D.3.2. FINAL GUIDELINES REPORT (M19-JUNE 2024)

Revision: v.1.1

Work package	WP3
Task	Task 3.2
Due date	30/06/2024
Submission date	30/09/2023
Deliverable lead	UPM
Version	1.0
Authors	Ana M. Moreno (UPM), Ernestina Menasalvas (UPM), Juan José Moreno-Navarro (UPM), Shirley Kavanagh (TCD), Flora Josette Thibaudeau (TCD), Julie Byrne (TCD), Max Welford (BLU)
Reviewers	Eugenia Kypriotis (Martel), Valentina Peniche (AIOTI)

Abstract	This document reports the final recommendations gathered during WP3 to cover the gaps identified during WP1 and WP2, with respect to the demand and supply of ADS.
Keywords	Skills, HEI, VET, academia, demand, training, education, industry

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DOCUMENT REVISION HISTORY

Version	Date	Description	List of contributor(s)
0.1	March 1, 2024	Preliminary outline	Ernestina Menasalvas (UPM), Ana M. Moreno (UPM), Mattia Trino (BDVA)
0.2	March 15, 2024	Appendixes with workshops summaries	Ana Moreno (UPM), Ernestina Menasalvas (UPM)
0.3	April 14, 2024	Preliminary categorisation of recommendations	Ana Moreno (UPM), Ernestina Menasalvas (UPM) Bendan Rowan (BLU)
0.4	May 2, 2024	First completed version of deliverable with synthesis of recommendations	Ana Moreno (UPM), Ernestina Menasalvas (UPM)
0.5	May 14, 2024	Updated recommendations schema	Ana Moreno (UPM), Ernestina Menasalvas (UPM)
0.6	May 29, 2024	Final version to be reviewed by Martel	Ana Moreno (UPM), Ernestina Menasalvas (UPM)
0.7	June 10, 2024	Final version to be reviewed by AIOTI	Ana Moreno (UPM), Ernestina Menasalvas (UPM)
0.8	June 18, 2024	Addition of workshop outline – High-level Policy	Ana Moreno (UPM), Tanya Suárez (BLU)
0.8	June 25. 2024	Final draft completed	Ana Moreno (UPM), Ernestina Menasalvas (UPM)
0.9	June 26. 2024	Final review	Brendan Rowan (BLU
0.10	June 27, 2024	Final version for release	Ana Moreno (UPM)
1.0	June 27, 2024	Release	Brendan Rowan (BLU)

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* R: Document, report (excluding the periodic and final reports)
DEM: Demonstrator, pilot, prototype, plan designs
DEC: Websites, patent filing, press & media actions, videos, etc.
DATA: Data sets, microdata, etc
DMP: Data management plan
ETHICS: Deliverables related to ethics issues.
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OTHER: Software, technical diagram, algorithms, models, etc.

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EXECUTIVE SUMMARY

The aim of Work Package 3 (WP3) in LEADS is to define recommendations to cover the Advanced Digital Skills demand-supply gap identified in the previous data analysis and stakeholder engagement.

For that aim, we run a set of workshops during the first period of WP3 (March 2023-September 2023) and generated a preliminary set of recommendations documented in D.3.1. Preliminary Guidelines. This document, D.3.2 contains the results of the work conducted by WP3 during its second period (October 2023-June 2024). This work effort includes:

1) The development of four workshops aimed to address specific scenarios which emerged both from the results of the demand/supply ADS gap analysis conducted under WP2 (D.2.2 submitted by September 2023) and the preliminary guidelines reported in D.3.1.

2) One high-level policy event orchestrated with the collaboration of the Commission to engage in insightful discussions on the internal and external factors limiting the supply of ADS and provide actionable recommendations to the problem at hand.

The methodology employed to gather the expected recommendations mirrors that used during the initial period of WP3. Workshops were selected as the primary qualitative data collection technique. To analyze the data from these workshops, two qualitative data analysis methods—thematic analysis and content analysis—were utilized to extract pertinent recommendations. Subsequently, an inductive process was applied to synthesize all the recommendations generated throughout WP3, encompassing both the first and second periods. This comprehensive process yielded a set of 54 recommendations, organized into eight distinct recommendation categories, aimed at education and training providers, industry stakeholders, and policymakers.

These recommendations address five key areas:

- Creating a holistic Advanced Digital Skills (ADS) training landscape.
- Defining a comprehensive ADS curriculum that meets industry needs.
- Promoting a flexible ADS delivery schema.
- Facilitating ADS acquisition.
- Fostering the ADS training offering.

From this extensive set, the LEADS consortium has identified ten primary recommendations deemed essential for bridging the ADS supply and demand gap.

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ABBREVIATIONS

ADS	Advanced Digital Skills
AI	Artificial Intelligence
AIOTI	Alliance for the Internet of Things Innovation
BDVA	Big Data Value Association
BI	Business Intelligence
CAGR	Compound Annual Growth Rate
CATI	Computer-Assisted Telephone Interview
CISO	Chief Information Security Officer
EC	European Commission
ECF	e-Competence Framework
EU	European Union
GPU	Graphics Processing Units
HE	Higher Education
HEI	Higher Education Institution
HPC	High Performance Computing
ICT	Information and Communication Technologies
IoT	Internet of Things
IT	Information Technologies
JU	Joint Undertaking
ML	Machine Learning
MS	Member State
MSP	Managed Service Provider
OECD	Organisation for Economic Cooperation and Development
VET	Vocational Education Training
WP	Work Package

1 INTRODUCTION

The Leading Advanced Digital Skills (LEADS) project is responsible for identifying the future Advanced Digital Skills (ADS) demands across Europe and the actions required to support the Digital Decade targets of reaching over 20 million ICT specialists by 2030.

The active and effective role of the different educational actors is crucial to training in digital skills. It can stimulate productivity and improve well-being, as it can empower people to decide what they want to learn, where and when they want to work, and how they get involved in society (OECD, 2019)[1]. In this context, education is a major piece in the supply ecosystem. Education and training are to be considered from different perspectives, higher education and vocational training for the new workforce, as well as re-skilling and up-skilling for the existing workforce.

1.1 WP3 and Deliverable 3.2. Purpose

The aim of LEADS WP3 is to develop a set of flexible guidelines and recommendations that help to address the different challenges identified in WP1. Skills Profiling and WP2. Supply Mapping, which analysed the current and growing demand of ADS, and identified and detailed the expected ADS demand-supply gap. The generation of these guidelines requires the engagement of the different stakeholders involved in the ADS provision, Higher Education Institutions (HEI), vocational training providers, industry, and policy makers. The result of this engagement is not only to provide guidelines and validation, but also to promote and increase awareness in the ICT community on the need to take an active role on the process of ADS talent development. In this sense, WP3.

Ecosystem Formation results have also been disseminated and validated with the SPECIALISED projects[2] through WP4. SPECIALISED Portfolio Management, which acts as bridge to other relevant initiatives in the ADS community. Figure 1 presents an overview of the LEADS work packages, grouped according to their main objective in the project. As can be seen, WP3 is part of the ecosystem engagement block of the project, built over the knowledge generation WPs (WP1 and WP2).

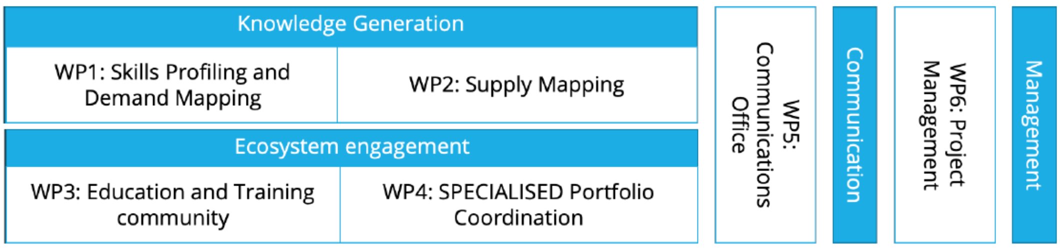

Figure 1. LEADS Work Packages

[1] OECD (2019). OECD Skills Outlook 2019. OECD. https://doi.org/10.1787/df80bc12-en

[2] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/digital-2021-skills-01-specialised;callCode=null;freeTextSearchKeyword=digital-2021-skills;matchWholeText=true;typeCodes=0,1,2,8;statusCodes=31094501,3109450

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WP3 runs from March 2023 to June 2024 and provides two deliverables. D3.1. "First guidelines generated" reported the results of the interactive workshops, held during the first period of WP3 (from October 2023 to August 2023), under Task 3.1. Education & Training. The workshops generated during this period were motivated by the results of WP1 regarding the ADS categorisation (D1.1 and D1.2), and demand and forecast of ADS (D1.3). The first results of WP2 on the supply and gap analysis provided by June 2023 (D2.1) mainly focused on the data analysis methodology, while the detailed results of the gap analysis were provided in D.2.2 (September 2023).

D3.1 presented preliminary recommendations derived from a set of workshops motivated by the analysis of the context in which ADS talent is provided, as well as the results from the ADS demand analysis provided by LEADS project in June 2023. Over twenty recommendations have been formulated for various stakeholders including training providers (HEI, and VET), industry and policy makers. These recommendations primarily focus on strategies to increase the pool of potential for ADS workforce, identifying the ADS content, optimising the delivery methods of such content, and effectively training and retaining proficient ADS trainers. Those results, as well as the detailed results of the gap analysis in D2.2 have motivated and guided the new engagement events organised by WP3 during its second period (from October 2023 to June 2024). The overall results of WP3 consolidating recommendations from D.3.1. as well as the new ones generated during the WP3 second period are reported in this deliverable D.3.2. 'Final Guidelines Report' as result of Task 3.2. Recommendations & Guidelines. Consequently, D.3.2. contains a set of 54 recommendations for policy makers, education providers and industry to contribute to fill the advanced digital skills needed in this rapidly changing technology environment.

D3.2 is structured around several sections. Firstly, section 2 summarises the methodology employed for WP3 to generate the corresponding guidelines, focusing on the second period of WP3. It outlines the method for gathering input and feedback from the involved community in an interactive and dynamic manner, along with the qualitative analysis and synthesis process used to formulate recommendations and guidelines from the corresponding input.

Section 3 begins by revisiting the previous results from LEADS, specifically focusing on the analysis conducted in WP2 regarding the gap between the demand and supply of advanced digital skills. Additionally, it reviews the main outcomes from Deliverable D3.1. These analyses have identified five LEADS topics considered to be of significant importance, warranting further discussion and elaboration. These key topics have led to the formulation of a set of leading questions that have guided the organisation of the workshops held during the latter part of WP3. The section concludes with brief description of these workshops and references their outcomes, which are summarised in the corresponding appendices of this document and posted in the corresponding LEADS site.

Section 4 focusses on the final recommendations derived from the whole WP3, including the results of the workshops organised during the first and second period of the work package. A total of 54 recommendations, grouped around eight recommendation pockets, are organised according to the main topics discussed in Section 3. Such recommendations cover action points for policy makers, education providers and industry.

Section 5 contains the conclusion of this deliverable.

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1.2 Target Audience

This deliverable provides several recommendations. The major actors involved are trainers with special focus on academia, industry participants responsible for human resources and IT managers as well as policy makers.

- The results of this deliverable can be particularly useful for educational IT programmes managers as the recommendations can be directly implemented at programme level. Academics responsible for ADS content can also obtain interesting and practical suggestions in order to improve the learning process of course content.
- The IT industry can also benefit from the recommendations, as they are concerned with skilling, up-skilling and re-skilling of the IT workforce. This deliverable will also help IT industry managers to better face the ADS talent acquisition challenges and to improve this important process.
- A significant number of the recommendations obtained are directly related to policy makers. Overall, the different recommendations will be helpful to make informed decisions about the definition of strategic agendas for education policies, to modify or create new legislative frameworks that improve the ADS training and re-training process, as well as to allocate funding and resources.

1.3 Related Deliverables and Publications

D.3.2. uses the information from D.2.2. Gap Analysis to identify the main findings of the ADS supply/demand study resulting from WP2. These findings will be used to generate the main LEADS topics that will drive the organisation of the workshops during the second period of WP3.

