SUMMARY RECOMMENDATIONS

Consolidated recommendations for the development of Advanced Digital Skills in Europe

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1 INTRODUCTION

1.1 Purpose

Leading Europe's Advanced Digital Skills (LEADS) has been exploring and defining the challenges and opportunities for the development of Advanced Digital Skills within the European context. Over a period of 20 months, the consortium has partaken in a data-led study to understand current and future demand horizons, a measure of the existing state of supply, the coordination of the ADS portfolio of funded initiatives under the DIGITAL Programme and an extensive workshop series with stakeholders from industry, higher education, VET, policy and technology developers.

The question related to Advanced Digital Skills is a complex and multilayered, and the varied conversations and discussions held by the respective partners has been highly rich and dense in nature. For this reason, we sought to provide an actionable distillation of the main recommendations as a set of calls-to-action.

Detailed data sources and discussion of each of the recommendations found here within can be sourced through the formal deliverables and reports provided by the project, which includes, among other publications:

- D1.3 Final ADS Demand and Forecast Report
- D2.2 LEADS Gap Analysis
- D3.2 Final Guidelines Report
- D4.3 SPECIALISED Impact Assessment and Recommendations

The views and opinions expressed within this document are expressly that of the LEADS consortium and do not in any way those of the European Commission nor that of the European Health and Digital Executive Agency.

1.2 Advanced Digital Skills and the DIGITAL Programme

The Digital Europe Programme (DIGITAL) (2021-2027) is an EU funding programme focused on bringing digital technology to businesses, citizens and public administrations. It provides strategic funding to answer these challenges, supporting projects in key capacity areas such as: supercomputing, artificial intelligence, cybersecurity, advanced digital skills, and ensuring a wide use of digital technologies across the economy and society. With an overall budget of over EUR 7.9 billion, DIGITAL aims to shape the digital transformation of Europe's society & economy. The DIGITAL Programme also has five interrelated specific objectives:

- Specific Objective 1 – High Performance Computing
- Specific Objective 2 – Artificial Intelligence
- Specific Objective 3 – Cybersecurity and Trust
- Specific Objective 4 – Advanced Digital Skills
- Specific Objective 5 – Deployment & Best Use of Digital Capacity & Interoperability

These align particularly with the digital ambitions for 2030 for the EU, as outlined in the Digital Compass developed under the Digital Decade Strategy which includes the ambitious target for reaching 20 million ICT Specialists employed in the EU by 2030 with greater gender convergence.

LEADS is funded in the context of the Strategic Objective 4 (SO4) of the Digital Decade, in relation to skills. It was a Coordination and Support Action tasked with providing data, analysis, foresight and guidance on the demands for advanced digital skills across Europe by the end of the decade to support the definition of Advanced Digital Skills actions to be funded under the Digital Europe Programme. It aims to reduce the cycle between tech development and skills development to accelerate adoption by

providing tech adoption trends, mapping existing offerings and exploring leading methods and approaches for tackling the large challenge affecting all sectors and organisations within the EU.

To achieve this, it performed a market data-driven analysis of demands based on tracking of over 200 use cases in advanced digital skills, cross-referenced with exsiting course availability, combined with expert stakeholder engagement across several workshops, events and round-tables.

The wider cluster of actions considered under the SO4 umbrella includes:[1]

- 24 Higher education programme design and deployment actions
- 12 Short-term training course design and delivery actions
- 2 Training platform development projects
- 4 Coordination and Support Actions

1.3 Defined populations and structuring of ADS demands

Across the LEADS initiative, the whole consortium has been tasked with providing data, knowledge, and insights on the need for the EU to reach the target of 20 million ICT Specialists employed in the EU by 2030.[2]

Within the scope of investigation has been the defined purpose of the DIGITAL Programme[3] is to "*to support and accelerate the digital transformation of the European economy, industry and society, to bring its benefits to citizens, public administrations and businesses across the Union, and to improve the competitiveness of Europe in the global digital economy while contributing to bridging the digital divide across the Union and reinforcing the Union's strategic autonomy, through holistic, cross-sectoral and cross-border support and a stronger Union contribution*."

Specifically, under Advanced Digital Skills the objective is for the:

"Development of advanced digital skills in areas covered by the Programme in order to contribute to increasing Europe's talent pool, bridge the digital divide and foster greater professionalism, especially with regard to high performance and cloud computing, big data analytics, cybersecurity, distributed ledger technologies (e.g. blockchain), quantum technologies, robotics, AI, while taking gender balance into account."

This leads to the first question, given the emphasis on developing the competitiveness of Europe's digital value chains, what talent is it that we are developing – across the discussions the definition of ICT Specialists is moderately defined while Advanced Digital Skills remains subjective in nature and the elucidation of which populations are we seeking to develop.

ICT Specialists are defined as persons who have the ability to develop, operate and maintain ICT systems and those that ICTs constitute the main part of their job (OECD, 2004). Apart from that, the OECD indicates that ICT task-intensive jobs including both ICT specialists4 and ICT users5, in line with

[1] For a full overview, please refer to the ADS Cluster Brochure here:

[2] Europe's Digital Decade: digital targets for 2030 – European Commission

[3] Regulation (EU) 2021/694 of the European Parliament and of the Council of 29 April 2021 establishing the Digital Europe Programme and repealing Decision (EU) 2015/2240

[4] ICT specialist occupations are identified by three-digit classes of the 2008 revision of the International Standard Classification of Occupations (ISCO-08): Information and communications technology service managers (133), Electrotechnology engineers (215), Software and applications developers and analysts (251), Database and network professionals (252), Information and communications technology operations and user support (351), Telecommunications and broadcasting technicians (352) and Electronics and telecommunications installers and repairers (742).

