LEADS WP 3 WORKSHOP SUMMARY: ADVANCED DIGITAL SKILLS IN DATA AND AI: CURRENT DEMAND, FORECASTED SCENARIOS AND EXPECTED GAP

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UPM

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1 Topic Introduction and Motivation

LEADS CSA participated in a workshop* on the relevance of Advanced Digital Skills (ADS) in Data and Artificial Intelligence (AI) during Lulea's Data Week. The purpose was to share the project's results and to engage with the specialised community, in particular SMEs. It was intended to discuss how best to deliver the skills needed to meet the current and future demands in the areas of Business Intelligence, Data Analytics and AI technologies in the EU. The event took place during the spring gathering of the European Big Data and Data Driven AI research and innovation communities, organized by the Big Data Value Association and the EUHubs4Data project in collaboration with the Research Institutes of Sweden (RISE).

As mentioned, the original aim of the workshop was to discuss and gather recommendations about how SMEs can address the existing challenge related to the lack of ADS talent. However, unexpected issues with the invited speakers and representatives of SMEs, necessitated an adjustment from the initial aims of the discussion. A new focus of the meeting addressed the role of the different stakeholders in delivering the required ADS skills.

There were a number of key questions addressed as follows: (1) what is the current demand of ADS relevant for the upcoming Data Spaces; (2) which skills will be most and less needed in the future; (3) are we prepared for the transition; (4) do we have the right human resources and if not, how can these be acquired. These were some of the questions that triggered the conversation between researchers, industry experts, policymakers, and practitioners during the LEADS workshop and these key questions which were also crucial to the Data Week's main theme: Data Meets Infrastructure at the Edge.

2 Workshop Implementation

The workshop took place on Wednesday Jun 14 2023, 14:00-15:00 in the Agnar room of Quality Hotel Luleå (Storgatan 17, Luleå, 971 28, Sweden), within the Data Week 2023 which was co-organised by BDVA and EUHubs4Data project in collaboration with the Research Institutes of Sweden (RISE).The workshop was organised by Universidad Politécnica de Madrid (UPM) and Blu Space (Blu). In particular, the organisers were Ernestina Menasalvas (UPM) and Martín Robles (Blu).There were approximately 30 attendees from diverse backgrounds (industry and consulting), and a small representation from the academia.

3 Workshop structure

The Objectives of the workshop were:

- Present LEADS research on ADS current and future demands, relevant for BDVA.
- Present the Porini SRL use case of niche ADS formation through customized programmes.
- Present engagement strategies between academia and skills demands.

The expected outcomes were as follows:

- Analysis of learning methods and learning providers.
- An understanding of the context in which those methods and providers can interact in order to meet the demands for professionals.

The agenda was as follows:

- 14:00 Welcome: Ernestina Menasalvas, UPM, Brendan Rowan, BluSpecs
- 14:05 Context setting: An overview of Leads Project by Martín Robles. LEADS and BluSpecs
- 14:15 A success story, by Luca Malinervo and Matteo Beshara of Porini
- 14:30 Learning methods and learning paths, by Javier Segovia. Universidad Politécnica de Madrid. UPM Coordinator for EIT-Digital
- 14:40 Debate
- 14:55 Wrap-up

4 Workshop Development

LEADS presented the main findings from their initial release of the Future Demands of Advanced Digital Skills report, followed by a presentation by Porini SRL, an ICT skilling SME. They shared their successful approach in efficiently delivering essential Advanced Digital Skills that are in high demand in the market. This case study was followed by a guided conversation exploring the ultimate responsibility for providing these skills, identifying the key stakeholders who should invest in their development and discussing how Industry and Universities can effectively collaborate to avoid outdated approaches. The discussion was facilitated by the UPM's representative in EIT-Digital.
The questions posed to the audience were:

- Q1: How should the following actors fill this gap?
- Skilling (Data Scientist)
- Reskilling (Economist to Data Scientist)
- Upskilling (Software Engineer to Data Scientist)
- Q2: Who should pay?
  - Students
  - The technology providers
  - The final customer (Industry with the lack of skilled HR)
  - The EC/Governments
- Q3: What part should be covered by the Universities?
  - Skilling (Data Scientist)
  - Reskilling (Economist to Data Scientist)
  - Upskilling (Software Engineer to Data Scientist)
- Q4: Should it be alone or hand in hand with the industry?
- Q5: How can industry work with the tradional rigid frameworks of universities and their budgetary constraints. What kind of resources can be used?

