
LEADS WP 3 WORKSHOP SUMMARY: BEST PRACTICES FOR ALIGNING HIGHER EDUCATION CURRICULA TO ADS DYNAMIC DEMAND

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1. Topic Introduction and Motivation

The Leading European Advanced Digital Skills (LEADS) program aims to provide insights into the changing advanced digital skills (ADS) demands within a dynamic technological development context. It also aims to provide insights, in the context of current digital transformation, on how best to equip skills suppliers (education and training) with the knowledge, guidance and best practices to shape the future of European ADS talent.

WP 3: “Ecosystem Formation” aims to iteratively develop a series of practical guidelines for addressing the current and future supply of ADS whilst addressing the challenges of working to achieve the optimum contexts.

The workshop “BEST PRACTICES FOR ALIGNING HIGHER EDUCATION CURRICULA TO ADS DYNAMIC DEMAND” was the first workshop organized in WP 3. The aim of the workshop was to discuss possible strategies for aligning curricula to dynamic demand in the context of higher education. The main objectives of the workshop were as follows:

- To gather and discuss the problems that the lack of updated ADS creates for industry in the context of inadequate supply of employees with ADS skills.
- To gather insights into how higher education institutions, (HEI) can integrate the needs of industry specialized skills in the design of their programs.
- To gather and discuss the position of formal education providers regarding the inclusion of ADS in their programs. This includes the cons, pros, barriers and to understand the difficulties faced by third level education when trying to integrate ADS into their program offerings.
- Outline some tentative solutions or lessons learnt from existing experiences to bridge that gap.

This document summarises the workshop content as well as the main findings and recommendations derived from the event. Section 2 presents the workshop structure and a brief description of the invited speakers. Section 3 details the discussions held during the event paying special attention to the debate guided through a set of questions raised by the moderator. The rest of the sections focus on the workshop results from different perspectives. Section 4 discusses potential implications of such results due to different skills or industry sectors, while Section 5 summarizes the main challenges identified in the universities and industry alignment. Finally, Section 6 summarizes the main recommendations categorized according to their target, that is, education providers (universities and vocational training), policy makers and industry.

2. Workshop Implementation

2.1. Workshop structure

The workshop took place on 27 March 2023, 13:00-14:30 in an online format. It was organised by Universidad Politécnica de Madrid (UPM) and Trinity College Dublin (TCD). In particular, the organisers were Ernestina Menasalvas (UPM) and Laurent Muzellec (Trinity College Dublin).

There were approximately 30 attendees from different backgrounds (industry, academia and consulting), and 55% of those present were academics.

The agenda of the meeting is presented in Table 1.

27 TH MARCH, 2023		BEST PRACTICES FOR ALIGNING HIGHER EDUCATION CURRICULA	
13:00	5 min	Welcome	Ernestina Menasalvas (UPM)
13:05	5 min	LeADS context	Brendan Rowan (BLUSpec)
13:15	10 min	An overview of ADS	Leonardo Leonardo Freitas (IDC)
13:25	30 min	Round Table	Spekers
13:55	30 min	Discussion	Audience
13:25	5 min	Conclusions (Wrap-up and Key Take-Away)	Laurent Muzellec (TCD)
END OF MEETING			

Table 1. Workshop agenda

2.2. Speakers

Three invited speakers participated in the workshop. These were chosen to cover the main stakeholders connected to the aims of the workshop, i.e. industry, academy and consulting. Below, there is a brief description of each of the speakers.

Gonzalo Gómez-Lardies, INETUM

Gonzalo has seventeen years of professional experience in corporate strategy, consulting, and business development, all from a technological perspective. In 2020 he assumed the role of

Inetum Group Chief Marketing Officer. In this role he analyses the 27 EU countries market trends in a global context and helps business and industry sectors with their go-to-market strategies.

He also has experience in academia, where he was responsible for the Digital Banking & Fintech Expert programme at the International University of La Rioja.

Kieran McCorry, MICROSOFT

Kieran is Microsoft's National Technology Officer in Ireland and has worked in the technology industry for more than 30 years. He works in multiple sectors of the technology landscape, including analytics, the Internet of Things, AI, cyber security, and quantum computing, as well as others like innovation, digital transformation, or collaboration.