[5] ICT user occupations include the following ISCO-08 classes: Business services and administration managers (121); Sales, marketing and development managers (122); Professional services managers (134); Physical and earth science professionals (211); Architects, planners, surveyors and designers (216); University and higher education teachers (231); Finance professionals (241); Administration professionals (242) and Sales, marketing and public relations professionals (243).

the early findings of the LEADS project that ICT-intensive occupations are composed by both specialists and users. From the extensive activities, the following profiles have been identified that can serve to support actions and policies, and provide the structure for discussions and research into the topic:

GROUP A – INVENTORS AND CREATORS OF NEXT-GENERATION AND NOVEL ADVANCED DIGITAL TECHNOLOGIES

Refers to those researchers both in research institutions and companies that are at the forefront of the knowledge of digital technologies and their development. These tend to have progressed through an academic pathway having achieved a PhD qualification and continued in the research field with ongoing work in development of key enabling technologies.

This group is out of scope for the DIGITAL Programme but is nonetheless critical for the future competitiveness of European industry and innovation ecosystem and the development of future apex talent profiles.

Examples include: LLM Developers, HPC Architects, R&D Directors.

GROUP B – ICT SPECIALISTS – DEEP SYSTEM KNOWLEDGE EXPERTS

The first group of ICT Specialists are those with deep knowledge and experience in the design and development of platforms and solutions. They are professionals who are responsible for the implementation of systems and architectures and can provide maintenance, revision and solution of problems through their combined application of theoretical expertise and practical skills.

Examples include: Software Architects, Computer Scientists, AI Engineers, ML Engineers, Data Scientists (model designers)

GROUP C – ICT EXPERTS - SYSTEMS USERS AND APPLICATION DEVELOPERS

This group refers to the advanced users of the platforms and tools that require development and a level of knowledge of systems, languages and solutions. These ICT Experts are those roles that build solutions and applications to solve a defined challenge or need from a domain expert.

Examples include: Software Developers, Cloud Application Developers, Cloud Solution Architects, AI Application Developers, Security Analyst, Data Scientists (model users/execu).

GROUP D – ADVANCED DIGITAL TOOLS USERS

As advanced digital technologies mature and the tools become more user-friendly with non-specialist skills required for their use through adapted interfaces, there is a class of experts who will need the skills to apply them to their current functions. Examples include low-code or no-code platforms or the recent incursion of ChatGPT.

The value of the domain expertise, which combines industry knowledge, experience and value chain expertise, will become a driver of productive advanced digital technology adoption. These domain experts are able to critically evaluate the results of automated systems and interpret data analysis provided to accept or reject outputs from systems. They need to remain at the forefront of tools and technologies that can assist their role transformation and have a clear understanding of how specific technologies work, their limitations and opportunities.

They also play a key role in the development of novel solutions and require the capacity to direct or engage with ICT Experts or ICT Specialists to support application development.

Examples may include: Supply Chain Analysts, Manufacturing Supervisors, Hedge Fund Managers, and Compliance Officers.

2 HIGH-LEVEL VIEW ON THE ADS CHALLENGE

Brendan Rowan, Managing Consultant - Tech, Policy, and Skills, BluSpecs

Across the engagement with hundreds of stakeholders, organisation of dozens of roundtables, workshops and events, participation in high-level forums and the in-depth analysis of key data, the LEADS consortium, and by extension the ADS SO4 Cluster of the DIGITAL Programme have identified the following key messages in relation to the stimulation of the supply of ICT Specialists and advanced digital talent.

CHANGE IS THE NEW STATUS QUO – THE ERA OF FLEXIBILITY AND ADAPTABILITY.

The rate of change of technology development and deployment is in an accelerated state and there are few indications that this will slow over the next decade. This translates to a required state of readiness for European society to navigate novel technology irruptions and the capacity to adapt to new changes in supply chains and global competition. No actor can be fully ahead of trends and developments but our labour force, our companies and our education and training institutions can be in the best placed position to adapt and respond.

THERE IS NO SILVER BULLET – ADS REQUIRES MANY ROUTES AND PATHS

The area of advanced digital skills and digital skills in general can be considered a 'wicked problem' in that it holds much complexity, is a moving target and is dependent on the outcome of other key areas of policy; education, social and industry. The digital skills challenge has many layers and providing interventions successfully within the dynamic advanced digital skills context requires a consolidation of the prior phases in the education and training pipeline. These can cover upskilling, reskilling, new educational approaches, restructuring of systems, upskilling of teaching professionals, social campaigns, and awareness raising. This often falls under different portfolios both at a MS and EU level. What is clear is that there is no right answer for providing the supply of relevant, productive and high-quality advanced digital talent. The routes to achieving this are numerous and equally valid.

There is a need to take a multi-strategy approach that acts along a short-, medium-, and long-term horizon with distinct objectives, that provides that scope for adaptiveness and responsiveness.

EXPERTISE AND DEMAND IS DISTRIBUTED UNEVENLY – A CASE FOR EU VALUE-ADD

Between Member States, between stakeholder organisations, there is not a consolidated winner in the ADS challenge, and no-one can claim to have the winning formula. The perfect supply of experts with the right skills and knowledge to support a dynamic and thriving ecosystem of digital talent does not exist. Highly specialised individuals can be found in universities, in industry, in one MS and not in another. Gaps will always persist in this highly specialist environment, including the generation of a critical mass of demand. There is a significant opportunity for integrated cross-border collaboration that leverages the complementarity between institutions across regions, individual expertise and the sharing of resources.

SERIOUS INVESTMENT IS NOT FOLLOWING THE SERIOUS AMBITIONS – THE SEVERE RISK POSED TO OUR COMPETITIVENESS IS NOT BEING MET WITH ENNOUGH ACTION

While there are significant announcements and strategies made at Member State and European levels related to skilling and digital talent, the focus of Advanced Digital Skills is not being matched with the scale of investments. Considering that the supply of talent is the fundamental key to ensuring European companies are able to develop and drive global leadership in digital supply chains, the scale of investments is not on par with that provided to R&D, onshoring, value chain reorganisation or similar actions that our current situation requires. As previously referenced, ADS is the pinnacle of education

and training and sits upon infrastructure, both tangible and intangible that retains a significant debt in underspending over years and decades. ADS cannot be resolved comprehensively without a comprehensive investment in Europeans.

