competent*" including skills specific to the area(s) of specialism and quality standards.[90] Working in the IT domain with a scant qualification is not sufficient to be regarded as an IT Professional across all the EU Member States. On the contrary, there is a T-shaped portfolio of skills. Expertise in new technologies is required to allow the development of successful and efficient organisations. The definition adopted for the scope of the study clearly expresses the need for the IT professional to gain a core set of competences together with a constant commitment to develop them through work experience and formal/informal training or education. This would be essential to match the demand expressed by the IT labour market recruiters and consequently to deliver value to users.

Value for users

The framework on e-competences represents a cost-saving solution and a key driver of an IT-enabled economy (EC, 2012). A common framework would provide a unique language thus, supporting a more coherent understanding of IT competences across the EU. By providing a unique basis for the dialogue, an alignment between recruiters and applicants is expected to take place. Shifting from the theoretical to the practical dimension, the adoption and application of the e-CF might lead to positive effects for a wide range of users (e.g. public entities, private sector companies, HR departments, education providers, policy makers).

Firstly, the e-CF allows any professional to **objectively assess his competences**, skills and proficiency levels against those required by both the private and public sector to successfully perform multiple tasks and assignments. As a consequence, it would increase the **transparency** of the IT career paths and development. Secondly, its application by companies across Europe offers the possibility to **better orientate the internal processes** for development. Thirdly, the e-CF might be used **to inform national policy-makers** on the priorities and needs expressed by the market allowing them to better design their policies and strategies.

On a large scale, the adoption of the E-CF by both public and private companies and organisations is expected to lead to an **efficient development of IT human resources** towards higher proficiency levels favouring the supply-demand matching in the market and stimulating their mobility across Europe. Finally, the e-CF will **positively affect the competitiveness** and innovativeness of the EU IT Labour market.[91]

Literature review and different uses cases have shed light on significant applications of the e-CF suggesting its potential benefit for different users:

- *For IT professionals:* The e-CF, provides self-assessment tool for to select appropriate training, education and certification programmes. This application will contribute to improve the available online tools for competences development and to better design education and training programmes.

- *For Employers and HR function:* The e-CF serves as a common tool to develop job profiles through a common understanding of the required competences. It can be used to improve job descriptions, to clearly identify the roles of IT professionals and to establish a predictive competence management system as part of the corporate strategy. The e-CF value lies in the possibility to better orientate the e-skills industry thus providing the IT professionals access to more opportunities. To this end, the e-CF has been used as a tool to support decision-making for the alignment between the company's competence development and its business strategy, objectives and purposes. This is valid especially for SMEs activities and business for the effective assessment of capabilities. The e-CF has a significant value for the IT SMEs to prove their core competences, to assess their "know how" and to communicate it to the wider public.

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[90]   European Commission (2012)
[91]   European Commission (2012) "e-Skills and IT Professionalism, Fostering IT Professionalism in Europe", Final Report

- **For Education and Certification providers:** The e-CF serve as guidelines for competence driven curricula. Education provider can the set of competences, levels and knowledge as described in the e-CF to design, improve or map their programmes in order to match learning outcomes with certification requirements and industry needs. In regard to the IT marketplace, the framework would allow a better alignment between Learning modules supply and individual career progression demands. The e-CF allows qualification providers to answer market needs providing evidence of their adherence to European guidelines.
- **For professional Associations:** IT professional associations usually establish entry-level criteria for membership. The assessment of newcomers' skills and competences can be based upon the e-CF in order to ensure mutual recognition of personal competences across Europe and thus, to generate a common sense belonging.

The added value of the e-CF lies in its accessibility and wide applicability. By providing a common vocabulary at EU level, it satisfies the requirements a wide range of organisations and companies. Therefore, it can also be used as benchmark of professional capabilities at international level.

Interestingly, in Italy all IT companies have been asked to map their professionals to e-CF. An initiative steered by the unions, and with support of an AICA self-assessment tool. Since 2013, Capgemini Italy used EUCIP (the European standard before e-CF) in the Back on Track programme in order to evaluate the IT skills. Both employers and Unions appreciated this approach very much. After the launch of the e-CF launch, Italy (UNI) set it as national IT competences standard. Clearly, the e-CF is now closer to the 'market language' than the internal career framework. Capgemini leveraged both views for employability evaluations and through a unique online test (AICA) for assessing both e-CF and Capgemini's career framework, it now uses both 'languages'. In a similar fashion this could be re-used in other countries.

The below is an illustration of the output of the pilot that made people realise the complementarities and the value add.

Employee	Capgemini Career Framework role	E-CF profile
Employee A	Service Delivery Lead	SERVICE DESK AGENT
Employee B	Software Engineer Lead	TECHNICAL SPECIALIST
Employee C	Software Engineer Lead	DIGITAL MEDIA SPECIALIST
Employee D	Software Engineer Lead	NETWORK SPECIALIST
Employee E	Senior Service Delivery Manager	SERVICE MANAGER

Future challenges

The general overview of the uses cases has served to strengthen the agreement on the e-CF added value among all potential users. Nevertheless, the practical implementation of the framework into the organisational settings has raised some issues that need to be discussed further.

A list of the **main challenges** can be provided below.

- **A new concept**: there is a lack of understanding of basic terminology of the e-CF and low awareness and familiarity of e-CF structure, concepts and language; providing awareness of the e-CF is preliminary to the use of the framework of reference for competence management and improvement.
- **Unclear added value**: new incentives should be found to support its adoption and implementation within businesses. At present, job profile descriptions are usually based on qualifications while the e-CF builds upon competences. A shift in the current practices is needed.
- **Lack of transparency**: there are no universal indicators to assess the e-competences. On the contrary, evaluations are still subjective and depend on personal judgment since self-assessment of competences by IT professionals are usually carried out as tick box exercise.
- **Need for a flexible approach:** not all the certification programmes and contents can perfectly match the competences described in the e-CF. Consequently, mapping education and training against the e-CF requires flexibility.
- **Sustainability:** if commercial exploitation drives adoption, it will be important that third parties provide commercially available solutions to enable an easier adoption by organisations. To a certain extend that is already taking place but could be facilitated in order to accelerate. In this it will be important to not only see e-CF as the solution, but the complete IT Professional Framework.

In the view of improving the e-CF implementation in the future, the agreed priority will be the identification of complementarities or overlaps with existing frameworks at national level leveraging on their interoperability. For instance, the e-CF will align with SFIA to complement it and to improve comparability at EU level, rather than replacing it. The formal recognition of the e-CF as a EU standard and alignment with national framework will ensure a greater impact of future versions.

ESCO: European Skills, Competences, Qualifications and Occupations

ESCO[92] is the multilingual classification of European Skills, Competences, Qualifications and Occupations. ESCO is part of the Europe 2020 strategy. The Commission services launched the project in 2010 with an open stakeholder consultation. DG Employment, Social Affairs and Inclusion – supported by the European Centre for the Development of Vocational Training CEDEFOP – coordinates the development of ESCO. Stakeholders are closely involved in the development and dissemination of ESCO.

The ESCO classification identifies and categorises skills, competences, qualifications and occupations relevant for the EU labour market and education and training. It systematically shows the relationships between the different concepts. ESCO has been developed in an open IT format, is available for use free of charge by everyone and can be accessed via the ESCO portal.

The first version of ESCO was published on 23 October 2013. This release marks the beginning of the pilot and testing phase, including the ESCO mapping pilot. Until end of 2016 the classification will be completely revised.

ESCO includes occupations rather than job profiles (as is done in the e-CF) and for each occupation skills and competences are provided. It also links to qualifications in EQF.

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[92] Information collected from
https://ec.europa.eu/esco/portal/escopedia/European_Skills%252C_Competences%252C_Qualifications_and_Occupations_%2528ESCO%2529

4.1.2　Knowledge: Foundational IT Body of Knowledge

Having deep knowledge gets the job done, but having broad knowledge helps us understand what the job is in the first place[93].

Differently from skills (*know-how*) and their application (*competences*), knowledge constitutes the *know what* of the IT profession.[94] A multitude of Bodies of Knowledge exists in the IT field across the world. The global landscape is characterised by many Bodies of Knowledge developed by professional associations with the aim to define the core knowledge of IT professionals. Each one of them differs in its key features: the scope, the approach, the purpose, the model, the target and the origins.　Thus, the landscape is very fragmented and there are many overlaps and gaps: some countries have a national IT Body of Knowledge adapted to their national context; others have carried out a standardization of the knowledge and skills in isolated fields of IT.[95] The main challenge addressed by this pillar is the lack of a global or European Body of Knowledge encompassing and addressing all the aspects of IT. Furthermore, the lack of an authoritative source within the EU that defines and organises the core knowledge of the IT discipline, is a major issue. The analysis of several key Bodies of Knowledge existing in the global landscape (e.g. those developed by the IEE[96], ACS[97], IPA[98] and ACM[99]), has inspired the development of the EU Foundational IT Body of Knowledge.[100]

History

A first version of the European Foundational IT Body of Knowledge (version 1.0) was released in February 2015[101]. The approach taken to develop the foundational IT Body of Knowledge was outcome-based since the IT profession was observed from what the IT professional was expected to know in the practice depending on the IT domain, the sector, the size of the business and the national specificities. The attention paid to the outcomes allowed to identify a set of knowledge areas useful for individuals, academy and industry. Such knowledge areas would have been used in the design of curricula and educational programmes.

The European *Foundational IT Body of Knowledge* is intended to capture the general core knowledge areas. It has been defined "the base-level knowledge required of all IT professionals and acts as the first point of reference for anyone interested in working in IT" (CEPIS, 2012). From this perspective, the *foundational BOK* refers to the core IT knowledge shared by all the different IT sub-domains and which any IT professional should master even before approaching a career in the sector. To be an efficient IT professional, the user will need to know a relevant part of the BoK especially at the entry-level of his career. Clearly, in practice the IT professional will not need to know the whole BoK but just those areas that are relevant for the selected industry. An appropriate BOK encompasses the documented and agreed set of concepts which often inform course syllabi and serve as a basis for proficiency standards against which industry certifications and higher education qualifications can be issued.

Current state of the play

The Foundational IT Body of Knowledge (BOK) is the accepted ontology in the field and an essential building block for the promotion of IT professionalism in the EU Digital Single Market. Built on a comprehensive repository of concepts, terms and definitions, the foundational BOK aims to constitute a **'go-to' reference** for IT in Europe and the fundamental basis to set standards and certifications.

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[93]　　Gavin Payne https://blogs.technet.microsoft.com/uktechnet/2015/05/28/thinking-wider-as-well-as-deeper-maturing-an-it-professionals-knowledge/
[94]　　Ibid.
[95]　　European Commission (2014). E-skills for IT Professionalism. Brochure.
[96]　　Institute of Electrical and Electronics Engineers (IEEE).
[97]　　Australian Computer Society (ACS).
[98]　　Information technology Promotion Agency (IPA).
[99]　　Association of Computing Machinery (ACM).
[100]　　Ibid.
[101]　　European Commission (2015): "The European Foundational IT Body of Knowledge", Version 1.0 Final Report

As regard the structure, the Foundational IT BOK encompasses a spectrum of IT foundational knowledge areas ranging from strategy to technology. This spectrum is further detailed into sub-domains and specific knowledge areas developed through a definition, the foundational knowledge required, a list of competences, job profiles, references to the e-CF and examples of specific BOK, certifications and training possibilities. These can be obtained through formal or higher education. The spectrum indicates that there is no definite hierarchical order in the presented areas.

Figure 4.1 Structure of the European Foundational IT Body of Knowledge

Furthermore, the Foundational IT Body of Knowledge has been represented ideally as an 'inverted T-model' where the horizontal axis shows the spectrum of the knowledge areas within the IT domain, while the vertical axis encompasses the specific knowledge and skills an individual has to acquire to specialise in a single domain.[102] In contrast with the "I" model, the mainstreamed T-Shaped metaphor (Guest,1991), adds further complexity to the previous model combining the vertical axis of functional/disciplinary skills into a specific IT domain, with horizontal axis referring to the ability of applying knowledge to different situations and to collaborate across different disciplines.

Taking the IT foundational Body of Knowledge into account as starting point, several specific Bodies of knowledge, certifications and advanced training courses have been developed as examples of IT specialisation paths. The foundational BOK finds the common DNA to offer a guide to the breadth of IT knowledge that any professional might acquire.

Including legal, ethical, social and professional practices but also soft skills, the foundational BOK supports the maturing of the IT Profession towards multi-disciplinarity. In fact, the nature of jobs is changing and thus, it is no more sufficient for an IT professional to have a technical expertise. The IT job market requires "multidisciplinary IT professionals" or *dual thinkers*, indicating those who integrate the technical with soft skills and have a good understanding of business or managerial knowledge. Successful IT professionals will be oriented towards team building, collaboration, negotiation and e-leadership (EC, 2015).

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[102] Further details on the structure of the Foundational IT Body of Knowledge could be found in the report prepared for the European Commission, *The European Foundational IT Body of Knowledge*, Version 1.0 (No 290/PP/ENT/CIP/13/C/N01C011). Available online here: http://ictprofessionalism.eu/wp-content/uploads/EU-Foundational-IT-Body-of-Knowledge_Brochure_final.pdf

Value for users

The ambition guiding the development of the Foundational IT BOK is not to provide an exhaustive repository of the conceptual universe surrounding the IT Profession but rather, to offer an instrument to guide students and individuals willing to enter the IT profession and to orient them in their future career choices. More generally, the target audience of the foundational IT BOK includes anyone interested in working in the IT field and in understanding how to approach a career. Similarly, people experiencing career shifts from other professions, can use this reference to improve their awareness of the IT domain.

The value of the foundational IT BOK stems from the possibility to be adopted by many potential users a 'go-to' point of reference for their own mission. Few examples of different uses of the BOK for some categories of stakeholders can be listed:
- Education providers: use the BoK as source of inspiration for curricula design and development;
- Professional Associations: promote the BoK to their members as the basis for certifications;
- HR Departments: use the BoK to improve the recruiting and people development processes.

The foundational IT BOK should be considered as part of an IT professionalism framework together with the e-CF and the European IT Profile Family Tree. Over the last decade, the rise of IT in all the industry sectors as well as in the society, has determined a rapid increase of stakeholders' expectations and requirements about IT professionalism.

Due to the complexity of the field, the tree has been used as a metaphor to visualise the framework and to highlight the relationship with computer literacy, education, the e-CF and specialisation in the form of certification and training. The foundational knowledge addressed by the BOK is the level beyond IT literacy but coming before specialisation in any IT sub-domain. In the metaphor: the roots refer to the basic IT literacy - the knowledge and the ability to use computers and technology efficiently - tested by the ECDL (European Computer Driving Licence); the middle part of the trunk is the core knowledge of the IT profession including business and technical components; the upper part captures the specialised knowledge (or BOKs) gained through advanced master's programmes or management schools; the branches of the tree represent in-depth specialisation into niches domains.

Figure 4.2 Visualisation of the Foundational IT BOK in the context of lifelong learning
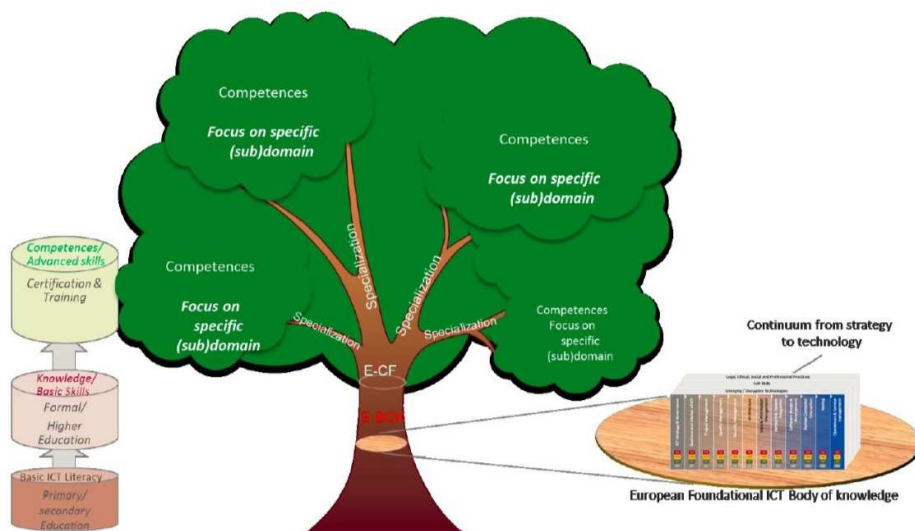
The tree metaphor suggests that the EU foundational BOK should be considered in the wider context of the IT Professionalism together with the e-CF and other integrated components to deliver more value to its users. Being an essential part of the overall framework for IT Professionalism, the IT Body of knowledge will contribute together with the e-CF to the maturing the profession and to the improvement of its perception into the wider public. Furthermore, the detection of a common DNA will boost the EU competitiveness in the near future. An in-depth analysis of the direct links and synergies existing among the different pillars of the Framework will be provided later on in the report.[103]

Future challenges

The use of the Foundational IT BOK to inform the syllabi and national curricula, is supposed to provide a sound basis which in turn, eases the communication and mutual understanding between all the potential users across Europe. This would be possible only if the foundational IT BOK is adopted in practice.

Based on inputs gathered from selected stakeholders thorough interviews and during the project's workshops, the EU Foundational IT Body of Knowledge v.01 is still relatively unknown and initiatives to further develop and communicate this model to the public is required to support its **practical use** among the IT professionals.

To achieve this, it will be necessary to establish an open collaborative network involving all the relevant stakeholders, including "champions" for the promotion. These could be professional associations representing the interests of IT professionals, but also other actors having a pivotal role in decision-making processes. Direct value add may come from the cooperation with international partners since many initiatives on the development of BOKs have been already launched across the globe (for instance in Japan, Canada, the US and Australia).

As regard the specific BOKs, there is a wide range of specific IT BOKs, setting standards and qualifications recognised at international level and which have been regulated in some countries via national legislation. To a wider extent, some Member States have adopted national provisions regulating the use of each particular IT Body of Knowledge. These topic-specific BOKs will be the references for the European Foundation Body of Knowledge to gain insights on certain specific IT fields. It should be mentioned that many of these BOKs address IT professionals who have already entered the IT domain or are working in the field but want to specialise more. In fact, many State agencies and employers stipulate that possession of one or more Bodies of Knowledge is suitable to increase IT professionals' employability. From this perspective, the main challenge is to **align** the existing specific IT BOKs to the foundational one developed at EU level so as to contribute to its maturing in the future.

However, the EU IT foundational BOK has been built as a permissive and not an exhaustive model to adapt to the diversity of the IT domain. Given its flexibility, it constitutes a sound and robust point of reference able to adjust to future technological changes and knowledge developments in the IT profession. Therefore, its value in guiding and growing new generations of IT practitioners is expected to be maintained in time.

4.1.3   Education and certification (quality labels)

In the context of a knowledge-based economy aiming to compete globally across various sectors, education represents a key factor to attain a stable and sustainable growth in Europe.

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[103] See Paragraph 4.2

History

Europe 2020 strategy[104] set an ambitious schedule to build a smart, sustainable and inclusive growth. According to the 2013 Annual Growth Survey (AGS)[105], there was a urgent need to "tap the job potential of expanding sectors" such as, among the others, the IT through "future-oriented and reliable legal framework, the development of adequate skills and targeted public support". [106] An OECD survey over 17 EU member states, revealed that in 2013 there was a significant percentage of adults having not the basic IT skills (around 5%) and even more lacking any prior computer experience (9.3%).[107] Furthermore, it also revealed the existence of **short gaps** in the IT due to a misalignment between the stock of skills and the skills required in the labour market.[108] The promotion of e-skills frameworks via certifications, the establishment of multi-stakeholder partnerships (e.g. the Grand Coalition for Digital Jobs), and the investment in IT skills also through the strategic use of European structural funds[109] became key actions to tackle the digital skills gap and to solve the problem of thousands of unfilled IT-related vacancies across all the industry sectors.

As underlined by CEPIS, industry demanded IT professionals "the right skills in the right place at the right time".[110] Since formal education was not able to meet that demand, new approaches had to be developed to address those mismatches, skills gaps and shortages and to support different educational paths.

Current state of play

Education is considered one of the cornerstones of, and key enablers for, the adoption of the EU framework on IT professionalism. The report emphasises the need to give equal recognition and importance to non-formal and informal learning and to formal qualifications and certifications. Certifications, qualifications, non-formal learning and informal learning are mutually supportive components for the development of an IT professional's career since they attest to an individual's competences and skills. This is particularly important for the maturing of the IT profession. However, while formal education paths are well established, with recognised accreditation and validation methods, atypical educational paths still need public recognition.

Several initiatives have been carried out throughout EU, to recognise and validate IT professional career development based on formal education and training, certification by industry, non-formal and informal learning. These include:
- The European Qualifications Framework (EQF)
- The European Credit System for Vocational Education and Training (ECVET)
- Europass
- European Quality Assurance in Vocational Education and Training (EQAVET)
- Validation of non-formal and formal learning

Two important initiatives are highlighted in below: the Euro-Inf Quality Label by EQANIE, and the Quality Labels for Industry-based certification.

The Euro-Inf Quality Label (EQANIE)[111]

The European Quality Assurance Network for Informatics Education (EQANIE) is a non-profit association seeking to enhance evaluation and quality assurance of informatics study programmes and education in

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104 European Commission (2012). Europe 2020. Retrieved from http://ec.europa.eu/europe2020/index_en.htm.
105 COM(2012) 750 final
106 The Commission spelled out ways to tap this potential in its Communication "Towards a job-rich recovery" (COM(2012)173) of 18 April 2012.
107 OECD Skills Outlook 2013, Survey of Adult skills
108 OECD Skills Outlook 2013, Survey of Adult skills
109 Communication: "Towards a Job rich recovery." COM(2012) 173 final, Strasbourg, April 2012.
110 Further information is available on the CEPIS website (http://www.cepis.org/).
111 More information available online: http://www.eqanie.eu/

Europe. It was founded on January 9th, 2009 in Düsseldorf, Germany. It has around a dozen institutional members from countries across Europe. Each institution nominates a representative to the General Assembly, the governing body of EQANIE. The General Assembly appoints members of an Executive Board, responsible for the management of EQANIE activities. The Executive Board appoints a Secretary General who supports these activities.

EQANIE develops criteria and procedures for the evaluation and quality assurance in informatics study programmes and education. Furthermore, it develops and maintains a system for the award of a European quality-label (Euro-Inf) for informatics degree programmes as well as its protection and continued further development. EQANIE provides information about events, activities and publications relevant to quality assurance in informatics education and lists study programmes that have been awarded the Euro-Inf quality label. It maintains contacts and relationships with other European and non-European organisations with similar goals. EQANIE also promotes the development of national and regional accreditation bodies and organises events, seminars, workshops and conferences in its field of activities.

The main objectives of EQANIE in the area of accreditation and quality assessment are:
- Improving the quality of educational programmes in informatics;
- providing an appropriate "European label" for accredited educational programmes in informatics;
- facilitating mutual transnational recognition of programmes by validation and certification;
- facilitating recognition by the competent authorities, in accord with the EU directives and other agreements;
- increasing mobility of graduates as recommended by the Lisbon Strategy

Consistent with the framework of the Bologna process, accreditation distinguishes between first and second cycle study programmes; it covers informatics degree programmes offered by all types of Higher Education Institutions (HEI).

The **Euro-Inf Quality Label** is awarded to degree programmes at Bachelor's and Master's level that comply with the Euro-Inf Framework Standards and Accreditation Criteria.

The objectives of the Euro-Inf Quality Label are

- To enhance quality and transparency of educational programmes in informatics;
- To provide information on study programmes across Europe through an appropriate label for accredited educational programmes in informatics;
- To facilitate mutual transnational recognition of qualifications
- To increase mobility of students

The quality of informatics degree programmes, according to EQANIE e. V., derives from a functioning qualification process, the interaction of its elements and the level of achievement of objectives – i.e. the attainment of the intended learning outcomes by the graduates of a programme.

Accreditation with EQANIE aims to review the logics and efficacy of a qualification process within a degree programme in the field of informatics. Central to the overall assessment is the effective attainment of the educational objectives set by the institution applying for the Euro-Inf Quality Label.

More than 250 labels have been awarded in 13 countries and HEIs are now aware about this label. Connecting results (e-CF, accreditation initiatives…) with Euro-Inf could help to land the project amongst universities.

What are the benefits of Euro-Inf?

The Euro-Inf system is internationally recognised and facilitates both academic and professional mobility.