He belongs to several industry boards and government forums, focused on technology skills development and strategic planning.

Prof. Dr. Juan José Moreno-Navarro, UPM

Juan Jose Moreno-Navarro is a full professor in the Computer Science department at the UPM, as well as senior researcher at IMDEA-Software (Madrid Research Institute in Software Development Technologies).

He has a long research trajectory, which has been combined with extensive work in policy creation from 2008, where, among other roles, he has been General Director of Planning and Coordination (Ministry of Science and Innovation), General Director of University Policy (Ministry of Education). He has also been vice-rector of digitalisation, and Academic Planning and doctorate studies at the UPM.

3. Outline of the Workshop

3.1. Leads Project Presentation

Brendan Rowan presented the project to the audience. In his presentation he mapped the future demand of ADS, with a strong basis on tech trends and tech options. The initial results of the project (presented later) illustrate the critical ADS demands of industry. The analysis highlights the importance of effective learning programmes where opportunities are created for collaboration between industry and academia. In doing so, allowing for retaining and receiving talented students, and supporting the industry to identify where it is best to invest. The project should provide guidelines in real time, ensuring that it is practised in that way.

3.2. An overview of ADS

Leonardo Freitas presented the framework of skills and job roles related to ADS which has been created by WP1: Skills Profiling. WP1 identifies 80 different skills from a forecast and demand analysis in different layers and areas. In particular, those skills are distributed in five skills areas

and 29 skills pockets. The skills areas identified are: Artificial Intelligence (AI), Business intelligence, Cloud computing, Security technology and Internet of Things (IoT). The slides presented during the workshop show the full details.

3.3. Round table

After the presentation of the project and the first results, the round table began. The main ideas discussed by each of the invited speakers are discussed below.

Gonzalo Gómez Lardies, INETUM

Gonzalo focused on the Consulting sector, showing some relevant data, especially for Spain:

- more than 230,000 professionals, showing an annual increase of 12%,
- 30% of them with a university degree, most of them (70% men, 59% women) from STEM areas,
- 30% of them under the age of 25, when the young unemployment in Spain is very high,
- investment of around 80 million euros in training of employees, with consistent increments year by year,
- the analysis of required skills focusses on soft skills (e.g., capacity of learning, teamwork, being customer and resource orientated) with a relatively small gap between the required skills and those shown by candidates. He concluded that HEI could assist in the preparation on them, and they have experiences in collaboration of industry with educational institutions on these topics,
- the importance of technologies is expected to increase in the near future, especially in those areas identified by the project. This means important investment in research and innovation (around 800 million euros in 2021).

Kieran McCorry, Microsoft Ireland

Kieran introduced Microsoft in Ireland and provided a comprehensive overview of the role of the Irish operation: 2,200 employees of different nationalities, main division for Global sales and marketing, operations and corporate centre, digital sales, engineering group - the European Development Centre - a large data centre, plus around 2,500 additional employees in LinkedIn, creating an important and unique footprint in Ireland. In particular, they have several programs that are focused on societal impact.

He described the types of skills that Microsoft Ireland wants to encourage and are needed in the market, not just for Microsoft, but also amongst partners and customers, i.e., developing skills in the ecosystem. The technical skills are focused on areas such as artificial intelligence, cyber security, quantum computing, and data science. In all of them, the demand can be characterised as advanced skills, but there are also a demand for broad skills on sustainability, and the notion of low code, no code platforms, where a STEM degree is neither needed.

Microsoft is very focused on a range of sponsorship programmes in Ireland. Between 80 and 100 Ph.D. Students are funded at different academic institutions, mainly focused on the advanced technic skills already mentioned, especially AI, cyber, and data science.

But Microsoft is also aims to promote other types of training with higher education organisations and vocational training, for example, in cyber security. He described how Microsoft have created

programmes that seek to create talent pools from non-standard backgrounds, e.g., people from disadvantaged backgrounds or those outside the working environment for some time, who want to return to the workforce. In these cases, a technology background is not necessary, but equally important are innovative and creative characteristics.