MORE MONEY DOES NOT EQUAL MORE TALENT – UNDERLYING STRUCTURES REQUIRED TO MAXIMISE INVESTMENTS

In contrast to the above point, it is not believed that sudden capital injections will yield acceptable returns until underlying barriers and structural limitations are addressed. The created expectation for individual institutions or stakeholders through the movement of liquid capital will generate friction unless we can collectively ensure that elements such as accreditation, industry readiness and awareness and data integration is completed. Our systems have been developed for a more static world and the impact of skilling initiatives should be measured by the performance of the individual who has developed their skills and is able to apply them productively to the benefit of themselves, society and the economy – this is a complex tangle of education, motivation, opportunity and coherence.

RISK TAKING IS CENTRAL TO THE CHALLENGE – URGENCY OF THE CHALLENGE REQUIRES THE UNUSUAL APPROACH

Akin to the venture capital position for developing the next generation of market-ready technologies, companies and industries – the application of the Power Law needs to be considered in decision making. That is, to expect a majority of value creation or returns to arise from a minority of the investments made. This is at odds with common policy instrument approaches and how funding programmes are evaluated – there is a preference for a lower-level linear relationship is expected for all investments. The scale of the challenge to reach 20 million ICT Specialists and the risk to our future prosperity is too great for the current business-as-usual, more risk appetite is needed with novel mechanisms employed to support this, for example the European Innovation Council.

ADVANCED DIGITAL SKILLS IS A WHOLE OF SOCIETY ISSUE

ICT and digital industries and roles are elite. There is a domination of gender, educational background and socioeconomic profiles both in academia, research and industry. Too often is talent being left behind for lack of access, systemic issues, cultural challenges or routes to match their potential and achieve quality work and develop leadership of the future of European digital industries. The global relevance of European industries and economies is a real and immediate challenge. Without the development of the right digital leaders, European society will be adversely affected with fewer and fewer resources at its disposal. We require our whole team, regardless of profile, to come to meet the challenge and we need to transform the view of society at large to drive change at all levels.

3 SCALE OF INVESTMENT AND MAXIMISATION OF EU INVESTMENTS

Nuria de Lama, Consulting Director, IDC

CALLS TO ACTION

- Address the challenge of ADS as a holistic problem that involves many different stakeholders and that should not be considered as an isolated objective within a specific programme, i.e. DIGITAL, but embedded across all funding instruments.
- The DIGITAL funding should be strategic in frontier digital economy development, but the much larger Horizon Europe programme should be adapted to include skilling and training as a mandatory action in all technology development projects. This could have an enormous potential for growing the development of skills if properly designed and drive long-term successes building on the DIGITAL.

The Horizon Europe Programme is defined for Research and Innovation, with a total budget of EUR 95.5 billion for the period 2021-2027. By comparison, the DIGITAL Programme has a budget of just under EUR 7.9 billion, while Erasmus+ has EUR 26.2 billion in the same period. The focus of DIGITAL is on close-to-market large scale investments to super charge the advancement of European digital value chains. The work of LEADS has showcased the big impact of ADS on EU competitiveness on a wide umbrella of sectors, if not all, and is both a driver and barrier for innovation to develop and adopt new technologies that guarantee European sovereignty.

Given the sheer scale and importance in developing the future technologies within Horizon Europe, it is becoming increasingly common to find dedicated work packages for skilling to ensure the uptake of the developed innovations is possible. This is especially relevant for Innovation Actions.[6] Such activities are particularly needed in the context of SMEs, but also when technology components are expected to be reused in wider IT systems and very specialised knowledge is a prerequisite.

This analysis builds upon observations gathered by the LEADS consortium along the project duration and bring us to a desired scenario in which some specific support actions as the ones currently funded by DEP should provide horizontal capabilities and complement a much more ambitious approach to the development of ADS, which should be tightly integrated with the work plans of most projects, be them managed by DEP or HE. All European funding that is linked to digital innovation must consider the skills development as part of the go-to-market and technology transfer process. The integration with other activities, the capability to reach out a much wider network of stakeholders and the scale of investments would showcase a much greater ROI and would align with the size of the challenge that Europe faces in terms of skills, quantified in great detail by the LEADS project.

AFFECTED STAKEHOLDERS

- IT industry developing and supplying advanced technologies in the context of project implementation
- IT adopters, working in different sectors, deploying, validating and adopting specific solutions in their operational environments as part of the work of the project
- Education providers, be them HE entities or VET. This would allow some universities already working in the project to expand their research work to training and education and at the same

[6] As an example, PISTIS (HORIZON-CL4-2022-DATA-01-04) has developed a work package – "Extrovert Excellence Diffusion and Skills Cultivation Activities" that involves, among others, the generation of training material, including MOOCs, or focused training activities, open training workshops and webinars. The personnel efforts assigned to this WP account for almost 14%, which gives evidence of their importance and the volume of resources that may be needed to address the challenge of ADS if reasonable impact is to be achieved.

time would open the door for other entities like VET to participate in these projects where their presence is very limited, with a meaningful role.

EXPECTED OUTCOME

- Wider scale and greater impact in generation of ADS, resulting in speeding up the rhythm to overcome the gap between supply and demand of ADS.
- Greater investment and the implementation of education and training actions in many different fields and in parallel would not only give a quantitative result (higher number of professionals with specific skills acquired, higher number of training materials) but a clear recognition and understanding of the challenge and the way it should be addressed in different contexts (maturity of skills, technology fields, SMEs, etc.).

