Bridging the Digital Talent Gap - Towards Successful Industry-University Partnerships

Workshop in Rome, 30 October 2019

Digital technologies offer great opportunities for the EU to stay competitive, increase its potential for innovation and remain an inclusive society. Today's most successful businesses are those that use digital technology not just to boost productivity and improve internal processes, but as a means of reinventing themselves: their operational models, their value chains and their customer relationships. In order for this transformation to materialise, people with proper knowledge and skills to create, develop, roll-out, and use these technologies are a necessary condition. This implies satisfying the growing demand for specialists in digital technologies, as well as up-skilling the EU's citizens and workforce in the context of rapid digitalisation.

Currently, the EU is facing a systemic gap in terms of digital competences, including the most advanced. While digital experts are among the most demanded professionals, almost all Member States face shortages for both software developers and analysts as well as database and network professionals. 53% of companies who tried to recruit digital specialists find it difficult, and the limited availability of proper knowledge and skills is the most frequently cited obstacle to investment across the EU (expressed by 72% of companies). The demand for advanced digital competences has been rising strongly over the past decade, with growth in ICT specialist employment of 3.7% a year over the last 10 years. However, supply is not keeping up with demand and the EU already lacks around 1 million ICT specialists. This figure could grow to 2 million by 2030, if the problem is not adequately addressed, and could significantly hinder Europe's competitiveness and growth.

An important element to consider in this scenario is the tension between the need of universities to provide solid foundations to its students, and the rapid change in competences demands from business, deriving from the fast pace of technology. This situation is more acute in exponentially burgeoning fields such as Artificial Intelligence, Cybersecurity and High-Performance Computing.

In addition to that, the field has complex multifactorial ingrained problems that need to be addressed for Europe to reach a higher offer of highly skilled ICT professionals. The most elementary being: (i) the low number of school students deciding for a higher education degree in Informatics/Computer Science (resulting, among other factors, from the lack of proper teaching of the discipline in schools and the very low proportion of women among the incoming students) and (ii) the low graduation rates (a significant number of students enrol, but do not complete their studies) in Informatics/Computer Science Bachelor programs.

The purpose of this workshop is to gather views about possible ways for increasing the specialised educational offer in high demand areas such as Artificial Intelligence, Cybersecurity and Software Engineering, and how cooperation among universities and business partners, developing and deploying digital technologies could contribute to this objective.

The updated agenda is available online.

Session 1: Artificial Intelligence (including Data Science)

Facilitator: Tanya Suarez, BluSpecs, Spain
Rapporteur: Daniele Nardi, "Sapienza" University of Rome, Italy

Artificial Intelligence (AI) has reached one of the spikes that have characterized the development of the field since its beginning (typically dated in 1956). The technology that has currently produced the breakthrough is known as Deep Learning, which achieved an outstanding level of success in several problems, largely due to the ability to handle large amounts of data. These successes opened a wide range of opportunities to solve problems in many application domains.

Like the introduction of computers, the introduction of AI techniques may lead to the automation of tasks that could not be performed by a machine earlier. As in the case of computer automation, the development of AI solutions requires not only AI service providers or experts, but also domain experts that can identify where AI solutions can improve the business.

Hence, different levels of expertise seem to be needed to bridge the gap and, consequently, the impact on the curricula is not limited to the creation of AI experts, but also to create AI competences across manifold domains.

Regarding the supply of AI skills and training and the demand provided by corporates, SMEs and start-ups and research groups. A set of specific challenges can be identified surrounding different aspects specific to AI:

1. Currently in Europe, there is an AI (and related skills) brain drain driven by organisations outside the EU, PhD students and researchers are offered conditions that are too good to turn down.

2. Within Europe, the demand for skilled persons is so high that SMEs, start-ups and research groups are unable to compete for talent with consequences of a shoring up of talent by the big companies and consultancies with ramifications for the talent landscape and pipeline as well as the competitive economy.

3. The skills currently required for the development and implementation of AI solutions in the market are achieved through practical experience and specialisation, i.e. PhD level.

4. AI is a platform technology, more akin to the introduction of IT systems within businesses, i.e. it can provide the solution to distinct and broad challenges across many domains. Currently the principal domains are healthcare, finance, media and retail, but the application of AI in each of these domains is differentiated from the other.

5. The definition of AI is rapidly evolving as are the groups of technologies on which AI solutions are developed are diverging, leading to challenges in coherency and the potential for open source skills similar to current software development.

6. Within Europe, there are certainly a number of master programmes that provide the skills for AI, but do not focus specifically on it or mention it within their titles; however, the market and industry requirements are constantly shifting and universities have non-responsive curricula added to competition for subject slots.

7. Depending on the development and application approach of AI solutions, there is an underdeveloped and unclear legal responsibility, as well as ethical, that is difficult to clarify.