The skills most likely to be in the demand in the future were outlined during the session, The question regarding how that knowledge should be produced provided some valuable insights:

- The solution to the problem of the lack of advanced digitally skilled people is not just about skilling. It is also about re-skilling and up-skilling, and there is a challenge in quantifying the need for each.
- Re-skilling seems to have the stronger weight given market demands, much more than we might think, this is due to the unstoppable stream of the Digital Transformation which affects all economic sectors worldwide.
- Universities are slow at changing their curricula and when they do, the approach remains very traditional and not adapted to the dynamism of the labour market needs. However, they do possess expertise and capacity, and if unexploited will only increase the ADS gap.
- Industry is most affected by the skills shortage, therefore the load and cost of skilling should be shared between Industry and Academia. The rationale for this sharing of cost is because of the expectation that academia will fill this gap including professional training, a potentially new area of focus for universities.
- Finding innovative ways in which curricula/content is dynamic and yet quality assured, will require complementary and coordinated action between Academia, SMEs and Industry. Producing the guidelines for such actions needs to occur at a European level.

5 Analysis and Recommendations

In line with the workshop discussion, in this section, we will analyse how to cover the shortage of ICT skilled people using the three different educational scenarios: skilling, upskilling and re-skilling.
The shortage of ICT skilled people, is also impacting the availability of trained academics. Skilling is the main goal of the universities who are now struggling to find candidates in the ICT sector. The main factor impacting potential recruits is most likely the lower salary levels in universities compared to industry. Therefore, the first recommendation would be:

Recommendation 1: Conduct an analysis of the impact of the ICT skilled labour shortage on university recruiting processes and develop measures to address this shortage. Proposed measures may include European programmes that supplement government-provided salaries in each country, mobility programmes to facilitate the transfer of teachers from countries with a surplus to those with a greater shortage, and other relevant initiatives. These measures aim to mitigate the impact of the shortage and ensure a more balanced distribution of skilled ICT professionals across European universities.

Industry needs more ICT graduates, but what can be done to increase the students' demand? Entertainment media is now being supported to promote European cultural and linguistic diversity and heritage, through the European Commission's Creative Europe programme, with a budget of € 2.44 billion.

Recommendation 2: Create programmes at European level to promote STEM related Entertainment media, at the same level as it is currently promoting European cultural and linguistic diversity and heritage.

The final point about skilling is related to the short cycle tertiary ICT programmes. This is precisely the type of education that is growing fastest, whilst it is about a third of Bachelor students. ICT Education suffers a paradox. In a company, the pyramid of employees is typically organized in a hierarchical

structure, with distinct levels representing various roles and responsibilities. The pyramid structure is often designed to have fewer employees at the top, representing higher-level decision-making and strategic planning. There is a larger number of employees at the bottom, representing the workforce responsible for executing those plans and tasks. The paradox for ICT education is that nobody seems to be in charge of providing the workforce for the lowest levels, i.e., those graduates from the short-cycle tertiary ICT programmes, and therefore what universities are providing is a rhombus shaped population of graduates, instead of a pyramid of skilled people.

As an example of this 'limbo' in which short-cycle tertiary ICT programmes seem to be living, let's take the Euro-Inf Framework Standards and Accreditation Criteria, developed by the European Quality Assurance Network for Informatics Education (EQANIE), and used to accredit quality of informatics degree programmes in Europe[1]. The Euro-Inf standard provides only guidelines for first cycle (bachelor) and second cycle (master) degrees, but nothing about short cycles.

The international Association of Computing Machinery together with the IEEE Computer Society also develops very well-known world-wide guidelines for first cycle ICT degrees[2], but not for short cycles. The unique institution which may be standardizing someway short-cycle tertiary ICT programmes could be the British Computer Society[3].
The next recommendation addresses skilling:

> **Recommendation 3:** Analyse the industry demand of skilled people at short-cycle level and with industry create industry standards for short-cycle tertiary ICT programmes. This information can be used to guide and help both governments and educational institutions to create a differentiated offer from the traditional Bachelor and Master programme.