Benefits for Higher Education Institutions:
- Additional certificate of quality
- Means of promotion: programme meets academic and professional standards
- Benchmarking against other programmes
- Reliable information on quality of Bachelor programme for admission to Master programmes
- Incentive for students to choose programme

Benefits for Students:
- Assurance that programme meets high international standards
- Easier access to Euro-Inf Master programmes
- Additional quality label recognised by employers Europe-wide
- International recognition of degree meeting professional standards

Benefits for Employers:
- Applicants knowledge and competences meet international standards
- Reliable information about quality of degree programme without knowing its details
- Not only academic standards checked but also relevance for the profession

Quality labels for industry-based certification

Certifications have become essential for IT practitioners in all IT-related positions to prove their set of skills, competences and knowledge. Nevertheless, the extreme variety of the landscape of certifications requires the adoption of common references for better orienting IT professionals and recruiters. Quality labels can provide this insight. Based on the e-competence framework e-CF and a set of quality indicators (developed in the e-Skills Quality Label project[112]) two kinds of Quality Labels – for the programme or for the delivery of the programme- can be assigned to e-competence related training and certification programmes. In detail, programmes are mapped against the e-CF and included in the list of e-competence certificates.

Thus, the principle followed in developing the quality label is *a dual-channel structure* indicating that two key elements should be monitored and assessed as satisfactory, to give formal recognition:
- An education institution and its associated delivery process: European e-skills Education Institution Quality Award;
- An education programme and its content: European e-skills Education Programme Quality Award

Furthermore, a set of e-skills quality label criteria has also been proposed. This set includes mapping against the European e-Competence Framework as a major criterion for the quality label.[113] The mapping of industry-based e-skills certifications against the European e-Competence Framework (e-CF) will make the label clearer for IT-professionals, consultants with specific e-skills, training providers, certification bodies, employment and recruitment agencies and the staffing industry.

Thus, a clear need for the full development of e-skills quality label and tools has emerged in Europe.

Value for users

There is a general consensus on the relevance of certifications to assess the set of competences/skills acquired by the IT professional. Academic institutions and their educators, students and staff benefit from digital curriculum and certifications for fundamental technology skills.

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112 Further information is available at http://www.eskills-quality.eu/home/
113 Empirica (2013). "Towards European e-Skills Quality Labels for IT Industry Training and Certifications". Study on behalf of the European Commission.

Common European instruments and principles are necessary in order to contribute to recognition and consistency of employment, education and training throughout Europe. Such provisions enable also the enhancement of mobility and transparency across Europe, inducing the development of multidisciplinary skills required in the analysed professional and learning pathways.

In regard to E-Competence Quality Labels, introduced above, they have a clear value for learners, employers, employment agencies, training providers since they allow to identify the skills needed in the market, make them available to recruiters and ensure the demand-supply matching. From this perspective, quality labels are expected to bring transparency to the IBTC market, and to ensure a higher quality of teaching and delivery.

Future challenges

The IT market is still affected by **skills shortages** consisting in higher demand than supply and consequently, more effort in education and skills policies is needed to make European workers more IT literate and competent.[114]

In this regard, it is important to mention recent research from ThinkYoung[115] that observes that countries with low youth unemployment are those where VET and apprenticeships are more developed. This could be an important trigger for countries to take into account when developing (effective) education policies.

Despite the development of a unique framework on e-competences at EU level, there is still a wide universe of IT certificates which can be used by the IT professionals. The **lack of transparency** in IT certification world - defined also as a jungle- is still the hardest challenge to face in the future. Thus, more effort is needed.

The wide adoption of e-Competence Quality Labels could help solve this issue. Furthermore, the e-skills Landscape Service[116] constitutes a prototype tool based on the European e-Competence Framework and on the CEN IT Profiles and the mapping of IT industry certificates, which can help to distinguish different types of training and certifications by reference to quality labels.

Trends in education: Innovative teaching methods

The changing face of the university lecture is a hot topic that has been discussed by students and lecturers alike for many years. With the rapid rise of the digital age and of innovation in teaching, where students are using smartphones, tablets and laptops as learning tools and there is a phenomenal wealth of information available online, is there still a place for the traditional lecture[117]? For students, it is not just what we teach, but the way we teach it. Millennials are constantly growing in 'digital' and the way they think and act must be aligned with the way they are taught.

In the words of the European Schoolnet[118]: a trend is a shift or tendency within a system, for example schools, that is likely to grow in importance and influence how the system operates. Examples include economic developments, changes in society or in employment, or in attitudes and behaviour. Some trends are opportunities, others disruptive, a challenge or threat; some turn out to be a short-lived novelty (an innovation can develop into a trend, or die out), others slow-burning, even barely noticeable but seismic and enduring over the long term. Many trends are of course outside the control of schools, but others can be taken into account in school development planning and designing effective teaching and learning. A trend may emerge in one country but not another, another may be global. The European Schoolnet's 'Future Classroom Initiative[119]' explains very well what is happening from the different viewpoints of teachers, students and technology, and

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114 COM(2012) 173 final
115   Available online here: http://www.skillsmismatch.thinkyoung.eu/#!2016/tzhf6
116 See: www.e-skillslandscape.eu
117   Innovative teaching methods vs the traditional university lecture, BBC Active, available online here:
      http://www.bbcactive.com/BBCActiveIdeasandResources/Innovativeteachingmethodsvsthetraditionaluni.aspx
118   See: http://www.eun.org/observatory/trends and
119   http://www.eun.org/observatory/trends/trends-by-teachers-students

also includes various good practices such as the 'Technology compass for education[120]' (Kennisnet, the Netherlands) and 'Innovating Pedagogy 2014[121]' (Open University UK).

One interesting and much debated concept is **Problem-based learning (PBL)** which is a student-centred pedagogy in which students learn about a subject through the experience of solving an open-ended problem[122]. Students learn both thinking strategies and domain knowledge. The PBL format originated from the medical school of thought, and is now used in other schools of thought too. It was developed at the McMaster University Medical School in Canada in the 1960s and has since spread around the world. The goals of PBL are to help students develop flexible knowledge, effective problem solving skills, self-directed learning, effective collaboration skills and intrinsic motivation. Problem-based learning is a style of active learning.

Most teachers have done projects, but the majority do not use the defined set of methods associated with high-quality PBL[123]. These methods include developing a focused question, using solid, well-crafted performance assessments, allowing for multiple solutions, enlisting community resources, and choosing engaging, meaningful themes for projects. PBL offers the best method we have presently for combining inquiry with accountability, and should be part of every teacher's repertoire.

It's true that some people are just naturally more creative than others. But creativity can be nurtured in everyone and all students can learn to use a process for effective innovation[124].

There are more trends in Education; and this probably deserves a report on its own. For the purpose of this report we want to stress the importance of keeping teaching in line with expectations of students, and aligned with technology innovations as well as needs for technology skills.

'Badging' – an emerging trend in education

Digital badging is one new practice worth examining for its potential benefits for teaching, learning assessment practices in both formal and informal learning settings[125]. Digital badges have emerged as a way to document ongoing community engagement, professional development, and accomplishments. Badges recognise incremental learning in highly visible ways. They can support and enhance a career portfolio and may help illuminate a learning path[126]. Those individuals who meet established criteria have an opportunity to earn digital badges in recognition of their engagement with the association. When you earn, display, and share badges, you help draw attention to your community involvement and professional development experiences. It is also a great way to attract young people.

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[120] https://www.kennisnet.nl/
[121] http://www.open.ac.uk/blogs/innovating/
[122] Hmelo-Silver, Cindy E. (2004). "Problem-Based Learning: What and How Do Students Learn?". Educational Psychology Review 16 (3): 235–266
[123] Markham, Thom, 10 Ways to teach innovation, April 2013, available online here: http://ww2.kqed.org/mindshift/2013/04/01/10-ways-to-teach-innovation/
[124] Larmer, John, How Can We Teach and Assess Creativity and Innovation in PBL?, February 2014, available online here: http://bie.org/blog/how_can_we_teach_and_assess_creativity_and_innovation_in_pbl
[125] From: http://ict4kids.ca/teaching-and-learning/how-can-digital-badging-aid-learning/
[126] From: http://www.educause.edu/badging

Figure 4.3 Badge EcoSystem[127] and cartoon developed during 1st workshop on IT Professionalism
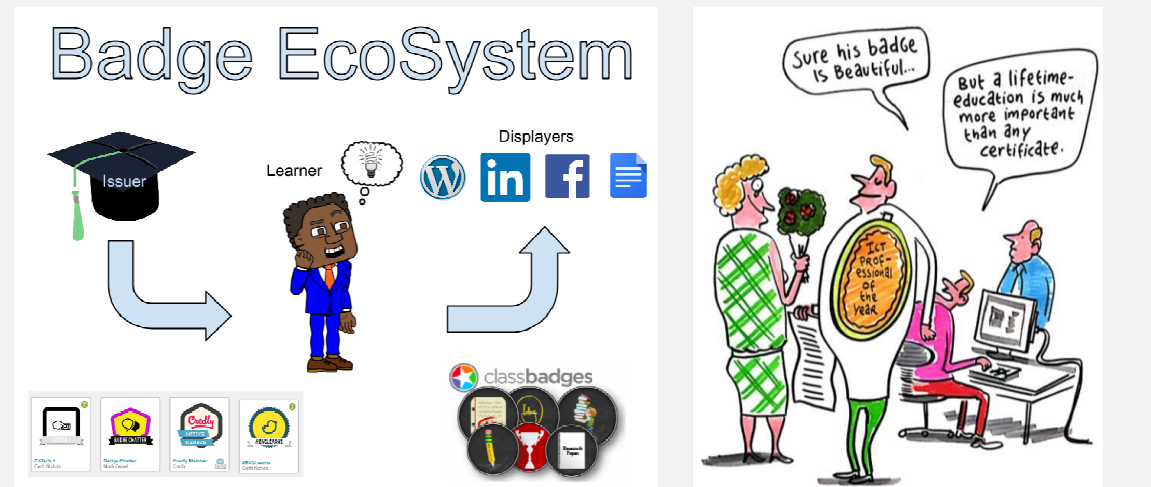
Potential benefits of digital badges are that they consist of a way to showcase the skills of learners beyond traditional structures like formal education offers. When lifelong learning becomes an essential ingredient of success and productive citizens, badging could offer a transparent way of measuring and recognising new learning. These badges could be linked directly and posted on websites such as LinkedIn and others to allow relevant stakeholders to see. A digital portfolio (i.e. blog, wiki, site etc.) can also provide a rich platform for dialogue and asynchronous communication between educators and learners through comments and messaging. In way this resembles the Irish CPD practice (see paragraph 3.3.4), that illustrates a unique pathway of learning.

There are also concerns with this trend, and as with all trends follow the Hype Cycle, substantial experiencing will help to overcome these barriers and might lead to productivity and value-add.

4.1.4   Ethics: towards European Ethical Guidelines?

Ethics in the IT Profession regulates the boundaries of relationships with customers, colleagues and society.[128] The ethical principles can be embodied into different forms ranging from high-level documents specifying principles of individual behaviour to specific initiatives.

There is a formal distinction between Codes of Ethics and Codes of Conduct/Professional Practice (Berleur et al.2004):

- *Codes of Ethics* are static in nature since they comprise high level statements or guidelines on general and accepted principles governing the individual ethical conduct (e.g. honesty, integrity).
- *Codes of Practice/conducts* encompass specific and detailed statements dealing with "good practice" or the practical and technical execution of the individual work within an operational environment. Such codes relate to specific domains such as security, software engineering and are subject to evolving technological environments leading to sudden changes.

According to the distinction made by IFIP and CEPIS, the "Code of Ethics" generally mirrors the computer society's vision and objectives in terms of its public mission and guidelines addressing the profession in general. Differently, the "Code of Conduct" focuses on the profession or professional practice also imposing

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127   Retrieved from: https://ict4kids.ca/teaching-and-learning/how-can-digital-badging-aid-learning/
128 CEPIS Professionalism Taskforce (2010), Characteristics and Benefits of Professionalism in IT, Version 0.1

enforcement rules which are binding on all the professionals and whose violation leads to sanctioning processes. As underlined by the Institute of Engineering and Technology (IET) any profession is characterised by adherence to a shared Code of Ethics/Conduct that allows to pursue different purposes including self-regulation, responsibility and accountability or improved reputation of the IT profession (Berleur et al, 2004; Udas et al, 1996). Whilst the conduct codes focus on behaviour and aspirational values, the practice ones deal with processes and products which evolve rapidly.

History

An overview of past experiences is useful to both advocate the relevance of this component into the IT framework and to identify the state of the art for future intervention. Already at the very beginning of the 2000s, the development of a IT charter was conceived as a way to ensure reciprocity of conducts and to benefit the community rather than the few following the mainstream idea of "people coming first" (The real world of technology 1999).

The Council of European Professional Informatics Societies (CEPIS) Taskforce has been working on this building block to support the adoption of a cohesive approach and initiatives suggesting concrete actions to develop the framework for IT professionalism. As part of its lobbying activities on the UN and EU institutions, the CEPIS has advocated the inclusion of accountability and transparency requirements into the ethical codes as a key aspect. In regard to the content, codes adopt a holistic approach comprising high-level statements that aim to inspire the individual conduct, demand the use of good practices and expect a professional attitude. [129] The main goal of CEPIS activity is to provide practical tools not only to raise users' awareness of the ethical issues in the IT field, but also to strengthen the experts' capability in ensuring compliance with ethical norms.[130]As an achievement of its lobbying role on the institutions, CEPIS has also found that the level of enforcement of these principles depends on the existing infringement measures.[131]

Beyond Europe, it seems that a more balanced view is spreading worldwide. Two cases can be illustrated:

- In Australia, the 2012 Government IT Young Professional of the Year Award, Christopher Giffard from the Department of Education, Employment and Workplace Relations, underlined in his speech the importance of standards and equal accessibility for all citizens to web content and information services (ACS, 2012)[132].
- In India, the Al-Ameen Movement has supported the education of young students to become IT professionals of tomorrow. Targeting the most modest part of society in the region of Bangalore, the education model focused on the integrated development of technical, moral, physical and spiritual issues besides formal education (AISS)[133]

Current state of play

The ethic domain encompasses codes of Conduct covering integrity, confidentiality and competence; initiatives related to the accessibility of IT, the management of the safe use of IT or the promotion of forms of Green IT to minimise energy wastage; specific safeguarding actions against the spread of software piracy.

In the IT sector, professionals' commitment to ethics can be proved by compliance to a code of conduct or to specific thematic-oriented initiatives. Codes of conduct define the way professionals act and think and their role is to establish agreed standards against which individual practices are measured and tested (Software

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129 Simon Rogerson, IT Codes of Ethics, PPT Presentation, CEPIS Ethics Conference 2015.
130 CEPIS website: www.cepis.org
131 EU IT Professionalism Final Report
132 ACS, Australian Government IT Young Professional of the Year Award Winner, available at: http://www.acs.org.au/news-and-media/news-and-media-releases/2012/2012-australian-government-IT-young-professional-of-the-year-award-winner   (accessed February 2016).
133 AISS, Al-Ameen Institute of Information Sciences, Principal's Message, available at http://aiis99-edu.org/principal_message.htm (accessed February 2016).

Engineering Code of Ethics & Professional Practice, 2002) Nevertheless, ethical guidelines or norms are strictly dependent from the national geographic context where they are produced and applied. In reality, they are strictly linked to traditions and culture as well as to the degree of professional maturity. Therefore, adherence to codes which are not in line with a shared "cultural ethics" is likely to lead to dichotomies (Grodzinsky 2000). Each code belongs to a specific ethical environment where they can be applied, enforced or sanctioned and thus, they are not universally valid nor transferrable to other cultural contexts. As a consequence, a framework on the IT profession should adopt a high-level and high level perspective on ethical issues to maintain the potential to be applied to different codes, laws and guidelines across different geographic contexts.

Value for users

Evidence gathered through *interviews* has showed that there is a general consensus on the existence of a core corpus of principles that should be respected in major professional societies. Ethical principles should inspire and inform any individual daily professional practice to keep the IT professionals accountable for their work.

Nevertheless, there are uncertainties on the type of principles to be included in such codes and on the role of the European Commission in developing them further. Except from a strict nucleus of principles common to all the professions, ethical norms are perceived as natural expression of a specific culture and society. Despite the agreed relevance of such principle for IT professionals, a strong criticism covers their binding nature and the level of enforcement it is possible to ensure in case of breaches.

Future challenges

A variety of codes is not only accepted but also safeguarded by involved stakeholders as not belonging to the domain of competence of the European Commission. IT professionals can belong to different organisations and consequently they could not know how to behave by adhering to one code or another (Oz, 1993).

In order to develop common guidelines for national Codes of Ethics, general core ethical values and on associated requirements for the specific professional conduct need to be listed and structured.

The first category can be applied to any profession society. A non-comprehensive list is presented hereby:
   – Honesty
   – Integrity
   – Transparency
   – Confidentiality
   – Objectivity
   – Respectfulness
   – Obedience to the law
   – Loyalty

In sum, there are still strong ambiguities both in the identification and in the endorsement of the ethical principles in the IT domain. Nevertheless, like any other profession, there is a clear need for ethical guidelines within the IT profession in order to keep professionals accountable and responsible for their activities.

Past and current initiatives related to this building block have contributed to start the discussion on ethics in the IT field and to stimulate the public debate on codes, but there is still a barrage of **ethical challenges** to address. Participants to recent stakeholders' events on the ethical issues have raised some key points and dilemmas to be discussed further. A sample list of **future ethical challenges** has been included below.
   • The theoretical attitude and adherence to codes are not usually part of the general skill set demanded for recruitment.[134] In fact, IT professionals may work at the same time for many

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organisations and the alignment with different organisational systems is based on the personal adherence to adopted codes. The lack of strict forms of censure or enforcement poses a threat on the effective application of shared ethical principles. The debate on ethical values for IT professionals has been politicised and reduced to a demand for a tick-box compliance rather an effective adherence (Rogerson 2014).[135] In sum, compliance is still *voluntary*.

- It is impossible to control or to stop different individuals from writing codes nor should they.[136] Plurality of sources is also a consequence of the fact that "the innovation journey is never over" (Floyd 2013).
- Despite the attention paid by education systems to the need to consider IT domain as ethically charged, the silo-mentality in delivering ethic concepts and norms has not favoured the development of a transdisciplinary approach which helps to recognise ethic related risks and challenges in different situational contexts to allow the individual judgment (Rogerson 2014).
- Future will be unknown. The gap between reality and what was predicted is usually huge and any attempt of forecasting leads to the paradox of a wide variety of technology futures which are likely to fail.[137] The nature of computer technology, its 'logical malleability', leads to high levels of complexity, unreliability and uncertainty. In Computer Ethics, it is important to consider the moral frameworks and assumptions which influence the way we look at risk, accountability and responsibility.[138] Therefore, it is important to train for *styles of thinking* since they are more likely to guide in future applications.[139]
- Compliance requirements are effective only if there is the possibility to exclude a company from organisational membership or an individual for not following the accepted codes. To get anyone to implement and respect codes would require that ethical needs are attractive to both the corporations and the individuals (Kimppa 2015).

To address these challenges, it is important not to offer methods to solve specific problems but rather to indicate decisions support systems, sources of information and available codes to orientate behaviours. Practical tools that might be used to face the current challenges and to stimulate ethical behaviour have been proposed together with possible methods of application.

- Education: mandatory ethics and IT education at bachelor level IT professional studies but also through other activities(e.g. seminars on professional ethics, peer learning within companies and between computer society members, professional magazines, scientific journals or books);
- Ethics work groups to share common practices and to guide each other;
- Promotion of Ethics through Code of Conduct and not through ban of unethical behaviour;
- Introduction of ethics certification or accreditation with possibility of losing them.[140]

To conclude with, the process to ensure virtuous action comprises many steps going from education & Training to design & governance which influence final conducts.

A non- exhaustive list of **possible developments** of this building block would include:

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135 Rogerson, S. (2014) Preparing IT professionals of the future, Mondo Digitale, 13 (50).
136 Kai K. Kimppa, Future Ethical Challenges and the Task of the Professional, PPT Presentation, CEPIS Ethics Conference 2015
137 Horner, D. (2007), Digital futures: promising ethics and the ethics of promising. ACM SIGCAS Computers and Society, 37, (2), pp.64 -77 [ISSN:0095-2737]
138 Horner, D. (2010) Moral luck and computer ethics: Gauguin in cyberspace Ethics and Information Technology, 12 (4). pp. 299-312.[ISSN 1388-1957]
139 Ibid.
140 Ibid.

- Address in an univocal way the complex and multiple ethical issues related to IT EU professionals in the multi-stakeholder and international context, providing general guidelines to be implemented by national computing associations. The need for a set of guidelines stems from the plethora of possible applications of technology and from the risk to harm the society when recipients' needs are not duly taken into account;

- Fill the gap between ethics taught at university and the ethical issues faced in the workplace. It is uncertain whether IT professionals are prepared to face ethical challenges even if they have been educated to recognise and understand the main issues and types of challenges to be faced.

- Although we do not know the future, we can predict some uses of applications we are designing and thus, it is possible to adopt a preventive rather than reactive approach in the assessment of potential risks;

- Promoting IT social responsibility. Beyond legal compliance and fiscal requirements, the recognition of social responsibility requires a change in the adopted perspective and in moral individual action. For instance, by taking into account not only the stakeholders' interests but also their wellbeing and by ensuring that all the business processes are managed applying a social responsibility perspective. This approach would also mean being accountable for global common values and local cultural differences.[141] This would contribute to establish and maintain a safer and more reliable e-Business environment and information society regardless of organizational, social and cultural structures;

- Professional codes should not be an instrument of compliance but rather, an instrument of appliance in maturing ethical IT profession. This means that ethical values must be embedded in professional practices and thinking (Rogerson 2010)[142].

- Raise the awareness of IT Professionals' responsibilities and obligations towards society. In fact, professionals must be conscious of their role as the custodians of the 'most powerful and flexible technology mankind has invented' (Rogerson 2010).[143]

4.2   Creating synergies

Technology is changing very rapidly and consequently the society is changing very fast. Therefore, professionals who work with these technologies are required to keep up with ongoing developments. This general rule applies to all areas of expertise with no exception.

In this view, a unique framework at EU level to help professionals in a changing environment will be welcomed. Due to the speed of technological change, the framework should be future-oriented to align with new technologies. The components of this framework must be open to new developments but also stable enough to provide the framework with a sound basis to cope with future developments in the IT field.

In essence, creating synergies among the four pillars also through a strict and wide cooperation of the wide network is crucial to maximise the potential value of each single component.

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[141]   Rogerson, S., Aspects of Social Responsibility in the Information Society, in: DOUKIDIS, G.I., MYLONOPOULOS, N.A. & N. POULOUDI, A. (editors), Social and Economic Transformation in the Digital Era, IDEA Group Publishing, Chapter 3, pp 31-46, 2004

142 Rogerson, S. (2010). A review of information ethics. Journal of Information and Management, Japan Society for Information and Management, Vol. 30, No. 3, pp. 6-18

143 Rogerson, S. (2014). Preparing IT professionals of the future, Mondo Digitale, 13 (50)re,

4.2.1 The European Framework for IT profession as a dynamic model

The EU framework for the IT profession is a **dynamic model** able to capture the constant evolution of the European Digital Single Market through its four blocks and to offer tailored services.

To attain this ambitious goal, the four pillars must be open to the external world but also connected through both structural and functional links and relations that create synergies. The four pillars do not work in isolation but they work together to deliver value to beneficiaries and final users of the framework. In essence, the framework is specifically designed to be more than the sum of its parts.

Figure 4.4 The building blocks of the Framework for the IT profession
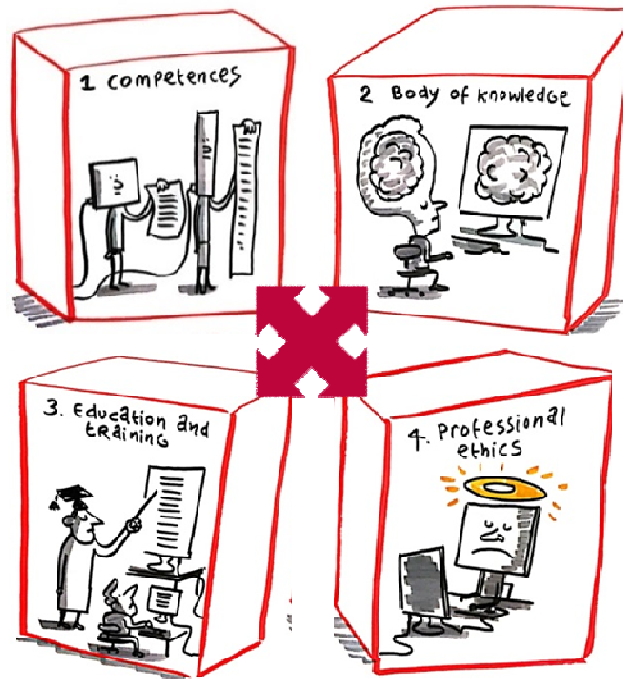
4.2.2 Structural and functional relations within the Framework

As widely described in the report, the European Framework for IT Professionalism is based on four building blocks essential to mature the IT profession: Body of Knowledge, Competences, Education & Training and Professional Ethics. The main strength of the proposed framework is the combination of stable components with a high degree of flexibility allowing to adapt to rapid IT changes and emerging market requirements.