D.3.1. First Guidelines Generated will be used to complement the identification of the main topics already mentioned, as well as to feed the final synthesis process of all the recommendations identified from the first and second periods of WP3.

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2 METHODOLOGICAL APPROACH

Error! Reference source not found. represents the overall approach followed in WP3. As already mentioned, during the first period of WP3, D.3.1. was produced with a preliminary set of recommendations derived from the workshops organised during that period. Those workshops were motivated by preliminary LEADS results as well as a set of scenarios that summarised the ICT education and training context in the EU. During the second period of WP3, we continued using workshops, as data collection tool, to create a forum that encourages dynamic communication and discussion among the different stakeholders in order to obtain, refine and validate recommendations and guidelines. Additionally, the application of workshops served a parallel objective to sensitise key stakeholders to the challenges and opportunities, and provide a vehicle for networking between groups across Member States.

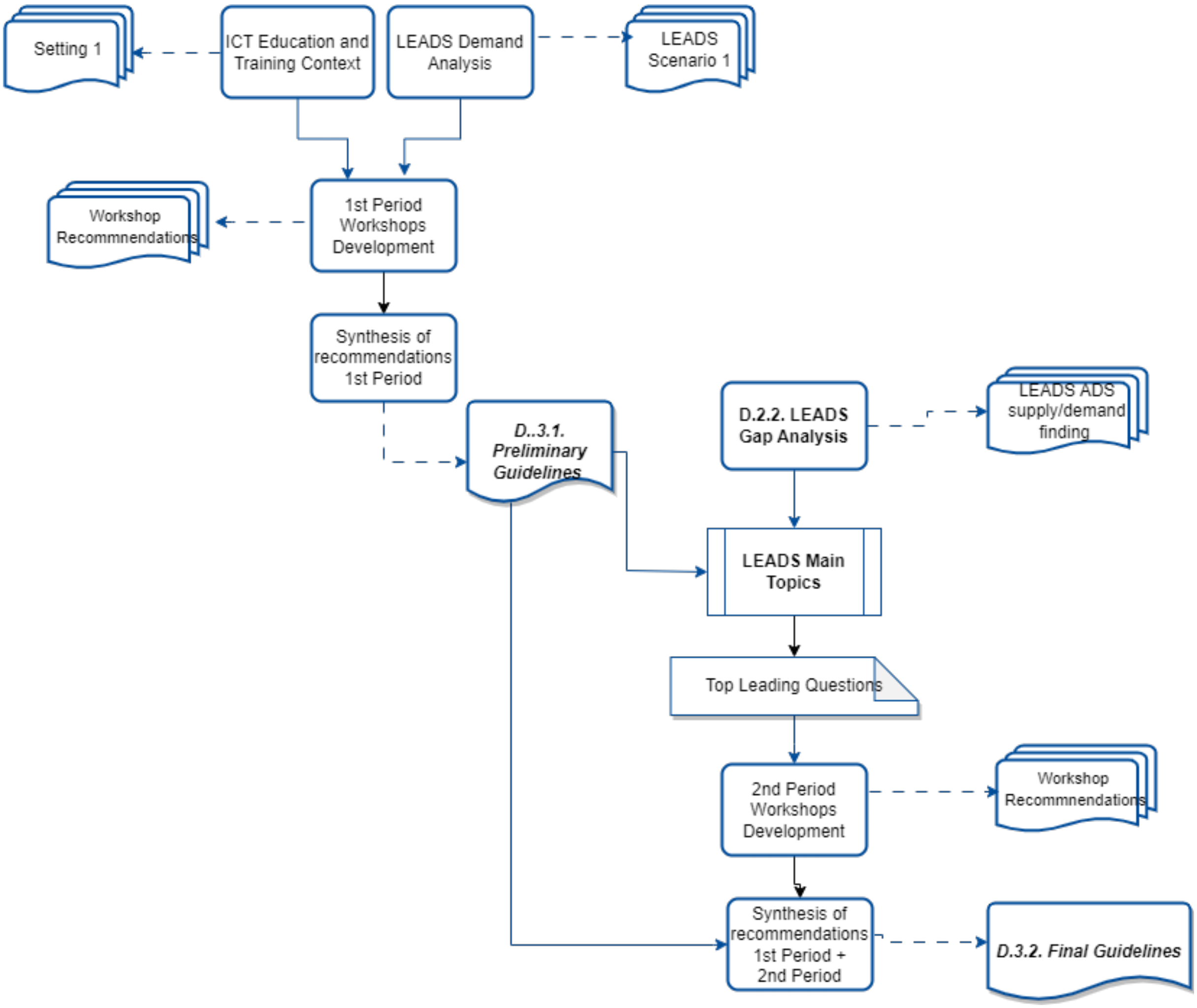

Figure 2. Overall approach applied in WP3

Following on from the gap analysis, the second round of workshops are driven by specific top leading questions, derived from a set of main topics identified by the consortium as hot topics to cover the ADS supply/demand gap. Consequently, five new workshops have been conducted during latter part of WP3, complementing the three workshops held during the first period. This document will contain the consolidation of all recommendations in WP3, both the ones gathered during the first period as well as the ones gathered in the second period.

The analysis of the results from each workshop has helped to identify those crucial aspects to take into account when facing the corresponding leading question. A qualitative analysis process has been conducted on the results of the discussion held during the event. In particular **thematic analysis** guided by open codes[3],[4] and themes has been used to generate a set of recommendations. They have been organised according to the main actor either involved and/or needed to implement them. These actors are education providers, mainly universities and VET providers; demand providers generally represented by industry; and education enablers represented by policy makers.

Finally, a synthesis of the recommendations from all WP3 workshops was conducted to provide a comprehensive view of the results generated within the work package. An **inductive content analysis**[5] was employed to identify the LEADS main topic related to each recommendation. The consolidated categorisation of recommendations has been finally obtained by grouping them based on the objective they address. This categorisation emerged as a result of the synthesis process, following an inductive approach. Overall, this is an iterative process which involves discussions and consensus-building first among WP3 partners and subsequently among all LEADS consortium partners. These results were shared with the ADS community during the LEADS 20X30 Advanced Digital Skills Summit, held in May 2024 in Madrid.

[3] D.S. Cruzes and T. Dyba, "Recommended Steps for Thematic Synthesis in Software Engineering," 2011 Int. Symp. Empir. Softw. Eng. Meas., no. 7491, pp. 275–284, 2011.

[4] D.S. Cruzes, T. Dybå, P. Runeson, and M. Höst, "Case studies synthesis: a thematic, cross-case, and narrative synthesis worked example," Empir. Softw. Eng., vol. 20, no. 6, pp. 1634–1665, 2015

[5] J. F. DeFranco, P. A. Laplante, A content analysis process for qualitative software engineering research, Innovations in Systems and Software Engineering (2017) 1–13

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3 CONTEXT

This section provides the context that motivates the organisation of the different events in the second period of WP3. In that sense, Section 3.1 delves into the most relevant results of the LEADS gap analysis in which supply of ADS is analysed in relation to its expected demand. Section 3.2 summarises the main outcomes gathered from D3.1. Preliminary Set of Recommendations. Both outcomes have been used to generate the LEADS main topics, which highlight the critical issues identified by LEADS as essential to addressing the ADS supply/demand gap, which are described in Section 3.3. The main topics have led to what we have called "top leading questions" that have driven the workshops of the second period of WP3 as described Section 3.4. These top leading questions were further discussed and elaborated upon through their corresponding workshops. **Error! Reference source not found.** illustrates this process.

3.1 LEADS Gap Analysis Findings

D.2.2 LEADS Gap Analysis provided an analytical comparison between the offering of ADS in the EU and the expected demand. On the demand side, LEADS established a framework of definitions and estimated current and **future demand for over 30+ skills pockets, 80+ skills details in six different technology areas** (AI, IoT, Cloud, Cybersecurity, Quantum Computing and Business Intelligence/Data Science). On the supply side, LEADS designed a data collection framework based on the definition of skills and technology areas (the LEADS Framework), analysing over 1100 STEM related ADS courses in Europe from Higher Education institutes (Bachelors and Master programmes), Vocational Education Training (VET) and Third-Party Training providers. The goal of data collection was to understand the presence (or lack thereof) of ADS skills (same skills defined by the demand side) in the European learning landscape, identify which subjects have more presence and where, and those in need of revaluation.

Figure 3 summarises the ADS demand and supply information gathered by LEADSs. The figure represents current and expected workforce (demand forecasting by 2027) within the different technology areas covered by the LEADS framework (AI, BI/Data Science, IoT, Cybersecurity and Cloud). In addition two scenarios, a "low growth" technology scenario and a "high growth" technology scenario are represented. The pink dotted line in the chart represents the estimated coverage in education within HEI, VET and Online combined for each of the technology areas. While technology areas may present a different coverage depending on training modality and course type, the teaching of advanced skills in its totality is still not widespread enough to cater for the substantially high increase in ICT professionals needed by the industry over the next years. D2.2 Gap Analysis provides an extensive analysis on the demand vs supply of the different LEADS technologies. For the shake of this deliverable we will concentrate on the main findings extracted from D2.2:

These findings can be summarised as follows:

- **Extensive ADS training sprectum** (F1): According to estimates from the EC and LEADS, the European industry will need **over 11 million new workers** in ICT to have a chance to close the technology skills gap in the coming years. However, less than half of EU specialised ICT courses currently cover the most emerging advanced skills in their

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curricula. Therefore, it is evident that the demand for ADS must be addressed through a diverse range of training provisions, including university and higher education, VET, in-house company courses, short-term courses, and specialist training programmes. Both short-term actions for upskilling and reskilling, as well as graduates with skills acquired through longer-term education, are required to meet this demand.

- **Holistic higher education, beyond technical proficiency** (F2): According to D2.2, results from the validation workshops indicated that experts believe Higher Education should focus on teaching students not only technical skills, but also soft and transversal skills. For instance, critical thinking and adaptability to rapidly evolving technologies, along with a solid foundation in concepts like AI for continuous learning, are essential. Additionally, transversal skills such as presentation, analytics, and data visualisation are crucial for preparing students for future careers. Addressing the demand for ADS is recognised as a wicked problem, implying that it is a continuously shifting target. Consequently, solutions need to be flexible and adaptable, ensuring that we are not only addressing today's gaps but also building structures, relationships, processes, and systems that can meet the needs of tomorrow.
- **Bidirectional collaboration between industry and higher education** (F3). D.2.2 highlighted that addressing the ADS gap will require collaboration, cooperation, and coordination across various stakeholders and policy areas. For example, the survey and validation workshops underscored the importance of fostering healthy, reciprocal partnerships between industry and education sectors, which does not predicate the dominance of one.
- **Flexible VET and higher education** (F4). D.2.2 emphasised the importance of developing and prioritising adaptable strategies to cater to evolving demands. This includes investing in flexible learning pathways, trustworthy training options, and sector-specific ADS awareness that embraces innovative learning methods. Simultaneously, HE institutions should consider offering short-term programmes and micro-credentials, integrating VET certificates for flexibility, and providing value for employees transitioning between workplaces.
- **Pedagogical Challenges of ADS Skill Development** (F5): As digital skills are inherently practical, applied and creative learning approaches are essential. While the findings indicate that higher education can utilise applied learning methods, theoretical approaches tend to dominate programme design and implementation. Conversely, vocational education may overly focus on applied learning tailored to a specific organisation's use of technology, potentially neglecting the development of broader skill sets. This highlights a significant pedagogical challenge in the development of ADS, which must be addressed to produce the appropriate level of expertise.