The related question is, of course, who should be in charge of delivering these short courses? Research Universities and Universities of Applied Science are doing their job delivering bachelor and master level education. Their funding is already 100% devoted to that activity, and the ICT graduate's production is absorbed totally by the job market. So, if we want them to keep doing that and also to deliver short courses, they would require an extra and ring-fenced budget for this activity.

There is also another key factor: existing academic staff at universities have a different profile than the ones needed to teach short courses. They are generalist and research oriented, while the academic staff required for short courses must be more application oriented and close to the latest developments in the market.

Europe is now promoting the micro-credentials[4], which involves short-cycle education, as a way to engage universities. This interesting initiative will be subject to the same problems: a separated funding support and different faculty profile than the existing ones at the university.
We may have similar problems with regard to upskilling and re-Skilling. European universities on average, are not very responsive to the need to re-skill and upskill the adult population. The reasons

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[1] https://eqanie.eu/quality-label/

[2] https://www.acm.org/education/curricula-recommendations

[3] https://www.bcs.org/qualifications-and-certifications/higher-education-qualifications-heq/

[4] https://education.ec.europa.eu/education-levels/higher-education/micro-credentials

are the same: lack of resources and different academic profile. With regards to upskilling and re-skilling graduates, universities can contribute to these cohorts to some degree. One example at the EU level is the EIT Digital Masters School.

EIT Digital Masters programmes are mainly ICT upskilling dual degree programmes (2-years and 120 ECTS) with the requirement to study in two different countries. The curriculum includes 1 year of studies at the Entry University (60 ECTS) and 1 year of studies at the Exit University (60 ECTS). The programme curricula includes a mandatory Innovation & Entrepreneurship (I&E) minor (30 ECTS) taught over 2 years. Upon fulfilment of all degree requirements, students will receive two degrees, one from the entry University, and another from the exit University. The programmes cover fields like Autonomous Systems, Data Science, Cloud and Network Infrastructures, Embedded Systems, Human Computer Interaction and Design, Cyber Security, and Fintech.

EIT Digital provides financial support for organization and coordination tasks, tuition fee waivers, and student mobility in the masters programmes. However, due to budget limitations, there is no provision for hiring new professors. To collaborate on these masters, universities applied a simple approach. Instead of creating entirely new courses from scratch, which would require additional human resources that are already dedicated to existing degrees, they opted to design the new masters programmes by combining existing courses from other relevant master's degrees.

By selecting existing courses that align with the focus and curriculum of the new masters programme, universities could efficiently utilise existing resources. Only a few new courses were developed, and these were typically within the capacity of the university to hire new teachers or allocate the additional teaching load to existing faculty members. This approach enabled universities to introduce new masters' programmes without putting a strain on their limited resources. To our knowledge that is how European universities are also able to participate in programmes like the Erasmus Mundus Joint Masters[5] or the Digital Europe Programme[6], programmes which also target ICT upskilling and reskilling.

These types of programmes can indeed be part of the solution to address the shortage of ICT-skilled professionals. They may serve as a seed to create new ICT upskilling masters, but there is a question regarding the potential germination of the seed because these funding programmes have a defined duration. It would be worth understanding the survival rate of the Erasmus Mundus masters from the beginning of this programme onece the funding finishes.

This type of information would help us to understand to what extent these programmes achieve their goal. How many of them used that funding to seed a new master's degree that still receives students once the funding has ended? If the masters survived it means that it created a stable source of students for the university and the university is paid for that in its state funding. We tried to find this data but we could not find any information. The next recommendation will be about creating greater understanding of this topic.

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[5]   https://erasmus-plus.ec.europa.eu/opportunities/opportunities-for-organisations/cooperation-among-organisations-and-institutions/erasmus-mundus-joint-masters
[6] https://digital-strategy.ec.europa.eu/en/activities/digital-programme

Recommendation 4: Analyse the impact on universities of programmes like Erasmus Mundus, Digital Europe in terms of flow of new students, funding and academic staff. This will provide understanding of the extent to which these programmes created a stable source of students for the university, for which the university is supported by state funding.