Juan José Moreno-Navarro, UPM

To illustrate the problem and being a bit provocative, a comparison of the contents of the degrees in Chemistry and Computer Science (CS) 30 years ago with the current one was presented. Although chemistry shows some minor additions (nuclear chemistry, spectroscopy, chromatography, and polymers), in the case of CS the magnitude of changes is colossal, either in the number of topics (new elements includes logic, object orientation, neural networks, ethics, human computer Interaction, security, service-oriented systems, nanotechnology, semantic web, scientific computation, HPC, robotics, data warehouse, image processing, biometry, scalable systems) and in the particular contents (e.g., the changes on the programming languages used). The same results are observed when comparing CS with other areas such as physics, history, or economics.

He commented that although Universities are wonderful in many aspects, they sometimes are late in incorporating changes; they usually do them in a very consistent way, but maybe late. The university is an institution with centuries of history. This means that universities and university systems have adapted to an incredible number of changes. There is no doubt that they will adapt to the needs of the society they serve. However, as a large institution, moving them to new directions requires some effort and decisions.

To allow for the agility needed in advanced digital skills, Juan José highlighted some significant barriers to solve. If we look at the missions of universities, namely education, research, and technology transfer (or third mission, in general), there are barriers on all of them.

The accreditation of new degrees requires some bureaucracy: approval in the department, then in the university council, the accreditation agency evaluation, and some formal steps until the degree is formally approved by the government. Although there may be changes from one country to another, it is not an agile process, usually taking more than one year. Even updating an existing degree-modifying subject could require formal approval.

Non-formal courses could overcome some of these problems (agility in the offer, capacity to include external staff and professors, non-standard calendar, timetables, etc.). Although formal courses encourage confidence in the degree and improve mobility throughout Europe, non-formal studies usually have a faster implementation. In some countries, it is possible to have accreditation of non-formal courses, offering the best of both worlds.

3.4. Debate

The debate was moderated by Laurent Muzellec through several questions that we discuss above.

3.4.1. What are the difficulties of recruiting and fulfilling jobs related to advanced digital skills and how is this potential gap managed?

This question was mainly posted to the industry and consulting side of the audience.

Kieran McCorry focused on the Irish cyber security market. Cyber security jobs are probably running at 80% of capacity. This creates a shortage of 20% of people that is required creating a huge challenge for many companies. In terms of what academia delivers, he observed a disconnect between what industry needs and what academia is offering, although not a huge one. Finding people with a good general degree in computer science is relatively easy and but it is more difficult when specialised training is needed and there are few M.Sc. Programmes in cyber security or data science, for example.

Leonardo Freitas, in the chat, commented that LeADS is preparing a survey to answer some of these questions on the attraction of workforce in these areas (difficulty of recruitment, efforts to make sure companies are providing candidates with the right opportunities despite disabilities, and if there is enough interest from current professionals to be reskilled) and establish ways to make the ICT sector more attractive to future professionals.

3.4.2. How adequate are the master programmes or short credited programmes in ADS, and the type of institution partnering to address this problem?

For this question, *Kieran McCorry* explained that Microsoft focuses on vocational training. They also fund post-graduate programmes as well as certificate programmes for graduate and undergraduate. These are more practically focused than theoretically focused, e.g. in AI or data science. The cost of entry for those programmes is more achievable, both in financial terms (with some help from the Irish Government) and academic background and gives more flexibility for employees and the company.

Leonardo Freitas comments on the lack of planning in companies behind acquiring those skills, mentioning a study that shows that only very few companies are doing a mapping of what future requirements for recruitment and for upskilling right. These could produce future bottlenecks and exclude a structured demand for training. He emphasised the importance of communication between the business side and other stakeholders, including governments, in order to form education policies. This is also an additional goal of the LEADS project, a first mapping to create awareness of, or at least given north to, different stakeholders. As most speakers, he recognises the importance of soft skills.

Gonzalo Gómez discussed the relationship between academia and the enterprise, concluding that there is not a large mismatch but there is room for improvement. The existing mismatch is double: one is the qualitative, when the capabilities are not exactly as they need from the companies. The

second is quantitative, with the difficulties of acquiring the talent needed and with significant competition between the companies.