TARGET STAKEHOLDER(S)	• Policy Makers
RELEVANT POPULATION	• GROUP A – INVENTORS AND CREATORS • GROUP B – ICT SPECIALISTS
TIMELINE	• Medium-term

4 LEVERAGING THE MOST OF DIGITAL INVESTMENTS

Eugenia Kypriotis, Project Manager, Martel Innovate

CALL TO ACTION

- **Embrace a strategic shift towards building upon existing initiatives.** Focus on enhancing and adapting successful partnerships, courses and training programmes on ADS already proven effective within collaborative networks of European universities and SMEs. This approach minimises the risks of developing entirely new curricula and accelerates implementation by building upon established partnerships and models
- **Ensure accreditation readiness from the outset.** Proactively address accreditation requirements from project inception to avoid potential delays and complexities. Ensuring unified accreditation standards across diverse regulatory landscapes early on enhances credibility, aligns partners, and facilitates smooth implementation and scalability across multiple European universities.
- **Form smaller consortia to reduce administrative burdens** Optimise decision-making and streamline communication by forming smaller, agile consortia. Through this approach administrative overhead will be reduced, stronger collaboration will be fostered among members, and projects will be enabled to navigate operating challenges more efficiently.

The recommendations are derived from interactions with SPECIALISED projects within the framework of the LEADS project, where support was provided via Topic Group meetings in the development of their master courses and training on Advanced Digital Skills. These meetings, held either monthly or bi-monthly, covered a range of crucial topics, including Programme Design & Joint Accreditation, SME Engagement, Digital Engagement, and Communications & Recruitment. Additionally, SPECIALISED Project coordinators were involved as needed.

Through these interactions, it became apparent that embracing a strategic shift towards building upon existing initiatives allows projects to leverage proven courses and training that have already demonstrated their viability. For instance, rather than creating a new master course in Cybersecurity from scratch, a project might enhance and adapt an existing course that has been successfully implemented and accredited across multiple universities within the EU. This approach minimises the risks associated with developing entirely new curricula and procedures from scratch, increasing the likelihood of success of the funded action which only possesses a 4-year period to reach impact, a relatively significant challenge in the context of course development and the integration of multiple institutions.

Similarly, prioritising the leveraging of existing courses and collaborations among partners, particularly those that have successfully **resolved administrative challenges** faced by their institutions through cooperation schemes. These pre-existing frameworks provides DIGITAL actions with a solid foundation for rapid progress. Drawing upon the established models and strategies from existing partnerships enable projects to accelerate their implementation processes, thereby reducing time-to-market and delivering value more promptly. Capitalising on the experiences and solutions developed in previous administrative collaborations ensures that projects can focus on developing courses that are sustainable and possess a feasible business model for operation.

AFFECTED STAKEHOLDERS

- **Participants and stakeholders directly involved in SPECIALISED projects** within the Digital Europe programme, including project coordinators, researchers, educators, and industry partners
- **Decision-makers and policymakers at the European Commission** responsible for funding and overseeing the Digital Europe programme

- **Technology providers and industry experts** engaged in developing digital solutions and innovations
- **Accreditation bodies and regulatory agencies** responsible for evaluating and accrediting educational programmes and initiatives within the digital domain
- **SMEs** and other organisations seeking to leverage digital investments and advancements for their growth and competitiveness

EXPECTED OUTCOMES

Enhanced project efficiency and resource use

Leveraging existing initiatives and forming smaller consortia, will help projects to streamline their operations and allocate resources more effectively. This will lead to optimised project workflows, reduced administrative overhead, and maximised use of available resources.

Accelerated project initiation and implementation processes

Building upon established frameworks and business cases enables projects to start off and implement activities swiftly. With proven models and strategies at their disposal, projects can expedite the initiation and implementation of activities, reducing the time required for project commencement and enhancing efficiency in project implementation.

Increased impact and innovation in the digital domain

Leveraging existing courses and partnerships, particularly those that have addressed administrative challenges, allows projects to focus on driving impact and innovation. By capitalising on proven approaches and lessons learned, projects can push the boundaries of digital innovation and deliver transformative outcomes.

Strengthened alignment with programme objectives and stakeholder needs

Prioritising accreditation readiness and forming smaller consortia ensures that projects are aligned with programme objectives and stakeholder needs from the outset. This alignment enhances project credibility and relevance, fostering greater support and engagement from stakeholders throughout the project lifecycle.

TARGET STAKEHOLDER(S)	• Policy Makers • HEIs • SMEs
RELEVANT POPULATION	• GROUP A – INVENTORS AND CREATORS • GROUP B – ICT SPECIALISTS • GROUP C – ICT EXPERTS • GROUP D – ADVANCED DIGITAL TOOLS USERS
TIMELINE	• **SHORT** Begin discussions with relevant stakeholders to explore the feasibility of implementing the recommendation Develop a work programme for transitioning towards leveraging existing initiatives, ensuring accreditation readiness, and forming smaller consortia • **MEDIUM**

Monitor and evaluate the progress of the implemented strategic shift, making adjustments as necessary to optimise effectiveness and efficiency

- **LONG**

Consolidate the changes across future SPECIALISED projects, ensuring that they become standard practice and are embedded within project workflows and procedures

Assess the long-term impact of the strategic shift on project outcomes and overall programme effectiveness

Continuously review and refine the strategic approach based on ongoing feedback, emerging trends, and evolving needs within the digital landscape, ensuring sustained improvement and innovation

5 BALANCING THE NEED FOR SKILLS AND QUALIFICATIONS FOR CAREERS

Julie Byrne, Assistant Professor in Online Education & Development, Trinity College Dublin.

CALLS TO ACTION

- Recognise the different motivations of individuals and industry with regard to the necessity of accredited vs non-accredited ADS education and training.
- Provide a range of learning pathways, both accredited and non-accredited, to meet the needs of these stakeholders and to reflect the diversity of profiles.
- Where qualifications are offered, a range of qualification types should be available.

REASON FOR THE RECOMMENDATIONS

Industry and individual learners have different motivations when it comes to the acquisition of qualifications and certifications and the pursuit of non- accredited learning. The ADS needs of industry are pressing and the immediate short-term focus is on the acquisition, upskilling or reskilling of the individual to perform a particular task or set of tasks. Qualifications do offer a quality assured certification of learning outcomes. When these outcomes are tightly linked to company need, the qualification performs a valuable role in delivering an employee equipped with the required skill and ready to work. However, where this a gap or discrepancy between the learning outcome and the company need, the incentive to support, fund or release staff to acquire such qualifications can be low and the short-term return on the investment is difficult to justify. Product and tool certification also act as a strong driver for companies where income is directly linked to the number of staff certified to use certain products and tools.