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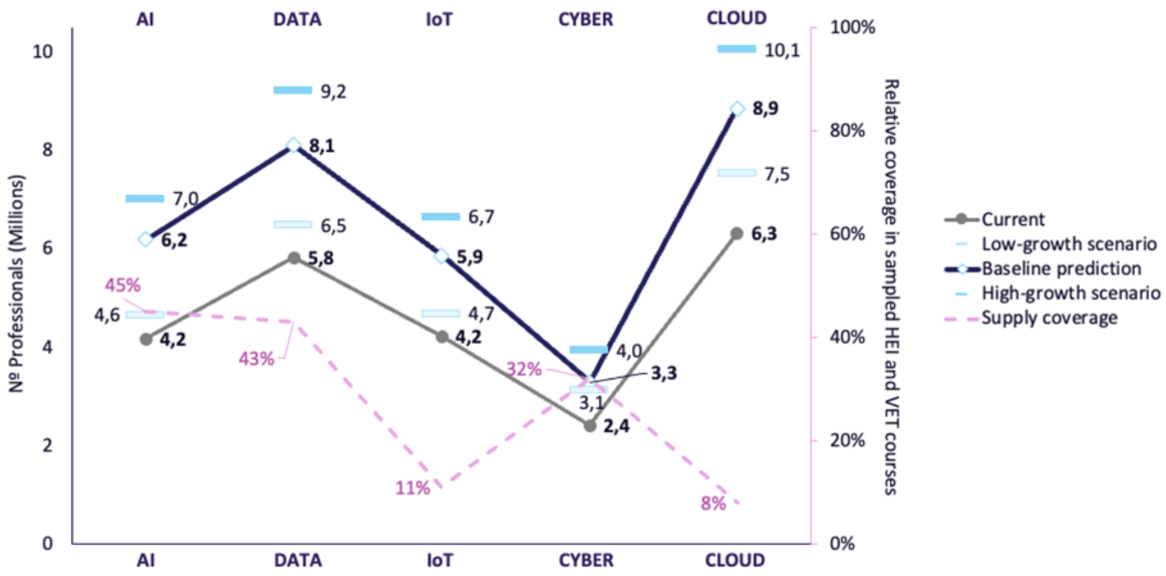

Figure 3. Workforce with ADS including demand predictions for different scenarios

3.2 Preliminary Recommendations from WP3 First Period

D.3.1 describes the preliminary recommendations obtained from the three workshops organised by WP3 during the first period (March 2022-September 2023) of the project. Workshops were run taking as input the contextual situation and the results obtained by LEADS by that time (WP1 and D2.1). The first workshop was specifically oriented to the academia, identifying the challenges for HE to adapt to a dynamic ADS context. The second workshop had as main actor the industrial sector, who discussed about the challenges of organisations to meet the ADS talent. The third workshop explored the role of the different stakeholders in delivering the required ADS skills.

As a result of those workshop we concluded that the strategy to be followed should concentrate in the following areas:

- **Attraction of STEM and ICT students.** Attracting a relevant pool of students potentially interested in ICT areas is crucial to address the expected gap in ADS. The three workshops held on this topic emphasised that attracting STEM students primarily focuses on primary and secondary education. Specific actions were discussed to create awareness among teachers at these levels and to motivate students effectively.
- **Identification of the proper ADS knowledge to be provided at the different levels of ADS education and training**. There was a consensus on the importance of industry developing a strategic plan to articulate their requirements in terms of ADS. This plan can serve as a foundation for defining the knowledge to be imparted by various training providers. By aligning industry needs with educational offerings, this strategic approach ensures that training programmes effectively address the demands of the evolving digital landscape.
- **Definition of the most adequate approaches to provide ADS knowledge.** Various initiatives for skilling, upskilling, and reskilling in ADS were discussed, encompassing both VET programmes and official bachelor's and master's courses. For instance, there was deliberation on creating official programmes through collaboration among

multiple universities or integrating existing courses to alleviate the anticipated workload on trainers. The necessity to make education and training more agile and responsive to industry demands in ADS was a focal point. Specific issues addressed included the need for an agile accreditation process and the establishment of mechanisms for industry-university collaboration. These discussions aimed to ensure that educational offerings remain closely aligned with the evolving needs of the industry in the field of ADS.

- **Attraction and retention of the adequate trainers.** Ensuring a sufficient pool of ADS trainers is paramount. Thus, discussions during the initial period emphasised the need to train trainers and motivate them to remain within the academic realm. This initiative aims to cultivate a skilled cadre of educators capable of effectively imparting ADS knowledge and ensuring the continuity of high-quality education in this rapidly evolving field.
- **Fostering the industry role in ADS talent acquisition.** An engaging discussion took place concerning the proactive involvement of industry in the ADS talent production process. Participants highlighted the importance for industries to establish a skills strategy within their organisations, incorporating pathways for practitioner training. Moreover, there was a recognition of the imperative to strive for gender balance in these initiatives. By actively participating in talent development, industries can contribute to shaping a skilled workforce that meets the evolving demands of the digital landscape while promoting diversity and inclusion.

3.3 LEADS Main topics

The results discussed in the previous sections have highlighted five main topic of special interest for LEADS.

- **Holistic ADS training landscape**: Meeting the demand for ADS necessitates a multifaceted approach to training, incorporating diverse avenues such as HE, VET, in-house company courses, short-term courses, and specialist training programmes. Therefore, both skilling, upskilling, and reskilling are imperative to bridge the ADS gap effectively. However, it is crucial to clearly define the skills to be provided at each level of training. Additionally, flexible pathways for transitioning among these levels are essential to accommodate the evolving needs of individuals and industries in the rapidly changing digital landscape.
- **Comprehensive and flexible ADS body of knowledge to cope with highly evolving skills**: Delivering effective ADS training necessitates the precise identification of the knowledge required for ADS professionals. This preparation is crucial to enable them to adeptly tackle diverse industrial projects requiring ADS expertise, collaborate effectively within various teams, and be equipped to embrace continuous learning throughout their careers.
- **Effective ADS delivery**: Ensuring effective ADS training also entails careful consideration of the most impactful training methods. Additionally, special attention must be given to the availability and training of ADS trainers. Their proficiency is pivotal in delivering high-quality training that effectively equips learners with the necessary skills and knowledge in the rapidly evolving field of ADS.

- **Supporting/facilitating ADS acquisition**: Efforts are imperative to ensure accessibility to ADS training for individuals who desire or require it. This entails implementing initiatives and programmes that remove barriers to entry and provide opportunities for individuals to access the necessary training, regardless of their background or circumstances.
- **Fostering the ADS training offer**: Expanding the range of available ADS training offerings is essential to meet the anticipated demand for ADS skills. By diversifying the training options and increasing their availability, we can better address the growing need for skilled professionals in the digital domain.

		LEADS Main Topics				
		Holistic ADS training landscape	Comprenhensive and flexible ADS body of knowledge	Effective ADS delivery	Fostering the ADS training demand	Fostering the ADS training offer
LEADS **Gap Analysis**	Extensive ADS training spectum	X		X		X
	Holistic HE		X		X	
	Bidirectional collaboration industry HE		X	X	X	X
	Flexible VET and HE	X		X	X	X
	Pedagogical challenges of skills dev.			X		
LEADS Preliminary Recommendations	Attraction of STEM and ICT students				X	
	Identification of the proper ADS knowledge		X			
	Definition of learning approaches			X		
	Attraction retention of ADS trainers			X		X
	Fostering industry's role	X	X	X	X	X

Table *1* shows these topics as well as its relation with the previous LEADS work.

		LEADS Main Topics				
		Holistic ADS training landscape	Comprenhensive and flexible ADS body of knowledge	Effective ADS delivery	Fostering the ADS training demand	Fostering the ADS training offer
LEADS Gap Analysis	Extensive ADS training spectum	X		X		X
	Holistic HE		X		X	
	Bidirectional collaboration industry HE		X	X	X	X
	Flexible VET and HE	X		X	X	X
	Pedagogical challenges of skills dev.			X		
LEADS Preliminary Recommendations	Attraction of STEM and ICT students				X	
	Identification of the proper ADS knowledge		X			
	Definition of learning approaches			X		
	Attraction retention of ADS trainers			X		X

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	Fostering industry's role	X	X	X	X	X

Table 1. Relationship between LEADS main topics and previous LEADS results

3.4 LEADS Top Leading Questions

The topics identified in the previous section lay the roots of the top leading questions that have been addressed in the second period of WP3. In order to solve these questions a series of workshops focused in each one were conducted. As described in Section 2, each question has guided the organisation of a workshop focused on providing specific answers and action points that contribute to addressing it.

The top leading questions are briefly discussed below.

- **How can we design a comprehensive strategy to allow integration across pathways in VET and HE courses? (LQ1)**

  Even when up-skilling and re-skilling will take a relevant role in ADS talent provision, HE and VET will need to provide the bulk of the training required. To ensure that demand is adequately covered, alignment and cooperation between both domains are essential. HE provides long-term programmes based on well-founded knowledge and prepare the students with learning skills for a quick adaptation. On the other hand, VET graduates are trained through shorter programmes in very specific, practical and up-to date problems ideally driven by industry demand. Additionally, graduates will need to improve and develop new skills during their professional road for which VET offer will be essential. In sum, the strategy to align both domains needs to be defined to include dynamic industry demands and to provide a holistic framework for ADS learning.

- **How can education and training meet demands for advanced digital skills? (LQ2)**

  Development of curricula that remains adaptable and relevant in the face of rapid technological evolution. Additionally, previous result have highlighted the need for embedding real-world, problem-solving abilities into the curriculum to better prepare students for the challenges they will inevitably encounter once they transition into the workforce. The role of industry in this process is essential both as identifiers of ADS needs as well as, as real world experience providers to improve the students learning process.

  Meeting these challenges also requires innovative learning strategies to provide learners with an experience that combines theoretical knowledge and practical skills training. This is the aim of this top leading question, to go deeper in the identification of specific solutions to provide students a comprehensive ADS training.

- **How to ensure the availability of appropriately recognised micro-credentials, short-term course and online learning options to meet industry and learner demands? (LQ3).**

  The concept of micro-credentials has arisen in WP3 and WP2 as a key element to cover the existing industry demand of ADS. The dynamic evolution of ADS knowledge requires a continuous and lifelong learning up-skilling and re-skilling process. Additionally, the provision of micro-credentials integrated into university programmes

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will contribute to provide students with the recognition of their knowledge prior to their final degree. The challenge is how to define those micro-credentials so as the knowledge acquired during this process is recognised by industry and, on the other hand how to make it available in a flexible way so practitioners can combine their professional practice with the learning process. This top leading question will provide a deep analysis of these topics.

- **How can Generative AI revolutionise ADS Curriculum Development and Learning Support Systems, propelling education into a new era? (LQ4)**

  The limited resources in education, and in particular the lack of ADS teaching talent, is one of the existing challenges already discussed in LEADS. In this context, new innovative learning methods need to be used to teach ADS knowledge in an efficient way. The use of AI and in particular, generative AI in education was gaining attention as an innovative learning method with a huge potential. However, important challenges such as bias in training data, ethical considerations, and the need for careful implementation need to be considered when applying this tool. The answer to this top leading question is intended to provide insights to this issue.

- **Is it possible for universities to overcome structural challenges and barriers to respond to the needs of advanced digital skill development? Is there a role for policy to support reforms in the HEI sector or change the expected roles for universities? (LQ5)**

  Universities play a crucial role in the effort to cover the ADS demand. They have a relevant pool of workforce, knowledge and infrastructures to face skilling in a trusted way motivated by academic excellence. However, as already discussed during the LEADS project, they also have a rigid structure and are guided by strict administrative and regulatory rules, both at national and at regional level. These controls limit HEs flexibility to quickly adapt to the ADS dynamic changes and knowledge, as well as to define the required collaboration with industry and other training providers. This top leading question raises the existing challenges faced by universities to this respect in search of potential ways to overcome such challenges in a flexible way.

Table 2 shows the relationship between such questions and the main topics discussed in Section 3.3.