He focused on the lack of interaction between academia and enterprise in two aspects: the co-operation needed to evaluate the adaptation of students to a company (knowledge, soft skills, ...) and the collaboration in curricula and particular subjects. He also mentioned his experience in the co-operation in a master course as part time professor, covering the gap between the technical perspective with the point of view of enterprises and customers.

Inetum has a strong level of co-operation with universities (significantly with UPM but also with another 9 universities) with several programmes (industrial chairs, co -labs, awards, courses and outreach sessions, internships – even with Secondary School-, etc.) that help, among other things, to create awareness of the best talent. This co-operation could serve as an example for other companies.

Gonzalo also reflected on trends at this specific moment. Today, the trending topic is ChatGPT, and all clients want to incorporate it into projects, but a couple of years ago the trending topic was blockchain. In every period of time, there is something pretty new that we need to incorporate and for doing this we need to be closer to innovation technology.

The mention of ChatGPT and open AI provoked some comments among the attendees. Kieran expressed his conviction about the importance and impact of these technologies in the future, giving rise to new skills, of which there is a huge lack of supply. He gave the example of Prompt Engineering, a completely new technical skill, and a challenge in the industry. But, at the same time, he advised about the ephemeral nature that these skills can have, giving the example of blockchain. *Gonzalo* corroborates this opinion about the drop in interest in blockchain and the consolidated emergence of open AI.

3.4.3. Which framework should be used for a better collaboration between industry and academia?

Laurent Muzellec came back to the topic of industry and academics and the alternative of needing more skills in some areas and more people with ADS. He asked directly the third speaker about the framework for working together industry and academy.

Juan José Moreno-Navarro recalled the assertion that companies are not planning for the future, and the same can be applied to universities. CS University departments need to strategically design their research, technology transfer, and industrial co-operation to cover a significant number of emerging topics and to improve their course offerings.

Juan José directly suggested: Be strategic! Technologies evolve, we face a dynamic demand, and a long-term Strategic Plan is needed. The goals to fulfil should be complex and probably cannot be achieved by the universities themselves, and cooperation with other stakeholders is needed: companies, research centres, administration, etc.

The sources to develop and update such plans should come from many places, but one of them should be cooperation with industry. The plan could be supervised by an Advisory Board with membership from companies with whom the universities co-operate. But it is the correct order, an advisory board advises about something, the university planning, in order to develop, modify, update, and evaluate it.

Ideally, collaboration with industry should go from partnership in projects to medium- or long-term agreements. These allow us to be aware of new advances and demands from research, technology transfer, innovation, and market demands. All of which can be used to identify ADSs to be included in the educational offer.

The strategic plan must also establish a hiring policy, prioritising the inclusion of experts in advanced areas where there is not enough internal expertise. Universities could also create some additional positions for these new needs, some of them coming from external partners and companies.

Laurent Muzellec came back to the problem of being sure that an emerging skill will consolidate in the future (blockchain, prompt engineering) and the availability of people with enough digital skills.

3.4.4. Which strategies can be used to attract students to STEM related degrees?

Simona Ramanauskaitė and *Eugenia Kyriotis* used the chat to put on the table the problem of student attraction to STEM (Science, Technology, Engineering, and Mathematics) areas. So, this was the next question addressed in the workshop.

Kieran McCorry mentioned the Microsoft proposal to increase the quantity rather than the quality of the students in Ireland in the last 5 years, by working not just in secondary school, but in primary school level from age 4 plus right up to their late teenage years. Therefore, giving them an opportunity to see and learn about the world of STEM and science and technology. Microsoft premises include a learning centre that receives two classes from schools every day, a primary school class in the morning, and a post-primary school class in the afternoon, with three full-time school teachers. It is complemented by Dream space TV and a whole set of programmes developed for teacher education on STEM. Around 500,000 school children in Ireland have been engaged and a significant number of teachers. The plan for the next years targets one million of school children and to franchise this model out across other Microsoft subsidiaries, given the success of the experience.

Outi Ahonen, in the chat, mentioned a health care sector project to ask if the LeADS project will handle the level of multidisciplinary groups and skills to understand new health technology and how many engineers are needed to develop suitable technology for health care. *Leonardo Freitas*, in the chat, answered that LeADS is not measuring the level of proficiency for the skills due to the limited time frame, but plans to do an estimation of the number of professionals needing to acquire such skills.