Re-skilling individuals in ICT is a complex task for universities. Traditionally, universities have focused on offering upskilling masters that cater to individuals already with an ICT degree, as these programmes align closely with the research interests of the faculty. However, when it comes to re-skilling, which involves teaching basic and fundamental ICT concepts to individuals with a bachelor's degree but without an ICT background, it is less appealing for university professors, and it has never been the focus of the universities. There are exceptions, such as MBAs and professional masters designed for graduates from non-business or non-economic backgrounds. That is a type of re-skilling masters programme with a long tradition in the university, but it is the exception.

It is challenging to find any ICT masters in Europe specifically tailored for graduates without an ICT background (the same happens in most fields: there are no masters on mathematics for non-mathematicians, no masters on history for non-historians, etc.). This poses a significant problem as digital transformation affects industries across the board. This creates a much broader dimension e.g., the future digital tech, digital wellbeing, digital cities, digital industry, digital finance, etc. This in turn means that we need to train doctors, civil engineers, industrial engineers, economists, lawyers on ICT, and at present there are no specific programmes to meet this broader requirement.

Therefore, re-skilling would need to create masters with new courses specially tailored to that audience. ICT graduates represent 4.2% of all graduates. From the other 95.8% of graduates, there are a number of questions that will need to be answered as follows. How many need to be re-Skilled into ICT? From which programmes? Which non-ICT industrial sectors are more affected by digital transformation? What kinds of masters should be created? The actions to inform these questions are contained in the next recommendation.

Recommendation 5: Analyse firstly the industry demand for ICT re-skilling in all industry sectors under the Digital Transformation. Secondly, (and depending on the sector and students' backgrounds), design and create, with the industry, the standards for ICT re-skilling programmes, to guide and help governments and educational institutions to create a new offer of ICT re-skilling Masters.

As it has been pointed out, delivering Short-cycle tertiary ICT programmes and delivering ICT re-skilling Masters at universities would require a differentiated new academic staff workforce with a different profile, and a new allocation of core budget. The next recommendation addresses this topic.

Recommendation 6: The European Parliament should urge the national governments to allocate funds for universities that are targeted at the delivery of short-cycle tertiary ICT programmes and ICT Re-Skilling Masters. These funds should be additional to the funds currently devoted to skilling and upskilling.

Universities are not the only actors who play a role in upskilling and re-skilling. Companies are already providing this type of education, and furthermore are increasing their activities, as they have the flexibility and resources to deliver this learning to their employees. Therefore, potentially one of the possible solutions comes from coordinating actions between universities and companies.

The Centres of Vocational Excellence[7] (CoVEs) potentially provides inspiration. CoVEs are formed by networks of partners that develop local "skills ecosystems" to provide high quality vocational skills to young people and adults. CoVEs are not intended to build new VET institutions and infrastructures from scratch (although they may also do so). They can be existing vocational schools/providers that strive to achieve excellence by engaging in the set of activities proposed by this European initiative. CoVEs can also be new centres established with the purpose of providing excellent training offerings and services responsive to labour market needs. CoVEs achieve their objectives by bringing together and working closely with a set of local/regional partners. These VET providers include: higher education institutions including universities of applied sciences and polytechnics, research institutions, science parks, innovation agencies, companies, chambers and their associations, social partners, social enterprises, sectoral skills councils, professional/sector associations, national and regional authorities and development agencies, employment services, qualifications authorities, social inclusion and reintegration organisations, etc.

The concept of fostering collaboration between industry and Vocational Education and Training (VET) institutions can be expanded to include the delivery of short-cycle tertiary ICT programmes and ICT re-Skilling Masters. This proposal involves the establishment of "Centres for Professional Excellence" as specialised entities within universities or universities of applied science. These centres would be solely dedicated to providing short-cycle tertiary ICT programmes and ICT re-skilling Masters programmes, aligning closely with the rapidly evolving technology and labour market. While the foundational ideas of universities of applied science share some similarities with this concept, the proposed approach represents a new and innovative concept.