Looking at the four pillars, different types of relations can be found:

Structural relationship: this kind of relation refers to existing links between pillars within the structure of a pillar itself. Some examples can be illustrated to better describe the structural relationships:

- *Link between the Foundational IT Body of knowledge, e-CF and Ethics*: Building on the existing frameworks, the EU framework establishes a clear correspondence between the knowledge areas of the Foundational Body of Knowledge and the e-CF. In detail, the European Foundational IT Body of Knowledge consists of different knowledge areas within the IT domain ranging from a strategic to a technological perspective. Each knowledge area provides reference to the e- Competence Framework and thus, to possible job profiles. It is worth noting this function of referencing is one of the key strengths of the model, as it allows any user and the wider public to understand what it comes next.

In fact, base-level knowledge is required to start a career in the IT and to get a job. Then the acquirement of a specific knowledge in an IT sub-domain combined with sophisticated skills also including soft and managerial aspects will be necessary to develop competencies for professional and career progression.

In addition, the Foundational IT Body of Knowledge offers an overview of practices designed to ensure the highest level of ethical conduct, standards of practice and integrity in carrying out any IT professional activity.

- *Link between e-CF and Education, Qualification and Certification*: The European Union has developed several instruments to support the transparency and recognition of knowledge, skills and competences to make it easier to study and work anywhere in Europe. A variety of initiatives has been launched with a view to improve the overall transparency and equal recognition of skills and qualifications across Europe. One of the most relevant initiatives is the European Qualifications Framework (EQF), which helps to compare national qualifications systems, frameworks and their levels to make qualifications more readable and understandable across different countries and systems in Europe. In detail, proficiency levels of each e-Competence are closely related to the EQF levels so that we have a direct correspondence between e-CF levels 1 to 5 and EQF levels 3 to 8.

Functional relationship: this kind of relation refers to the combined use of two or more pillars for a common purpose/function. A relevant example is presented below.

- *The link between IT Certifications and e-CF*: When obtaining a new job or moving within and across borders, IT students and workers should get their skills and qualifications quickly and easily recognised. This is essential to attain higher skills levels and increase employability. Mapping certifications to competences pose a challenge as there is no widely agreed standard for assessing the requirements nor commonly agreed methods of testing candidates for these certificates. Therefore, the mapping of e-Skills certifications against the European e-Competence Framework is part of the Quality project launched by the European Commission DG Enterprise and Industry. To date, many IT certification vendors such as CompTIA, Microsoft, Cisco, Cert-IT, LPI, and EXIN have already started mapping their certifications against the e-CF proving the interest in finding common solutions in this field. Furthermore, the current mapping is not just an update of the previous positioning exercises, but it affects the IT-related roles in organizations for which the certificates may be relevant. To this end the e-competence 'profile' of the certifications has been compared to the European IT-Profiles (Draft CEN Workshop Agreement of the CEN IT Skills Workshop). This enables a new approach in positioning of the e-skills related certifications for students, professionals, organizations and training providers which can be used, for instance, in the self-assessment tool within the e-Skills Online Landscape Tool and Service.

With the ambition of providing a clear guide to enlighten mechanisms between the four pillars and to support users to orientate in the IT professionalism, the framework will provide concrete solutions leading to strengthen, standardise as well as establishing relations between pillars.

4.2.3 Examples of synergies the Framework offers

The EU framework for the IT profession has to be intended as a comprehensive guide to orient and support the IT practitioners throughout the professional life cycle, from the early school years to career development,

thanks to the integrated and joint effort of the four pillars. Therefore, the components of the framework structure (Body of Knowledge, Competences, Education and Ethics) should not be considered in isolation but as parts of a whole, which interacts with the surrounding technological environment and evolves in time.

The term "synergies" has been used in this study to refer to the virtuous interactions that can be established between pillars. Similarly, the concept of "synergetic" (Fuller, B. and Applewhite, E. J. 1982) well explains the "system of holistic thinking" with reference to:

- A dynamic state in which combined action is favoured over the difference of individual component actions;
- A behaviour of whole systems unpredicted by the behaviour of their parts taken separately, known as emergent behaviour;
- The cooperative action of two or more *stimuli*, resulting in a different or greater response than that of the individual *stimuli.*

From this perspective, the EU Framework generates synergies between the four pillars and builds upon them to provide concrete solutions to the involved stakeholders. The ultimate goal is to guide users and stakeholders into the IT profession by promoting an effective and integrated usage of the framework components. The expected outcome is an increased advantage for users, further development and improvement of the building blocks, higher transparency in access to the four pillars and related tools.

For the scope of the study, we relied upon relevant practices derived from the desk research and experts' interviews to explore the potential synergies between the pillars at each step of the professional lifecycle.

A non-exhaustive list of cases is provided below to show the virtuous synergies between the pillars.

a. **How the Foundational BOK interacts with the Education & Training and the e-CF**

The foundational Body of Knowledge encompasses the basic knowledge beyond the simple IT literacy and it is oriented towards programming and problem solving. From a synergetic perspective, the base-level knowledge included in the Foundational Body of Knowledge can be used to map and align existing foundational training courses and to design new courses based on a common framework aimed at developing core e-competences and skills.

Being the repository of the core concepts that any IT practitioner should master before approaching a career in the IT domain, the foundational BOK should constitute the basic reference to inform the main contents and structures of the education and training programmes. This would allow the IT practitioner to acquire a set of knowledge and skills at basic proficiency levels to successfully start a career in the IT domain.

Furthermore, close links exists between the foundational BOK and the e-CF since the structure of the body has been developed using different families of IT job profiles for the clustering of the knowledge domains. Moving from the structure to the practice, the adherence to the foundational BOK would create bridges with the e-CF and job profiles providing a clearer view of future career paths. The direct positive impact on the image of the IT profession will improve its perception within the wider public and thus its attractiveness.

This synergy does not only favour the IT practitioners at the entry level of their career, but throughout the professional life cycle. In fact, a key feature of the EU framework on IT professionalism is the attention paid to the professional development of the practitioner targeting the existing skills shortages and gaps, which hinder the individual career progress. By adhering to a common foundational BOK, formal learning and certification programmes contribute to decrease the e-skills shortages and gaps experienced in the IT sector, with a consequent positive impact on the career paths and progress. Finally, all the expertise areas within the IT sector share a common base of core competences. By expanding the common competences shared by different IT profiles, a positive impact would also be experienced in the employers' mobility within the IT sector.

Example1. ITIL Foundation training courses and foundational BOK

An example of the link between the foundational is the training course ITIL Foundation where the knowledge items of the Foundational BOK have been used to structure the contents. The ITIL Foundation training courses and related certifications address: Service Lifecycle, Portfolio, Infrastructure, Knowledge Management and Process Management.

FOUNDATIONAL BOK		ITIL Foundation				
KNOWLEDGE AREAS	KNOWLEDGE ITEMS	Service lifecycle	Portfolio	Infrastructure	Knowledge management	Process management
ICT Strategy & Governance	■ The role of ICT within organisations and benefit realisation	■				
	■ Concept and theory of strategic planning	■				
	■ International standards for corporate governance of information technology (ISO 38500)		■			
	■ Foundations of ICT strategy design	■				
	■ IT decision-making processes	■				
Business and Market of ICT	■ Distribution and delivery models	■				
	■ Business Process Management					■
Architecture	■ Technical architecture			■		
Testing	■ Life cycle testing	■				
Operations and Service Management	■ Basic concepts of service management (including the concept of service and service level agreement)				■	
	■ Service management processes (including design, transition, delivery and improvement of services)					■

As illustrated above, the knowledge areas of the foundational BOK and items are strictly linked to the training contents. New ITIL Foundation training courses, like Security Foundation, Data Scientist Foundation have also been developed based on the Foundational BOK confirming the value of the approach taken[144].

b. How the e-CF interacts with the Education & Training and the Specific BOKs

While the Foundational IT Body of knowledge is the reference point for developing wide basic knowledge at entry level, there is a growing awareness of the advantages of approaching advanced education and training from a competence viewpoint. In these circumstances, the e-CF is a valuable tool, supporting the design of training programmes.

According to a competency-based approach to educational programmes, various forms of education should be aligned with different national and European frameworks, with particular emphasis on alignment with the European e-Competence Framework (e-CF).

In this respect, education providers can provide visibility into the competences and proficiency levels developed through various education routes. Qualification providers may use the e-CF or the European IT Professional Profiles in different ways: for example they can improve their programmes to match the learning outcomes with the e-CF and to achieve corresponding certification requirements. Universities usually create degree programmes to comply with higher education accreditation rules and frameworks. Lately more and more have matched their programmes to the e-CF, particularly the outcomes, to enhance communication with industry and to meet labour market needs.

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[144] Further details on the ITIL Training & Certification can be found on the website: http://www.newhorizons.com/courses/itil-training.aspx

Mapping of education courses to the e-CF help improving the transparency, relevance and comparability of courses in terms of developed e-competences and associated proficiency levels, and support more informed course selection decisions. The transparency and consistency of this mapping of courses to the e-CF are essential to its successful adoption.

In addition, given the general agreement on the need of validating non-formal and informal education, e-CF can be used as reference point for developing such processes.

Example2. e-CF and E&T: Develop training and reskilling material

One of the most pressing areas of improvement concerning education and training is promoting training/reskilling programmes: in order to ensure the full development of required competences for practitioners who move from one profession to another in the IT field. A typical training course can be based on competences and skills. To design a training course it is useful to use the e-CF as reference point.

See below for an example of training courses based on Product Certifications Architecture of The Open Group

Training course	e-Competence
Archimate	A.5. Architecture Design
	B.6. System Engineering
Togaf 1	A.1. IS and Business Strategy Alignment
	A.5. Architecture Design
	A.7. Technology Trend Monitoring
	B.6. System Engineering
Togaf 2	A.1. IS and Business Strategy Alignment
	A.5. Architecture Design
	A.7. Technology Trend Monitoring
	B.6. System Engineering
	(with higher proficiency levels)

Example3. e-CF and E&T: Positioning IT Certifications against e-CF

Since 2004, the CEN initiative and project "IT Certification in Europe" has been working closely with industry stakeholders and IT vendors such as Cisco, Microsoft, LPI, EXIN, etc. as well as with IT Professionals associations as CompTIA, CEPIS, IEEE, etc. and other standardisation endeavours such as Learning Technologies under the umbrella of CEN. The new CEN Workshop Agreement (CWA) IT Certification in Europe proposes a methodology to position certifications against the European e-Competence Framework (e-CF). The aim of the working group is to exchange information about the current state of play as well as future trends and developments on the training and certification market.

In 2014, the Linux Professional Institute (LPI) received the e-Skills Quality Label by EXIN based on the e-CF, for its certification programme. LPI's certification programme has been used by a global affiliate network that has delivered more than 430,000 certification exams worldwide. Above all, the use of the e-CF for positioning Certification programmes has added value to the LPI's certifications by increasing the international recognition of the certifications which in turns favours the horizontal mobility into the labour market and the attainment of better job positions. This is valid not only at the entry level of the labour market but also for career development and changes within the IT sector. In fact, holding a recognised certification providing an accurate measurement of knowledge is essential to proof the ownership of skills required to perform a job, the flexibility to adapt to different tasks, the ability to solve troubleshoot problems and a higher reputation.

While the foundational BOK provides the core knowledge in the IT domain, the specific BOKs have a focus on a specific topic (i.e. Security Management, Service Management, Business Analysis, etc.). Following the same

approach taken in the previous case, specific BOKs constitute the basis for education curricula and training courses to improve the individual competences and skills.

In a long term perspective, positioning educational curricula against specific body of Knowledge contributes building a bridge to the IT job career by defining a common reference for lifelong learning and for career changes. When coming from a non-IT sector, professionals are concerned with important issues: the unawareness/incomplete understanding about what IT is and what it can bring in terms of career opportunities, the lack of awareness of skills/competences required to different role profiles due to high specialization/segmentation of jobs. At this stage, strong synergies built between the specific Body of Knowledge and the education and qualification/Certification are essential to acquire the competences and sophisticated skills required by in a specific IT domain.

In sum, the EU framework for the IT profession has been envisioned and designed as a dynamic model able to evolve into different states to adapt to the surrounding environment and based upon fluid structural connections and functional interactions between its pillars.

The next chapter will describe in more detail how the EU Framework, leveraging on synergies between the four pillars, will provide a positive impact on different stakeholder groups.

5 Target audience and stakeholders

The European Framework for IT Professionalism is an international reference framework that can be adopted and applied by IT professionals, educational providers, employers, government users, social partners and organisations from both the public and private sector across Europe. With this aim in mind, a useful approach to this framework is to distinguish the **target audience** from the **potential users**, who will adopt and use it.

The **target audience** encompasses the individuals for whom the framework has been designed and developed. It primarily consists of IT practitioners throughout their career as well as people willing to approach this profession. The **potential users** are all the stakeholders within the IT community who will use the framework as a point of reference to fulfil their mission and to meet their expectations.

The **IT community** as a whole comprises a universe of stakeholders characterised by different needs, interests and expectations within the IT domain and labour market. They are not just potential users of the framework on IT professionalism but co-editors contributing to its development and maintenance through the development of the toolsets and services to support its adoption. In reality, the successful implementation and uptake of the European framework for IT professionalism requires a **coordinated and joint effort** from all the interested parties of the IT ecosystem. Maturing and promoting the IT Professionalism needs time but the establishment of a collaborative network bringing about all relevant stakeholders, would be an enabler of success.

All relevant stakeholders active at a national, regional or local level can be clustered into groups and framed within a 'European dimension' where complementary to their current practices can be found. A solid strategy to promote IT Professionalism in the future will rely upon their fruitful interactions and synergies.

As well described by CEPIS in the final report about the IT profession in Europe[145], multiple stakeholders have to be considered as key users due to their twofold role as players and interested parties.

A list of the main stakeholders representing the framework's audience, together with their main value in relation to the IT profession, is introduced in the table below[146].

Stakeholders	Value Statement
IT practitioners and managers	– Improved public perception and image of IT professionals – International recognition of IT competences and knowledge, enhancing mobility and credibility – Improved clarity over IT career paths and competence requirements
Employer	– Reduced cost, effort, and time to recruit, deploy, train and develop suitable IT resources, as well as improved capability to align IT resources with business requirements – Competent professional IT workforce, reflecting industry demand – Potential to facilitate outsourcing opportunities through consistent, agreed definitions of roles and competences
Education Provider	– Increased market size opportunities resulting from improved

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[145] CEPIS (2012), e-Skills & IT Professionalism: Fostering the IT Profession in Europe, Final Report.
[146] A preliminary list of identified needs can be found in the Technical Proposal for this study, which has been expanded based on interviews performed with selected stakeholders.

	–	transparency and comparability of educational offerings
	–	Improved demand for education to support life-long learning requirements
	–	Enhanced alignment with demand from industry
Local/National/European Government Entities	–	Enhanced visibility of supply and demand of IT skills, helping to provide a robust and granular basis for informed policy setting at local, national and European level
	–	Enhanced competitiveness on a global stage resulting from improved efficiencies within industry
Professional associations	–	Opportunity to mature the IT profession and boost membership
	–	Stronger role in communicating/shaping emerging industry practices
	–	Promote interests of IT workers at organizational, national and international level (e.g. employment prospects, security)
Society	–	Reduce risks resulting from an increasingly IT enabled society
	–	Improved employment prospects

Table: Key stakeholders and their principle needs

A wide variety of stakeholders may contribute to the integration of the framework on IT professionalism into organisational strategies and public policies. To achieve that, advantages for each stakeholder group must be evident. In reality, the framework is designed to answer multiple needs and to provide benefits and value to each single stakeholder group taking into account the different perspectives. The point is to understand how and to what extent the framework can support all the targeted stakeholders in addressing the main issues identified in the IT field.

5.1   Target audience: IT professionals as prime beneficiaries

The EU framework on IT Professionalism is primarily designed for IT practitioners, but also links to e-Leaders.

Defining the core characteristics of this category is preliminary to size the magnitude of the potential benefits and the added value delivered by the use of a common framework for a better career start and development. A practical approach to tackle this identification challenge would primarily look at available definitions and agreed concepts to better understand who the IT practitioner is.

Despite common belief and practice, the profile of the IT professional slightly differs from that of the IT specialist, defined as people whose job is strictly related to Information and Communication Technology (IT) and who are able to perform multiple tasks involving corporate IT systems. To a wider extent, the Framework has been developed to also address the needs of both IT managers and senior professionals characterised by an advanced or highly specialised knowledge and an innovative strategic thinking.[147]

The EU framework for the IT profession has to be intended as a guide to orient and support the wide category of IT practitioners throughout their professional life cycle, from early school years to career development and progress.

With this in mind, a brief description of the main issues detected throughout the IT professional's career path which might pose challenges together with the role played by the different stakeholders core, is preliminary to

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[147]   e-CF levels descriptions (v 3.0)

understand how the appropriate use of the framework can deliver value to the users and enact potential stakeholders' interactions.

In regard to the approach, the methodology of use cases[148] has been adopted to simplify the complexity of the IT domain and to carry out an analysis of the framework's value taking into account the core issues and the stakeholders' expectations at each step of the IT Professional career. Several scenarios are described below.

a. Preparing to enter the IT profession

The lack of clear career paths and related opportunities in the field of IT has damaged the attractiveness of the IT profession among the youngest generations in Europe. The negative public image of the IT profession combined with a poor reputation - a 'nerdy' image of IT - is the main issue hampering a fresh flow of brilliant young talents into the IT world.[149] Despite a growing e-skills demand, there has been a continuous decrease in computer science graduates since 2005 intensified by the exit of IT practitioners from workforce. The decline in the number of school leavers studying IT related courses contributes to this lack of maturity within the IT profession and presents significant challenges for society as well as European competitiveness (Sherry, M. et al. 2013). It is however starting to move upwards again which is a positive sign policy efforts are paying off; the gap is still there though, and growing. Also

people who have already chosen IT studies, share common concerns and unclear views of the career opportunities and future achievements they might attain based on their specific backgrounds. As pointed out during the 2nd workshop on IT professionalism, the complexity of the IT domain and the poor maturity of the profession do not allow to clearly establish links between curricula and possible IT positions. Furthermore, the existence of a variety of qualifications from different education providers which are not comparable, reduces the cross-border mobility of IT professionals. Across Europe and beyond, there currently is neither uniformity in qualifications/certificates, diplomas and titles provided nor uniformity in the adopted criteria and processes.

At this stage, the focus is on how the framework can be used to improve the IT Professional image, and thereby motivating more people to choose an IT career as well as to acquire the entry-level knowledge needed. As a matter of fact, a number of surveys (Didero, M., Husing, T. and Korte, W. 2009; CEPIS, 2011) suggest that many IT practitioners do not study computing as the main aspect of their degree course. The individual willingness to pursue an IT career can also be affected by the lack of attractiveness of the educational programmes and the teaching methods adopted at primary and secondary school which are not in line with innovation and emerging technologies. A root cause of this is that teachers are not enough «IT smart».

With this in mind, the framework is expected to support the maturity of the IT profession and its **rebranding** through an improved image of the IT Professionals as those who combine a high level of technical expertise with managerial and soft skills. Clearer and more linear links would be established between the IT related curricula and IT positions or jobs depending on the acquired competences. Thanks to the introduction of quality labels used as guidance in the field of certifications, it would also be easier for IT students and

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[148] A use case is a methodology used in system analysis to identify, clarify, and organize system requirements. The use case is made up of a set of possible sequences of interactions between systems and users in a particular environment and related to a particular goal. The use case should contain all system activities that have significance to the users. A use case can be thought of as a collection of possible scenarios related to a particular goal, indeed, the use case and goal are sometimes considered synonymous.

[149] As an evidence of this phenomenon, 17% of students surveyed in a recent CompTIA survey, saw IT careers as "sitting in a backroom with little or no social contact" (CompTIA, 2012).

graduates to orient themselves towards the best suited certifications to access the IT market and the best available opportunities.

b. Starting a career in IT

At the very entry level of the IT career, the main problem is the mismatch between demand and supply of IT professionals in the labour market caused by the lack of IT skilled graduates and workers. An important goal for the 21st century would be the need to strengthen skills related to/based on STEM : Science, Technology, Engineering and Mathematics (EC,2012). This goal mainly involves fresh graduates willing to work as employees or as self-employed starting their own business in the IT field.

From this perspective, people starting a career in IT are concerned with some relevant issues including the value of certifications when looking for a job and their potential to assess individual competences. As anticipated in the previous case, the existence of a diverse set of IT competence frameworks and certifications makes it difficult to compare them and to choose the best suited

option. The complexity also stems from the distinction between local IT competence frameworks (for instance, the SFIA in the UK and the AITTS system in Germany) and their co-existence with a European e-Competence Framework (e-CF). In addition, there is a wide diversity of certificates related to technical training offered by nearly every IT vendor combined with certificates existing in parallel to formal vocational and higher education (Empirica, 2014). Therefore, there is a "certification jungle" covering IT qualifications and surrounding IT skills frameworks.

Furthermore, a misalignment between education and market requirements arises from the fact that education provides foundational knowledge, while specific knowledge is required to obtain an IT job. Employers have found difficulties in filling vacancies because even highly-qualified candidates do not possess the right skills. The CEDEFOP's new European skills and jobs survey (2014), underlines that in order to overcome skill mismatches, more and better jobs that invest in people's skills will be needed. In fact, around 26% of the 50.000 interviewed adult employees stated that they did not possess the required skills needed to be proficient in their job. Usually, young people are seen as 'digital natives' due to their exposure to digital devices but this is not sufficient to guarantee their proficiency level at the workplace (Thomas, 2011; Helsper E. J. and Eynon, R. 2010).

Another important issue is the lack of transparency in the IT labour market and the unclear rules governing the recruiting process which forms a barrier to select the right employee in line with the company needs and business strategy. In reality, matching the IT qualifications with IT skill profiles at different levels is a hard but vital process (Petersen et al., 2004). However, this process is hindered by the existence of incomparable job profiles using different languages and key words to express the core skills required. For the sake of transparency, the wide variety of IT job profiles in the IT Business Process has been clustered into 6 main IT Profile families encompassing 23 Profiles and yet, this simplification has not prevented the proliferation of other profiles (CEN Workshop IT Skills, 2013). This trend may be the result of the internal lack of understanding within companies of the core IT profession requirements and of a common language to describe the IT profiles.
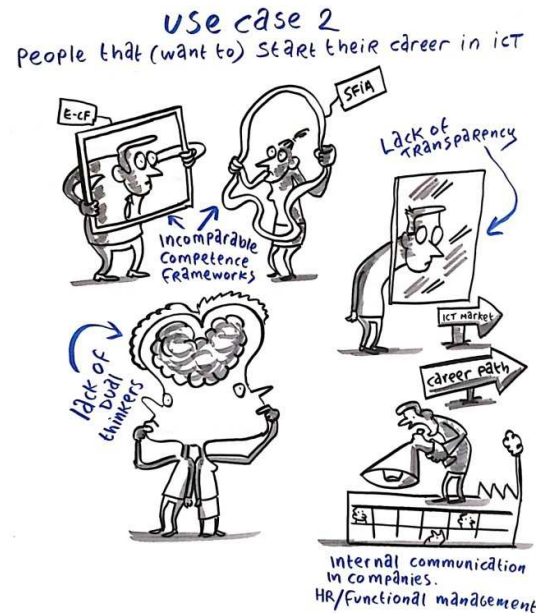
From this perspective, the framework can provide a common language as a reference to properly define job roles and positions. Through the e-CF and related proficiency levels, it would be easier to map the curricula and consequently to identify the IT Professionals which better align with the companies' requirements thereby increasing the transparency of the selection and recruiting procedures. Finally, the use of the framework at the entry level for IT graduates and newcomers will significantly help to minimise mismatches with labour market demands as the vital driver for the competitiveness and long term prospects of European companies.

c. **Changing career**

Due to the quick dynamics and evolutions of the IT job market, IT professionals may experience unexpected career changes in their positions between sub-domains within the IT sector. The main problem encountered in this process is the assessment, re-use and re-cycle of the skills and competences acquired in the previous IT position valuing the past experience, while at the same time, building on the individual set through re-training/re-skilling programmes.

From the demand side, IT skills are subject to rapid technological changes due to short technological life-cycles. New profiles continuously emerge and external developments may cause skills obsolescence or skills shortage (European e-skills forum, 2004). IT professionals are confronted with a raising demand of new skills when applying for a new job and only a high degree of flexibility would allow them to easily adapt to new workplaces. Therefore, gaining flexibility of work and at the same time, receiving IT-focused training have been regarded as a priority for companies to boost competitiveness and for Europe to reach a competitiveness edge (Mueller &Scherer 2003, Reilly 1998). On the contrary, IT professionals with a narrow professional development and a specific expertise in a single area will be side-lined, especially in a field characterised by a high job mobility such the IT field (Schreinemakers, J.F. & Peereboom, L.S. 1999; Scholarios et al., 2008).

As in the previous cases, the existence of a diverse set of incomparable certifications is likely to negatively impact on fluid career changes. Indeed, the IT certification world remains non-transparent with thousands of different certificates, ranging from technical ones (offered by each single IT provider), to those offered by foundations in information management. Also in this scenario, the multitude of existing e-skills certification systems imposes not only the categorization, but also the choice of internationally agreed standards to improve transparency and to ensure equity across Europe.