For the individual however, the motivations to acquire qualifications and certification can be seen as part of a wider career development need. In other words, the value of a qualification or certification to the individual is derived not just from current tasks and jobs but to long term employability and mobility. For the individual, any investment in qualification acquisition may yield returns beyond the short-term, by equipping learners with foundational knowledge, transversal and soft skills which will be of benefit to them over the medium to long term course of the career. In this way, the return on investment for the qualification cost in time and money has to be evaluated within a different time frame.

Because the interest in qualifications may differ between these stakeholders and the required learning pathways vary depending on the profiles (section 1.3), it is clear that a wide range of learning pathways (both accredited and non-accredited) is required. To meet the diverse needs of learners and companies, accredited pathways should include a range qualification options including; stand alone and stackable micro credentials, product certifications, short-term VET qualifications, as well as longer term educational programmes such as degrees, diplomas and masters.

AFFECTED STAKEHOLDERS

Those involved in the delivery of education and training and the provision of qualifications and certifications. Industry. Individual learners.

EXPECTED OUTCOME

- Support for individual career development, incentivising the individual to invest in ADS not just for the job of today but the career of tomorrow.

- Better engagement from beneficiaries for upskilling initiatives and stronger demand across populations.
- Efficient and targeted education and training actions, by offering accreditation only where it meets the needs of the individual and industry, the education and training system can be more targeted in its efforts and the time to bring ADS courses to market can be reduced.

TARGET STAKEHOLDER(S)	• HEIs • VET providers • Industry
RELEVANT POPULATION	• GROUP B – ICT SPECIALISTS • GROUP C – ICT EXPERTS • GROUP D – ADVANCED DIGITAL TOOLS USERS
TIMELINE	• **SHORT** Drive awareness of need for credential-based approaches between industry, VET and HEI Support the development of micro-credential and ECTS based frameworks to support • **MEDIUM** Review the accreditation approaches at MS level and promote a harmonisation across HE and VET for the EU to maximise efficiencies and novel developments while ensuring quality of the offering is assured.

6 AN URGENT STIMULATION OF INDUSTRY COLLABORATION MECHANISMS

Na Fu, Professor in Human Resource Management, Trinity Business School

CALLS TO ACTION

- Foster concrete and directive partnerships via developing mechanisms to support direct and actionable partnerships between industry, academia, and policymakers. This will bridge gaps by ensuring cohesive strategies and collaborative efforts in the ADS landscape.
- Implement data-driven decision-making frameworks via utilizing data analytics to evaluate the effectiveness of and alignment between current ADS policies and industry practices. This will enable stakeholders to make informed decisions, ensuring resources are allocated effectively and efforts are continuously improved.
- Encourage industry engagement with HR Departments via involving HR departments in ADS projects to ensure industry professionals understand and fulfil their roles in digital initiatives. This will align workforce skills with industry needs, enhancing collaboration and addressing sustainability issues.

REASON FOR THE RECOMMENDATIONS

The LEADS project successfully engaged with multiple stakeholders to deliver insights and provide roadmaps and guidelines for navigating the dynamically evolving ADS landscape. However, this project also revealed significant disconnections and gaps. For instance, industry efforts focus on reskilling and upskilling their existing workforce to meet business needs, while education providers are hindered by the tedious accreditation process, delaying the development of new courses and joint programs across member states. These issues contribute to significant ADS demand-supply gaps. Despite considerable efforts and resources from governments and funding agencies, existing mechanisms emphasize activities and KPIs, which fails to support sustainable and systematic development of ADS talent.

Addressing these disconnects and gaps between ADS demands and supplies is crucial. Urgent action is needed to develop mechanisms that foster concrete and directive partnerships among stakeholders, including industry, academia, and policymakers, to achieve the shared and sustainable goal of developing digital talent for Europe. Such partnerships are essential to bridging the gaps identified in the LEADS project, ensuring all stakeholders collaborate effectively towards common goals. Effective partnerships can lead to cohesive strategies, shared resources, and collaborative efforts that advance the ADS landscape. By nurturing these partnerships, stakeholders can leverage each other's strengths, address ADS talent shortages, and promote a more sustainable and integrated approach to digital talent development in Europe.

To develop these concrete and directive partnerships, it is important to build upon existing collaborative frameworks among stakeholders and ensure their effectiveness. In this regard, data-driven decision making is recommended where data needs to be used to assess the effectiveness of current policies and industry practices, and align efforts across the industry, policymakers, and academia based on empirical evidence. This approach will identify successful policies, areas needing improvement, and optimal resource allocation to maximize impact. Implementing data-driven frameworks ensures that efforts are aligned, effective, and continually improving, fostering a more responsive and adaptive ADS ecosystem.

Furthermore, future projects on ADS need to actively engage HR departments to ensure industry professionals understand and fulfil their roles in digital initiatives. HR departments play a vital role in aligning workforce skills with industry needs. Their engagement in ADS projects ensures employees are well-prepared for digital roles, fostering collaboration and effectively addressing sustainability

challenges. Encouraging industry collaboration with HR departments will cultivate a more adept and responsive workforce capable of meeting industry demands. Collaboration among business leaders, educators, trainers, and HR professionals will facilitate the co-creation of guidance for articulating clear, actionable goals, thereby enhancing collaboration and urgency in tackling digital challenges.

AFFECTED STAKEHOLDERS

- **Industry Leaders and Businesses**: Companies involved in ADS initiatives, focusing on reskilling and upskilling their workforce. In particular, the HR departments within these organizations responsible for workforce development aligned with digital strategies.
- **Educational Institutions**: Universities, colleges, and training providers/educators navigating accreditation processes for new ADS courses and joint programs.
- **Policymakers and Government Entities**: European Commission and national policymakers shaping policies and funding initiatives for digital talent development; and government agencies responsible for overseeing ADS programs and initiatives.
- **Digital Talent and Professionals**: Individuals pursuing careers or currently employed in digital roles, impacted by training opportunities and alignment with industry demands; and participants in ADS projects and initiatives, including researchers and project coordinators.