These kinds of centres must have the following typical characteristics:

- Have a different and separated budget from the other university centres and schools.
- Its regulations, especially regarding the contracting, must have the same flexibility as a company. This will allow to adapt the human resources very rapidly to technology changes
- Teaching staff must be composed of three profiles:
    o Experienced professionals with extensive knowledge of their respective fields, hired in part time.
    o Companies extending their current ICT upskilling and reskilling activities to an earlier stage: the prospective employees
    o Academics ensuring the quality of the education

The "Centres for Professional Excellence" would serve as a catalyst to foster collaboration between universities and companies, enabling a focused and concerted effort to optimize and share resources. As an example of the type of degrees that these centres could offer, we have the Master in ICT Consultancy currently being offered at Universidad Politécnica de Madrid. This degree was specifically requested by the Spanish Association of Consultancy Firms to address the market need

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[7] https://erasmus-plus.ec.europa.eu/programme-guide/part-b/key-action-2/centres-vocational-excellence

for re-skilling engineers. The program spans 60 ECTS and is scheduled for Friday afternoons and Saturdays to accommodate working professionals. The teaching staff consists of 70% professionals from the association, ensuring a wealth of practical industry experience. The budget for the program is independent of the university's core budget and is primarily funded through fees and support from the association. With its targeted approach, separate budget, and industry-experienced faculty, the Master in ICT Consultancy exemplifies the features necessary to effectively meet specific market demands and facilitate the re-skilling of professionals.

These centres will also allow:
-   Universities to include modules and courses from these degrees in their elective or extracurricular portfolio of their Skilling degrees.
-   Companies to have access to talent an early stage.

Furthermore, since these centres will primarily concentrate on short-term tertiary ICT programmes and ICT re-skilling Masters, which serve as complementary rather than competing forms of education alongside the skilling and upskilling programmes offered by universities, we will mitigate any resistance from university faculty and staff to integrate this education into their existing programmes and structures.

The idea of these "Centres for Professional Excellence" is totally aligned with the Digital plenitude scenario, described in the report "The Future of Education for Digital Skills" of EIT Digital[8] as the best scenario to fill the gap of ICT professionals. This scenario is described as:
•   Public sector offering, through governance reforms and more investment, becomes more responsive, flexible, and dynamically adaptive to the changing technologies and related labour market needs.
•   Universities abandon the traditional and rigid definition of curricula to add more adaptive and dynamic short courses and master's in all domains of Key Enabling Technologies (KETs).
•   The opportunities for partnerships *(of companies)* with public institutions increase, which in turns help universities, to be more innovative and dynamic and offer new courses for the adult population.

Therefore, this will be our last recommendation:

Recommendation 7: To urge the countries to create "Centres for Professional Excellence", as specialised and independent centres within universities or universities of applied science totally devoted to deliver short-cycle tertiary ICT programmes and ICT re-skilling Masters in conjunction with companies.

One final word about initiatives like EIT Deep Tech Talent Initiative[9]. It is a pioneering programme led by the European Institute of Technology and Innovation (EIT) that will skill one million people within deep tech fields over the next three years. Its target audience is:

•   Pupils, especially young women, in secondary education with an interest in deep tech.
•   Students of Higher Education with a need for more specialised training in deep tech; and

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[8]   https://www.eitdigital.eu/fileadmin/2022/ecosystem/makers-shapers/reports/EIT-Digital_Report_The-Future-of-Education-for-Digital-Skills.pdf
[9] https://www.eitdeeptechtalent.eu/

- Adult Learners in companies and on the job market who need additional skills in deep tech.

This will be supported thought the creation of a platform where:

- Education and training institutions offer educational and training courses
- Enterprises that are using or developing deep tech offer in-company training, mentoring, open innovation competitions, and other means of support

We acknowledge that initiatives of this nature can complement the regulated and coordinated ones we are proposing. We believe that the issue should be tackled with a mainstream solution by integrating short-term training programmes and reskilling degrees into the standard offerings of higher education institutions. This approach should involve active participation from governments in terms of planning, support, and considering these additional initiatives as supplementary measures.

As can be seen from all these recommendations **policy makers** play a key role, as they set the regulation and funding needed to enable implementation and provide ongoing support. Other actors like training providers and companies will also be essential to articulate and put these initiatives into practice.