	LEADS Main Topics				
Top Leading Question (second part WP3)	Holistic ADS training landscape	Comprehensive and flexible ADS body of knowledge	Effective ADS delivery	Fostering the ADS training demand	Fostering the ADS training offer
How can we design a comprehensive strategy to allow integration across pathways in VET and HE courses?	X		X	X	X
How can education and training meet demands for advanced digital skills?	X	X	X	X	X
How to ensure the availability of appropriately recognised micro-credentials, short-term courses and online learning options to meet industry and learner demands?		X	X	X	X
How can Generative AI revolutionize ADS Curriculum Development and Learning Support Systems, propelling education into a new era?		X	X		X
Is it possible for universities to overcome structural challenges and barriers to respond to the needs of advanced digital skill development? Is there a role for policy to support reforms in the HEI sector or change the expected roles for universities?	X	X	X	X	X

Table 2. Relationship between LEADS main topics and Top Leading Questions (second part of WP3)

A summary of the different workshops developed during the second part of WP3 are provided in the appendixes and the corresponding workshop report is available through the LEADS web site. In Table 3 one can find information regarding each leading question, the workshop conducted, and the appendix in which it is summarized together with the link to the web where the workshop full report is published.

Leading Question	Workshop title	Appendix
How can we design a comprehensive strategy to allow integration across pathways in VET and HE courses?	Empowering Tomorrow's workforce bridging the digital skills gap through higher education (WS4)	Appendix A
How can education and training meet demands for advanced digital skills?	Advanced digital skills: meeting the education and training challenges (WS5)	Appendix B
How to ensure the availability of appropriately recognised micro-credentials, short-term courses and online learning options to meet industry and learner demands?	VET-Oriented reskilling in the domain of ADS Leveraging Micro-credentials and MOOCs (WS6)	Appendix C
How can Generative AI revolutionize ADS Curriculum Development and Learning Support Systems, propelling education into a new era?	Gen AI in University Education (WS7)	Appendix D
Is it possible for universities to overcome structural challenges and barriers to respond to the needs of advanced digital skill development? Is there a role for policy to support reforms in the HEI sector or change the expected roles for universities?	Clearing the Path to the Digital Decade (WS8)	Appendix F
URL	https://advancedskills.eu/ https://zenodo.org/communities/leadsinitiative/records?	

Table 3 LEADS Top Leading Questions and their corresponding Workshops

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4 KEY RECOMMENDATIONS AND GUIDELINES

4.1 Synthesis of recommendations

LEADS recommendation have been the result of multiple iterations of discussion of the consortium partners in order to end with a validated and consolidated view. In each iteration the following criteria have been used:

- **Representativeness**: Recommendation pockets clustering individual recommendations aimed at contributing to such pocket aim have been identified following an inductive content analysis process, as described in Section 2.
- **Meaningfulness**: Individual recommendations were evaluated to ensure their significance, with each being supported by evidence from at least one workshop.
- **Consensus**: Agreement among WP3 partners was reached regarding the topic, main actor, and pocket of each recommendation.
- **Temporal Applicability**: Discussions were held to determine whether recommendations were short-term (implementable within about one year) or mid-term (requiring one to three years for implementation), considering the effort and requirement for their implementation.
- **Impact**: The impact of each recommendation on addressing the ADS supply/demand gap—whether high, medium, or low—was assessed and agreed upon.
- **Principal Recommendations**: A set of primary recommendations was identified and agreed upon as key contributors to address the ADS supply/demand gap.

By adhering to these criteria, we aimed to ensure that our recommendations are robust, actionable, and impactful in addressing the challenges posed by the ADS supply/demand gap.

Figure 4 summarizes the resulting recommendations. They have been organised around the already mentioned LEADS topics. On the other hand, in most recommendations, actors of different categories (policy makers, education providers or industry) are involved. For the purpose of this deliverable, we have organised the recommendations according to the main actor, which is the stakeholder who has the major role in the implementation of the recommendation, even when the participation of other roles might be crucial to perform it satisfactorily.

Figure 4 also shows with double background the recommendation pockets. Note that one pocket might be addressed under different topics and different actors, so it might be repeated in Figure 4.

The following sections elaborate on the specific recommendations under each topic, cluster, and main actor. For clarity and traceability, we have utilized various icons to denote their properties, as depicted in Table 4. Additionally, each recommendation is accompanied by a reference to the WP3 workshop or workshops from which it was gathered. These workshops include both those conducted during the first period (WS1, WS2, WS3) and the second period (WS4, WS5, WS6, WS7, and WP8). This approach ensures transparency and facilitates traceability of each recommendation to its source workshop(s).

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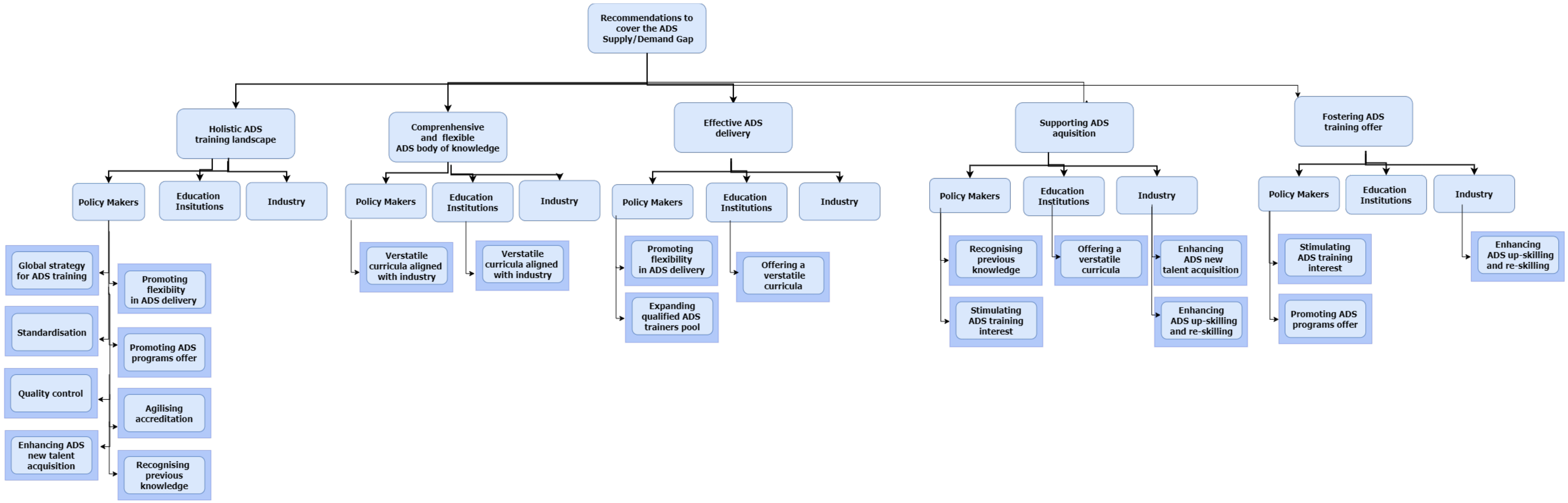

Figure 4. Recommendation pockets grouped by LEADS topic

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Impact Assessment	
Low	
Medium	
High	
Temporal Applicability	
Short-term	
Middle-term	
Relevance	
Primary recommendation	★★★

Table 4. Recommendations icons

4.2 Primary Recommendations

A total of 51 recommendations have been identified from the work conducted in WP3. Table 5 summarises the number of recommendations identified by topic, distinguishing between primary and secondary recommendations. Primary recommendations are those collectively agreed by the partners as actions with higher impact on the ADS gap.

LEADS Topic	Primary recommendations	Secondary recommendations
Holistic ADS training landscape	3	16
Comprehensive and flexible ADS body of knowledge	3	4
Effective ADS delivery	1	8
Fostering the ADS training demand	1	10
Fostering the ADS training offer	2	3
	10	41

Table 5. Number of recommendations by topic and relevance

Table 6 provides a summary of the primary recommendations, which encompass all the LEADS topics and involve key stakeholders including policymakers, education providers, and industry representatives. These recommendations serve as pivotal focal points for addressing the challenges posed by the ADS gap comprehensively.

Below we briefly discuss the primary recommendations according their topic.

- **Holistic ADS training landscape**. The first recommendations in Table 5 address the creation of a holistic ADS training landscape. They offer a comprehensive approach to fostering ADS training within a dynamic educational landscape. Firstly, the call to regulate and promote flexible ADS training pathways—bridging HEIs and VET—reflects a crucial step towards accommodating diverse learner needs. This initiative encourages seamless transitions between educational levels and disciplines, fostering a transdisciplinary and interprofessional ethos. For instance, enabling VET students to progress into universities or facilitating Humanities graduates' specialisation in ICT underscores the importance of adaptable educational routes.

  Secondly, the emphasis on periodic assessment of ADS training initiatives is essential for maintaining educational relevance and industry alignment. Regular assessments

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ensure that training programmes evolve with technological advancements and global industry demands. By periodically evaluating training content, institutions can proactively adjust curricula to equip learners with cutting-edge skills and competencies.

Lastly, advocating for the creation of frameworks that recognise and value micro-credentials is essential. These systems should ensure recognition and value of skills across educational institutions and industries. This requires a collaboration to ensure alignment between skill acquisition and industry demands, promoting workforce agility and responsiveness to evolving needs. By implementing such frameworks, individuals can effectively leverage their micro-credential-acquired skills in diverse contexts, enhancing their employability and contributing to economic growth. This initiative signifies a strategic partnership between government entities and industry players to bridge the gap between education and employment, facilitating a smoother transition for individuals.

- **Comprehensive and flexible ADS body of knowledge**. Three primary recommendations have also arisen in relation to the creating of a flexible curriculum aligned with industrial needs. This aim requires on proactive measures involving education providers both in HEI and VET. By preparing curricula based on industry skill profiles and establishing feedback loops with industry through Advisory Boards, educational institutions can adjust their programs to ensure responsiveness to evolving workforce needs, while providing students with the right skills for a long learning path. Strong collaborations with industry provide valuable insights into current and emerging requirements, enabling the development of ADS training that directly address practical job market needs. Regular feedback from industry professionals facilitates timely adjustments to course content and delivery methods, enhancing the effectiveness and applicability of skills-focused education.

  Learners need to be equipped with the practical competencies sought after by employers. By integrating guest lectures, real-world projects, case studies, and simulations into the curriculum, educational institutions can ensure that learners acquire practical skills directly transferable to their professional roles. Guest lectures from industry experts provide first-hand insights and experiences, bridging the gap between theory and practice. Real-world projects and case studies offer opportunities for students to apply theoretical knowledge in practical scenarios, enhancing their problem-solving abilities and critical thinking skills. Simulations simulate real-world environments, allowing learners to practice skills in a controlled setting. Therefore, by emphasising hands-on application, educational institutions can effectively prepare students for the challenges and demands of the modern workforce, ensuring their readiness and relevance in the professional landscape.