When people coming from a non-IT background take on IT positions, career changes refer to job shifts from outside into the IT sector. In this case, the most relevant issue is the unawareness or rather incomplete understanding about what IT is and what it can bring in terms of career opportunities. Despite the relevance of IT for companies, there is little understanding of IT as a profession and to a wider extent, of the fact that IT professionals belong to learned or skilled professions (Weckert, J. et al. 2013).

From this perspective, the EU framework on IT professionalism supports the maturing of the IT profession improving its reputation among the newcomers in the IT sector and within its borders. To those willing to change their career coming from another sector, the four pillars provide a guidance to make the proper choices among the available IT jobs, in line with the previous experiences and acquired skills. The use of the e-

CF as self-assessment tool combined with the guidance on certifications would help new IT professionals to select the most suited training and development programmes to progress in their career paths.

d. Developing a career

The EU framework for the IT profession does not address exclusively the IT professional at the entry level of his career, but it is expected to support his long-life learning and professional development. In fact, regular upgrade in career development keeping skills/knowledge up to date is essential to attain higher proficiency levels and to cope with changes in the tech environment. Due to the extent to which the IT skills have spread to all the economic sectors, it is possible to distinguish emerging issues within and beyond the IT domain. IT professionals developing their career in the IT domain usually experience problems in personal branding. Above all, the poor attention paid towards the individual professional development usually leads to stagnation which in turns damages the individual employability. This is mainly due to the prevailing professionals' attitude, which is less focused on growth/development with a higher eagerness for technology. The underlying problem is that professionals in the IT framework usually develop specific IT skills but lack combined business and management skills required by companies (Gourova, 2003). To pave their career, IT professionals should be early-adopters of new technologies by supporting lifelong learning to cope with changes in the labour market. Furthermore, the lack of transparency and equity in professional quality recognition is a challenge for all the HR departments within companies, since the same proficiency levels are recognised differently by each company. This issue is extremely relevant in today's IT labour market, where recruitment processes are mainly cross-border.[150] In this sense, a common EU framework for the IT professional would guide employees in building a "round" profile avoiding skills imbalances (technical or personal).

Differently, for non-IT people who are required to use IT more extensively, the main issue is the lack of IT professionals. In fact, IT is becoming part of all jobs but frequently employees are not educated or skilled in IT. New IT skills are required for their current job and thus, re-skilling and training based on a common framework would be beneficial.

In conclusion it becomes evident that a common framework for the IT professionals primarily serves the needs of the whole population of IT professionals; ranging from IT specialists to top managers also including those willing to work in the IT domain and to progress in their career path. The value-added synergies enacted by each component, would support IT professionals in addressing all the issues encountered along their career life cycle. Nevertheless, the successful implementation of the framework in favour of the IT professionals as ultimate beneficiaries, will strictly depend on its use by the core stakeholders. Specific insights on how this instrument can be adopted to deliver advantages and value to its users are presented below.

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[150] Towards a European Quality label for IT industry training and certifications, Conference, 24 January 2013

5.2   Stakeholders: the IT professionalism ecosystem

As previously mentioned, the framework for the IT profession does not exclusively address the IT professionals but also the wider IT community where many stakeholders interact. Despite the heterogeneity of stakeholders' interests and needs, the framework represents a flexible structure to serve all.

The unstable and endemic evolving nature of the IT environment does not allow to empirically assess the magnitude of the added value delivered by the use of a unique framework to each specific stakeholder group (e.g. HR managers, policy makers, procurement managers). Yet, a qualitative analysis of the potential benefits could be introduced. Above all, there currently is a general consensus among the stakeholders regarding the advantages deriving from the adoption of joint solutions at EU level to overcome the national fragmentation and to find a common ground for interaction. The EU framework for the IT profession is a potential tool to support the stakeholders in their individual roles and functions, since it offers a platform to share and build on best practices.

Provided that each stakeholder may act as enabler for the concrete uptake of the framework, it is essential to understand how this value-driven framework might help each stakeholder to fulfil their mission.

Finding a value proposition would be important to ensure the continued engagement of stakeholders in the further development and uptake of the framework.

a)   Education providers

The root cause of current demand-supply mismatches and skills shortages lies in the inadequate education of IT graduates entering the IT market place. The approach taken in designing the EU framework for the IT profession values the life-long learning of the IT professional paying a constant attention to education and training as crucial components of its structure. Therefore, education providers play a pivotal role throughout the IT professional lifecycle orientating people's choices and individual careers. At every step, the EU IT framework can be adopted by education providers as a tool to tackle the emerging issues and challenges.

Above all, the framework may be applied to train teachers in primary and secondary schools using the foundational BOK and the e-CF as references to assess their gaps or shortages and choose IT-focused programmes. To cope with pervasive technologies in the Digital Single Market, teachers need to gain core IT skills and relevant knowledge in order to become "IT smart". In a virtuous circle, they will be able to transfer the foundational knowledge to the younger generations allowing them to attain high proficiency levels.

Furthermore, education providers might use the framework to help students during the preparation process towards the IT profession. By providing a clear guidance and a wide overview of the available career opportunities, they will attain a double effect. On the one hand, they could make IT courses and curricula more attractive to students establishing clearer links between the required knowledge, the set of skills/competences needed and the final IT position/job. On the other hand, the perception of the IT profession in the wider public is expected to improve. Education providers are directly concerned with the improvement of certifications, qualifications, formal learning and informal learning resulting from the mapping and the definition of curricula or courses against the e-CF and the agreed BOK including soft skills. The adherence to a common framework at EU level would support the standardization of formal education (both in the duration and in curricula) across different countries improving students' mobility across the EU.

Secondly, education providers have a clear responsibility in easing the access to IT jobs tackling current mismatches between education and industry requirements. Based on the e-CF, specific strategies aiming at filling the knowledge gaps (e.g. ad-hoc post-graduate education programmes; the participation of representatives of industry, associations and unions to the courses) could be developed. A better understanding of the market requirements gained through the use of the framework could facilitate the alignment between the demand and supply side thereby supporting graduates' placements. Despite the

distinction between foundational education and professional training, important results in the area of education and training will be achieved only through a strict multi-stakeholder partnership (Empirica, 2014).

Finally, regarding career developments, this framework would allow education providers to set up reskill programmes in close cooperation with the industry. As a consequence, the role of the education providers in enhancing students' employability would be strengthened paving the way towards a better match between demand and supply in the IT labour market.

b) Policy makers and governmental bodies

As underlined by the EU's long-term e-skills strategy, Europe is still a "patchwork of countries functioning under different regulatory systems" while the IT industry operates globally (EC, 2007). Whereas the European Union has been actively promoting digital (e-skills) and IT careers for more than a decade through different initiatives, national governments are recognising more and more the need to act upon this sector to boost national competitiveness and growth. To date, national governments are proceeding at different speeds but more is needed. It is worthy to underline that policy makers and governments have a pivotal role in the development of the EU framework for IT professionalism, as well as in the implementation of the pillars at national level.

Recalling their mission, national governments set policy directions and adopt measures to stimulate macro-level changes in supply-demand dynamics affecting aspiring IT professionals. Therefore, they share the responsibility for maturing the IT profession in conjunction with the industry, the education providers and the IT community as a whole. In detail, the tri-partite engagement and collaboration involving Industry, education and government has been considered a driver for increased levels of IT professionalism (CEPIS, 2012).

The adoption of a comprehensive EU framework would bring advantages to this stakeholder category both at national and EU level. By adhering to a comprehensive and flexible framework at EU level, national policy makers will achieve a better understanding of the skills required by the industry gaining a precious source of information for national strategies and actions. In addition, governmental bodies play a key role in the design of curricula and study programmes and thus, the use of the framework would help them to integrate the right IT skills in teachers' study programmes. This would also result in a highly IT skilled workforce allowing countries to obtain a competitive advantage in the global market. In line with the activity of education providers, national policy makers can promote the recognition of common standard proficiency levels across companies to support cross-border mobility and cross-sector IT practitioners. Finally, the use of an EU-wide approach would provide a common reference to national policy makers to assess ex-ante, monitoring and evaluating ex-post the impacts of strategies, policies, actions aimed at promoting IT skills and competence.

From a wider perspective, policy makers contribute to raise the awareness of the relevance of technology for a digital world. Therefore, the framework would further support them in the promotion of research activities and campaigns to improve the image of the IT workforce.

c) Professional associations

Professional associations represent practitioners in the IT domain and provide inputs based on the expectations of practitioners. They support the promotion/adoption of the framework providing inputs and raise the awareness of IT jobs among IT students by illustrating professional opportunities in the sector.

The use of an EU-wide common reference would support their functions and promotion activities for a better image of the IT Profession.

In close cooperation with governments, IT professional associations accredit certification providers promoting transparency and providing guidance to employers. To this aim, the establishment of a widely-accepted quality label based on the e-CF has been considered key to overcome the barrier of a complex IT certifications

landscape as underlined on the occasion of workshops and international conferences related to the work of the "Grand Coalition for Digital Jobs"[151] and as recommended by the European Parliament and the Council in 2009 (155/01).[152] Therefore, the IT Professional Associations should stimulate employers to adopt the e-CF as reference in the definition of the job profiles and the possible career path, to improve the transparency in the IT labour market.

Professional associations are also involved in the promotion of self-assessment processes to IT professionals and in the development of related tools to better channel them to the right IT position. Coupled with an e-skills online service landscape, self-assessment tools have also been conceived as essential for focused development and to provide up-to-date information (EC, 2013). In this regard, the skills and proficiency levels established by the framework provide the basis for any individual assessment besides certifications facilitating the tasks of the professional associations.

Finally, the framework would help them to choose a uniform set of soft skills for IT professionals and to set up standards for proficiency levels recognised by different companies in order to improve the limited employability of professionals. By aligning with the framework, professional associations across Europe will also update their codes of ethics/conduct and by sharing common criteria, guidelines and a core set of issues beyond diverse cultures in Europe. In doing so, further harmonisation will be achieved.

d) Employers

Employers have a complex mission in the IT labour market being responsible for the recruiting process of young graduates while paying attention to the dynamics of the market. Employers provide information on career opportunities and on the competences required for IT Professionals in the recruitment phase.

In fact, they aim at fostering the employability of IT professionals defined as "the extent to which employees have skills that the market and employers regard as attractive" (Scholarios, D. et al. 2005). Their support is essential in the design of master programmes as well as in the promotion of vocational training as different but strictly linked to formal education.

Thanks to the use of the EU Framework for the IT Profession, employers will be able to recruit the best suited practitioners in line with the companies' needs. In fact, the use of role profiles aligned with e-CF competency and proficiency levels will support employers in the definition of the role description and in monitoring/improving IT workforce capabilities. The advantages consist in a more accurate role description defined in terms of e-competences, an enhanced job advertisement and promotion across the EU and improvements in the company capabilities and development strategies. More generally, the adoption of the framework would support all their functions by providing a common language consisting of effective technical terms for internal and external communication.

Similarly to the IT professional associations, the framework supports the employers in providing self-assessment tools and career guidance through coaching or mentoring. This would improve the IT practitioners' employability and ease the matching between demand and supply in the IT labour market, one of the main issues affecting this domain. Finally, while the professional associations should set up standards for proficiency levels, it is essential that employers accept and adapt to these standards to obtain concrete results.

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[151] A full list of events is available on the Grand Coalition for Digital Jobs webpage <http://ec.europa.eu/digital-agenda/en/milestones-events>.

[152] European Parliament and Council (2009), Recommendation on the establishment of a European Quality Assurance Reference Framework for Vocational Education and Training, 18/06/2009

e) Certification Providers

Local, national, European and global IT qualification and certification providers are primarily concerned with the extreme variety of existing national based certifications. Starting from the entry level of the IT career, certification providers play a crucial role in providing sound evidence of the skills and competences acquired by IT graduates. Throughout the career life cycle, certification providers are responsible for offering services and products to support the professional's career development and to assess the individual competences and skills.

From this perspective, the framework allows to align competency frameworks and certifications through the mapping against the e-CF resulting in adopting a joint solution. In detail, the e-CF, as main component of the framework, supports the definition of jobs and qualifications, the improvement of training courses, career paths, formal and non-formal learning paths. Certification providers would also benefit from a common guidance into the wide IT certification landscape mapping certifications to the Framework and thus, defining a general overview at EU-level.

5.3   Summary conclusions

The current state of play shows a strong disparity in the level of maturity and adoption of the four pillars and, more in general, reflects the poor integration between them. As described at the beginning of the section, many initiatives have been launched so far to develop and promote the IT professionalism pillars but most of them address a single pillar, not the overall framework.

Now, a systemic approach is required to tackle main challenging and pressing issues concerning the IT profession.

In order to build on the four pillars to develop the European Framework for the IT profession, it is essential to first   understand the relationship between Body of Knowledge, Competences, Education and Training and Ethics in order to provide a sound basis for generating supportive synergies.

At this aim, managing the four pillars in a more integrated and complementary way is the key success factor for developing the European Framework as a unique point of reference for all beneficiaries and users dealing with the IT profession. It could be used as a basis by IT practitioners to orientate themselves with the IT professional lifecycle, from early school to career development, as well as Education providers, Professional Associations, Industry and Public sector, Policy makers in providing the right conditions to promote IT professionalism and ultimately increase European competitiveness.

6 Implementation of the framework for the IT profession

'Begin with the end in mind' said Einstein, illustrating how important visualisation of the end goal is. It allows to better understand the long-term goal to which a project is contributing, for others to identify with that goal and possibly offer support, and – last but not least – it enables to break down the consequent steps that are required to reach that goal.

The Framework for the IT Profession aims to further mature the IT profession, while at the same time generating an increased interest for a career in IT. The previous chapter described these goals, and how the four building blocks work in synergy towards those goals. This chapter focuses on the implementation of the Framework. A well operationalised programme is a pre-requisite for effective implementation. The more clearly components are defined and validated, the more clearly implementation actions can be focused on bringing these 'to life' and sustaining and improving them in the context of practices, organisations and systems[153]. So, what does 'implementation' exactly mean, and what does a successful implementation require? Besides answering these questions, this section will explain the approach of this project from generating solutions to starting the actual implementation. There is a particular emphasis on the solutions that were generated both by the consortium as well as many committed stakeholders – many more than could be expected. The support for maturing the IT profession, and the engagement to reduce mismatches and get more people into work is overwhelming. It is also a prerequisite to any successful implementation and therefore leaves us confident that – also after the project ends – there will be continuation of the actions initiated under this project as well as follow up on other important ideas raised in the first phase of this project.

This interim-report is made up halfway the project's timeline. The ambition for this interim report was to have at least a clear view on possible interested countries and a longlist of solutions, with the aim of preparing the implementation during Phase 2 of the project, and starting the implementation during the last three months of the contract. At the moment, besides those goals, three initiatives are already starting up and various others are in the pipeline. This is very encouraging and positive signal for the second phase of the project. But more: it is a great step towards establishing an IT profession that is mature, transparent, and trustworthy.

6.1 The end goal and challenges regarding implementation

Implementing a Framework. Definitely a phrase that needs an explanation to reveal what it exactly means, and how this is approached. This paragraph first describes the end goal and ambition of the European Commission and stakeholders, and then zooms in to how this project contributes to that goal and which challenges need to be taken on to succeed. In the next paragraph, the project's practical approach to implementation is further elaborated.

6.1.1 Professionalism is fundamental to the effective practice of IT

Let's start with determining the end goal of the implementation of the Framework. There is a significant difference between a person being considered to be 'professional' in their approach to conducting business, whatever that business may be, and a person being part of a profession and therefore considered to be a professional. This difference has created enormous misunderstanding and confusion within the information and communications technology (IT) sector, and hampered its progress towards being recognised as a

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[153] Fixsen, D. L., Naoom, S. F., Blase, Duda M. (2015), Implementation drivers: assessing best practices, National Implementation Science Network (NIRN), 2015. Available online at: http://implementation.fpg.unc.edu/sites/implementation.fpg.unc.edu/files/NIRN-ImplementationDriversAssessingBestPractices.pdf

profession. Being part of a profession is a vocation requiring knowledge of some department of learning or science, for example, medicine, law, engineering, architecture, accountancy and, more recently, IT[154]. **Standardising is a means to further mature a profession**. Obtaining the status of a profession requires professional bodies to set suitable standards of knowledge and codes of conduct. Professionalism is absolutely fundamental to the effective practice of IT. The ambition of the European Commission and stakeholders is therefore to develop the Framework into a standard, as is currently the case for the e-CF only. A standard that includes not only competences, but also knowledge, ethics, and education and certification. An international standard brings benefits for the economy and for society. It helps employers in providing a common language for professional development of IT professionals across Europe (and potentially beyond), while stimulating the mobility of employees and offering them tools to develop their careers. Any organisation would want its IT staff to be professional in their practice, and to be recognised and accepted as being professionals. The benefits to organisations and society include practitioners having an adequate level of knowledge, providing a higher level of products and services, and abiding by professional standards and codes of ethics[155].

Long-term goals need to be properly embedded in strategy and policy, and engagement from stakeholder coalitions to ensure continuity and sustainability. In such an environment, initiatives like establishing and implementing a Framework for the IT profession can flourish and progress. This is a condition-sine-qua-non which is very well set out at both European and national levels, and even beyond through collaboration with major economies like USA, Japan and Canada.

6.1.2   Maturing the professional framework and the profession go hand in hand

The aforementioned ambition puts forward two requirements or sub-goals:
- The building blocks of the Framework should be further developed and reach a level that allows them to be recognised as standards – similar to the path of the e-CF;
- The Framework itself should be adopted by (professional organisations in) countries in Europe, and used in practice.

This project is assigned to initiate the implementation of the Framework in at least three countries, during the last three months of the contract, or sooner if possible. In this project we aim to trigger organisations to start concrete actions that in the long-term lead to implementation of the framework. Obviously, these initiatives should be carried by key stakeholders in those organisations who are convinced of the value add of such Framework, and who will be the drivers of that change. To achieve successful take-up of the Framework across all European countries in the long-term, early-adopters are required on the short-term. Organisations that are willing to lead by example, and create a movement that others want to be part of too. These early-adopters can pave the way for others, as they will need to find solutions with the challenges in the implementation that they are bound to encounter. Others can then learn from that experience.

This project is not primarily meant to develop the contents of the building blocks itself, though through the course of this project rich feedback is gathered and will be shared with the organisation responsible for this. Ideally, this project will also contribute to maturing the building blocks itself, by initiating actions that are an example of implementation while at the same time will generate feedback/improvements on the Framework or a specific building block itself. The case of developing a first version of a Pan-European Ethical Guideline is a

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[154] John Ridge, Australian Computer Society,
http://press.anu.edu.au/apps/bookworm/view/Professionalism+in+the+Information+and+Communication+Technology+Industry/10791/ch02.xhtml
[155] John Ridge, Australian Computer Society,
http://press.anu.edu.au/apps/bookworm/view/Professionalism+in+the+Information+and+Communication+Technology+Industry/10791/ch02.xhtml

clear example of this, as will be further described in the paragraph 6.5.1. Hence, maturing the IT Professional Framework, and the profession itself by means of organisations adopting the Framework, go hand in hand.

Concluding, in the long-term the European Commission is aiming the Framework to be recognised as a standard that is used (implemented) by all European countries. Early adopters taking the first actions in that process of implementation will trigger others to follow, and eventually reach that long-term goal. This project, on the short-term, will identify these early adopters, select feasible actions that can be started during the course of this project. Commitment of these early adopters implies they will continue to push and monitor the actions initiated after this project has ended.

6.1.3   Uniting diversity: encouraging progress at different levels

Europe is unique. Each country has a different background composed of historical, cultural, economic and societal roots. There are different needs, different approaches and a different mentality. Each country can benefit from applying European standards and adhering to a European common language as regards IT professionalism, but the road towards that goal should take into account those differences.

Indeed, front runners can encourage others to follow. They can inspire and share lessons learned. This is particularly relevant for countries that are in need of advancing the most, and/or have interest in specific pillar of the Framework. Early adopters also have an important role in using the instruments of the Framework in practice and feedback experiences and possible improvements.

But besides these early adopters, the instruments itself should also allow to be easily used by a diversity of countries and organisations in those countries. Any standard or instrument should allow for a certain flexibility in order to be of practical use to stakeholders. A too rigid approach would risk Europe-wide adoption. This is, for instance, why the Foundational IT Body of Knowledge applied a meta-model approach to describing the base level knowledge required from IT professionals. Such an approach allows stakeholders to customise in a certain way, and while it references sources of specific knowledge it is possible to add more detail or granularity to the use. The e-CF, being the most mature of the 4 pillars, could act as a corner stone of the Framework for the IT Profession, as it is widely known and recognised for its added value. It could be the vehicle that carries the other instruments.

6.1.4   Changing routines: it is not just a new template

Another challenge to keep in mind while lining up for implementation, is the fact that adhering to these European standards has significant impact on user-organisations. There is significant work to be done if an organisation wants to adopt a new competency framework: for the HR department in writing the career framework and curricula guidelines, for the IT department to possibly ask for knowledge and competencies in different wording than before, and for the IT professionals working for that organisation in developing their own profile and career. It takes more than installing a new template. It requires structured organisational change.

There are many definitions of implementation. Implementation can be defined as a "specified set of activities designed to put into practice an activity or programme of known dimension[156]". A synthesis of the research in the field describes implementation as "a mission-oriented process involving multiple decisions, actions, and

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[156]   Fixsen, D. L., Naoom, S. F., Blase, K., Friedman, R. M., & Wallace, F. (2005). Implementation research: A synthesis of the literature. Page 5. National Implementation Research Network, University of South Florida, Louis de la Parta Florida Mental Health Institute Available online at http://nirn.fmhi.usf.edu/resources/publications/Monograph/

corrections"[157]. A sound implementation strategy will avoid pitfalls of 'implementation as usual[158]', that could lead to the Framework being either adopted on paper, but without meaningful changes taking place at the practice level to support adoption and deliver new services, or fragmentation due to ineffective operating structures that do not provide the support necessary (or the wrong support). The key is to design for impact. New procedures and operating structures should directly support adoption of the Framework and its instruments.

Without repeating the many books that have been filled with approaches to change management, it at least involves thinking about political/executive sponsorship and commitment, gaining support amongst those affected by the change and involving the key persons ('change angels') to create ownership, assessing the impact, communication and possibly training or support activities during the implementation and after.

In terms of efficiently implementing the Framework for the IT profession, it is hence necessary to think about ways to support this process within organisations. For this reason, practical guidelines will be developed (during phase 2 of the project) that support take-up of the various instruments by stakeholders. Specific tools, like the one that AICA developed in Italy, can also have great value.

Besides guidelines, in order to convince organisations to use the Framework, it should be very clear 'what is in it for them'. In other words, describing a business case to why this change will sort effect in the long term.

Finally, for initiating implementation it is also important to carefully select countries. A strong network of stakeholders that are committed to further mature the IT profession and close the skills gap is a necessity for successful take-up of the Framework's instruments. As described in the chapter 5, each stakeholder plays a specific role in the process, and they should act together.

6.1.5   Optimising effectiveness: balancing between enforcement and voluntarism

John Ridge, the former president of the Australian Computer Society, tackled this issue very clearly[159]: 'It would be plausible to think that organisations, as a way of guaranteeing professionalism, would seek to employ IT practitioners who are part of the profession and members of a professional body. ***One problem is that membership of a professional body is not a prerequisite for IT practitioners to practice, unlike other professions such as law or accounting***. In most of these professions, membership of a professional body is inextricably linked to the ability to practice, either in reality or by common perception and, in some cases, the loss of that professional membership results in the loss of the right to practice. The absence of this professional obligation in IT can result in practitioners employing haphazard levels of knowledge, with inadequate understanding of codes of ethics and professional practice.'

There are examples, like in Malaysia, where government efforts to implement a mandatory registration top-down almost ended in a revolution. It ignored the needs and wishes from the many IT professionals who didn't share the need for this initiative. There is a wide range of IT professionals, ranging from those who have university degrees and minimum level of experience, through people with industry certifications, to practitioners who gained their skills and experience on-the-job. It shows how sensitive taking steps in this regard can be, and that it should be planned for carefully. Professional bodies can play a role in establishing criteria to distinguish professionals from practitioners. The Dutch VRI, together with the NGI (both professional associations), opts for a bottom-up approach and is aiming to open a voluntary registration of IT professionals,

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[157]   Fixsen, D. L., & Blase, K. A. (2006). "What works" for implementing "what works" to achieve consumer benefits. National Implementation Research Network, University of South Florida, Louis de la Parte Florida Mental Health Institute

[158]   Metz, A. J.R., Base, K., Bowie, L. (2007), Implementing Evidence-based practices: six drivers of success'. Available online at: http://incredibleyears.com/wp-content/uploads/Child-Trends_6-Success-Drivers_10-07.pdf

[159]   John Ridge, Australian Computer Society, http://press.anu.edu.au/apps/bookworm/view/Professionalism+in+the+Information+and+Communication+Technology+Industry/10791/ch02.xhtml

offering transparency in competencies and promoting a code of conduct (and liaised disciplinary rules). Here, the challenge is to fill that register and to trigger organisations to require their IT professionals to be part of it.