EXPECTED OUTCOMES

- **Strengthened Partnerships between Industry, Academia, and Policymakers**
  - Development of robust partnerships that foster innovation and shared resources for ADS initiatives.
  - Establishment of enduring collaborations beyond individual projects, promoting sustainability in digital talent development efforts.
- **Improved Policy and Program Effectiveness**
  - Enhanced effectiveness of policies and programs through stakeholder input and collaboration.
  - Data-driven decision-making supported by stakeholders' contributions, leading to informed policy adjustments and resource allocation.
- **Enhanced Digital Workforce Preparedness and Alignment**
  - HR departments actively engaged in ADS initiatives ensure that industry professionals are adequately trained and prepared for digital roles.
  - Enhanced capabilities among stakeholders to contribute effectively to ADS initiatives and programs.

TARGET STAKEHOLDER(S)	• Industry • Policy Makers • HEIs • Digital talent and professionals
RELEVANT POPULATION	• GROUP A – INVENTORS AND CREATORS • GROUP B – ICT SPECIALISTS • GROUP C – ICT EXPERTS • GROUP D – ADVANCED DIGITAL TOOLS USERS
TIMELINE	• **Short term** Analysing and evaluating: Existing Partnerships between Industry, Academia, and Policymakers Policy and Programme Effectiveness Involvement of HR Departments in Digital Talent Initiatives and Projects

- **Medium term**

Identifying Mechanisms for:

  - Strengthening Partnerships between Industry, Academia, and Policymakers
  - Improving Policy and Program Effectiveness
  - Involving HR Departments in Digital Talent Initiatives and Projects

- **Long term**

Implementing Interventions Combined with Continuous Improvement Plans for:

  - Strengthening Partnerships between Industry, Academia, and Policymakers
  - Improving Policy and Program Effectiveness
  - Involving HR Departments in Digital Talent Initiatives and Projects

7 TRANSFORMING THE HIGHER EDUCATION SECTOR FROM WITHIN – A CULTURE OF CHANGE

Ernestina Menasalvas, *Professor of Information Systems and Languages, Universidad Politécnica de Madrid*

CALLS TO ACTION

- **Invest in trainers' development.** Ensure trainers are equipped with the latest knowledge, skills, and tools to provide high-quality digital education that meets the demands of the evolving digital economy.
- **Promote trainers' upskilling in their career paths.** Develop clear and structured career advancement pathways for trainers, outlining the necessary skills and qualifications, and offer incentives such as awards, promotions, or salary increases for achieving specific upskilling milestones.
- **Create specific positions at HE institutions to incorporate industry experts.** Establish roles within higher education institutions for professionals with industry expertise to bridge the gap between academic knowledge and practical industry skills.

REASONS FOR RECOMMENDATION

Achieving the digital decade targets is crucial to maintaining Europe's competitive edge in technology and innovation. However, a significant challenge in this endeavour is ensuring that trainers—professors and educators—are well-equipped with the skills, knowledge and confidence to deliver high-quality digital education. To overcome these challenges, it is essential to implement a multi-faceted strategy that includes comprehensive upskilling programmes, improved retention efforts, and enhanced collaboration between academia and industry to ensure trainers are well-prepared to meet the demands of the digital economy.

Trainers and teachers from both HEIs and VET need to continuously upgrade their skills to keep pace with rapid technological advances. This can be achieved through professional development programmes that include regular workshops, seminars and courses on the latest digital technologies and teaching methods. Particularly in Higher Education in Europe, academic and teaching staff are often considered equivalent to civil servants which provides limited range for progression or going above and beyond their assigned responsibilities, limiting their practical exposure to and cutting-edge knowledge of the latest technologies. Furthermore, it is observed that the percentage of academic staff over the age of 50 has remained static at 40% over the second-half of the past decade.[7] To prevent qualified educators from leaving for more lucrative positions in industry, it is crucial to offer attractive incentives

Collaboration with industry is crucial, as partnerships with technology companies can provide hands-on training and exposure to real-world applications. It is also essential to provide educators with the latest tools and resources, including access to cutting-edge research, software and digital platforms. These are increasingly likely to be found outside of academia and in the research units of large tech providers;[8] major companies (e.g. the Magnificent Seven) possess the resources and control the data essential for cutting-edge developments. By ensuring that educators have the necessary tools and support, institutions can create a more conducive and fulfilling work environment.

Given the shortage of qualified trainers, it is essential to promote mobility between industry and academia. This can be facilitated by secondment programs that allow industry professionals to work

[7] Education at a Glance 2022: OECD

[8] LEADS workshop Best Practices for Aligning Higher Education Curricula to ADS Dynamic Demand

temporarily in academic institutions, sharing their expertise and gaining teaching experience. Additionally, inviting industry experts to deliver guest lectures and workshops can bridge the gap between theoretical knowledge and practical application. The creation of dual appointments, allowing individuals to split their time between industry roles and academic teaching, may promote a continuous exchange of knowledge that benefits both sectors.

In terms of conditions and context, examples of incentivisation can include reducing teaching loads can provide educators with more time to engage in research, professional development, and staying current with technological advancements. Flexibility in scheduling or generous time-off policies (e.g. sabbatical periods) can help educators maintain a healthy work-life balance. Other incentives might include offering professional development opportunities, recognition and awards for exceptional work, and creating clear pathways for career advancement. These measures can significantly enhance job satisfaction and retention, ensuring that educators remain motivated and committed to their roles. Sharing knowledge among different HEIs through specialised courses offered by one institution to address knowledge gaps in others is another way to expand ADS knowledge across the EU.

Europe's goal to reach 20 million ICT Specialists by 2030 is both ambitious and necessary for the continent's future prosperity. By focusing on upskilling educators, incentivising the retention of academic talent, and promoting mobility between industry and academia, we can help create a robust framework for digital education. These efforts will ensure quality education, foster innovation and create a sustainable pipeline of skilled professionals who can drive the EU's digital economy forward.