3.5. Conclusion

The seminar concluded with the organisers thanking all participants and encouraging them to be aware and participate in other activities of the project.

4. Relevant Advanced Digital Skills and Sectors

During the workshop, many references to particular sectors and ADS were posed, but there was too much evidence of differences in the previous questions. However, the goal of the seminar does not include this level of details in the analysis, and conclusion about these facts will be postponed for next events.

5. Challenges and Constraints

This section summarises some of the main challenges identified from the workshop for universities to dynamically adapt to ADS.

5.1. University Offer

The university is an institution with centuries of life, and the university systems have adapted to a significant number of changes. In the future, they will continue to adapt to the needs of the society they serve and, therefore, to the ADS demands. As a large institution, moving them to new directions requires some effort and decisions, facing barriers in all university missions: education, research, and technology transfer (or third mission in general).

Accreditation of new degrees requires some bureaucracy: approval in the department, later in the university council, evaluation of the accreditation agency, and some formal steps until the degree is formally approved by the government. It could change from one country to the other, but it is not an agile process in any case, usually taking more than one year. Even the updating of an existing degree-modifying subject could require formal approval.

There is an important challenge related to the lack of university teachers who are experts in ADS, and consequently can provide proper training. Regarding research and technology transfer, it is a must that all University professors need to develop adequate research. Otherwise they are facing the risk of being outdated and, consequently, the degrees they are involved in will also be outdated, if such research is not directly involved with ADS.

Usually, professor positions are restricted to those with an academic career, including a PhD, a good research record, mobility, and so on. In most countries there is room for part-time professors with industrial experience. However, there are some restrictions, for instance, they cannot be responsible of a subject and must share it with a professor or there may be limits on the number of such positions. These part-time professors are essential in areas like engineering or health. Very often external experts to universities have a lot of limitations when teaching formal degrees.

The university structure, with public servants in many cases, precludes the organisation of activities and courses after hours.

And an additional serious problem is related to the lack of STEM vocations, especially for women.

5.2. Faculty

In general, finding adequate personnel in companies, university faculty, and vocational training professors on ADS is a recognised problem. The competition for talent, including universities, is very high. The problem is significantly worse in vocational training institutions.

For these talented experts, the competition with salaries is tough. It is noted that university and vocational training professors in several countries are civil servants, and the salary is fixed. The only way to overcome this situation is to use salaries complements when participating in research projects with industry.

5.3. Collaboration

Co-operation is crucial in all university activities (education, research, and technology transfer). Co-operation has shown excellent results for companies that can be helped by universities and research centres in their innovation policies. Although there are usually many programs for public/private cooperation in research and technology transfer, less effort has been made in co-operation in educational activities.

The experiences in join study programmes in Europe are very successful (in particular, Erasmus Mundus, but there are also some additional examples). Many European initiatives have significantly promoted the collaboration between industry and higher education institutions; for example, the European Institute of Innovation & Technology EIT (in particular, EIT Digital¹ for the IT sector) and the European Universities initiative². However, the effective impact of these initiatives in the European productive section is still limited.

6. Recommendations

Below we present some of the action points derived from the workshop, either gathered directly from the speaker's presentation or through the debate.

¹ <https://www.eitdigital.eu/>

² <https://education.ec.europa.eu/education-levels/higher-education/european-universities-initiative>

6.1. Education providers

6.1.1. Higher Education Institutions

In this section we summarise the most relevant recommendations directly related to HEI. Notice that with the exception of the last recommendation, they are directly related to the aim of the workshop, how HEI can dynamically adapt to ADS industry demand. The last recommendation presents a more general issue related to the problem of the lack of ADS workforce.