Both examples represent different approaches to providing transparency in IT professionals' competencies and further maturing the IT profession. The implementation of a Professional Framework cannot be made mandatory. Successfully achieving the end-goal of maturing the profession would require take-up on a large scale though. This requires commitment of all stakeholders involved, and their willingness to act. It also requires them to consider – after adopting the Framework - how to ensure a broad reach amongst IT professionals. This is particularly relevant for the professional bodies.

6.2   Stepping stones towards implementation

The approach to initiate implementation with at least three early adopters consists of five steps:
1. Generate potential solutions for implementation
2. Identify countries that are interested in implementation
3. Select solutions / countries
4. Prepare for implementation
5. Initiate / support implementation

Each step will be shortly explained in concept in this paragraph, and consequently described in detail in the following paragraphs (where actual results and progress is revealed).

6.2.1   Step 1. Generate potential solutions for implementation

In order to enhance the value of the European Framework for the IT profession, a list of concrete solutions have to be identified. Solutions that can be started up on the short term, bringing real benefits and improvement to IT practitioners and stakeholders.

Stakeholder engagement constitutes a key step in generating potential solutions, for two main reasons:

- Consulting stakeholders is crucial to gather expectations on future development of the four building blocks: Understanding real needs on the European framework for the IT profession will allow us defining direction for further developments and identifying potential solutions that are consistent with broad expectations
- Involving stakeholders is a condition for the implementation process: in order to facilitate the implementation, quality and effectiveness of proposed solutions is not sufficient. General consensus has to be generated that provide a constructive base for implementation phase, and in particular to ensure continuity after this project itself has ended.

This first step aims at generating a long list of potentials solutions. The focus here is on identifying a significant number of potential solutions to be considered. In this stage there are no bad or impossible ideas, as should be the case in a proper brainstorming phase. The only requirement is that a solution addresses one or more of the four building blocks, or the Framework as a whole.

The process of generating potential solutions started early on in this project and has already seen very positive advancements after the completion of desk research, experts' interviews and workshops. This will be shared in paragraph 6.3.

6.2.2   Step 2. Identify countries to start the implementation

Essential to the further development and the embedding of the Framework for IT profession in practice, is gaining a deep understanding of the different e-Skills and / or IT Professionalism policies in Member States. The national key drivers of IT Professionalism differ, being public or private drivers or a combination of both. Moreover, it is essential to have a clear view on the influential stakeholder groups to make the Framework 'stick'.

This is an important step, which should preferably be taken as early in the project as possible. General approach to this step is to:

- Determine selection criteria (e.g. commitment, geographical balance, maturity)
- Map countries on those criteria
- Make a selection and establish contact with these countries to ensure commitment
- Finalise selection and agree on implementation solution/plan

A short explanation of two most important selection criteria, e-Skills maturity and Commitment:

e-Skills Maturity

Following previous European initiatives, such as Digital Champions and the dissemination and uptake of the e-Competence Framework, we know that a leading practice is a successful vehicle to promote adoption in other European countries and stakeholder groups. On the basis of the criteria below, it could be possible to determine which countries are the leading countries when it comes to IT Professionalism:

- The country has served as an example for other countries when it comes to IT Professionalism[160]

- The country has an elaborate digital strategy / agenda, under the responsibility of one ministry.

- The country has a high level of policy and stakeholder activity in the e-skills domain[161]

- The country uses the e-CF, or another skills framework at governmental or departmental level.

- The country has made a national or local coalition pledge in the context of the Grand Coalition for Digital Jobs.[162]

- The country is listed in the top 25 of the World Economic Forum Network Readiness Index[163]

Besides indicating the most mature countries, it is important to further identify the national stakeholders such as the responsible ministries, multi-stakeholder initiatives and the professional associations that are at the foundation of IT Professionalism.

Commitment: a clear mandate to operate required

Most critical criteria is that implementation will require political will and commitment for the national stakeholders, which is a process that can take some time. For this reason it is advisable to start the

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160 Input in Steering Committee on 12 June 2014.

161 Empirica, Country Reports 'e-Skills: Monitoring and Benchmarking Policies and Partnerships in Europe', see: http://eskills-monitor2013.eu/results/

162 Member States are now launching national coalitions in the context of the Grand Coalition for Digital Jobs launched by President Barroso in March 2013 (e.g. A Greek coalition was launched on 6 May 2014 and a Bulgarian coalition was launched on 10 June 2014. It is expected that an Italian coalition would be launched this year). We will continue to monitor these important developments.

163 World Economic Forum, Global Information Technology Report www3.weforum.org/docs/GITR/2014/GITR_OverallRanking_2014.pdf Network Readiness Index measures the performance of 148 economies in leveraging information and communications technologies to boost competitiveness and well-being

implementation with the countries that have already taken action to implement parts of the Framework for IT professionalism, in particular the e-CF. It then helps if quick access can be established.

6.2.3   Step 3. Select solutions for implementation

This step builds on step 1 where possible solutions are generated. After identification of concrete solutions on the four building block, these solutions are evaluated against requirements in terms of being simple, demand-driven, pragmatic, scalable and sustainable.

- **Simple**

  The balance of simplicity and complexity is relevant in all business and technology fields. John Maeda, professor at MIT University, defines: "*Simplicity is about subtracting the obvious, and adding the meaningful*".

  For the scope of this work, the level of complexity of the solutions to be chosen and implemented will be balanced with the actual goals to be achieved and gaps to be filled, without overloading and oversizing the scope of each of them. The pursued simplicity of the solutions will receive added value and further enhancement through the interactions and synergies developed across and through the pillars of the European Framework for the IT profession.

- **Demand-driven**

  In manufacturing, a demand-driven network is a method of supply chain management which involves building supply chains in response to demand signals.

  In the context of the European Framework for the IT profession, it becomes a fundamental requirement for individuating and choosing potential solutions. A proactive response is required for aligning the solutions to the IT dynamic marketplace, in terms of managing, selecting and shaping a mix of initiatives, activities, channels and stakeholders. Furthermore, deviations caused by internal or external events must be taken into account, based on the analysis of multiple scenarios and multiple demand forecasts.

  One of the main outcomes of a demand-driven approach is the skills matching between the supply and demand of IT practitioners. Examples of efficient good practices already implemented are: German Dual Apprenticeship System, UK Apprenticeship Vacancy Matching, and the EURES Job Portal tool.

- **Pragmatic**

  In order to achieve the scopes of the tender, the solutions presented will be analysed and evaluated from a practical point of view, focusing on concrete results and consequences on the real-world scenario. Theoretical approaches and analyses are already in place for several topics, our goal will be also the conversion and enhancement of such initiatives in order to achieve the related practical expected outcomes.

- **Scalable**

  The concept of scalability can be related to all technological and business fields. It is defined as the ability of a system, network, or process to be able to handle growing volumes in a capable manner.

  In our approach to the development of the European Framework for the IT profession, the analysed solutions must fulfil this requirement in order to be adapted to the multi-layer and multi-dimensional context. In fact, the implementation of the proposed programmes must be consistent, efficient and effective both at national and international level.

- **Sustainable**

  The concept of sustainability is derived from the Latin 'sustinere' (i.e.: to hold). Sustain can mean "maintain", "support", or "endure".

  Here sustainability is intended as the set of strategies that make it possible to use available resources to their best advantage. The use of resources should be both efficient and responsible, and likely to provide long-term benefits. The solutions proposed for the development and implementation of the European Framework for the IT profession will be justified from an economic point of view through different methodologies and networks of financing. One key objective will be the identification of areas in which resources are not being utilised in the most efficient manner, in order to take steps to correct the situation. At the same time, future scenarios will also be evaluated due to the dynamic nature of the sector, in order to ensure long-term sustainability and potential future developments of the framework. The strategy will include a cross-sector coordination, involving key stakeholders at national and European level.

Of course there is a need to discuss these solutions with the aimed for countries where implementation could start. That is why we involved many stakeholders from these countries at an early stage of the project (via interviews and workshops) as they are best able to estimate what is/is not feasible, and to match the activities to their own (strategic and implementation) agenda's. Their commitment is pivotal to ensure continuity after this project ends.

6.2.4   Step 4. Prepare implementation

This step defines what solution will be implemented, how, when and by whom. It should also determine when the implementation should be considered a success, and ensure and stimulate continuous learning.

The following activities are required:

- **Bring stakeholders on board**

  Ensure the collaborative validation of pilot. The people dimension matters a lot, it's a collaborative exercise. People matter: Finally, Albert Einstein once said: "Not everything that counts can be counted, and not everything that can be counted counts". The "people" side of this process is one that cannot easily be counted, but one that significantly influences the overall success of the process. Hence why people matter and why engagement is necessary with these individuals.

- **Define clear and measurable goals**

  Collectively to ensure acceptance and understanding of KPIs. KPI's are an actionable scorecard that keeps your strategy on track. They enable you to manage, control and achieve desired business

results. The KPIs have to credible, measurable and relevant metrics to measure achievements against a set of objectives over time. KPI's imply causality between the goal, the actions taken and the expected impact. So we're after statistics that reliably reveal cause and effect. These have two defining characteristics: They are persistent, showing that the outcome of a given action at one time will be similar to the outcome of the same action at another time; and they are predictive—that is, there is a causal relationship between the action, the statistic measures and the desired outcome.

Building on the above, KPIs need to be credible, measurable, relevant, and easy to understand and positioned into time. In the context of the e-SENS WPs, a five step approach should be followed.

- Step 1: Define your goal: be specific, look at how this goal can be achieved. e.g. to increase awareness around the project and engage beyond the usual supporters.
- Step 2: Define your performance metrics: identify measurements that are important in achieving your objective. e.g. To have 120 participants attending the event in Luxembourg. e.g. to have 3 countries live per use case by the end of the project, with at least 3 countries live per use case in the first wave.
- Step 3: Define your frequency: determine periodicity and timing of measurements to show progress overtime in achieving your objectives.
- Step 4: Conduct measurements: collect the data required within your metrics.
- Step 5: Assess progress: explore causality between actions and realization, identify room for improvement.

- **Prepare guidelines**
  A hands-on document on political and organisational aspects. A solid planning. Clear responsibilities.

6.2.5   Step 5. Run and support the implementation activities

Have joint working sessions: action learning
Joint working with the countries selected via a series of action learning groups, similar to bench learning. Bringing together the (at least 3) participating countries would be valuable in this context.

Joint working can be done via so-called Action Learning workshops. The Action Learning workshops concept was elaborated by Capgemini and IDC, alongside other partners, during their work with DG CONNECT, responding to the need to design a process with stronger collaboration and learning outcomes. Projects such as bench-learning activities on improvement of public services have been proven successful and appreciated by Member States[164.] We describe here briefly the concept.

Action Learning is a first step away from traditional settings of workshop collaboration i.e. typically meetings constrained by 'protocol' with little follow up and learning opportunities for participants.

Action Learning in essence differs from traditional workshops in two ways:

- It is geared towards Learning (as opposed to sheer attendance). The key question therefore is not whether a participant has attended a workshop but how she has benefitted from it and which lessons learned she can take back home, to her organization.

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[164]   Final Study Report Bench learning study on the economic and social impact of inclusion policies, European Commission (DG CNECT) June 2012

- It engages participants in a continuous cycle of understanding and improving. The key question therefore is not what has happened at the workshop itself but what actions have been taken before and after and what impact the workshop has had on transforming the attendees' behaviour and attitudes and as a consequence her organization's daily work routines, strategies and performance.

We will facilitate this by seconding an expert into the team to work alongside the existing team. This joint working will initiate the knowledge transfer into the local team.

Evaluate the implementation
- Including the preparation, roll out and impact.

Whereas this paragraph set out the context and approach to the implementation of the Framework for the IT profession, the following paragraphs will subsequently provide the detailed results for each step in this approach (from generating solutions to initiating action). With the project halfway, and implementation to a large extent being part of the second phase of the project, not every step is already completed and some placeholders apply.

6.3   Possible implementation initiatives

This paragraph lists all the possible initiatives that have been generated during the course of the first phase of this project (up until this interim report). Initiatives have been proposed by engaged organisations and individual stakeholders from various countries during the interviews and workshop, or have been developed by the consortium itself based on desk research and the countless conversations with stakeholders.

6.3.1   Pillar 1: Knowledge

The gathered actions concerning the 'Knowledge' pillar mostly address the need to further promote the creation of the version 1.0 of a European Foundational IT Body of Knowledge ('*fBOK*', April 2015). Promotion of this instrument should lead to organisations (e.g. education providers, knowledge foundations) using the fBOK in practice which contributes to the overall goals of creating uniformity and common language, but also would lead to feedback and recommendations to further improve the fBOK itself.

Suggested actions as regards 'Knowledge'
Provide fBOK guidelines so it is clear why and how to use it
Improve the visibility and usability of the fBOK through communication and by looking at language used
Merge with existing modules in specific BOK's and/or develop foundational modules related to fBOK knowledge areas, and certify these
Further promotion of the fBOK with the purpose of gathering feedback from academia and other stakeholders about v1.0
Apply in government career framework, and stimulate use of it by others, such as education and certification providers (government)
Further increase the number of references to specific BOK's and potentially training and certification
* fBOK: European Foundational IT Body of Knowledge (v1.0)

6.3.2   Pillar 2: Competences

Solutions generated as regards the pillar of competences mostly relate to stimulate take-up of the e-CF and the job profiles in e-CF. Obviously this is an important element. Increasing take-up of e-CF should start with an analysis of the 'as-is': how many organisations currently use e-CF? CEPIS publishes[165] a lists of 34 companies, governments and associations, and 6 educational providers, but it is likely there are more users[166]. One way of achieving this insight could be through the professional organisations in each country, and/or national coalitions that possibly have the network in place to generate more accurate numbers. Another option could be to allow *any* user of e-CF to be listed[167]. For this, it could help to make the e-CF available as an open standard, free of use, and hence make it possible to also register yet unknown e-CF users (who might not have purchased an official copy in the first place).

One action that has already been initiated (see for further explanation paragraph 6.5.2) concerns the alignment of the European e-Competence Framework (e-CF) and The Skills Framework for the Information Age (SFIA). SFIA has been developed in the UK at the beginning of the last decade. It is well recognised in countries such as Australia and registered trademark in 35 countries. In parallel the e-CF for IT professionals has been developed and is now a European standard with the support and approval of the UK. Given that both frameworks are widely recognised internationally and that there is a shared goal to establish a common language to describe the requirements of IT professionals, all parties are keen to collaborate on a move towards greater convergence of the two frameworks as well as contribute to the development of a European framework for the IT profession.

Another action that should be addressed when updating the e-CF to version 4.0 concerns matching of the knowledge items in e-CF with the knowledge areas in the fBOK. The fBOK already includes a mapping to e-CF, but it should now be used to at least ensure consistency but preferably also further fine tune the knowledge items in e-CF.

Suggested actions as regards 'Competences'
Further develop the framework by improving the level of granularity of description of competences. This would make the link between competences and role profiles easier to be defined and applied in HR processes (from recruiting to career development and re-skilling)
Add sectoral additions to the e-CF. There are many groups (e-healthy, data scientists) who are eager to see their specific competences introduced, and while this is perhaps not within the defined scope of the e-CF itself, it would be useful to develop a methodology that could be used to ensure sectoral 'additions' to the e-CF are completed in a systematic and consistent manner.
Motivate universities to adapt curricula of e-CF (e.g. Miages, CFA); Map certifications and education curricula against e-CF[168]
Raise awareness about e-CF complementary tools (self-assessment, benchmark, job profiles, etc.
Provide practical guidance as regards implementation of the e-CF
Align platforms such as LinkedIn with competencies used in e-CF
Stimulate take-up of European standards by asking for e-CF competencies in public procurement (by public authorities)
Explore collaboration and create 'one' mapping of e-CF and SFIA
Match the knowledge items in e-CF with the knowledge areas in the fBOK

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[165]   Please see here: http://www.cepis.org/e-CF
[166]   The e-CF website itself only includes 26: http://www.ecompetences.eu/current-e-cf-users/
[167]   The e-comeptences.eu website would be an excellent home for this. CEPIS is committing to ensure the sustainability of this website.
[168]   For example in Spain: mapping the recommendations provided by the Spanish Council of Deans of Informatics Degrees – CODDII – on organising bachelor and master programmes to the e-CF in order to harmonise and make all degrees understandable in the context of IT professionalism developments in Europe.

Monitor take-up of e-CF in countries (through professional associations' report)
Promoting a clear differentiation between IT professional competences and IT user competences, and how to implement this in concrete activities (training, certification, enterprises etc.)
Through national professional associations list main professional IT profiles in a country and define/standardise them using CF
Integrate the e-CF into job profiles
Create the possibility to also 'register' yet unknown e-CF users on e.g. e-competences website

6.3.3   Pillar 3: Education and Certification

The importance of teaching both IT user skills, as well as basic IT practitioner skills, already in primary and secondary education is widely recognised. Countries like Israel, who are successfully teaching computer science to all young kids for over decennia, are not confronted with a shortage of supply. There are several actions related to this topic. Some of these go beyond the scope of this Professional Framework, and should be embedded in national policies for instance, but the Framework could be of support when such actions would be set up in practice. Specific courses for teachers could be very well founded on the basics of the fBOK and/or e-CF and/or Code of Ethics. Foundational courses about what IT comprehends could be useful for teachers, but also for other people who are increasingly confronted with IT in their workplace (such as in Health, Finance).

Another key element that is repeatedly mentioned concerns increasing the collaboration between industry and the academic world. This could help to further match supply of and demand for IT professionals.

Suggested actions as regards 'Education and training'
Adapting primary and secondary education in order to provide basic IT user skills at an early age and raise interest in continuing with computing related studies after secondary school
More computer science in school, change curriculum as well as the exams, incorporate knowledge and skills development in the curricula
Map education courses to the e-CF and audit the mapping process in order to improve the transparency, relevance and comparability of courses in terms of developed e-competences and associated proficiency levels
Train the trainer initiatives/ teach the teachers, funded by the government[169]
Design a specific course for (IT) teachers
Foundational courses about what IT comprehends for teachers, but also for other people who are increasingly confronted with IT in their workplace. Possibly 'domain-specific' coursed for e.g. IT in Health, IT in Logistics, IT in Finance etc.
Stimulate collaboration between industry and education so both parties are involved in the curricula development.
Promote education and industry collaboration. Bring transparency in training courses. Quality benchmarking, invite industry to curricula development.
Introduce innovative learning and teaching (e.g. online courses, e-learning modules, tutorials and self-assessment tools) to stimulate students to acquire high level skills[170]

With transparency being one of the underlying goals of maturing the IT profession, certification is certainly an area where progress can be made. Often referred to as the 'certification-jungle', both professionals as well as

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[169] Ireland has a very good example on this: see 3.3.4 for more information.
[170] EQANIE through the Euro-Inf label does quality assessment of HEI courses in informatics. There is perhaps a role for them in ensuring quality in teacher training in this domain.

employers find it difficult to understand the real value of a particular certification. Initiatives have been set up with the aim of increasing transparency in this regard, but these would need to be scaled up to increase the impact and reach greater coverage across Europe.

Suggested actions as regards 'Certifications'
Diploma vs. recognition of skills by badges.
Bring transparency in certification jungle, e.g. by publishing a quality labels tool.
Use the professional framework as basis for professional certifications
Create a IT certifications map at national levels and then possibly scale-up, and/or link to certification quality labels
Implement a chartered IT professionals certification model
Improve mutual recognition of qualifications/certifications across countries by stimulating take-up of the European e-Competence Framework

Create an IT certifications map at national levels and then possibly scale-up, and/or link to certification quality labels

The IT certifications map is an action that aims to set up a database of available professional certifications and make it openly available for everyone. The map will be built crowdsourcing-style among professionals to obtain the information about the certifications they value.

The obtained database will include profiles of certifications and might be also complemented with the relations among them and with the instruments of the IT framework (namely e-CF and fBOK).

The approach to build the map is incremental: from the members of national working groups (WGs) to national-wide stakeholders, including certification providers, The first version of the map will be built in Spain, and then there are plans to scale it to other European countries.

The map will be designed according to open data principles, so third-party tools might be later built and deployed to query and visualise the information in the map.

By now, in Spain a WG has been created and is already working on the inception of the project and studying the state of the art: precedents, related European initiatives, relation with the rest of the IT framework and applicable standards.

6.3.4   Pillar 4: Ethics

The fourth pillar of the framework is the one that is gaining attention globally. A defining aspect of any profession involves adhering to professional ethical conduct. Ethics in the IT Profession regulates the boundaries of relationships with customers, colleagues and society. A Code of Ethics functions as an ethical charter for the profession and the general acceptance provides an explicit standard against which current practices can be measured[171]. It does not necessarily avoid undesirable behaviour – see infringements that occur in other professions such as Law[172] - but it does promote social responsibility in IT and contributes to a responsible culture within the working place. The creation of a first set of European Ethical Guidelines, as a

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[171]   Rogerson, S., IT Codes of Ethics, based on: Software Engineering Code of Ethics & Professional Practice. Available online here: http://www.cepis.org/media/SimonRogerson-ICTCodesofEthics1.pdf .

[172]   For instance the role of notaries is criticised in the recent Panama Papers affaire: 'Little ethics notaries in tax structures', available online here: http://nos.nl/artikel/2097489-weinig-ethiek-notarissen-bij-belastingconstructies.html

fourth building block in the Framework, will be taken up as one of the implementation actions in this project. Please see paragraph 6.5.1 for more information.

Suggested actions as regards 'Ethics'
Create first version EU code of ethics that is in line with existing documents, and determine tasks that need to be further explored
Raise the awareness of IT Professionals' responsibilities and obligations towards society
IT services and activities evaluation (determining impact of IT products and services in the general interest; explore if regulation is needed)
Explore/start (voluntary) registration of IT professionals; Licensing / registering
Training modules and/or communication campaign with launch of Code of Ethics to increase awareness on this topic
Ethical principles included in certification or accreditation
Mandatory ethics and IT education at bachelor level IT professional studies but also through other activities (e.g. seminars on professional ethics, peer learning within companies and between computer society members, professional magazines, scientific journals or books);

6.3.5   Initiatives covering the Framework as a whole

The overview in this paragraph includes some very valuable actions that cover the Framework as a whole. One of these is the need to improve the IT image in career development and provide clear career paths. There is no unique career structure providing a clear orientation and idea of sequential steps needed to become a technical, super technical or managerial professional. Beyond the e-CF and to ensure career development, it is essential to tell people where they are/could be going depending on their background.

Another interesting idea links to mobility of IT professionals, and could possibly support a more effective process of matching demand and supply. It concerns the promotion of a European Professional Card for IT Professionals.

- The European professional card (EPC) is available from 18 January 2016 for five professions (general care nurses, physiotherapists, pharmacists, real estate agents and mountain guides). It might be extended to other professions in the future.
- In 2014, the Commission launched a public consultation on introducing the EPC for seven professions (nurses, doctors, pharmacists, physiotherapists, engineers, mountain guides and real estate agents)

As part of implementation of the Framework, it would require promotion of a European Professional Card for IT Professionals (at least for engineering) on level 7 of the European Qualifications Framework (EQF). The initiative could be implemented as a specific process or as part of the process of making the EPC for engineers[173]:

- There are countries where engineering is a wide profession with different specialties or branches, such as IT engineering (for example Germany[174]);
- And there are other group of countries where each engineering is an specific profession, also IT engineering (for example United Kingdom[175]);

In any case, IT Professionals do comply with two important conditions for EPC implementation:

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[173] Proposal was made by the Spanish CCII as part of their excellent and elaborate support to mature the IT profession and implement the IT Professional Framework.

[174] http://ec.europa.eu/growth/tools-databases/regprof/index.cfm?action=regprof&id_regprof=928

[175] Generic Name Information Systems Engineer: http://ec.europa.eu/growth/tools-databases/regprof/index.cfm?action=regprof&id_regprof=2874

- High mobility and demand at European level;
- Different national regulations;

The EPC can hence be a useful tool for European IT professionals to increase their personal mobility, and for enterprises to comply with national regulations when implementing projects or contracts in different counties with different IT professionals.

Suggested actions that cover all pillars of the Framework
Provide practical guidelines on how to use the framework
Describe career paths as part of the Framework to illustrate to students/career changers
Share practical use of the Framework e.g. by showing case studies, best practices, experiences
Align recognised knowledge foundations in specific IT areas with the pillars of the Framework
Develop an assessment tool based on all pillars of professional framework that includes peer review[176]
Make sure there are funding opportunities so small initiatives of implementation will have a chance
Develop a MOOC to inform segments of potential professionals about the Framework and engage them in using it (e.g. career changers, students)
Setting up experts pools in countries to promote Framework and specific pillars
Create a single point of access to all IT professionalism and e-Skills related instruments, good practices and standards
Development of a European IT Professional Card: building on the EU decision to create professional cards for 5 professions, create an European Professional Card for IT Professionals, at least for engineering qualification level. This would imply an European Professional Card for IT Professionals on level 7 of the European Qualifications Framework (EQF).
Designing a logo for IT Professionals
New recruitment techniques for IT talent
Build on existing e-Government developments around creation of citizen service access points, as place for students to gain practical experience and train soft skills, and with start-up hubs as regards innovation, entrepreneurial skills and as place to inform start-ups about potential value of the Framework itself.