Expected outcome

- **Improving the relevance of the curriculum**, ensuring that educational content is closely aligned with industry needs and trends.
- **Developing innovative teaching method**s and research opportunities that drive progress in both education and industry.
- **Students will be exposed to real-world applications** and professional networks, better preparing them for their future careers.
- **Academia-industry mobility frameworks** are established to ensure that the latest technology is brought into the university.

TARGET STAKEHOLDER(S)	• HEIs • Policy makers
RELEVANT POPULATION	• GROUP A – INVENTORS AND DEVELOPERS
TIMELINE	**Short-term** • Encourage trainers to train themselves in the new technologies • Provide measures to facilitate training of the trainers **Medium-term** • Regulations to make it possible the mobility between the academy and the industry

8 VALUE OF THE TRANSLATION OF THE ICT EXPERTISE TOWARDS NON-ICT

Spiros Borotis, Analyst, Maggioli

CALLS TO ACTION

- Ensure not just ICT Specialists are developed but also equip other professions with Advanced Digital Skills.
- Enhance the curricula of non-ICT education programmes with specialised ICT courses.
- Promote an open model of delivery of entry-level training content (modules) for the public from education and training providers to encourage the engagement of professionals in recognised micro credential-based learning programmes.

REASON FOR RECOMMENDATION

In the context of the Digital Decade target, of the 10 million ICT professionals employed in Europe, 80% of them are men. The challenge to reach the 20 million profiles with is significant. The route to these roles, whether specialist or user, is dominated by higher education. According to Eurostat, 67% of ICT Specialists in the EU possess a higher education degree either coming through from undergraduate or joining through specialised Masters, or professional training programmes.

Currently, the proliferation of advanced technologies is transforming the production landscape, non-ICT profiles equipped with ICT knowledge and skills are now able to produce new software or even hardware, even employing 3D printers to this end. This resulting shift will see domain experts produce innovative, domain-specific solutions, products and services more effectively and efficiently; the advancement of ICT deployment can reasonably be expected to become less dependent on the availability of ICT Specialists i.e. an increased demand of Group D over Group C.

As a consequence of this hypothesis, there is a requisite need for enhancing the curricula of non-ICT degrees (mainly tertiary degrees) with advanced digital skills courses that will equip non-ICT specialists (especially women) with expertise to use specialised ICT tools. This effort could be enhanced further with the provision of short learning programs accompanied with certification (i.e. micro credentials)[9] on the use of specialised ICT tools from non-ICT specialists in order to address sector specific needs. Thus, the selected (of high demand) advanced digital skills should be reflected in the education and training courses offered in various disciplines. Especially in the non-ICT areas, the training content could be in some case more generic, contrary to the courses for ICT specialists that have to learn to comply with standards in particular domains (e.g. in cybersecurity) and high-level design and systems engineering.

Additionally, universities and other training providers could offer to the public training courses and content - without tutor support in the form of MOOC to establish better their connections with the society, attract professionals in their short learning programmes and masters' degrees.

Furthermore, SMEs could collaborate with training providers licensing their ICT tools to them, so as increase the awareness of the professionals and their engagement to them. This is commonly applied for large corporates and digital companies and is an important challenge in ensuring that training and certification does not result in an over specialisation and talent moats, which hinders their mobility and adaptability.

[9] Please refer to outcome report:

Apart from that, it is recommended to increase the recognition of non-formal learning on advanced ICT areas and to identify ways to validate knowledge acquired and skills developed through informal learning. The progress in various ICT domains is quite rapid, making difficult to wait the establishment and / or updating of formal education degrees, programs and courses. These efforts could facilitate Europe to achieve easier - or at least approach as close as possible - the tareget of 20 million ICT specialists by the year 2030.

EXPECTED OUTCOME

- Greater capacity for digitalisation and application of advanced digital technologies across the whole society.
- Improved transition from higher education to work, ensuring greater productivity and cross-disciplinary collaboration which fosters greater innovation and growth for European enterprises.
- Decrease the gender gap in ICT specialists through the broadening of the appeal and access to those without formal STEM training.

TARGET STAKEHOLDER(S)	• Education and training providers (HE, VET) • All industry sectors • Policy makers • SMEs
RELEVANT POPULATION	• GROUP C – ICT EXPERTS • GROUP D – ADVANCED DIGITAL TOOLS USERS
TIMELINE	• **SHORT** Create awareness to HE and VET programs owners so as to enrich their courses with relevant advanced ICT skills. • **MEDIUM** Facilitate HE and VET institutions to establish joint degrees between advanced-ICT and non-ICT disciplines. Provide guidance on the need of ICT specialised knowledge and skills in non-ICT sectors. Evaluate established programmes and courses. • **LONG** Assess the impact of enhancing non-ICT curricula with advanced ICT courses.

9 NEED FOR PRACTICAL DEVELOPMENT OF ADS

Jacob Nielsen, Associate Professor, SDU Metaverse Lab, The Maersk Mc-Kinney Moller Institute

CALLS TO ACTION

- Ensure that all education and training that supports ADS has both theoretical and practical dimensions, so that the learners arrive at the highest learning levels and will be able to design, implement, construct and develop systems within the ADS domain in question.
- Promote learning based on real industrial contexts, so that the learners get to use the right tools and work within the right problem contexts, to give them the skills that are directly and immediately usable when continuing their work at a professional level afterwards.

REASON FOR THE RECOMMENDATIONS

For a learner to obtain any skill within any domain, it is important to get practical, hands on experience within the domain. Both to learn how to use the relevant tools and to develop the necessary knowledge and experience. This is certainly also true for Advanced Digital Skills, and especially so, with the current needs of industry. The more practical experience the learner gains through their training and education, the faster they will be able to fill out their specific roles at a company at the end of their education. With advanced digital skills it is also of great importance that the practical training is supported with theoretical training, giving the learner the means for further educating themselves (life-long learning), when digital technologies and the need for skill-sets change.