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LEADS topic	Main actor	Recommendation	Description	Source	Impact	Time
Holistic ADS Training Landscape	Policy Makers	Regulate and promote flexible ADS training pathways	Allow and define flexible pathways between HEI and VET inter level, transdisciplinary and interprofessional (e.g., VET students continue studies in university, holders of a degree in Humanities to ICT specialization, etc.)	WS4 WS5 WS8		
		Define periodic assessment of ADS training initiatives	Those assessments ensure that the training content remains current, relevant and aligned with global industry needs	WS4 WS6		
		Create frameworks that facilitate the seamless transferability of skills acquired through micro-credentials	Governments can collaborate with industry stakeholders to establish systems that recognize and value micro-credential-acquired skills across educational institutions and industries.	WS6		
Comprehensive and flexible ADS body of knowledge	Education providers	Implement a skills-focused education	Prepare curricula to address the corresponding skill-focus profile to which industry is moving. Establish a continuous feedback loop with industry for curriculum definition (use Advisory Boards as tools to drive such collaboration).	WS5		
		Foster strong collaborations with industry partners	Collaborations provide valuable insights into current and emerging needs, establishing a feedback loop with industry professionals. Regular input ensures that ADS training aligns with job market requirements, offering ongoing assessment of programme relevance and effectiveness. This feedback aids in timely adjustments to course content and delivery methods.	WS1 WS2 WS4 WS5 WS6		
		Design courses with a strong emphasis on practical, hands-on application	Include guest lectures, real-world projects, case studies, and simulations to ensures that learners acquire practical skills that are directly transferable to their professional role.	WS1 WS4 WS5 WS6		
Effective ADS delivery	Policy Makers	Promote a learner centered delivery approach	Knowledge needs to be provided in a more agile way and in a learner centred delivery structure. For example, online classes, weekend courses, afternoon courses, hybrid/blended courses, are also options to be considered to allow learners to access courses.	WS5 WS6		
Fostering ADS training demand	Industry	Implement incentives for lifelong learning: Rewards upskilling and reskilling	Encourage employers to value ongoing ADS development, creating a culture that recognizes and rewards individuals who proactively engage in upskilling and reskilling initiatives	WS5 WS6		
Fostering ADS training offer	Policy Makers	Provide incentives for micro-credential programmes creation.	Provide incentives, such as grants or tax benefits, to educational institutions engaged in developing innovative and industry-relevant micro-credential programmes.	WS6		
		Urge the national governments to support universities to target short-cycle tertiary ADS programmes and re-skilling masters.	These funds should be additional to the funds currently devoted to skilling and up-skilling	WS1		

Table 6. WP3 Principal recommendations

- **Effective ADS delivery**. In order to promote a learner-centred delivery approach it is essential being able to offer knowledge in agile formats that prioritise the needs and preferences of learners. Options like online classes, weekend courses, afternoon sessions, and hybrid/blended formats accommodate diverse schedules and learning styles, ensuring a more inclusive, accessible and effective ADS delivery.
- **Fostering ADS training demand**. Industry has also been identified with a major role to support and facilitate the acquisition of ADS, in particular implementing incentives for lifelong learning. By encouraging employers to value ongoing ADS development and recognize individuals who engage in upskilling and reskilling initiatives, a culture of continuous learning is fostered. This approach not only motivates employees to enhance their skill sets but also aligns organisational goals with the dynamic demands of the digital landscape. Recognizing and rewarding lifelong learning initiatives contributes to a skilled and adaptable workforce, ultimately benefiting both individuals and the industry as a whole.
- **Fostering ADS training offer**. Finally, two primary recommendations have been identified in order for policy makers to enhance the ADS training offer. Urging national governments to allocate additional funds to universities for delivering short-cycle tertiary ADS programmes and Re-Skilling Masters enables universities to expand their offerings and meet evolving industry demands effectively, ensuring that education remains responsive and relevant in the rapidly changing digital era. Allocating additional resources specifically for these initiatives reflects a commitment to prioritising advanced digital skills development.

  In addition, the particular case of micro-credentials is addressed by incentivising the creation of micro-credential programmes by offering grants or tax benefits to educational institutions, either HEI or VET providers. By providing tangible incentives to educational institutions, policy makers encourage the development of innovative and industry-relevant micro-credential offerings. This approach fosters flexibility and responsiveness in training, enabling institutions to swiftly address emerging digital skill demands with targeted programmes.

Below we present in detail the individual recommendations related to each LEADS topic.

4.3 Holistic ADS Training Landscape

Figure 5 summarises the recommendation pockets and the individual recommendations that contribute to create a holistic ADS training landscape. As expected, the main role in this topic are policy makers who must promote and create the adequate context so ADS training is addressed as a whole.

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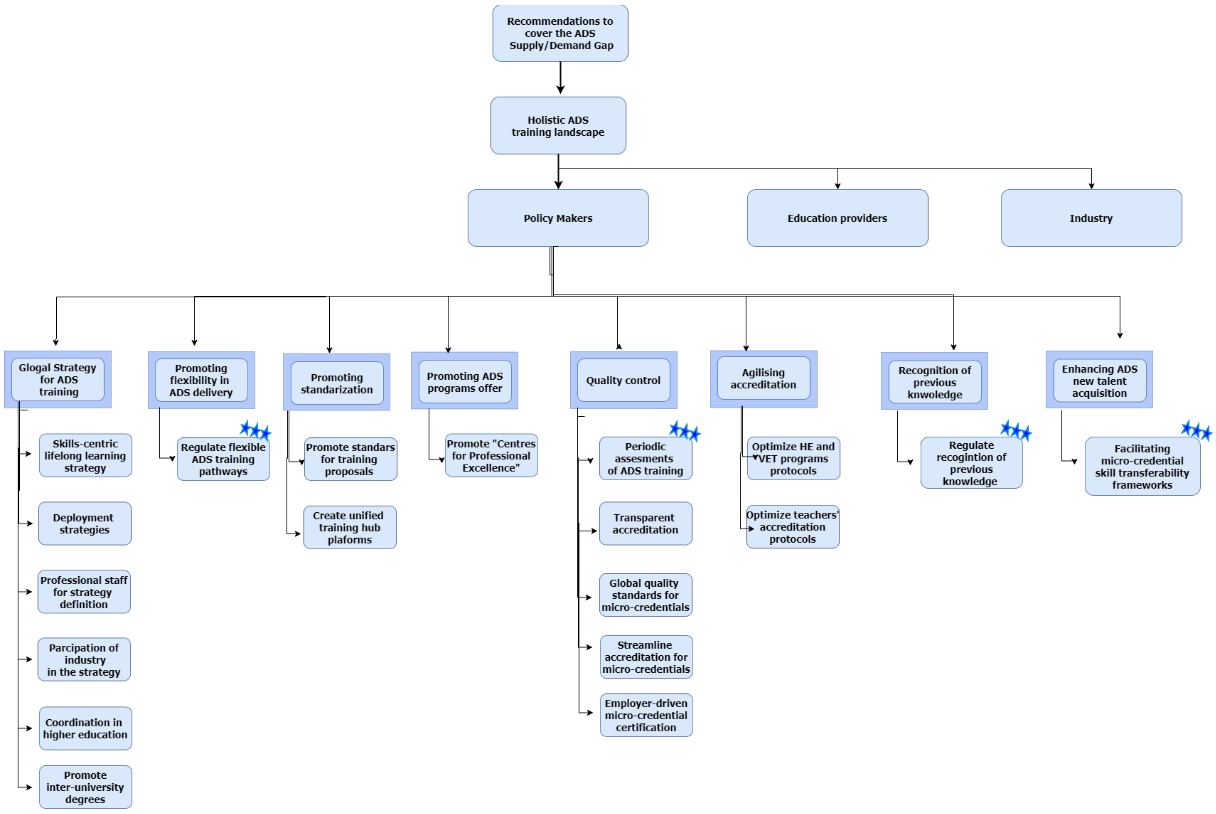

Figure 5 Recommendations contributing to the topic: Holistic ADS Training Landscape

4.3.1 Policy Makers

Next tables provide a brief description of each of the individual recommendations related to the Holistic ADS Training Landscape topic, grouped by recommendation pocket.

Global strategy for ADS training

Recommendation	Description	Workshop	Impact	Time frame
Create a strategy that reflects a transition to a skills-focused education promoting lifelong learning.	Universities and education authorities need to promote a transition to a skills-focused education and reflect it in their strategy and programmes. This transformation should focus on skilling but also on up-skilling and re-skilling. The ADS profiles targeted in each training provider along with the specific ADS and transversal knowledge to be provided at the different educational levels of each institution, including traditional Bachelor and Masters programmes with other short-duration courses needs to be defined.	WS1 WS3 WS5		
Ensure that educational institutions include deployment strategies.	The educational institution strategy must include not only contents to be taught, but also deployment strategies, including staff training. -	WS4		
Ensure that educational institutions provide professional and dedicated staff to manage aspects like strategy, innovation, and cooperation.	Innovation is not linear and professionalisation is needed in institutions. Ensure that schools and universities employ skilled and committed personnel to oversee strategy, innovation, and teamwork.	WS4		

Promote the collaboration of industry in the definition of the educational strategy.	Promote the creation of Advisory Boards in educational institutions. Such boards should be integrated by industry representatives, which provide advice on the different ADS contents according to the expected ADS demand. This advisory boards are essential both in HE as well as vocational training.	WS1 WS2		
Design and implement collaboration and coordination for higher education as a whole (HEI and VET)	View HEI and VET in an integrated way by establishing more formal and informal coordination mechanisms between higher education and vocational education and training to facilitate whole-system responses to emergent challenges such as ADS.	WS4 WS5 WS8		
Promote inter-university graduate and post-graduate official degrees.	There should exist collaboration between HEIs for ensuring adequate coverage in a particular area, taking advantage of the expertise of all universities in the area. European programmes could help in this task, although it is important to analyse the impact of EU investments in programmes like Erasmus Mundus and the like, to confirm that they are the seed for stable programmes.	WS1		

Promoting Flexibility in ADS Delivery

Recommendation	Description	Workshop	Impact	Time frame
Regulate and promote flexible ADS training pathways. ★★★	Allow and define flexible pathways between HEI and VET inter level, transdisciplinary and interprofessional (e.g., VET students continue studies in university, holders of a degree in Humanities to ICT specialization, etc.). (WS4) (WS5). High medium	WS4 WS5 WS8		

Recommendation	Description	Workshop	Impact	Time frame
Provide standards for training proposals.	Standard templates that ensure that all training proposals share the same information, allowing offer assessment, comparison, publicity and recognition by the different stakeholders.	WS4		
Create unified training hub platforms.	Common access points for available ADS training according to different profiles. Existing Regional/National/EC initiatives can be used for this purpose by federating proposal sites automatically (that could also be hierarchical – region, national, European, …) and, therefore, creating an efficient and simple way of inserting the information in the site. It is also possible to use these sites for other purposes: demand from companies, free recorded courses, etc.	WS4		

Promote ADS Programmes Offer

Recommendation	Description	Workshop	Impact	Time frame
Promote "Centres for Professional Excellence"	Centres for Professional Excellence can be considered as specialised entities within universities or universities of applied science, dedicated to providing short-cycle tertiary ICT programmes and ICT re-skilling masters. They would serve as a catalyst to foster collaboration between universities and companies, enabling a focused and concerted effort to optimize and share resources. Its regulations, especially regarding the contracting, must have the same flexibility as a company, having most teachers an industrial background..	WS4		

Quality Control

Recommendation	Description	Workshop	Impact	Time frame
Define periodic assessment of ADS training initiatives ★★★	Those assessments ensure that the training content remains current, relevant and aligned with global industry needs	WS4 WS6		
Promote transparency in the accreditation process	Promote transparency by providing clear and accessible information about the accreditation process, criteria, and outcomes. This transparency builds trust among learners, employers, and educational institutions, enhancing the perceived value training. WS6-G – Medium Mid	WS6		
Define global quality standards for microcredentials.	Promote collaboration among educational institutions, industry representatives, and accreditation bodies to develop comprehensive frameworks that define global and universal quality standards for micro-credential programmes.	WS6		
Streamline Accreditation for Micro-Credentials	Establish international dedicated accreditation bodies specifically focused on micro-credentials. These bodies can develop expertise in evaluating the unique characteristics of micro-credential programmes and contribute to the refinement of accreditation models tailored to this educational format, addressing legal and regulatory challenges that hinder the recognition of micro-credentials	WS5 WS6		

Make accreditation more flexible

Recommendation	Description	Workshop	Impact	Time frame
Optimize higher education and vocational training programmes protocols.	Revise higher education and vocational training programmes accreditation protocols. Capture essential quality requirements and Trust high reputational institutions to create efficient and responsive accreditation processes	WS1 WS4 WS5 WS8		
Optimize teachers' accreditation protocols	Improve the agility of teachers' accreditation protocols. Accreditation agencies and governing rules need to be more flexible in the requirements and certification process of teaching staff because experts (whenever they come) are always welcome	WS1 WS5		

Recognition of prior learning

Recommendation	Description	Workshop	Impact	Time frame
Regulate, when possible, the recognition of prior knowledge for learners ★★★	Recognise previous courses in cooperation with companies, research institutions, other universities and vocational education centres. Recognition of prior learning by universities would facilitate engagement of learners for re-skilling and up-skilling.	WS4 WS5 WS6		

Enhancing ADS new talent acquisition

Recommendation	Description	Workshop	Impact	Time frame
Create frameworks that facilitate the seamless transferability of skills acquired through micro-credentials ★★★	Governments can collaborate with industry stakeholders to establish systems that recognize and value micro-credential-acquired skills across educational institutions and industries. WS6- Mid Term-	WS6		

4.3.2 Education Providers

No recommendations have been identified for these actors under the corresponding topic.