6.3.6   Promotion and Communication related suggestions

Clearly, developing the Framework is not enough in order to stimulate organisations to use it. At the same time, the Framework is part of bigger trend towards further maturing the profession and this brings various ideas around improving the image of the profession.

A particular positive idea that is being initiated by the Irish Computer Society is the Day of the IT professional. This event will be run as part of Tech Week on April 25th, Ireland's national festival of technology. IT Professionals Day is a dedicated day to celebrate the role and contribution that IT Professionals make in advancing business and society across Europe. It is intended as a platform to raise awareness of the IT profession, its importance, the potential within the profession, the need for continued professionalism, and the value of further contribution to society as an IT professional. The event will consist of a series of talks concerning the impact, influence and needs of IT professionals, as well as the initiatives that help promote IT skills within Europe (CEPIS, the e-Competence Framework, etc.). All IT professionals are asked to take part on the day by adopting the Three Cs: Commit, Connect and Contribute[177].

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[176] Addressing comments that the verification of self-assessed competences by IT professionals cannot rely upon a tick box exercise but rather a neutral test is needed

[177] Source: https://www.ics.ie/news/it-professionalism-a-it-professionals-day and https://techweek.ie/it-professionals-day/

Suggested actions as regards Communication and Promotion
Annual IT professional event to share practical use of the Framework, discuss improvements etc.
Communicate a clear business case: Why should I (employee/employer) invest in the development of IT related skills and knowledge?
Explain IT to non-IT professionals (use case?) and to professionals whose work is substantially impacted by IT
Target family life to promote IT profession. Use the influence of family by promoting the IT job as a promising job. The media could tell a clear, simple and positive story about this.
Mentoring and role models to promote the positive image of the IT professional.
Share practical use of the Framework e.g. by case studies, best practices, experiences.
Add the 'IT Profession Pride Day' in a e-Skills week.
Think global, act/ implement local
Promote use of tools of self-assessment
Recruit digital champions to help to raise awareness
New recruitment techniques for IT talent

6.4   Frontrunners in Europe

At the moment, there are a few countries that are very interested in implementing the Framework for the IT profession by means of taking first steps in that direction: Spain, Italy, and Ireland have confirmed their participation and also the Netherlands sees positive developments. The stakeholder networks and key activities were shortly described in the paragraph 3.3 and you can find the lists of possible actions that are currently considered in Spain and Ireland in Annex D.

6.5   Selecting implementation initiatives

This section will focus on the initiatives that have started under this project, and will contribute significantly to both the development of specific building blocks of the Framework, as well as to the take-up of the Framework in Europe and possibly beyond. The goal upfront (as set in the contract specifications) is initiating at least three solutions. However, considering the momentum this project is gaining this target might very well be exceeded.

Three concrete implementation actions have already been initiated on the ground that they match the criteria (simple, demand-driven, pragmatic, scalable, and sustainable) very well and stakeholders involved have shown strong commitment to take the action. Following these, Spain and Italy are very eager to also initiate implementation of the Framework. Spain has shared an impressive list of potential initiatives that they are keen on taking forward within a selected network of 70+ Spanish experts representing key stakeholders. Besides these countries, there are also very positive conversations with for instance the **Open Group**, that is a global consortium of more than 500 member organizations, spanning all sectors of the IT community — customers, systems and solutions suppliers, tool vendors, integrators and consultants, as well as academics and researchers.

The three initiated actions are:
1. Development of a European Code of Ethics v1.0, with support of many stakeholders including CEPIS, and various national professional associations;

2. Mapping e-CF and SFIA – towards a global uniform language, increasing mobility for professionals and employers;

3. Adoption of the Framework for the IT profession by ASL-BISL foundation – one of the Services Libraries, a specific BOK. With the aim of convincing other foundations (ITIL etc.) to follow the same path – and hence creating uniformity and a common language for each role in IT;

These initiatives are further described in the following paragraphs.

6.5.1 Development of European ethical guidelines

There is no clear common understanding of the word 'ethics'. In reality, it is about the way the tasks are performed and the relationships established with employees. Various countries and organisations have a code of ethics but a common European guideline on ethics to refer to is missing. It would complete the Framework for the IT profession and could be used by organisations lacking a code to build one, while at the same time promoting social responsibility in IT. In order to be successful, it should be easily understood by everybody from any sector. The suggestion was made to refer to European Ethical Guidelines to avoid possibly existing negative connotations that 'Code' or 'Charter' could have.

During the workshops and interviews we found a general agreement as regards the relevance of individual attitude. This goes beyond a code or guidelines. The point is to provide professionals with a structure which allows them to take correct decisions and actions in different circumstances. There is a distinction between responsibility and attitude.

Furthermore, it is necessary to underline the clear distinction between societal ethics and self-confidentiality of the professional. IT Professionals are not always independent professionals but they work within organizational structures which also influence their conducts. Therefore, the nature of the organization as well as the assessment of the organizational culture and its 'ethical maturity', are preliminary to any evaluation of the individual dimension.

Creating European Ethical Guidelines as part of the Framework for the IT profession should hence take into account how these elements can be incorporated. It can be successful only if well embedded in the other pillars of the Framework.

The following concrete action received broad support from participants at the workshops and interviewees:

• **Development of a version 1.0 of European Ethical Guidelines**. This will likely be a collection of generally accepted principles, derived from the already existing codes such as provided in the repository from CEPIS that includes codes of ethics/conducts from different countries (like Ireland and the Netherlands who also shared theirs), but also with codes developed in specific domains (security, business information management etc.). It will also have to study international best practices in this regard, such as ACM[178], IEEE[179], CompTIA[180] and ACS[181].

• There should be adjacent guidance on how to use the European Ethical Guidelines, for instance how it is embedded in career paths, education and handled by role models. In the UK for instance, ethical attitude must be part of Computing Curricula and this is part of the accreditation process of universities.

• There could be a section on enforcement – despite the general opinion that it is not about punishing professionals if they act unethical but about boosting confidence and encouraging IT professionals to embrace

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[178] https://www.acm.org/about-acm/acm-code-of-ethics-and-professional-conduct
[179] http://www.ieee.org/about/corporate/governance/p7-8.html
[180] See: https://certification.comptia.org/testing/test-policies/continuing-education-policies/candidate-code-of-ethics
[181] https://www.acs.org.au/__data/assets/pdf_file/0005/7835/Code-of-Ethics.pdf

the right attitude and add value with their work. The challenge is in holding people accountable for breaches of the Ethical Guidelines, so key questions to be answered are amongst others: What is the mechanism for signing up to it and how will it be enforced?

An option is to offer voluntary registration of professionals, similar to the initiative that VRI in the Netherlands is setting up (see paragraph 3.3.5). The working group could at least provide some direction on this matter.

Composing this first version brings the opportunity to communicate about it, and create awareness with private sector and professionals as regards an ethical attitude towards their work. It was mentioned during one of the workshops that the next generation expects to get things for free – and this is not how it works. Both computing curricula in schools and universities, as well as broader communication campaigns could address this attitude and contribute to changing it on the longer term.

Another element that is of importance is to ensure that, in the words of professor Rogerson[182] 'a Code accounts for global common values and local cultural differences'. This is especially relevant as the European Ethical Guidelines should be in line with existing national and organisational codes. It should allow for a certain flexibility for 'adopters' to enrich or specify it depending on whether it is meant to serve within a specific IT domain/occupation or in a broader context of IT professionals. The European Ethical Guidelines could also develop a reference function, as for specific fields, specific norms are practiced. One of these fields likely is the security domain, where development of ethics training and a set of principles around security and the ethical conduct for security will be a mechanism to assist education of the IT industry as well as a platform to open the debate with society[183].

We are delighted that CEPIS has shown the commitment to lead this action and work towards European Ethical Guidelines by the end of this year.

6.5.2   Mapping of e-CF and SFIA

The 2nd workshop of the project marked an important step towards closer alignment of two major IT competency models that have similar goals in providing a common language to describe the requirements of IT professionals, and hence meeting private and public needs. The ambition of both the SFIA Foundation and the European Commission is to bring these frameworks closer together. During a constructive workshop with key experts of both frameworks a first discussion developed and lead to a concrete outcome that carried support of all involved.

It would make life easier for global organizations that now map their career frameworks to both models. James de Raeve, vice-president certification of the Open Group, said that the Open Group has to sustain two mapping which is time consuming and costly. He also made clear that at the moment there are various mappings, of different quality, and it is unclear which one to use. Everyone using both frameworks at the moment would benefit by providing clarity in this regard. He also referred to the fact that both frameworks do not have to compete – but are in certain areas complementary. SFIA describes skills in 7 proficiency levels, where the e-CF does not distinguish skills-levels. The e-CF on the other hand focuses on competences rather than skills, and could enrich the SFIA model. The challenge is make them fit together. An example of this could lie in professional certification.

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[182]   Rogerson, S., Aspects of Social Responsibility in the Information Society, in: Doukidis, G.I., Mylonopoulos, N.A. & N. Pouloudi, A. (editors), Social and Economic Transformation in the Digital Era, IDEA GROUP Publishing, Chapter 3, pp 31-46, 2004

[183]   IP3, GIC 2020 Skills Assessment, produced by GIC Directors 2015. Available online here: http://ipthree.org/wp-content/uploads/GIC-2020-Skills-Assessment-August-2015.pdf

In working towards a common solution, it is important to ensure a smooth transition to allow users to adapt to changes coming from updates in SFIA and e-CF. One of the early users of e-CF clearly stated that 'a rapid major change is not preferential as it would require the organisation to consequently adapt too'.

All participants agreed on the first actions to be taken:

- Establishing a working group consisting of several experts of SFIA and e-CF who, based on existing mappings, will determine how both frameworks should be connected to each other. It would lead to proposing one mapping as preferential. Representatives from CEPIS, BCS, AICA, CEN, Open Group and IFIP/IP3 volunteered.

- This working group should take into account how the frameworks are used in practice. This would provide important input to further design a roadmap and ensure careful communication towards users.

- The consortium of the project on IT professionalism will initiate and coordinate this exercise. This should take place before summer and results should be presented at the conference that will be held on 6 December 2016 in Brussels.

6.5.3   Adoption of the Framework for the IT profession by ASL BiSL foundation

Introducing the ASL BiSL foundation and its work

ASL BiSL Foundation has managed key ideas of the Application Services Library (ASL®) and Business Information Services Library (BiSL®) for several years, and is now developing them further. In doing so, it is seeking to bring business and IT closer together. The supply of information – perhaps by its very nature – needs to take place via an integrated chain. The Foundation is relatively young, as it is covering one of the new domains in IT, and is expanding its presence and knowledge and experience in this field further into Europe and other parts of the world (Canada, USA, Japan, China, and Russia). It is now introduced in 30 countries.

Business Information Management is an organisational capability that helps enterprises to realise short-term and long-term business goals by obtaining access to, and ensuring effective use of, valuable information and IT[184]. Information systems and related applications have a long shelf life. Constant modifications are making these systems increasingly complicated and expensive to manage and renew. Control of IT processes is crucial.

ASL BiSL Foundation is a meeting place for professionals with a common interest. The Foundation encourages the improvement of working methods and the exchange of best practices. The experience of others helps to improve management processes within each organisation. And each organisation's own experience helps other companies. The result should be an improvement in the quality of the overall service provided industry-wide.

The value add for the European Framework for the IT profession

The European IT Professional Framework includes instruments like the e-CF and Foundational IT Body of Knowledge that are reference models. The fBOK for instance describes elementary knowledge in all areas of the IT profession, and then refers to other specific bodies of knowledge for further specialisation. For instance, application design and development is a key part of the knowledge area of Software design and development. ASL is a specific body of knowledge that covers this topic extensively[185]. In August 2015 an international standard for application management based on ASL is published: the ISO 16350. This proves the international recognition of ASL's body of knowledge. For a next version 2.0 of the fBOK however it is essential that specific

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[184] Smalley, M, The making of the Business Information Management Manifesto, White paper, 22 February 2016, .Available online via: http://aslbislfoundation.org/?wpfb_dl=1147

[185] Pols, Remko van der, ASL®2, Framework for application management, Van Haren Publishing 2012. See more information on http://aslbislfoundation.org/2009-asl-2/

Knowledge Foundations such as ASL BiSL Foundation – but also others like ITIL, Prince, IPMA and the like – review the current version and map it to their own specific body of knowledge, with the purpose of a) improving both bodies and b) aligning them. At the same time, it is important for the ASL BiSL Foundation to work according to internationally accepted standards and terminology.

Concrete actions that ASL BiSL Foundation will take-up to implement the Framework for the IT profession

Already at the first meeting concerning possible collaboration, the Foundation responded very positively. Follow-up sessions resulted in the following actions that will be undertaken:

- Selecting e-CF competences to complete profiles of the Application Manager and the Business Information Manager – that are typically roles ASL BiSL Foundation distinguishes. This would lead to profiles that are in line with the Framework and could be used for upcoming updates of e-CF.
- Mapping of the BiSL Foundation certification and ASL Foundation certification to the fBOK.
- Provide feedback and recommendations for version 2.0 of the fBOK.
- Based on current training programs, certification from ASL BiSL Foundation, and the existing curriculum for AM/BIM within Capgemini, it is possible to describe the typical career path of both profiles.
- Exploration of how the to-be-developed European Ethical Guidelines could be applied within the ASL BiSL Foundation and its community – perhaps through the IT Manifesto that was designed by the Foundation last year.

The support of ASL BiSL Foundation as an early adopter could accelerate take-up of the Framework by other Knowledge Foundations while at the same time further maturing and developing it. To ensure this leads to the wished-for snowball effect, this collaboration will be acknowledged during the December conference in Brussels, but – more importantly – at the Dutch event in January 2017 that is organised by several Knowledge Foundations and professional associations together.

6.6   Phase 2 activities: Run and support implementation

The approach to supporting and running the implementation actions is described in paragraph 6.2.4 and 6.2.5. it will be part of phase 2 of the project. Besides the approach mentioned, there are two very practical and useful supporting actions.

1. A roadmap that visualises the various steps that are needed to implement the Framework for the IT profession. A birds-eye view of the general process that can help stakeholders to understand where they stand on that map, and what is consequently next.

2. Practical guidelines that support stakeholders with implementing these actions. Hands-on materials (check lists almost) that describe in detail what is needed, from whom, why and when. This can be gathered materials already existing (especially as regards e-CF implementation documentation is available) and/or newly developed documents.

The collaboration with many stakeholders in Europe and across the world has been very constructive and productive so far. We are looking forward to the second phase of the project to build on that and make the required impact.

7   Recommendations

Concluding this interim report, the following lines of thinking will feed into our recommendations that will be part of the final report. They are open for discussion and feedback is welcome. The final report will also include specific recommendations for each stakeholder group in order to ensure sustainability of the Framework for the IT profession and support increase of its take-up.

On continuously improving the Framework for the IT profession:

- Encourage an open dialogue with users of the Framework, and with non-users, to ensure lessons learned are captured and consolidated, and followed up quickly in a transparent manner. A single point of access would be the place to initiate a community and store feedback.
- More concrete implementation actions, by more countries than currently on board, are required. Building on the revitalising of the Grand Coalition, new pledges would ideally be in line with and contribute to the Framework.
- Following the example of ASL-BISL Foundation, trigger other knowledge foundations to take-up the Framework and help to further mature it. These foundations hold the most up to date specialist knowledge and through them certification in these areas is set up. They could to further mature for instance the Foundational Body of Knowledge but also as regards job profiles or specific ethical guidelines that apply in their domain.
- Following the Ethical Guidelines explore establishing a register at European level where - on voluntary basis -professionals can sign up with their CV's and acknowledge the guidelines in order to increase transparency and accountability[186].

On ensuring coordination between ongoing activities and sustainability:

- For the instruments that are part of the Framework and are published as standards (e-CF), the responsibility for updates lies with the CEN. This organisation hence is responsible for aligning updates of these standards (e-CF) with developments that take place in the fields of e-Leadership and KETs.
- For the instruments that are part of the Framework and are not (yet) published as standards (Foundational IT Body of Knowledge) there is no clear owner yet. We propose that a network of experts from various stakeholder groups will act as sounding board for developments that are relevant to the Framework as a whole and those components that are not considered a standard yet. This network should have a dedicated coordinator acting as an engine.
- This central coordinator of the experts' network could also be made responsible for ensuring coherent and consistent communication across these three topics towards stakeholders (education, professionals, young people etc.).

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[186] We understand the sensitivities in this recommendation and would like to express that the recommendation is about exploring options to increase understanding of pro's and con's and current tendencies in EU countries (and globally). At least in the Netherlands such register is initiated, in other countries we've heard similar ideas.

On sustaining collaboration with other parts of the world:

- Extend international collaboration to ensure further alignment of the Framework with parallel developments in other parts of the world (notably with Canada, USA and Japan, but also others) - at least to exchange knowledge and experiences, but possibly also to further align and map existing standards/frameworks and to come to joint statistics on the key indicators that indicate state of play. An International Sounding Board for IT professionalism could be established as a network of international – and committed - experts in the field.

On promotion of the Framework for the IT profession:

- Appoint a clear owner that is responsible for the continuous promotion of the Framework with the aim of creating higher levels of awareness amongst stakeholders and increase take-up in practice.
- Set up one single point of access to all information, instruments, tools and policies concerning skills required in the Digital Economy. Not just IT professionalism related content and tools, but unlocking also materials concerning e-Leadership and KETs. Again, this requires to indicate a clear owner. In our view this could either be the Commission (or a delegated partner) or the European representation of IT professionals (i.e. CEPIS).
- A European Day for the IT professional could support the above actions; ideally it would be a Global Day for the IT professional that would run from Japan through all time zones to the United States.

Appendix A: Demand and Supply Skills Model

The demand and supply skills model applied in this project is result of extensive work by IDC and empirica since 2009 to develop a consistent methodology for sizing and forecasting IT skills. This section provides an overview of the dynamics of the model in developing the data.

A.1.1   Methodological Approach

The forecast model is based on the following steps:
- **Development of baseline data for the year 2015**, which is the starting point for the forecast model. It is based on existing, consolidated data and presents the demand and supply of IT professionals (and their resulting balance) for the three main EU countries (France, Germany and the United Kingdom) and for the EU28. In addition, the model was extended also to Japan, Canada and the USA. The baseline data for is the starting point for the forecast model. The baseline model structure is based on the following equations:
  - Demand = realised demand + excess demand.
  - Supply = realised supply + excess supply.
- **Applying the forecast model**, estimating the correlation between the demand and supply of IT professionals for the period 2016-2020, including the main inflow and outflows parameters:
  - **Forecast of supply:** new market entrants come from computer science graduates entering the labour market as well as other graduates who possess the IT skills demanded. Also, career changers originally coming from a non-IT background may enter but also re-entrants who had been out of the labour market previously. Finally, immigrants may be a source of additional supply in the market. In addition, exits from supply can also include career changers, emigrants, and retirements.
  - **Forecast of demand:** the development of the demand forecast takes into account expected economic growth, estimates of future IT spending, impact of "IT delivery models" such as offshoring and cloud, and wage levels.

The following figure shows a simplified outline of the IT workers demand and supply model.

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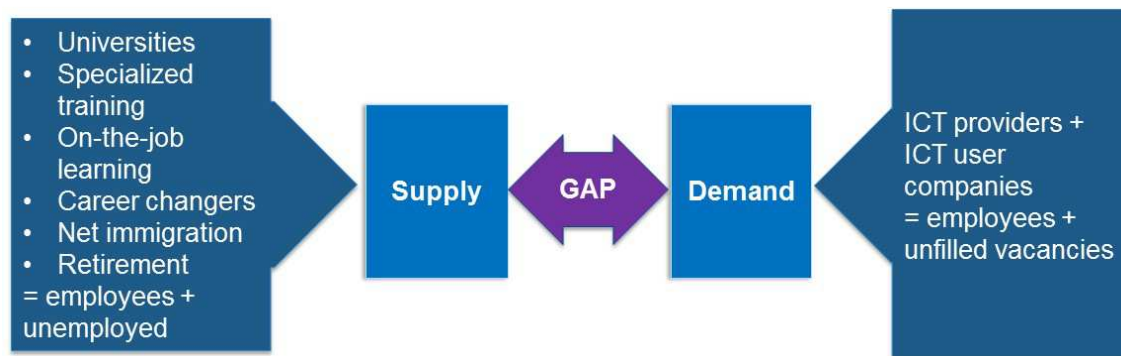
Source: IDC and empirica, 2016

IT Core Skills Definition

Since the start of the IT industry in the 1960s, the usage of IT has spread dramatically and the technologies that are adopted have developed in rapid speed. IT has changed from being mainframe centric, insular environments to spreading across organisations with access to computing power for employees in different departments in the business in the client server era, to being highly connected internally and externally with mobile devices bringing agility and flexibility in the usage of IT – and even with millions of connected devices feeding data into

However, despite the changes in technology the fundamental activities and types of skills needed to design, implement, support and operate an IT environment have remained relatively stable.

Creating a standard set of definitions of skills that can be used as the IT industry introduces new technologies and terminologies are paramount for the continuation of tracking the employment levels for IT skills and for establishing a solid reference framework against which new skills sets and capabilities can be developed. These skill sets will then reflect the changing technologies available in the market – but they will belong to the specific categories of skills needed to undertake the activities that make IT environments work.

Against this background, IDC and empirica define Core IT skills as follows.

Core IT skills are the skills needed to design, implement, support and run an IS environment and its related applications which secure the functioning of the core business activities. **The understanding of the core IT profession in this regard rests on that part of the Information System which is necessary for the core value chain**. The CEN IT job profile mapping can be taken as a background:

Source: CEN Job profiles (ftp://ftp.cen.eu/CEN/Sectors/List/IT/CWAs/CWA%2016458.pdf)
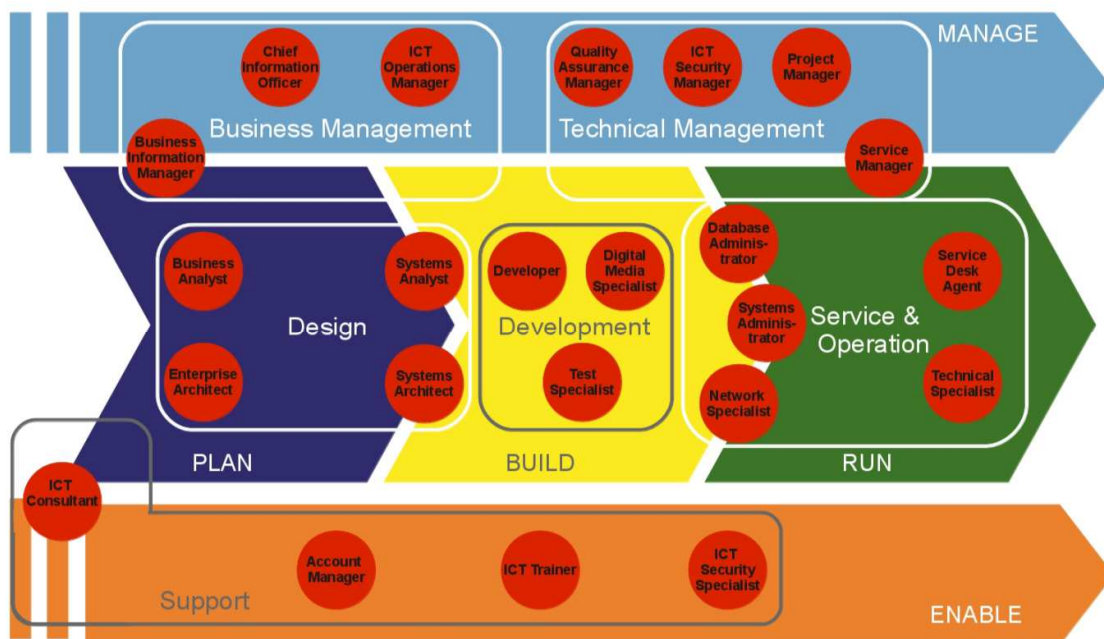
The core IT functions in this sense are the segments Plan, Build and Run, whereas "Enable" roles are seen as supporting (enabling) the core function. The section "Manage" as supervising and guiding role and ensures the alignment of business and IS and hence should also be included in the core definition.

 Specifically, based on ISCO-08, core IT skills include the following occupational codes:
- 1330: IT service managers
- 2511 Systems analysts
- 2512 Software developers
- 2513 Web and multimedia developers
- 2514 Application programmers
- 2519 Software and multimedia developers and analysts not elsewhere classified
- 2521 Database designers and administrators
- 2522 Systems administrators
- 2523 Computer network professionals
- 2529 Database and network professionals not elsewhere classified
- 3511 IT operations technicians

- 3512 IT user support technicians
- 3513 Computer network and systems technicians
- 3514 Web technicians.