With the practical training the tools have to be real, the settings have to be real, and the problem domains have to be rooted in real problems. For this to happen, it is a must that training institutions and companies collaborate more directly, and that easier means for collaboration are identified. Many education programmes already possess practical components and company collaboration, such as internships or in-company periods. But those are mainly rooted in general company training rather than specific skills-areas. We therefore recommend that this is changed or added to the ADS specific courses.

AFFECTED STAKEHOLDERS

Training Institutions, industry and policy makers

EXPECTED OUTCOME

Reduced friction between industry demands and higher education, providing a closer fit to the identified gaps. Lower levels of practical training is required for recent graduates and new hires to reach applicability of their knowledge and skills.

Development of more flexible profiles and a higher return on investments or positive outcomes from investments made in advanced digital technologies.

skills training within educations

TARGET STAKEHOLDER(S)	• HEIs • Industry
RELEVANT POPULATION	• GROUP B – ICT SPECIALISTS • GROUP C – ICT EXPERTS
TIMELINE	• Medium

10 WIDENING THE ACCESS AND PATHWAYS FOR ALL SOCIETY TO ACHIEVE CRITICAL MASS

Ana Moreno, Professor of Software Engineering, Universidad Politécnica de Madrid
Juan José Moreno, Professor of Information Systems and Languages, Universidad Politécnica de Madrid

CALLS TO ACTION

- Ensure minorities and socio-economic depress population have access to training through outreach programs specifically aimed at this target population so they have equitable access to training.
- Promote the re-insertion of those that abandon the training career through personalized re-entry plans and mentors for individuals who wish to resume their training. These plans should take into account their previous progress and current circumstances.
- Improve vocational education: Develop attractive, industry-supported vocational training options to increase the prestige and diversity of pathways into ADS.
- Provide financial incentives to companies that recruit and train individuals at appropriate ADS levels.
- Define mechanism enabling the recognition of prior learning. This allows individuals to gain formal recognition for skills and knowledge acquired outside traditional education settings, which can facilitate their integration into the workforce and further education.

REASON FOR THE RECOMMENDATIONS

Achieving the goal of 20 million advanced digital skills (ADS) specialists in the EU by 2030 requires widening the talent pool beyond traditional education pathways. In the broader STEM fields, data from 2021 indicated that the EU had around 4.3 million tertiary education graduates, with significant numbers in fields like engineering, manufacturing, and construction (14.9% of all graduates)[10]. More specifically, only about 4% of all EU graduates are from the ICT field[11], i.e., an annual production rate of only 172,000 new ICT graduates from HEIs.

At the same time many people have been excluded from these systems due to socio-economic barriers and lack of inclusivity, while others have fallen off the pipeline due to the requirements and restrictions of traditional education systems (e.g. those with neurodiversity, cognitive impairments, or lack of family support). By including these learners, the EU can access a wider and more diverse talent pool and ensure a steady supply of skilled workers to meet industry needs. Providing flexible learning pathways for those who have left the traditional education system will enable them to quickly up-skill and enter the labour market with the required skills.

Individuals outside traditional education pathways, often driven by the need to enter the workforce quickly due to socio-economic circumstances, bring diverse experiences and perspectives that can enhance innovation and problem-solving in the technology industry. Their diverse backgrounds contribute to more creative and comprehensive solutions in technology development and application, enriching the field of ADS.

In addition, some regions, particularly rural and economically disadvantaged areas, lack access to traditional higher education institutions. Providing alternative pathways to ADS education in these areas can stimulate regional development by creating local opportunities for quality employment and fostering regional innovation hubs. This approach can help bridge the digital divide by ensuring that

[10] Eurostat 2021 (educ_uoe_grad04)
[11] Eurostat 2021 (educ_uoe_grad02)

talent is not confined to urban centres but is cultivated across the EU. The recognition of prior learning is essential to motivate individuals to take these pathways.

In addition, these alternative pathways can include online learning platforms, community-based training programmes and industry partnerships that provide practical, hands-on experience. Such initiatives can be tailored to the specific needs of different communities, making advanced digital skills more accessible to a wider audience.

Furthermore, integrating people from different socio-economic backgrounds into the ADS pathway can lead to a more equitable and resilient digital economy. This inclusive strategy not only addresses skills shortages, but also promotes social mobility and economic empowerment. By tapping into a wider range of talents and experiences, the EU can accelerate the pace of workforce development, drive innovation and ensure that the benefits of the digital economy are shared more widely across society.

Tackling the under-representation of women in ICT is crucial to shifting our supply of digital talent. Women remain a minority in the field and targeted efforts are needed to inspire and support them to pursue careers in digital engineering. Awareness campaigns should specifically highlight the achievements of female role models in technology, showcasing their contributions and success stories. Integrate initiatives to promote gender diversity in STEM education from an early age to help break down stereotypes and encourage more young women to enter these fields.

In conclusion, extending ADS training to people outside the traditional education system is essential to achieving the common goals for the EU. It harnesses diverse perspectives, promotes regional growth and creates a more inclusive and dynamic digital economy. Through these efforts, the EU can build a robust and adaptable workforce, ready to meet the challenges and opportunities of the future.

EXPECTED OUTCOME

- Broaden the talent pool, addressing the current shortage of digital skills
- Improve social mobility by giving people from disadvantaged backgrounds the opportunity to secure stable jobs in the digital sector.
- Promote greater diversity in the digital workforce, bringing a wider range of perspectives and ideas that can drive innovation.

TARGET STAKEHOLDER(S)	• Policy Makers • HEIs • VET providers
RELEVANT POPULATION	• GROUP C – ICT EXPERTS • GROUP D – ADVANCED DIGITAL TOOLS USERS
TIMELINE	**Short-term** • Identify populations to be engaged • Establish the pathway for these population to have access to education **Medium-term** • Deliver actions to mitigate drop-offs/non-completion rates among target populations.

11 REFERENCE REPORTS AND PUBLICATIONS

Commented [BR1]: @Cristian Salis