4.3.3 Industry

No recommendations have been identified for these actors under the corresponding topic

4.4 Comprehensive and Flexible ADS Body of Knowledge

Figure 6 shows the recommendations that contribute to provide a comprehensive and flexible ADS body of knowledge. As expected, the most relevant actor in this context are ADS education providers, as they are the main roles in the final definition of the knowledge to be provided. It is however worth noting the role of policy makers in the promotion of GenAI research to develop and improve ADS syllabus.

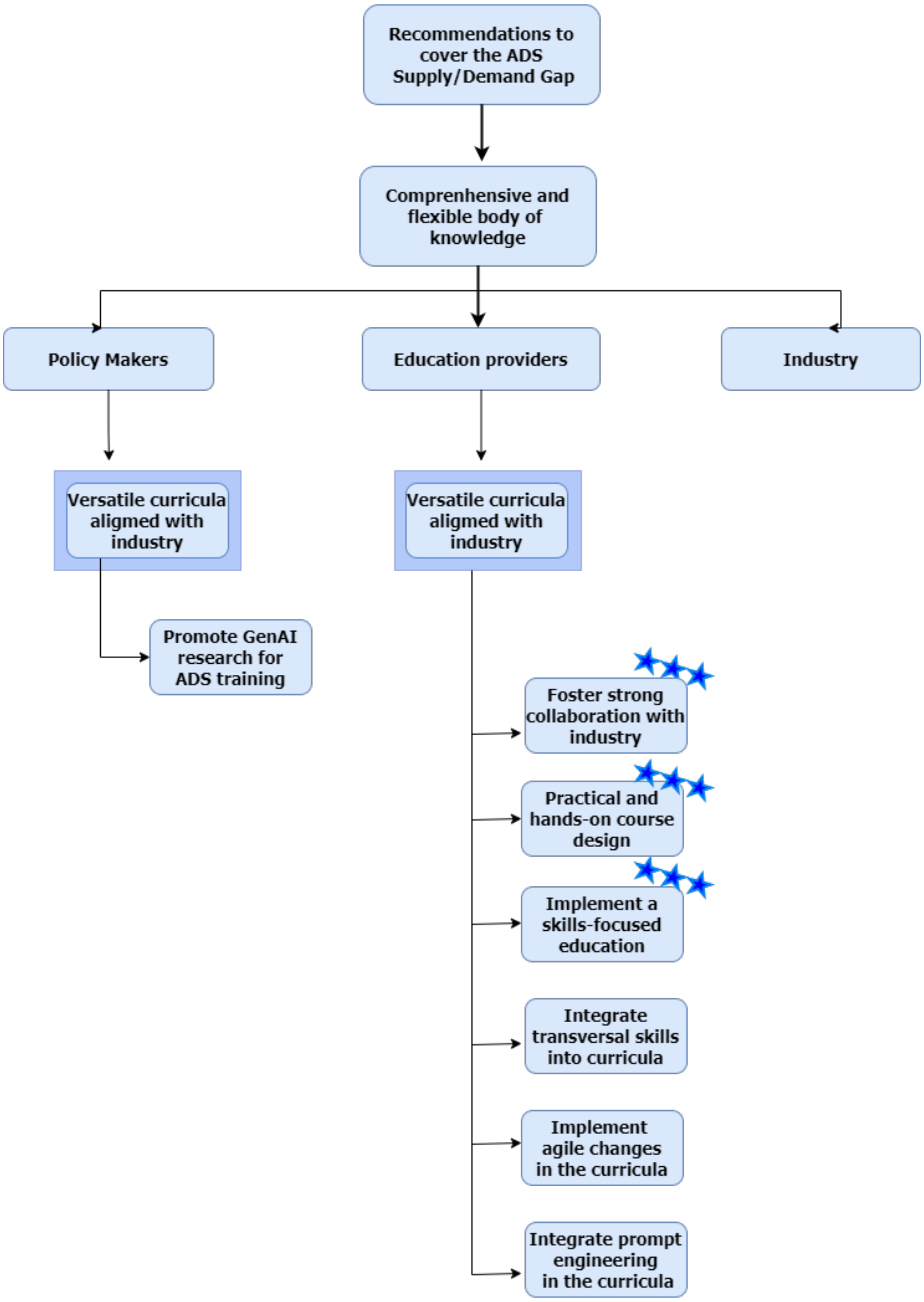

Figure 6. Recommendations contributing to the topic: Comprehensive and Flexible Body of Knowledge

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The next subsections detail these recommendations for each actor according to its corresponding cluster.

4.4.1 Policy Makers

Offering a versatile curricula aligned with industry needs

Recommendation	Description	Workshop	Impact	Time frame
Enhance EU Investments in Generative AI Research for University Education.	Generative AI remains under-researched in educational contexts, with limited established best practices for its use. Filling this gap is essential to understand and harness AI's potential not only in customizing student learning experiences but also in aiding professors by streamlining the preparation of teaching materials and assessments. The research should also consider the ethical use of AI in education.	WS7		

4.4.2 Education Providers

Offering a versatile curricula aligned with industry needs

Recommendation	Description	Workshop	Impact	Time frame
Implement a skills-focused education ★★★	Prepare curricula to address the corresponding skill-focus profile to which industry is moving. Establish a continuous feedback loop with industry for curriculum definition (use Advisory Boards as tools to drive such collaboration).	WS5		
Foster strong collaborations with industry partners ★★★	These collaborations allow to gain valuable insights into current and emerging needs establishing a continuous feedback loop with industry professionals. Regular input from industry professionals ensures that micro-credentials are aligned with the practical requirements of the job market. They can provide ongoing input on the relevance and effectiveness of micro-credential programmes. Regular feedback helps in making timely adjustments to course content and delivery methods	WS1 WS2 WS4 WS5 WS6		
Design courses with a strong emphasis on practical, hands-on application ★★★	Include guest lectures, real-world projects, case studies, and simulations to ensures that learners acquire practical skills that are directly transferable to their professional role	WS1 WS4 WS5 WS6		
Integrate Transversal Skills into Digital Education Curricula	Incorporate transversal skills, such as communication, team working, problem solving and entrepreneurship, into digital skills curricula. This would enable those with digital skills to also drive innovation, communicate initiatives, and collaborate to implement new concepts.. This is needed both in HE and VET.	WS2 WS4 WS5		
Implement agile changes in the curricula.	Formal degrees are less agile in reacting to changes. Use mechanisms like optional subjects, seminars, and broader subjects to include new demanded knowledge in formal education.	WS1		
Develop and Integrate Prompt Engineering Courses into University Curricula	Establish prompt engineering courses within university curricula, to teach and train future ADS-workers, to interact with and harness the power of Generative AI. The courses should be integrated into existing programmes, with a special emphasis on their significant impact on undergraduate education	WS7		

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4.4.3 Industry

No recommendations have been produced for this actor related to the corresponding topic.

4.5 Effective Delivery of Advance Digital Skills

Figure 7 summarises the recommendations contributing to an effective ADS delivery. In this case, most of the effort is related to policy makers to set the appropriate regulatory frameworks to allow an operative ADS delivery.

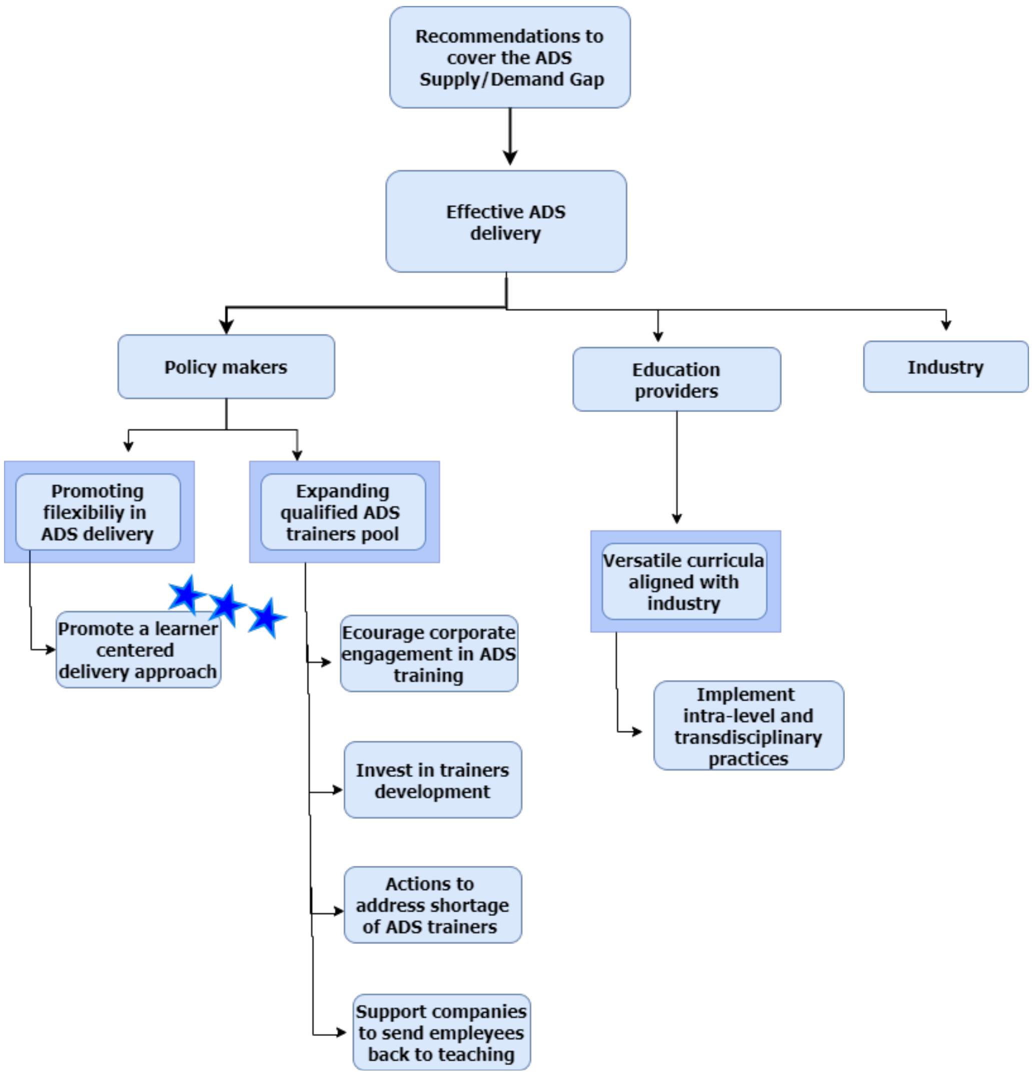

Figure 7. Recommendations contributing to the topic: Effective ADS Delivery

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4.5.1 Policy Makers

Promoting flexibility in ADS delivery

Recommendation	Description	Workshop	Impact	Time frame
Promote a learner centered delivery approach ★★★	Knowledge needs to be provided in a more agile way and in a learner centered delivery structure. For example, online classes, weekend courses, afternoon courses, hybrid/blended courses, are also options to be considered to allow learners, which are already employed, to access courses. (WS5) (WS6)	WS5 WS6		

Expanding qualified ADS trainers pool

Recommendation	Description	Workshop	Impact	Time frame
Encourage Corporate Engagement in ADS training	Companies could be encouraged to give time to teaching in universities and schools as a form of giving back. To address the shortage of teachers, initiatives such as the Teach First programme in the UK should be explored or the 'Teach Last' suggestion.	WS1 WS5		
Promote the creation of specific positions at HE institutions to incorporate experts in particular areas.	Positions like adjunct professors to be filled by industry experts or experts from other HE institutions.	WS1 WS2 WS5		
Invest in trainers development	Invest in ongoing professional development programmes for educators to stay updated on industry trends. This ensures that educators are well-informed about the latest developments and can integrate relevant insights into ADS programmes design.	WS5		
Develop financial and structural actions to address the shortage of ADS trained academics.	Implement measures to mitigate the impact of the shortage of ADS trainers and ensure a more balanced distribution of skilled ICT professionals across the public funding education system. Example of measures can be European programmes that supplement government-provided salaries in each country or mobility programmes to facilitate the transfer of teachers from countries with a surplus to those with a greater shortage.	WS3 WS5		
Support companies by funding to send employees back into teaching	As example, 50% funded and do it the other way with academics coming into the industry.	WS5		

4.5.2 Education Providers

Versatile curricula aligned with industrial needs

Recommendation	Description	Workshop	Impact	Time frame
Implement intra level and transdisciplinary practices in ADS training	Carry out multidisciplinary projects and activities not only between educational levels but also between disciplines (e.g., a restaurant app with participation of students of ICT – from VET, Food Technology – from University, AI and Data specialist, and Art – from a Master course.	WS4		

4.5.3 Industry

No recommendations have been provided for this actor in the corresponding topic.