Main points to be discussed

- Competition for talent from large multinationals could be preventing deep skills from being developed and inhibiting the growth of AI research groups and SMEs/start-ups.
- To respond to the rapidly changing nature of AI and the respective markets, more innovative curricula are required at third-level education.
- Current skills and learning are focused on existing non- European technology platforms and stacks.
- While the technical skills for AI are being developed, developers must also understand the ethical and legal implications of AI adoption.

Session 2: Cyber Security (including Cyber Physical Systems and Privacy)

Facilitator: Alexander Riedl, European Commission, Belgium
Rapporteur: Javier Lopez, University of Malaga, Spain

Our European society and economy are increasing their dependence on IT as every simple object is or can be connected to the Internet. Enterprises accelerate the adoption of digital technology to improve productivity and innovation capability. However, this comes at a cost as it increases the risk of cyberthreats and cyberattacks.

In a context where vulnerabilities and breaches take place in thousands every minute, we definitively lack enough qualified Cyber Security experts. Therefore, the growing investments in digital technology need to be matched with a sufficient availability of Cyber Security experts and skills at all levels of the workforce. The lack of a sufficient number of cyber experts has become one of the weakest links of cybersecurity defence, and the reasons for the shortage of these will be analysed during this Workshop session.

Certain studies claim that the gap of Cyber Security professionals may amount to 3 million at global level. Such figures undoubtedly indicate that it is highly critical for companies, education systems and public policymakers to address this issue. However, this urgency should not lead to hasty and possible wrong decisions. A number of issues need to be considered and examined as the number and variety of challenges and stakeholders concerned is large.

Particularly relevant for any solution to be approached is how the educational sector, public and private, will be able to react to the very high demand of Cyber Security professionals. For instance, it is questionable that the number of qualified educators is enough, and also if Cyber Security programs should be highly specialized or, alternatively, to holistically consider human and economic factors, legal implications, etc.

Questions to be addressed:

1. Do organisations map realistically the assets they have and the Cyber Security skills they miss? What kind of skills and experience are they looking for?
2. What are universities offering and to which extent does it match the need of businesses and other organisations?
3. How can businesses support higher education institutions to make their courses more relevant to the needs of businesses?
4. How to motivate more students to take up cyber security studies and to make sure graduates' skills remain relevant through continuous training during their professional career?
5. Are cybersecurity certifications after a Computer Science degree a better solution than a dedicated degree in Cyber Security?
6. To which degree should Cyber Security courses be integrated in other degrees to strengthen the protection from cyberattacks?

Session 3: Software Engineering (including Human Centred Engineering)

Facilitator: Alessandro Bogliolo, University of Urbino, Italy
Rapporteur: Gregor Engels, University of Paderborn, Germany

Software is the key factor of any innovation of today. Advances in mobile data networks and embedded systems have enabled the advent of the software-everywhere era, where computational resources are available in cloud, as well as in mobile and IoT devices. Thus, the development of new software as well as the migration, evolution and adaptation of existing software due to changed requirements is at the core of new products or services in any application domain. This is paired with a highly increased complexity of nowadays software as well as steadily decreased time-to-market demands. Also, the role of humans as users of software has changed, as systems are expected which are continuously adapted to the needs of individuals to gain appropriate acceptance. Lastly, software has not only to comply with standard quality characteristics, but also to obey social, legal, moral and ethical values.

All this has not only lead to an enormous demand for software engineers during the last decade, but in particular for highly-skilled people who are able to cope with the novel challenges of human-centric, intelligent software systems deploying novel technologies while requirements and contexts are changing continuously.

Modern software engineers have to have multifaceted skills. They have to understand application domains and to be able to speak to domain experts with an education in another discipline, they have to master agile development techniques, they have to deploy novel technologies and tools, they have to incorporate algorithmic services based on AI and machine learning techniques, they have to understand the role of humans as users and prosumers, they have to understand the potential of new network models and connected devices, they have to be able to exploit frameworks to enhance productivity, and they have to cope with the right choice of values.

It is a matter of fact that currently there is a huge shortage of those modern software engineers in industry. And due to too low numbers of computer science students in academic studies, this shortage will even increase in the future. All this will seriously hinder a surely desired socio-economic growth in Europe. Thus, the main questions to be addressed are:

1. What are the required skills of modern software engineers?
2. What can we do to increase the number of modern software engineers in Europe?
3. What can we do to provide on-the-job learning and qualification processes to software engineers in industry?
4. What can we do to attract more students to become a modern software engineer?
5. How can we incorporate software engineering concepts in studies of other disciplines?
6. These questions have to be discussed jointly by representatives from industry, academia, and politics to find solutions which can be installed in a short-term!