These can be mapped across the CEN Job Profile Scheme as follows
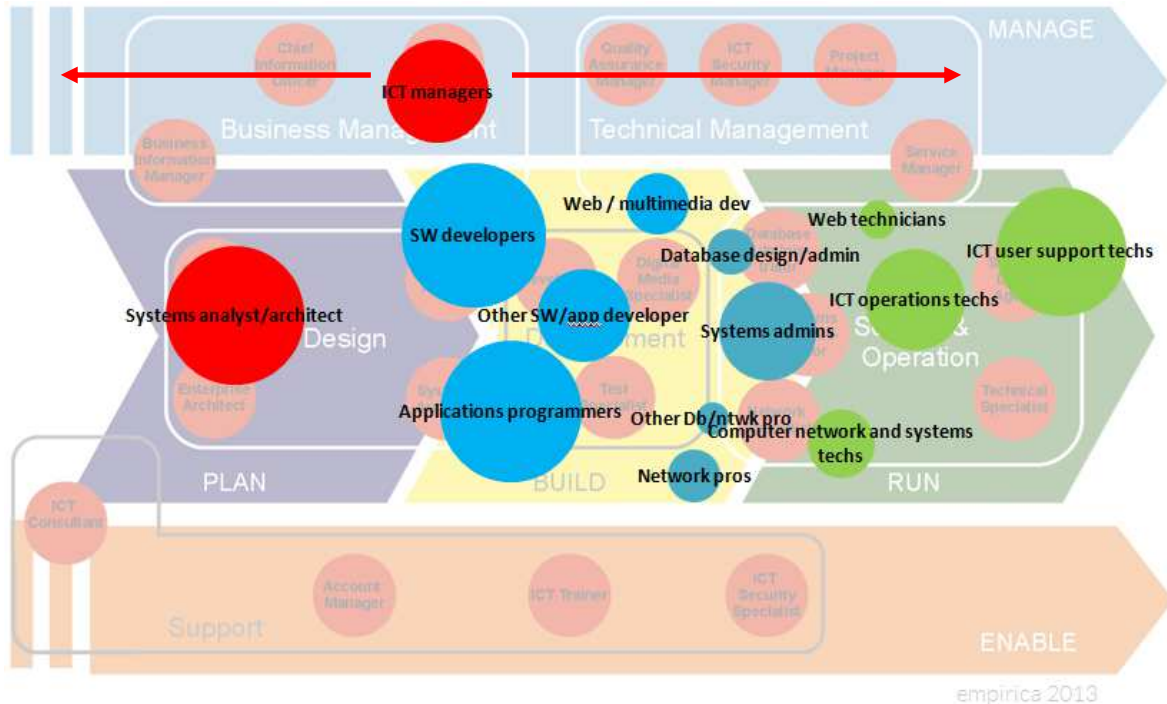
Source: empirica

These occupations will include the skills that demand a certain educational level to perform the role – typically with a tertiary degree as a base.

Specifically, the occupations listed above include those jobs which can be seen as at the heart of the disruptions and digital transformations we witness recently. For instance
- All software and app engineers, programmers and developers, across platforms (251)
- Big data roles, the IT parts of it – i.e. machine learning, algorithms, data storage and processing (especially 2511, 2521, 2529, 2522)
- Cloud and distributed computing (252, 3511, 3513)
- Security skills which are cross cutting and play a huge role in all of the above jobs (but specifically also in (1330, 2511, 3511 – 3514).

Exclusions and exceptions

For the core IT skills, IDC and empirica have excluded the following ISCO codes which are part of the broader IT workforce definition of Eurostat. However, some of these are included in the either broad or very broad definition of the IT workforce:
- *2152 Electronic engineers* and *2153 Telecommunication engineers* are computer and telecoms hardware engineers who are often responsible for the design of hardware, production and installation. They are more found on the supply side of IT and as such are not central to a profession view which focuses on IT as a business function.
- *3114 Electronics engineering technicians* and *3521 Broadcasting and audio-visual technicians* and *3522 Telecommunications engineering technicians* are computer and telecoms hardware technicians

who are often responsible for the installation and maintenance of hardware and equipment. They are not central to a profession view which focuses on IT as a business function.

- *2166 Graphics and multimedia designers* – these occupations are often employed to create **content** that can be dispersed or displayed via IT but they are not core to function of an IT environment.
- *2434 IT sales professionals* are professionals who sell, at wholesale level, complex IT hardware, software and services mostly to business clients. As high level sales representatives, they need to be tech savvy to a significant degree but do not necessarily need the professional knowledge of a core IT professional.
- 7421 Electronics mechanics and services and – the majority of people in this occupation will be involved in activities that are not directly related to IT systems. Although electronics, such as semi-conductors, are at the heart of IT, these occupations also include for example televisions, mobile phone handset, digital radios, manufacturing robotics, airplane control systems, etc.
- 7422 IT installers and servicers – although involved in activities related to IT - with a task complexity level in their work which is typically expected of installers and servicers are not so high as to justify inclusion in the core of the profession. For example, many people in this category would be self-taught– or provide simple swap and replace tasks.

A.1.2   Extending the Supply and Demand Model outside Europe.

For the project at hand, the extension of the supply and demand model to Japan, the USA and Canada was a key component. However, the availability of statistical data varies outside the European Union. This section describes briefly the approach taken to populate the model and validate the model output while keeping the integrity of the approach.

7.1.1   Japan

Most of the data for populating the model was readily available. For the rest, data, including employment by ISCO codes, student enrolment data etc. was supplied by the IPA, which was also interviewed as a stakeholder for this study. The outcome of the model was then verified and supported by IPA and by IDC Japan.

7.1.2   Canada

A large part of the data for populating the model was readily available. However, Canada does not report occupation by ISCO codes but rather by National Occupational Classification for Statistics (NOC-S) codes. These are not at the same level of granularity. However, the Canadian Information and Communications Technology Council, which was also interviewed as a stakeholder of this study has developed a detailed province by province study on the IT skills gap, published in 2015. This data was used to calibrate the base model. For the forecast, a similar approach as the EU model was taken with relevant comparable statistics available. In addition, IDC Canada has undertaken several studies on IT skills and verified and supported the model outcome.

7.1.3   USA

Developing the supply and demand model for the USA was under similar constraints as for Canada. However, the USA uses Standard Occupational Classification codes, which are not dissimilar to ISCO-08 and can therefore relatively easily be matched. In addition, IDC US has undertaken several studies on IT skills over the years, which provided guidance to ensure the baseline model results were in line. For the forecast, a similar approach as the EU model was taken with relevant comparable statistics available. IDC US verified and supported the model outcome.

Appendix B: Expert interviews

B.1.1 Objective and methodology of interviews

- During the first phase of the project, a series of detailed interviews have been carried out to collect high-quality data and information from experts as regards their view on the value of a European Framework for the IT profession and its current state of the 4 pillars. The objective of the interviews was to:

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- Provide insights on the main supply-demand trends of IT professionals' main drivers and barriers influencing the development of IT professionalism in the interviewee's country

- Provide inputs on the most recent evolution of IT industry training and certification activities, both formal and informal (existing offer, capability to respond to demand, quality of the offer, identity and type of IT vendors or other organisations providing certifications and training)

- Visibility of, and opinions about, existing online self-assessment tools for the certification of IT competences, their rate of success and level of take-up, including possible sources of information;

- Information about, and opinions on, the most recent policies and initiatives for IT professionalism, with a specific focus on each of the 4 building blocks of the EU Framework

- Indications about actual/upcoming good practices of implementation of IT professionalism activities falling within, or comparable to, the 4 building blocks of the EU Framework

- Interviews have been conducted by interviewers fully aligned on the survey topic and instructed on the objectives, on the expectations and next steps.

-

- The interviews have been streamlined in a standard interview guideline to ensure consistency of approach across countries and comparability of findings. Guideline provides a road-map to conduct the interview by setting the basic questions that need to be answered. The format used for the interviews was a semi-structured format which allows the respondent to express him / herself freely, rather than being confined to a strict template. Semi-structured interviews make it possible for interviewees to elaborate on certain questions and for interviewers to ask additional clarification questions. This does justice to the explorative character of the interviews.

Based on the list of stakeholders, 50 experts were selected and invited to attend the interviews. The main target group involved in interviews included **G**overnment, **Education/Training/Certification**, **I**ndustry**, Standard bodies and professional Associations** that are able to provide key insights on the four pillars.

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Distribution of experts interviews

- GOV 10%
- IND 20%
- EDU&T 24%
- STAND 4%
- ASS 42%
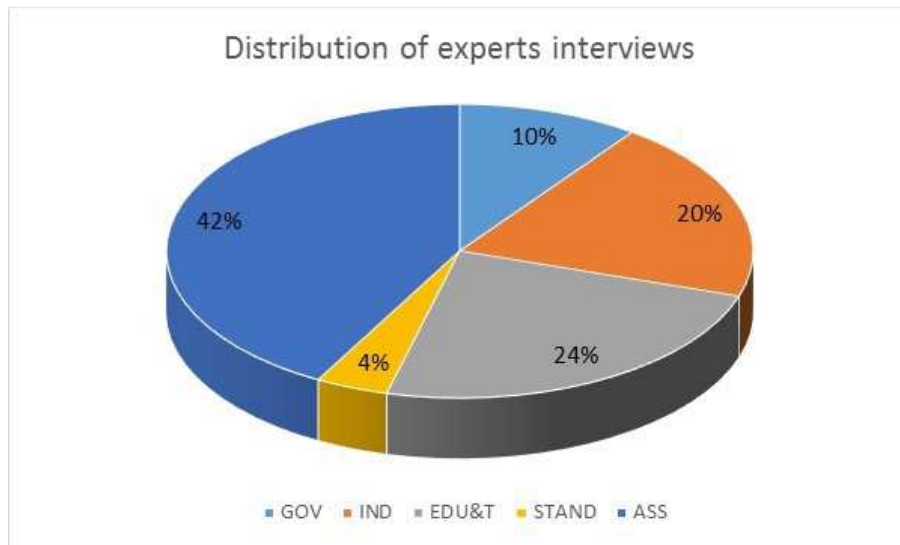
B.1.2   Structure and contents of the interviews

- To the end of capturing experts' views on the current state of play of the four building blocks and relevant input to develop the European Framework for the IT professionalism, some key topics have been investigated in order to meet final objectives. Main topics included:

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- Insights into IT innovation trends,
- Body of knowledge,
- Competences,
- Education/Training/Certification paths,
- Ethics,
- Policies and initiatives at national and international level for the promotion of the IT profession.

B.1.3   IT innovation trends

Main purpose of this section was to gather feelings about digital transformation, fast technological changes and their impacts on IT professionalism. Experts were stimulated to discuss about the strong influence the combined diffusion of Big Data, Cloud Computing, Mobile technologies, Social media and the Internet of Things (IoT) will have on the EU economy in the next years to 2020.

Emerging technologies and Digital transformation

Globally, the common perception of interviewees is that Digital transformation is a global key trend both for big companies and SMEs.

In **Denmark**, one of the most mature Countries in the terms of digitalization, the two groups that are following new trends are the public sector and the large companies, while SMEs are lagging behind. The strongest trends are in cloud, social and mobility. IoT is mostly the remit of large companies. Big Data is in the explorative stage in most organizations but there are a lot of activities and interest.

Also in the **US**, digital transformation is a highly relevant trend, as evidenced by the appearance of research that draws upon organizational examples of effective and ineffective implementations of the associated practices. It is evolving at an extremely rapid pace. The trend is important for larger companies as it is an

essential part of their strategy to survive in competitive and global market. It is specifically more important and vital for SMEs if we consider that many new startups are simply the product of the digital transformation.

The same position is underlined by **Sweden**, where many SMEs have been created following the wave of digitalization. In essence, digital evolution is an opportunity for SMEs creation and transformation.

The digital transformation is a dominant trend in **Germany**, and there is high recognition at policy level about the relevance of this trend. In some branches this trend is very fast; it is the case of automotive, financial services, industry machines, IoT (which accelerate a lot this trend).

From a global perspective, the use of social media and the diffusion of big data, Cloud Computing and other technologies, are having a profound effect on everything we experience. A lot of companies are adapting to these trends by reviewing business strategies, processes and systems. But they need to foster the types of skills that enable digitalization.

Demand of new e-skills

As a result of the rapid pace of change, interviewees agree that there will undoubtedly be a shortages in both required skills and in qualified candidates.

In **Canada** new education programmes are required to make skills up to date and increase attractiveness of IT profession. Nevertheless, the main point is that businesses and industries often have difficulty attracting the right skills, largely because of salary policies. They often have to secure resources as consultants because they can't hire staff with advanced professional qualifications: this is especially the case of SMEs, but not only. Firms should build capacity of such skills within their organizations by investing in training.

In **Japan**, supply-demand gap by technology is not fully captured. The highest risk, in this regard, is a loss of business opportunities by the skills shortage that cannot be predicted at the moment. For this reason, there is a strong need to identify and clarify the information in this field to take an action.

In **Europe**, according to Professional associations such as ACM Europe and IT Forum, there are significant challenges with Big Data, Data mining, Data analysis, and Machine Learning due to a lack of resources – in particular for the higher levels of IT education, such as computer scientists, SAP specialists, developers etc. Many of these issues feature basic education: emerging technologies have been incorporated in Computing / Informatics courses only recently. So it will take 4 to 5 years before we have Computing graduates with a formal education in many of these technologies. At the same time, the demand for professionals with these skills is already increasing fast. There is a clear need for more innovative curricula that provides a sound education in Computing / Informatics and prepares graduates to be responsive to and interested in these and other novel technologies. As mentioned by Fabrizio Gagliardi, Chair ACM Europe, *the quality of education in general in Europe is high, but the quality of education in Informatics could be higher. There is considerable potential for Europe to become leading in terms of Informatics and that is important. Suitable incentives and support could assist in developing that potential and this could help to attract and retain suitably skilled people and help with collaborate across Europe.*

From an industry perspective, companies like Bitkom and The Tech Partnership, the skills gap can definitely damage the competitiveness of the European industry. In a global environment, companies with better access to skills will be more competitive. European competitiveness could be damaged because of skills gap. This is true for both IT industry and users. There is high need for basic understanding of software development and big data, but it is more and more important to be able to use and understand how to use all these ICTs within all industries. Projects within all industries are going to become complex and generic IT skills will be more and more demanded by the users. This does not really mean that such trends are going to generate a demand for new IT skills. Users will need traditional IT skills, but all users will. On the other side, e-leadership skills and big data competences will be the more relevant.

Gender Gap

One of the most relevant phenomenon concerning the IT professionalism is the dramatically increase of gender gap.

There is a wide consensus, among experts from different countries and sectors, about the huge need to improve women involvement in IT careers through focused initiatives. Several good practices in this regard include Testimonials in schools who bring their success stories, Promotion and Communication campaigns aimed at putting in evidence the opportunities of working in IT.

Professional and scientific societies, such as ACM and IEEE, have very successful initiatives that have the benefit of supporting the entire IT community and forging linkages to educational institutions. The IEEE Computer Society in collaboration with Intel offers an annual Prize to the best female led software development team in the Game Sig College Competition. This is designed to encourage more females to take a leadership role in the profession. However, the common feeling is that there are a lot of competing initiatives without a central coordination that ensure effective and concrete results. Unless the issue is addressed, IT sector is missing out on the skills and attributes that women can bring to the profession.

B.1.4   Body of Knowledge

Questions in this section aimed at discussing the value, challenges and further development of the Body of knowledge, intended as the accepted ontology for a specific domain, a considerable repository for the professional knowledge as used by various professionals. The interview with experts covered both specific BoKs that consist of pertinent specialist knowledge in specific domain and foundational BoKs that encompass common IT knowledge across various specific domains.

Main issues and next steps

As regards this pillar, the most pressing issues according to interviewees concern:
- How increase awareness of the Bok and promote it
- How and when the Bok must be updated: technology changes very fast and Bok will need to align quickly
- How make it possible for everyone to easily use the Bok: currently, the level of granularity is quite difficult be clearly understood
- How increase collaboration between stakeholders in order to further mature the Foundational Bok and promote it in different contexts

In an evolutionary perspective, experts suggest several key actions for further developing the Body of knowledge and increase its value:
- Strengthen relationship with IT competences and roles, making clear the existing connections.
- Encourage education providers to use BoKs
- Encourage Libraries/Foundations (e.g. ITIL, BiSL) to align their foundational modules with the Foundational BOK (libraries/foundations of specific knowledge) (e.g. BiSL proposal)
- Create (more) foundational training modules and certify them (e.g. EXIN proposal)
- Determine the targeted audience and decide how they can use the BOK. Ideally provide career changers or students with roadmap to get into jobs and advance a career. Help them determine what do they already know and what actions can they take to develop to a certain level in IT

Relevant initiatives and good practices

Main input from experts' interviews show that the level of awareness and usage of the Body of Knowledge can vary significantly among sectors and countries.

In some cases, such as IEEE educational programmes, curricula have been developed based on the Software Engineering Body of Knowledge (SWEBOK). The IEEE CS SWEBOK is now available in wiki format to facilitate access, the process of receiving comments and feedback from industry professionals and academics.

In the same way, the Education Board of ACM develops curricula and their CS 2013 and SE 2014 are recent examples of very good practice. These are in use, not just by universities and colleges, but also by ICCP, for instance, for continuing professional development activities.

In other cases, the lack of a clear understanding of how to use the Bok and what target address brings to a limited adoption of the Bok itself. Nevertheless, there is a general agreement on the potential value of the Bok as the base for certifications in specific areas of expertise or explain IT to non-IT professionals.

B.1.5   Competences

An understanding of the capability and competency needs of individuals working in various roles is essential for organizations to effectively recruit and develop suitable employees. Understanding the core areas of expertise required by various roles and maintaining appropriate levels of competences through commitment to continuous professional development is necessary to building any profession.

The adoption of the e-CF among organizations, IT practitioners and educational providers will facilitate the use of a common language for describing e-competences in Europe. In doing so, IT practitioners will be able to describe themselves in terms of a set of e-competences, employers will be able to recruit for roles defined in terms of e-competences, and educators will be able to develop offerings to target gaps in e-competences."

Main issues and next steps

Developing the e-CF many different stakeholders have been involved to gather their interests and expectations and to design a commonly agreed framework. However, some barriers can be identified as regard the adoption of the e-CF.

From an industry point of view the main barriers as regard IT competences concern the lack of consistency and standardization: for instance job titles not always correspond to the same profiles and this is a big issues especially in recruiting IT resources. In this regard, according to the IEEE Computer Society, the most pressing issue is properly identifying the exact competences and skill levels an individual has to develop for a specific role. In addition, practical measures are needed to assess competences and skill levels of IT professionals. According to CompTIA, one of the challenges from SFIA or e-CF is to navigate through these frameworks as they are quite complex, difficult to understand and cumbersome to use. You can boil down the number of core roles within IT to a lot less than what SFIA or e-CF will have you think. Until there is a defined core set of roles, you will always have organisations trying to expand the roles and call them something else. There are huge similarities and the complexities need to be taken out. A similar feeling has been explained by Prof Marco Ferretti from CINI: The e-CF is a comprehensive scheme which encompasses different professional profiles. This has determined a conflict on the sub-provision, since although there has been consensus and recognition of the validity of the framework, the main stakeholders have claimed the possibility to define specific professional profiles.

According to CEPIS, the e-CF was not designed as an exhaustive list of competences to meet their specific needs; they should be enriched by professional associations/ industries. Another issue concern the co-existence of different frameworks that can generate confusion: for instance, the use of e-CF and ESCO should be clearly communicated. ESCO is obligatory for public tenders. How would this conflict with e-CF? Added value of e-CF because it has become a recognised standard (EN 16234-1, European Norm about IT Profession Competences by the European Committee for Standardisation – CEN, in the scope of CEN PC 428 e-Competences and IT Professionalism) so it is a more permanent standard. Finally, e-CF is not open for use: the national standardization bodies will 'sell' the e-CF. Each national standardization body will 'sell' the e-CF in their language after translating (this translation process will take 6-12 months) and develop tools based on the e-CF.

To further develop the pillar, different initiatives can be promoted according to experts:
- A multiple stakeholder commitment is required to promote adoption/implementation of the e-CF: public sector should lead by example, education should start to make visible how they deal with e-CF in their curricula, and industry should look at e-CF as a reference for HR recruiting and for developing career paths.
- A clear link to qualification and certification has to be defined in order to increase consistency in competence recognition
- A simple and flexible user interface is needed in order to reduce complexity and facilitate a wider adoption of the framework.
- A set of EU guidelines have to be developed, that clearly explain how to adopt the framework and define what kind of convergence between different frameworks. This could stimulate other parts of the world to do the same.
- Specific initiatives should be put in place in order to monitor successful projects and the usage of e-CF
- Beginning the fieldwork to updating process of EN 16234-1, European Norm about IT Profession Competences, including new IT matters and trends.

Relevant initiatives and good practices

Current state of play of this pillar shows a good maturity level of the e-CF. The framework is widely known and recognised as a standard, providing sound reference and common language to define the set of core competences for a wide range of IT profiles. Nevertheless, there are still few good practices in place that are commonly known, as the most part of experts interviewees have reported. Main successful initiatives gathered through interviews include:
- Success stories providing evidence of the full adoption of the e-CF within the organization: Airbus adopted the e-CF to map employees' profiles and design career paths. Sintel has proposed consortiums to refer to the adopted standards in the renewal of contracts. Dutch education providers are very active in this field and using e-CF in practice (HBO-I, LOI, Saxion, HU) – trying to find answers as to HOW to get from a certain level in e-CF to the next.
- Supportive initiatives aimed at developing e-CF driven tools to enable the framework and help final users: CEPIS e-Competence Benchmark and AICA e-CF plus are good example of such tools.
- Collaborative initiatives to consolidate e-CF at national and international level: EuroCIO is involved in establishing a European governance of the e-CF; national levels need European guidance to put it into effect. We need to establish a user community.
- Initiatives aimed at investigate and promote further convergence of existing frameworks: BCS and the European Commission are working together to map e-CF and SFIA. There will be a conversion available.

Besides these initiatives, many stakeholders suggest a wide variety of practices around alternative competency framework, most of them developed in house. An example is given by The Open Group experience. The Open

Group developed its own competence framework with over 7,000 people certified, working for over 160 organisations. The framework defines skills and experience that a professional should be able to demonstrate.

Similar initiatives and good practices may be found in many organisations.

B.1.6   Education & Training

Certifications, qualifications, non-formal learning and informal learning are mutually supportive components of a professional's career development and they attest to an individual's competences and skills. To date, a variety of initiatives have been launched with a view to simplifying the transparency and recognition of skills and qualifications across Europe (i.e. EQF, ECTS, ECVET, European inventory on validation of non-formal and informal learning). Vocational education and training (VET) for young people and adults is also an essential part of the Europe 2020 strategy.

Nevertheless, IT education and training has nowadays a very extensive, diversified and complex scenario (chaotic use of designations, descriptions and terms) and challenges become more and more pressing.

In this section, interviewees have been asked to provide their views about key areas of improvement, good solutions and further development concerning Education and training with the aim of definitely reduce one of the main issues in IT professionalism: the mismatch between skills/knowledge of students/graduates and industry needs.

<u>**Main issues and next steps**</u>

Looking at the general complexity of the scenario, ACM sustains that the different approaches to professionalism that have been adopted by EU, IP3 and IFIP, BCS, and others does not help; indeed it creates confusion.

Complexity reflects also geographical differences: there is a great variance across Europe with regard to IT education and skills. According to recent studies, UK, Finland, NL, Germany are doing better in terms of IT education than many other countries, but even here there is room for improvement. If one of the priorities at European level is to attract students and professionals from outside, Europe needs to be more open for non-Europeans to access Education. Without global mobility, compatibility of IT people is lower, consequently the inflow of expected IT professionals.

European CIO supports this position by suggesting an increase standardization of Educational programmes to help mobility: it is fundamental that studies and diploma from EU countries are valid and recognised in each country of the EU.

Among the IT Professionals there is a sectoral vision that will need to be changed in the future. In fact, the demand of IT professionals is likely to arise from different contexts; consequently, more flexibility is required.

Another key issue concerns the low attractiveness of current educational programmes: ACM considers the combination of MOOCs with traditional education as a key challenge in the coming 3 years.

From an industry perspective, misalignment between the education system and the demand of IT professionals is still the biggest issue to be tackle and a clear understanding of industries 'needs would be beneficial both for firms and for students. At high level, industry requirements can be summarised in two abilities: on the one side, as mentioned by UST Global, young people entering the IT career should have learned to learn, be flexible and open minded. Technicalities can be learned after, through specialization or advanced training. On the other side, students are asked to demonstrate 'up to date knowledge'. Technological developments will speed up in the near future and alignment between education and industry is

becoming increasingly important. As IMEC said, *"we speak about Big Data for a while, but the education for this still needs to be designed"*.

Looking deeper into educational programmes several stakeholders encourage the development of an e-leadership programme which combines business and IT. Besides I think studies about programmes, languages are too much theoretical. Education should be more focused on applying programmes: IT for health, for lawyers, for …whatever. This kind of approach should be part of the education programmes.