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4.6 Supporting/facilitating ADS acquisition

Figure 8 shows the recommendations contributing to support and facilitate ADS acquisition by those students that want or need to get trained. For this aim, several recommendations have been gathered implicating to all the actors, policy makers, education providers and industry.

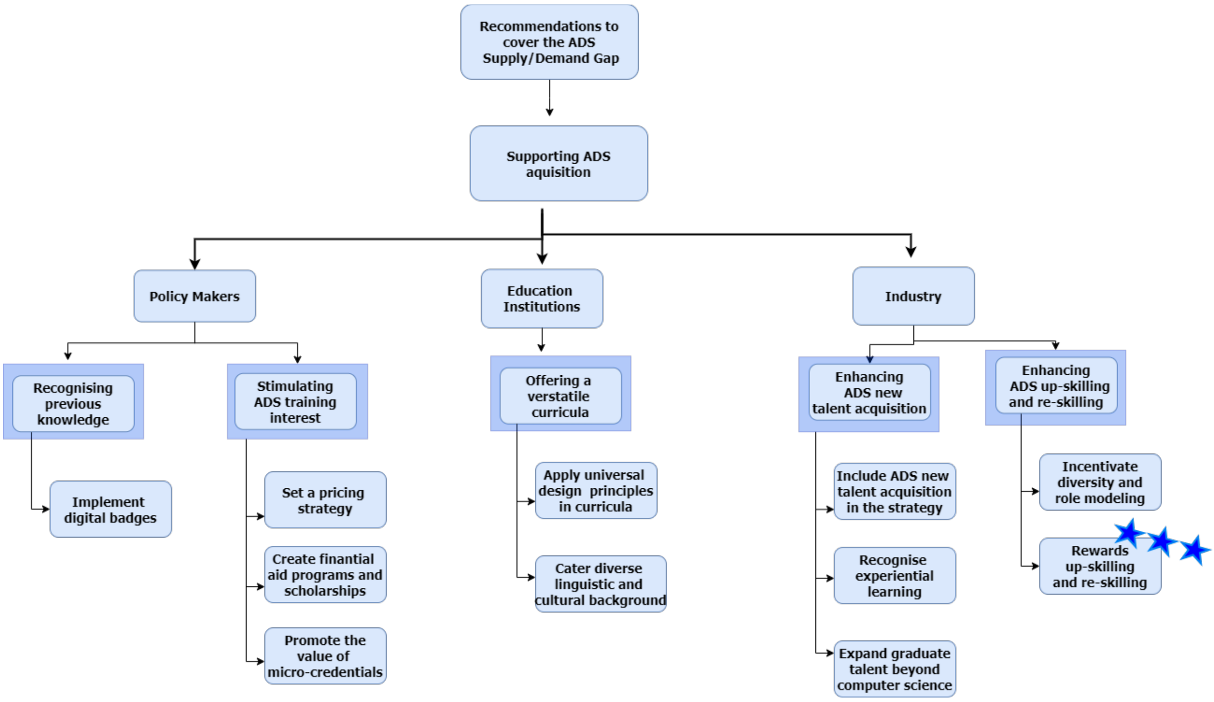

Figure 8. Recommendations contributing to the topic: Supporting/Facilitating ADS Acquisition

4.6.1 Policy Makers

Recognising previous knowledge

Recommendation	Description	Workshop	Impact	Time frame
Implement digital badges tied to specific skills.	Digital badges serve as verifiable proof of skills and are recognised by students and employers, contributing to the credibility and market value of formal and informal training.	WS6		

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Stimulating ADS training interest

Recommendation	Description	Workshop	Impact	Time frame
Set a pricing strategy.	This may include tiered pricing structures, discounts, or instalment plans to make these programmes more accessible to learners with varying financial capacities	WS6		
Create financial aid programmes and scholarship opportunities	Support learners facing economic constraints. This can alleviate the financial burden and enable a broader range of individuals to participate in ADS training	WS6		
Promote the value of micro-credentials.	Launch public awareness campaigns to Educate employers, learners, and the general public about the significance of micro-credentials in enhancing employability and addressing the evolving needs of the job market	WS6		

4.6.2 Education Providers

Versatile curricula aligned with industrial needs

Recommendation	Description	Workshop	Impact	Time frame
Apply universal design principles in the development of ADS programmes to ensure accesibility	Designing courses that consider diverse learning needs, including accessibility features for individuals with disabilities	WS6		
Localice content to cater to diverse linguistic and cultural backgrounds	Ensure that examples and case studies used in ADS courses represent a variety of cultural perspectives, promoting inclusivity and relatability for learners from different backgrounds	WS6		

4.6.3 Industry

Enhancing ADS new talent acquisition

Recommendation	Description	Workshop	Impact	Time frame
Include ADS new talent acquisition in the industry strategic plans	The specific requirements for HEI and VET talent acquisition, in terms of skills aligned with the different roles should be defined and known in the organisation.	WS4 WS8		
Set mechanism for recognising experiential learning.	Within industry a stronger focus on portfolios of experiential learning could increase the talent pool. People may not have formal education but could be working in computing and now require qualifications. Recognition of their portfolio and suitable in house or external conversion courses could be beneficial.	WS5		

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Enhancing ADS up-skilling and re-skilling

Recommendation	Description	Workshop	Impact	Time frame
Incentivating diversity and role modeling	Utilise Corporate Social Responsibility budgets to support initiatives which attract women and those from under-represented communitie. This can have a cluster effect, i.e., creating role models that attract others from the same demographic	WS2 WS5		
Implement incentives for lifelong learning: Rewards upskilling and reskilling ★★★	Encourage employers to value ongoing ADS development, creating a culture that recognizes and rewards individuals who proactively engage in upskilling and reskilling initiatives	WS5 WS6		

4.7 Promoting the Training Offering for ADS

Figure 9 shows the recommendations identified in WP3 to foster the ADS training offer. The main actor of these recommendations are policy makers who must define mechanism to raise the interest in ADS training and enrich the ADS training offer. Additionally, WP3 also generated one recommendation for industry to contribute to such aim.

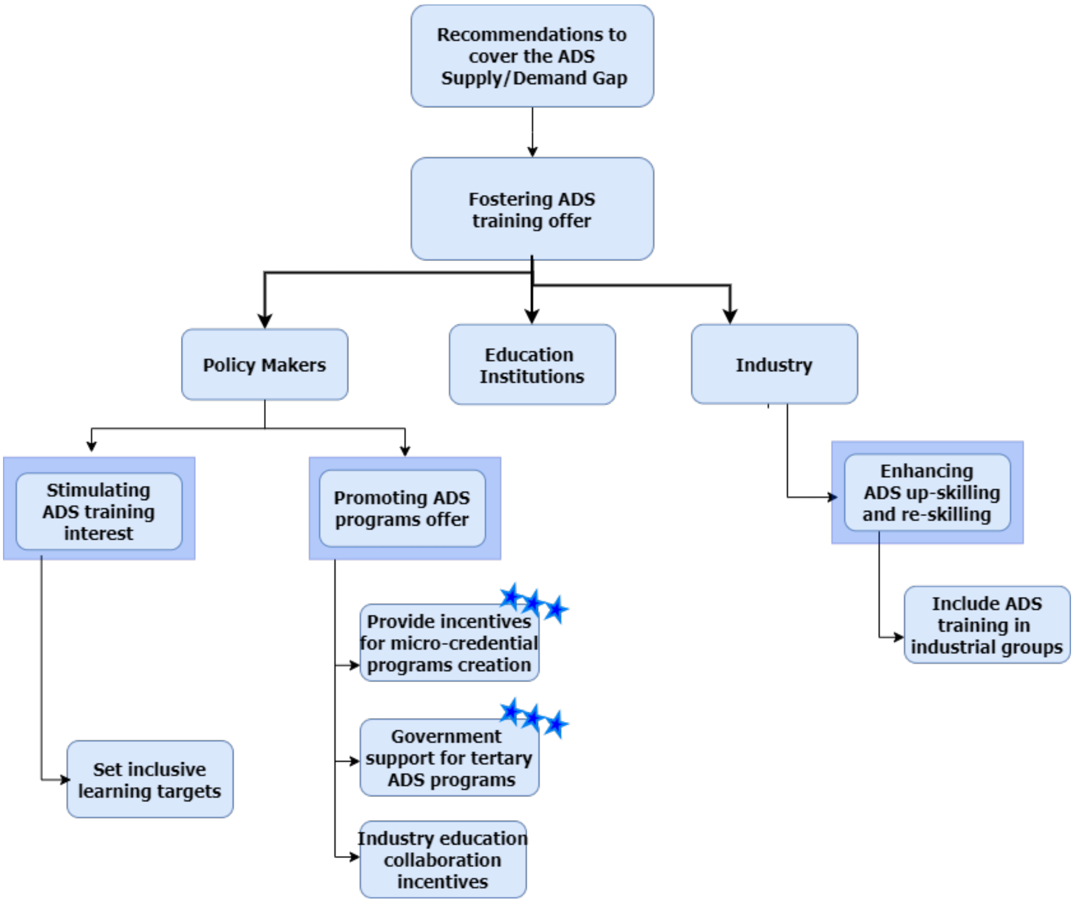

Figure 9 Recommendations contributing to the topic: Fostering the ADS Training Offer

4.7.1 Policy Makers

Stimulating ADS training interest

Recommendation	Description	Workshop	Impact	Time frame
Setting Inclusive Learning Targets for Marginalized Communities.	Create targets, especially for those marginalised and not participating due to lack of accessibility and flexibility of learning	WS5		

Promoting ADS programmes offer

Recommendation	Description	Workshop	Impact	Time frame
Provide incentives for micro-credential programme creation. ★★★	Provide incentives, such as grants or tax benefits, to educational institutions engaged in developing innovative and industry-relevant micro-credential programmes.	WS6		
Urge the national governments to support universities to target to the delivery of short-cycle tertiary ADS programmes and Re-Skilling Masters. ★★★	These funds should be additional to the funds currently devoted to skilling and up-skilling	WS1		
Advocate for government incentives that encourage collaboration between educational institutions and industries to train employees.	These incentives may include grants, tax benefits, or funding programmes that support joint initiatives aimed at enhancing workforce skills through micro-credentials.	WS6		

4.7.2 Education Providers

No recommendations have been generated for this actor in the corresponding topic.

4.7.3 Industry

Enhancing ADS up-skilling and re-skilling

Recommendation	Description	Workshop	Impact	Time frame
Include ADS training in activities of industrial groups of interest	Incorporate ADS training into the activities of relevant industrial groups. This integration will ensure that members are well-versed in advanced techniques and technologies, fostering a more skilled and knowledgeable workforce. For example, associations like BDVA, AIOTI, or professional (engineers, doctors, teachers, …)	WS4		

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5 CONCLUSIONS

This deliverable reports on the recommendations gathered from the ADS community involved in the different activities carried out during WP3. As we have seen in the different sections, the consortium followed an iterative and consensual process to generate and categorise the different recommendations.