- **Develop a university strategy**: CS University departments need to strategically design their research, technology transfer, and industrial cooperation to cover a significant number of emerging topics and to be prepared for adequate course offer. In order to develop, modify, update, and evaluate this Strategic Plan, an advisory board could be very useful.
- **Provide formal and non-formal training on ADS**: The European Higher Education Space (aka Bologna reform) designs general bachelor's degrees and specialised master's degrees to include advanced skills, so specific bachelor's degrees are also not generally recommended or even considered risky for students. Therefore, in order to implement a course in some of the advanced skills, the two possible mechanisms are a formal master or a non-formal course. Both have pros and cons. Formal courses encourage confidence in the degree and improve mobility along Europe. Non-formal studies usually have faster implementation and easier completion with external experts as teaching staff and implemented by nonstandard calendar and timetable. In some countries, it is possible to have accreditation for non-formal courses.
- **Use mechanism that allow agile changes in the curricula**: Formal degrees are less agile in reacting to changes. It can be improved by an adequate use of optional subjects, seminars, and broad subjects. Probably it is also necessary to be imaginative on the course organisation: breaking the 9 to 5 / classroom standard, to afternoon and weekend courses, summer courses, hybrid/blended courses (online lectures plus late classroom lectures), courses in cooperation with companies, research institutions, other universities, vocational education centres, ...
- **Prepare the university offer for a life-long learning process**. Universities must not only focus on young students but in accompanying them along their careers, which, in many cases, implies a deep transformation.
- **Promote training the trainers**, for examples through incentives for professors deeply involved in research and training in ADS.
- **Promote STEM areas**: Additional efforts should be made for programs and campaigns to attract more students to IT topics, especially female students. These actions should not be restricted to bachelor students, covering from primary school to vocational training.

6.1.2. Vocational Educational Training

Even when VET providers were not the focus of the workshop, we got an interesting recommendation that we consider worth to record.

- **Increase agility of VET processes**. Most job need, can and must be covered for vocational training. Some additional efforts must be done at this step in VET education that shares many

barriers with universities (lack of agility, bureaucracy, difficulty for finding adequate staff, etc.) even with less autonomy than HEI.

6.2. Policy Makers

By policy makers in this context, we mean governmental agencies, education ministries representatives or other actors which a relevant role of HEI regulation and policies. The recommendations gathered in the workshop in this context are the following:

- **Improve the agility of the curricula accreditation process.** The Bologna reform grants universities academic freedom and institutional autonomy with the condition to have accountability, transparency, and quality assurance. Accreditation agencies are playing a significant role in this role, so they are responsible for ensuring the quality of university degrees. In general, they should help to assess the adequacy of degree content and skills with society needs. Unfortunately, sometimes they are a bottleneck for the agile creation or updating of degrees. In general, they could be more confident in highly reputable universities.
- **Improve the agility of the teacher's accreditation process.** Accreditation agencies and governing rules need to be more flexible in the teaching staff requirements and certification process because experts (whenever they come) are always welcome.
- **Adapt the hiring process** making it easier for universities to create specific positions prioritising the hiring of experts in advanced areas where there is not enough internal expertise. Universities should be allowed to create some specific positions for these new needs, with experts either from industry or from other foreign HEI. However, the need to be updated to emerging topics is a responsibility of individual professors.
- **Promote inter-university graduate and post-graduate official degrees.** The Strategic Plan, already mentioned, should identify the emerging topic where each university wants to be active. There is no mandatory requirement for a particular University to cover in-depth all emerging topics and instead, could specialise to do research and teach good programs on a restricted number of topics. Policies should exist that promote collaboration among HEI for ensuring adequate cover in a particular area, taking advantage of the expertise in all universities in the area. European programs could help in this task.
- **Promote training through official or well recognized training providers,** either by official programs or micro-credentials. Isolated online courses are not a global solution, due to the disconnect with other subjects, lack of confidence and practical components, quality assurance, etc.
- **Promote the generation of a body of knowledge of successful practices.** Cooperate with existing institutions and associations for extending best practises (e.g., European Association of Universities, Informatics Europe, Industrial associations, etc.).

6.3. Industry

During the workshop the role of industry in this process also came to the arena. In particular we record two recommendations, the first one very relevant to help HEI's to be more dynamic.

- **Create a skills strategic plan.** Promote the creation of a strategic plan with future requirements for recruitment and for upskilling. This plan should be useful not only for industry purposes but could guide training providers in their own strategic plans.
- **Consider hiring graduate student in other areas than CS,** for very specific jobs. Due to the lack of workforce for specific technical jobs, industry might consider hiring and training other professionals with specific characteristics and soft skills.