Finally, two additional input can be listed among area of improvement:
- Firstly, the need to develop consistent reskilling programmes: in order to ensure practitioners who move from a profession to another one in the IT field the full development of required competences –
- Secondly, the need to develop a recognition system, especially for non-formal education, based on a common language to identify contents/topics

Relevant initiatives and good practices

Globally, strong effort is required to promote greater exchange of information among professional organisations, industry and countries. There is a need for a collaborative approach to IT professionalism in general and, more in specific, to Educational programmes.

To this end, relevant solutions can be put in evidence in order to inspire similar initiatives across European countries.

Many good practices show great effort in providing high quality educational offerings addressed to IT professionals. Several examples come from Orange Digital Academy - a collaborative platform for the on line training where experts work together to develop contents – or the ACM Learning Centre for instance.

The Irish Computer Society (ICS) is also very active in education and training: among the other we can mention the Graduate development programme, Techweek, Coding competitions, Leadership development programme, Continuous professional development (CPD).

CompTIA's curricula is based on what the industry is telling us is needed.

In Spain, Universities collaborate with industry for the design of post graduate Master programmes. They are also experimenting new tools to complement traditional education such as MOOCS, Blended learning, FLIP teaching. Furthermore CCII is designing an Spanish IT Certification Map as a tool to analyse and improve the current chaotic scenario and use of designations, descriptions and terms in this field ("certification", "accreditation", specialist, expert, master, etc. with a special issue about the use and abuse of "certification" term.

Within Canada there is an initiative to expand the BTM (Business Technology Management) programmes, accredit them and certify graduates.

BTM was introduced in 2009 at the undergraduate level in response to the feedback that new IT graduates didn't have the skills needed by businesses. Working together with academic institutions, industry and sector associations, ITAC Talent defined a set of learning outcomes and competency standards required by industry, drawing heavily on relevant international standards for similar programmes.

BTM is an innovative educational solution that opens academic and career opportunities for post-secondary business students. It equips graduates with the right technical and business skills to enter the workplace. BTM programmes prepare professionals who have the knowledge, skills and competencies to lead and support the effective, competitive use of information technologies.

Since its development in 2009, BTM has impacted thousands of graduates and is currently offered at 19 post-secondary institutions across Canada. BTM applications are rising by an average of 24% per year. (Source - http://itactalent.ca/talent-initiatives/btm/)

B.1.7   Ethics

A defining aspect of any profession involves adhering to professional ethical conduct. The need for professional ethics and adherence to established Codes of Ethics/Conduct, which specify principles of individual's behaviour within various professions, societies and organizations, is paramount to maturing any profession and to garnering positive public perception. To date no overarching European Code of Ethics is available but national codes exist which are developed by professional Associations at national level. Consequences of the lack of a code of ethics are dramatic: industry association in Denmark have not defined a code of conduct – and there have been several scandals (such as SKAT - tax authorities- and the job centres).

In this section, discussion with experts went around evolution of Ethics as a mean to further mature the IT profession as well as current initiatives and good practices in this regard.

Evolution of Ethics

Given the diverse cultures across Europe, a single common ethical code is unrealistic. However, alignment against a core set of ethical issues specified in a meta-framework of ethical issues, will help inform the nature and content of a Framework.

According to William Agresti - Johns Hopkins Carey Business School - given the advances in technology, we need to refresh the IT ethics scenarios so that they convey realistic and contemporary dilemmas faced by IT professionals.

To support this process of continuous update and alignment, all IT curriculum should include learning outcomes related to professional practice, social responsibility and ethics, as CIPS and IPA Japan agree.

According to BCS, ethics is a critical component of the IT professionalism and should be developed from the early stages of school. People building IT systems should be equipped with the right skills but also with the right ethical background. Especially in certain key areas such as the public sector: for instance, asking for adhering to a code of ethics in procurement processes would make industry need to follow.

As CEPIS puts in evidence, many professional associations have a list of ethics. However, the main question is: what do you do when someone is not complying with the code of ethics? This is a struggle. In an evolutionary perspective, we should get employers involved in the implementation of the pillars.

Similarly, Irish Computer Society, which developed a curricula including Ethics component, underlines the same issue: what if someone does not apply? A possible answer comes from UK, where disciplinary board can decide that someone cannot do his/her profession anymore.

Relevant initiatives and good practices

Relevant initiatives and good practices are in place concerning Ethics issues that have been collected through interviews.

Ethics is of considerable importance to ACM, which constantly review its codes and include Ethical issues in ACM curricula. ACM has a Code of Ethics and Professional Conduct as well as a Software Engineering Code of Ethics and Professional Practice (the most recent version being v5.2). People should be educated on ethics, and on the related legal issues. Codes of ethics should certainly feature within any IT BoK (such as the Foundational IT Body of Knowledge). Education is more important than certification when it comes to ethics.

The ASL BISL Foundation has released a Manifesto in December 2015 which we would like to align with the European standard. CIPS has a requirement for all certified members to complete an ethics exam. In addition, there is now a working group in place to update this ethics exam based on the feedback to date.

EQANIE standard is being revised and will include legal and ethical aspects.

In Spain, CII was set up in 2010 by a specific agreement of the Spanish Parliament. Among its duties CCII has:

- Representation of the Spanish informatics engineering professionals on the national and international level;
- Organisation and regulation of the professional practice;
- Ensuring proper standards and promoting an ethical practice and contribution of informatics engineering to general interest;
- Disciplinary proceedings / notification of sanctions or disqualification proceedings for the professional practice;
- Deontological control of the professional and its values in good practice, etc.

In Italy, the provision UNI11506 (point 7) deals with ethic and deontological aspects and thus, they have already been regulated in Italy. This is valid for Italy but there is also an ongoing discussion at EU level. Furthermore, the Appendix A includes, among the others, provisions on the privacy, non-competition and non-conflict of interest.

In UK, Legal social professional and Ethics are integrated in the education. The integration of ethics in education is built in the regulations: education will not get funding if ethics and security are not included in the educational programmes. BCS support education in applying ethics and security in training courses. Nevertheless the major issue concerns the fact that employers do not demand it; they rather focus on skills rather than licences. There is no competitive advantage for all companies to have licenced people. However, clearly there is an opportunity to initiate this.

B.1.8   Conclusions

In summary, interviews carried out with selected experts provided relevant insights into the IT professionalism, with specific focus on the four pillars and digital trends.

Main findings will contribute to increase the value of a European Framework for the IT profession and will serve as a compass to orient future implementation.

Inspired by existing initiatives and good practices we will be able to design the required solutions aimed at promoting the IT professionalism in Europe. Doing this, some priorities gathered from experts will be surely taken into account:

- The e-CF is a useful instrument for companies and consortiums to characterise their employees and to describe the individual profiles. It is necessary to further develop it in the future.
- An observatory platform where all information is presented and updated, tools are available etc. This would help to bundle the various pieces and make clear for people and organisations what is available and what it would bring.
- Lifelong learning and reskilling are key priorities as it becomes more important for people to be able to change their career, be flexible and mobile – also/especially people who are not working in IT but whose work in impacted by IT
- Structural implementation of digital skills and basic professional skills in early education.
- Ambassadors to move forward Practical use

- The involvement of the main entities in the field: business groups, professional associations, consortiums, agencies.
- The Framework should be practical, easy to understand (language!) and easy to use – e.g. by adding guidelines

Appendix C: Abstracts of EU studies on IT professionalism

At European level various projects have been undertaken that have proven to be important milestones in the further development of IT professionalism.

The relevant documents and initiatives are:

- "E-Skills and IT Professionalism: Fostering the IT profession in Europe" (2012)
- "Towards European Quality Labels for the IT Industry Training and Certification" (2013)
- "European e-Competence Framework 3.0" (2013)
- "e-Skills for Competitiveness and Innovation: Vision, Roadmap and Foresight Scenarios,"(2013)
- "European Foundational IT Body of Knowledge" (version 1.0): a first point of reference for anyone interested in working in IT (2014)
- "e-Skills in Europe: Measuring Progress and Moving Ahead" (2014)
- "The International Dimension and the Impact of Globalisation on e-Skills" (2014)

In the final report on "**e-Skills and IT Professionalism: Fostering the IT profession in Europe**" four building blocks for a European Framework for IT Professionalism were proposed. Firstly, a Body of Knowledge, which will serve as one method to define a common language. This is a common level of understanding of the topic, upon which specialist knowledge can be built on. Secondly, the need for a European competence framework was underlined. To be able to understand the capability and competency needs of individuals working in IT roles and organisations recruiting and developing individuals, it is essential to formulate a competence framework. Thirdly, education, training and certification in the IT sector needs to be rendered transparent. Especially in the IT sector formal, non-formal and informal education exist easily side-by-side and are perceived as mutually supportive components of an IT professional's career development. Fourthly and finally, professional ethics are a component of every mature profession and need to be addressed in the IT profession.

The subject of certification was further developed in the study "**Towards European Quality Labels for the IT Industry Training and Certification"**. The main goal of this study was to develop a proposal for a European e-skills quality label, along with prototype online services and tools to promote transparency and to provide tools and support for users in IT industry training and certification. As the prevailing idea is to use existing frameworks and further develop these, the proposed label is based on the European e-Competence Framework and EQAVET (the European Quality Assurance in Vocational Education and Training). The result is a mechanism that makes it possible to reference different types of certification and training against the e-Competence Framework and therefore enhance transparency on the job market.

The **European e-Competence Framework (e-CF)**, currently available in its 3.0 version, is a reference framework of 36 IT competences that can be used and understood by IT users and supply companies, by the public sector, as well as by educational and social partners across Europe.

The Framework provides an European general tool dedicated mainly to:

- IT practitioners and managers, with clear guidelines for their competence development.
- Human resources managers, enabling the anticipation and planning of competence requirements.
- Education and training, enabling effective planning and design of IT curricula.
- Policy makers and market researchers, providing a clear and Europe-wide agreed reference for IT skills and competences in a long-term perspective.

- Procurement managers, providing a common language for effective technical terms of reference in national and international bids.

The e-CF is structured around four dimensions reflecting different levels of business and human resource planning requirements in addition to job proficiency guidelines. "Dimension 1" includes five e-Competence areas, derived from the IT business processes: Plan, Build, Run, Enable and Manage. "Dimension 2" is made of a set of reference e-Competences for each area. "Dimension 3" are proficiency levels of each e-Competence ranging from e-1 to e-5, which are related to the EQF levels 3 to 8. "Dimension 4" are samples of knowledge and skills relate to e-Competences in Dimension 2.

Within the European e-Competences Framework some of the identified competences can easily be reconnected to skills closely connected to the e-leadership domain. The study **"e-Skills for Competitiveness and Innovation: Vision, Roadmap and Foresight Scenarios"** has underlined the need for e-Leadership skills, a new type of leadership that is becoming essential to organisational innovation and competitiveness.. Next to IT user skills, IT practitioner skills and IT business skills, e-Leadership skills are skills that enable one to accomplish a goal that relies on IT through the direction of human resources and uses of IT. This means that, e-leaders are leaders who draw on technology to accomplish an IT-enabled objective.[187]

To enhance communication and further develop the IT profession, end of 2014 the first version of **'The European Foundational IT Body of Knowledge**' was published. The IT body of knowledge is the base-level knowledge required to enter the IT profession and acts as the first point of reference for anyone interested in working in IT'. At the moment, there is no authoritative source within the EU that defines and organises the core knowledge of the IT discipline. An EU Foundational IT Body of Knowledge is therefore needed to provide the basis for a common understanding of the foundational knowledge an IT professional should possess[188]. Having a common way of referring to IT knowledge, i.e. a 'go-to' point of reference, will facilitate communication among IT practitioners and provide a baseline for competency models, certification programmes, educational programmes, and other workforce development initiatives[189]

The study "**e-Skills in Europe: Measuring Progress and Moving Ahead**" maps and monitors the supply and the demand of e-skills across Europe and benchmarks national policy initiatives and multi-stakeholder partnerships in the European Union. Based on the findings, in the report five policy recommendations have been made.

- Launch initiatives in countries lagging behind
- Scale up efforts through longer term policy commitment
- Adapt training and policy to the digital age
- Foster IT professionalism and quality
- Build bridges for all students, graduates and workers

To this end, the analyses of the evolution of the supply and demand in the last ten years, will help understand the impact of the initiatives launched at EU and national level since 2008, but will also help to efficiently propose new approaches to improve the situation and identify successful means to foster multi-stakeholder partnerships.

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[187] http://ec.europa.eu/enterprise/sectors/IT/files/eskills/insead_eleadership_en.pdf
[188] IT literacy is defined as being familiar with the fundamental information technology concepts and having the ability to utilise computers and related technology efficiently. One of the components is computer literacy. One way of becoming computer literate is to take the European Computer Driving Licence (http://www.ecdl.org/).
[189] "e-Skills and IT Professionalism: Fostering the IT profession in Europe";
http://ec.europa.eu/enterprise/sectors/IT/files/eskills/IT_professionalism_report_en.pdf

As the Digital Economy is not restricted to borders, and highly skilled IT professionals have high mobility, the study "**The International Dimension and the Impact of Globalisation on e-Skills**" focuses on the influence of more and more globalised world. This study explores the international dimension of e-Skills, a shortage that is global and growing. Moreover, the study assess the impact of globalisation on high-level e-skills as off shoring is impacting IT jobs. Certain skills will be less affected than others and understanding the impact of globalisation on the IT profession will lead to better address e-skills shortages globally thought education and policy action. Therefore it will be possible to promote IT Professionalism in the longer term. The solution is to further build on and develop multiple competence frameworks, educational standards, codes of ethics, and bodies of knowledge.

In the areas of e-Leadership and KET skills several studies have been completed as well. For relevant materials we refer to the project websites:

- e-Leadership: http://eskills-guide.eu/documents/ and http://eskills-scale.eu/home/
- KETs:http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=8764&lang=en&title=Final-report%3A-Skills-for-Key-Enabling-Technologies-in-Europe

Appendix D: Overview of possible actions in Spain and Ireland

D.1.1 Action plan for Implementation of IT Profession Framework in Spain

1. Objective of the document

The objective of this document is having a first working draft of a set of actions and action plan for implementation of IT Profession Framework (ICTPF) in Spain.
Sources:

- Some possible working lines and initiatives for IT Profession Framework. (CCII, 18th Jan 2016)
- Towards implementation of the Framework for the IT Profession in Spain. (CCII Presentation in Workshop 1. Towards a European Framework for the IT Profession, Brussels 4th February 2016.)
- More Ideas from CCII (CCII, March 8th, 2016)

This internal working draft, will produce a first action plan draft (Spain action plan v1.0) to be opened for suggestions, improvements and new action proposals by other IT agents in Spain.

2. Action table

Understanding the action table:
"Nº": Internal identification number
"Action title": Short name of the action
"Description and time": Short explanation and notes to understand the action scope and idea; and the estimated moment of implementation.
"Bloc": ICTPF blocs:
1: e-Competences
2: BoK
3: Certification, learning
4: Ethics
5: Others. Very important actions in the general scope of IT profession and the goals of the initiative, which are not clearly in any of the four conceptual blocs.

"Scope/Priority"
Scope: Spain or UE
UE means, we must decide inside the ICTPF initiative if this action is interesting to be implemented or at least promoted or proposed to EC to be developed in the near future, as another kind of outcome of the ICTPF initiative.
Priority: 0 to 10 number. Higher number means higher priority. May 10th, 2016

Action table:

Nº	Action title	Descripcion and time	Bloc	Scope/Priority
1	Promoting an spanish experts pool on ICTPF	Spain - Creating experts pool (Done) (With 4 expert blocs, with a CCII coordinator) - Achieving an intense contribution to ICTPF, as a key driving force to implement the ICTPF in Spain - 2016 + 2017 UE: In progess? How to link and coordinate EU experts with national experts?	All	Spain / 10 UE / ?
2	Spanish translation of European Norm EN 16234 "e-Competences and ICT Professionalism".	- In progress (Scheduled date june 2016) - Oficial presentation autumn 2016 (In coordination with AENOR (Spanish National Entity of Standardization. President of CCII is also de President of AENOR Subcommitee for this Norm in Spain.) - March 2016 – June 2016	1	Spain / 10
3	Diffusion in Spain of European Norm EN 16234 "e-Competences and ICT Professionalism".	- In coordination with AENOR (Spanish National Entity of Standardization. President of CCII is also de President of AENOR Subcommitee for this Norm in Spain.) - Informal advance diffusion information on DES Madrid (may 24th) - 2016 + 2017	1	Spain / 10
4	Applying EN 16234 by CCII to define an standardized version of the main professional IT profiles in Spain.	- EN 16234 is based on field research several years ago. This work is under revision and evolution, so this result will be interesting to be use with the updated EN version. - 2016. Priority 5 - 2017. Priority 10	1	Spain / 5 Spain / 10
5	Producing a report of evolution of use of EN 1624 in Spain	- In coordination with AENOR (Spanish National Entity of Standardization. President of CCII is also de President of AENOR Subcommitee for this Norm in Spain.) - 2017	1	Spain / 6
6	Promote the use of EN 16234 to generate an standardized version of Spanish university qualifications in informatics engineering.	- Specification of correspondence between competences of bachelor and master of informatics engineering university degrees with EN 16234.	1	Spain / 10
7	Promoting and Spanish map of EN 16234 standardized definition of the professional IT profiles	- This result will be very useful to informatics engineering universities	1	Spain / 10
8	Promoting a clear differenciation between IT professional competences and IT user competences, and the way to implement it in the real action (training, certification, enterprises, labour market, headhunters, etc.)?	- There are a lot of UE IT user oriented accreditation. Its very important to implement a clear differentiation between IT professional competences-qualifications and IT user competences-qualifications.	1	EU / ?
9	Diffusion of BOK in Spain ??	- (Decision depending on academic opinion.)	2	Spain / ?
10	Obtaning feedback report of spanish academia about BOK 1.0 versión and improving lines ??	- (Decision depending on academic opinion.)	2	Spain / ?
11	Benchmarking of existing international references (Other BOKs and Curriculum Guidelines) to generate a more wide version??	- (Decision depending on academic opinion.)	2	EU / ?
12	BOK 2.0??	- (Decision depending on academic opinion.)	2	EU / ?
13	Pilot matching of BOK in a small group of profles defined wirh EN 1624??	- (Decision depending on academic opinion.)	2	EU / ?
14	Nowadays IT Certifications Map	- Specification of Spanish IT Certification Map (Chaotic use of designations, descriptions and terms ("certification", "accreditation", specialist, expert, master, etc.). With a special issue about the use and abuse of term "certification". - First version v1 autumn 2016 (Spanish-wide) - In progress. Iterative and incremental approach to build the map: v0.1 pilot among experts pool, v0.2 with contributions from all CCII members, finally enlisting other Spanish stakeholders to	3	Spain / 10

		obtain v1. - Possible more wide version: Nowadays IT Education and Training Map (Certifications, qualifications, non-formal learning and informal learning)		
15	Proposal of New IT Certifications Map and certification quality labels	- 2017	3	Spain /10 EU / ?
16	CCII chartered IT professionals certification model	- CCII chartered IT professionals certification model as an implementation result of ICTPF in Spain. - 2016-2017	3	Spain / 10
17	Creation of Spanish National Comission on Information and knowledge technology Ethics	- Promoted by CCII - In progress - 2016	4	Spain /10
18	IKT Code of Ethics	- Evolution of deontological and ethics codes in regional informatics enginneering colleges in Spain, IT professionals participation process and ICTPF conclusions. - 2016-2017	4	Spain /10
19	Definition of the scope and practical results of this first version of IT Professional Ethics bloc and the pending tasks	- Clarifying Professional Ethics bloc scope	4	EU / ?

20	IT services and activities evaluation	- Deep and rigorous evaluation of the impact of IT products, activities and services in the general interest and the fundamental rights, with the objective of determining the cases in which it would be recommendable to establish some kind of regulation or administrative control due to reasons of general interest:
		    o Specific measures to materialize its **multidisciplinary** study, analysis and implementation, especially in relation to its impact on responsibility, fundamental rights, security, health, consumers, commercial transactions, the fight against fraud and intellectual and industrial property
		    o Different countries different criteria.
		    o Too complex to ordinary people and to political proactivity.
		    o It is a changing issue: Need of a professional continuous action and updating
		 - Convenience of UE IT Professional "recommendations" about this important IT Profession issue (Could be a key tool to be considered for European Commission and UE
			5	EU / ?

		members to implement european or national improvement actions) - Promoting the creation of governance, control and regulation mechanisms for IT products, activities and services at European and International level, in a manner consistent with the Information and Knowledge Society in which we live. - Precedent: http://www.ccii.es/images/ccii/documentos/InformatiCALL_en.pdf		
21	IT Professional standards and proceedings	- It could be useful to produce a document (and may be an online consultation service) with IT Professional standards and proceedings of IT sector. It's very important to professional and sectorial praxis	5	EU / ?
22	Implementation of "transparency exercise" for IT professions to promote and clarify IT Professional movement and recognition across UE	- In UE: - **Different situation in each country (Regulated professions).** - European IT Professional Card. (UE is implementing a global roadmap) - Outside UE (Recognition of UE professionals. Recognition of foreign IT professionals in UE) - Solution: Promoting the implementation of transparency exercise for ICT professions (at EU level or calling on every member state - CCII has requested EC to urge spanish government the Implementation in Spain of "transparency exercise" for informatics engineering professions to clarify spanish professional movement and recognition across UE. - If EC do not call on making this exercise on a concrete professional field, each member state decides to do or not to do this updating and comparing exercise in this field. So this action would be very important to the common evolution of the ICT professionals across Europe and each of his members states. And so with the global goals of the Framework.	5	EU / ?

23	IT Professional sector activity and occupations	- For a correct IT professional sector knowledge and general strategy we need:
		    A correct measure (present and log term)
		    A correct qualitative perception of the sector.
		 - Maybe it could be interesting as a part of ITPF to evaluate if the current classification and aggregation of IT Professional sector (specially for occupations) is done achieving this two objectives . In the present and in a long term sense, and also in a comparable way.
		 - We could analyse this issue in ESCO (European Skills, Competences, Qualifications and Occupations) (And maybe ISCO (International Standard Classification of Occupations)) And produce a conclusion report to be used as an UE IT Professional sector proposal for ESCO improvement.
		 - (The ESCO classification identifies and categorises skills, competences, qualifications and occupations relevant for the EU labour market and education and training, but there is not a
			5	EU / ?

D.1.2   Possible Actions for IT Professionalism Framework Implementation in Ireland

1. Convene an Expert Group of IT professionals to advise on the implementation and to contribute to idea development in Europe.
   a. This group was effectively launched at a workshop held on 12th May, following the 2016 IT Professionals Day.
   b. The Expert Group will also become the steering group for the re-establishment of the Irish National Coalition for Digital Jobs
2. Organise an official launch of EN16234 (e-CF) in September, in collaboration with the Irish National Standard's Body, NSAI.
3. Follow-up on proposal made to Irish qualifications authority, Quality and Qualifications Ireland (QQI), to map e-CF to relevant academic awards.
4. Publish the IT Body of Knowledge, and promote awareness of its existence to IT professional members of ICS.
   a. Map the BoK to common job profiles (generic and entry level)

b. Use the cross-referencing of e-CF and the BoK to assist the mapping of e-CF to academic awards (No. 3 above).
5. Initiate a project to use e-CF to assess and counsel employees on competence and education.
   a. Self-assessment, followed by manager validation
   b. Professional development/education planning
   c. Continuous Professional Development)CPD) points awarded

(this will initially be a paper based process until we can source (borrow?) an online solution that meets our needs)
6. Strengthen initiatives to grow the talent pool by working with primary and secondary schools, stressing the importance of both user and professional competence.
   a. Cliste –digital and computing skills programme integrated into Irish national primary curriculum.
   b. Computing Curriculum – second level computing courses created because IT/Computing is not an official school subject in Ireland.
   c. Tech Week
      i. Formula 1 in Schools Competition
      ii. National Scratch Competition
      iii. Bebras Challenge
      iv. IT Professionals Day
7. Utilise the 7 annual conferences run by ICS to promote the professionalism agenda.
   a. CIO and IT Leaders
   b. Health Informatics
   c. Business Analysis
   d. IT Architecture
   e. Data Protection and Privacy
   f. Training and Development
8. Leverage the ICS CIO Forum and Advisory Board, made up of key public and private sector senior IT executives (Xilinx, Bord Gais Energy, Intel, Zurich Life, Kerry Group, Symantec, Irish Life, Central Bank, DeCare Systems, Omnipay, Revenue Commissioners, and UDC Healthcare etc.).
9. Likewise, leverage the newly formed eHealth CIO Forum.
10. Take advantage of enhanced public visibility and media exposure attracted by the 50th anniversary of the ICS in 2017, and celebrator events.
    a. Turing Lecture, Dublin Castle, February 22nd, 2017.
    b. World Conference on Computers in Education, Dublin Castle and Trinity College, 3-6th July, 2017.
11. Extend the impact of IT Professionals Day, celebrated at the start of the national Tech Week, lobbying for replication in other EU countries, as happened in Malta in 2016.
12. Re-launch the Irish National Coalition for Digital Jobs, with a view to having a contribution to make at the Grand Coalition event in the autumn, 2016.

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