The result is a comprehensive set of 54 recommendations aimed at fostering a dynamic and responsive educational landscape. These recommendations cover the creation of a holistic ADS training landscape, the alignment of curricula with industry needs, the promotion of learner-centred delivery approaches, the role of industry in supporting ADS acquisition, and policy measures to enhance ADS training.

All are based on specific action points:

- **Industry collaboration in curriculum development**: Developing curricula in close alignment with industry skill profiles and maintaining feedback loops with industry ensures that education remains responsive to workforce needs. Educational institutions should actively engage with industry professionals to gain insight into emerging trends and requirements, facilitating timely adaptation of educational content.
- **Flexibility in educational pathways**: Flexible ADS pathways that bridge higher education and vocational education and training to meet the diverse needs of learners. Allowing seamless transitions between different levels of education and disciplines enhances the adaptability of the education system.
- **Continuous assessment and adaptation:** Regular assessment of ADS training programmes is essential to ensure that they remain relevant and aligned with industry needs. Regular evaluations help institutions to proactively update curricula.
- **Recognition of micro-credentials**: Establishing frameworks to recognise and value micro-credentials is necessary to promote workforce agility and ensure that acquired skills are recognised across sectors. Collaboration between education and industry is needed to create standardised systems that validate micro-credentials, thereby enhancing employability and economic growth.
- **Agile and inclusive learning formats**: Offering agile learning formats, such as online courses, weekend courses and hybrid formats, accommodates different schedules and learning preferences, ensuring a more inclusive and accessible education system. Education providers should adopt flexible delivery methods to accommodate a wide range of learners, increasing participation and effectiveness.
- **Encouraging lifelong learning:** Fostering a culture of continuous learning by incentivising lifelong learning initiatives helps to maintain a skilled and adaptable workforce. Employers should be encouraged to value and reward ongoing professional development and align organisational goals with the evolving digital landscape.
- **Increase funding for ADS programmes**: Providing additional funding to universities for short-cycle tertiary ADS programmes and re-skilling masters is essential to expand educational provision and meet industry demand. National governments should prioritise funding for these programmes to ensure that education systems can adapt quickly to the rapid pace of technological change.

Overall, the various recommendations gathered in WP3 emphasise a multi-faceted approach to bridging the ADS gap, including flexible pathways, industry-aligned curricula, learner-

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centred delivery methods, incentives for continuous learning and supportive policies. Together, these recommendations aim to create a dynamic and responsive educational landscape that meets the evolving demands of the digital age.

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Appendix A. Top Leading Question 1. How can we design a comprehensive strategy to allow integration across pathways in VET and HE courses?

A.1 Scope

Workshop 4 addressed LQ1 aimed at providing recommendations and action points to provide a holistic view of HE and VET training. The event was organised by UPM, in the context of the European Big Data Value Forum (EBDVF) which is the flagship event of BDVA. The 2023 event took place in Valencia, Spain, from October 25 to 27. Figure 10 shows the workshop planning.

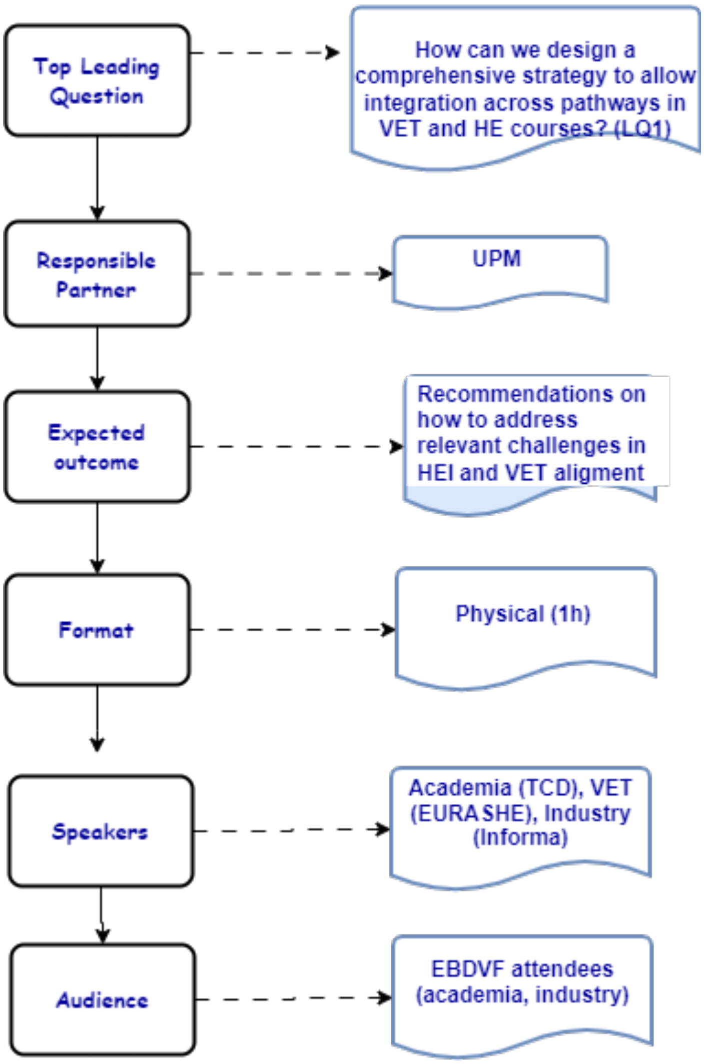

Figure 10. Planning results for the fourth workshop in WP3

The 2023 edition was built around the theme "Data and AI in action: Sustainable Impact and Future Realities". The event brought together industry professionals, business developers, researchers and policymakers from all over Europe and other regions of the world to advance policy actions and industrial and research activities in the areas of Data and AI.

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While some sessions of EBDVF mentioned the skill issue, the one hour session covered by the LEADS workshop was the only one focused on ADS and cooperation among different educational levels with different points of view: industry, universities, and educational institutions.

Workshop 4 was organised around the following objectives:

- Share the success stories of our speakers on the alignment of vocational training and higher education.
- Discuss more relevant challenges for this alignment and good practices.
- Obtain recommendations on how to address some relevant challenges in the VET and HEI alignment.

Due to the duration of the workshop (one hour), and with the aim to foster the discussion as much as possible, only three speakers were carefully chosen to cover the main stakeholders involved in the higher education and VET relationship: traditional universities, industries, and universities especially devoted to vocational training. In particular:

- Carlos Fernández Iñigo, Deputy General Manager of INFORMA D&B, S.A.U. (S.M.E.). His professional career has been developed in companies such as Saint Gobain, Indra, Reuters, and Fedea. At the present time, he is Deputy General Manager at INFORMA, General Manager at Dail Software, S.L. and member of the board of the XBRL Spanish Jurisdiction.
- Marta Rodrigues, Policy and Project Manager at EURASHE. The European Association of Institutions in Higher Education (EURASHE) was founded in 1990 as an international association promoting and emphasising Professional Higher Education.
- Julie Byrne, Assistant Professor at Trinity College Dublin. She is Professor of Online Education & Development at Trinity College Dublin. She led the development of Trinity's first fully online postgraduate programme and is a Lead in Trinity's Micro-credentials project.

A.2. Workshop Results

The workshop report contains the detailed results of the workshop in terms of challenges that universities and VET providers face in bridging the digital skills gap through HE and VET in ADS, some best practices provided by the speakers and generated during the debate, as well as specific recommendations and action points.

Table 6 summarizes the recommendations and action points gathered from the event. They have been grouped according to their main actor (training providers - yellow, policy makers – orange, and industry - blue). For each action point, its relation with HEI, VET or both is also shown.

Recommendations	Action Points	HEI	VET
Offer Versatile and Comprehensive Curriculum	• Redesign the bachelor degree to ensure that the graduates have the ability to cope with many different projects, many different aspects and accept new challenges, so they are ready for a lifelong learning process involving both formal and VET.	✓	✓

	• Push for interprofessional and transdisciplinary practices being flexible enough in pathways, not only between educational levels but also between disciplines (e.g., a restaurant app with participation of students of ICT – from VET, Food Technology – from University, AI and Data specialist, and Art – from a Master course.)	✓	✓
	• Include soft skills (ethics, communication, knowledge of business, critical thinking, creativity) must be included and a method of checking that the student has acquired knowledge of these skills must be implemented, both for HEI and VET.	✓	✓
Revitalize Higher Education	• Offer non formal short courses with micro-credentials cooperating with industry and VET providers to cover the industry needs and to provide general certifications (e.g., IOT Sustainability + Applied IOT + Ethical aspects of IOT; AI tool + AI ethics + Analytics)	✓	✓
	• Open the offer of short courses with online or blended approaches to increase the potential candidates to be trained.	✓	✓
Standarise Training Proposals	• Provide a standard for training proposals. This standard template could ensure that all proposals share the same information, allowing offer assessment, comparison, publicity and recognition.	✓	✓
Create a Unified Training Hub Platform	• Create a common access point for available training according to the profiles. Existing Regional/National/EC initiatives can be used for this purpose by federating proposal sites automatically (that could also be hierarchical – region, national, European, …) and, therefore, creating an efficient and simple way of inserting the information in the site. It is also possible to use these sites for other purposes: demand from companies, free recorded courses, etc.	✓	✓
Make Innovation part of Institutional Strategy	• Provide educational institutions, both HEI and VET, with a clear medium-term strategy on new courses, degrees, and mechanisms to address society demand (maybe by using an advisory boards). This needs to be combined with offices and dedicated staff to manage aspects like strategy, innovation, cooperation, etc. Innovation is not linear in research, and professionalisation is needed in institutions.	✓	✓
	• Include in the strategy the definition of deployment and strategies for deployment, including staff training.	✓	✓
Allow for Flexibility accessing Training Opportunities	• Open specialisation (non-formal) courses both from universities and VET centres to all students; there is usually a restriction (in some cases by rules, in other cases by mindset) applied to students (i.e., university courses only for to university degree holders, VET centres courses only for VET degree holders).	✓	✓
Agilise Accreditation	• Trust high reputational institutions to create a more efficient and responsive accreditation process.	✓	✓
	• Regulate and propose possible pathways between HEI/VET inter level, transdisciplinary and interprofessional (e.g., VET students continue studies in university, holders of a degree in Humanities to ICT specialization, etc.).	✓	✓
	• Regulate, when possible, the recognition of prior knowledge for learners.	✓	✓
Create an Integrated Training Plan	• Design and implement coordination and strategic plans for higher education as a whole. In many cases, VET and HEI depends from different ministries or separate departments in a single Minister, which does not help with coordination.		✓
Include ADS Training in Corporate Planning	• Include staff training in ADS and talent acquisition of employees to address ADS challenges in strategic plans. The specific requirements for HEI and VET talent acquisition should be defined and known in the organisation.	✓	✓

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Promote ADS Training in Industrial Groups	• Include ADS training in activities of industrial groups of interest (for example, BDVA, AIOTI, …) or professional associations (engineers, doctors, teachers, …) beyond common markets, technologies, innovation and research.		✓

Table 7. Recommendations for LQ1: How can we design a comprehensive strategy to allow integration across pathways in VET and HE courses

These recommendations and action points can be summarised in some takeaways:

- Cultivating a mindset of enduring collaboration among professional education, industry, and universities is imperative. It's crucial to acknowledge learning in a manner that aligns with future challenges: incorporating applied research, recognizing prior learning activities, establishing pathways between educational tiers, courses, programmes, and diverse learning formats, including apprenticeships and micro-credentials. Flexibility throughout the entire training process, encompassing HEI and VET, is essential to achieve this goal.
- Introducing a degree of standardization in training offerings is essential for enabling students to compare and choose among available options, and also for facilitating recognition of these offerings by industry and other training providers. This need is especially pertinent in VET, where there exists a broad spectrum of courses.
- Prioritizing a practical approach is essential. This involves devising solutions that integrate the strengths of education providers and building upon successful cooperation practices between training providers and industry. It also entails fostering collaboration among training providers themselves, with a particular focus on HEIs and VET providers.
- Accreditation processes need to be more agile and efficient to allow training providers to quickly adapt to industry needs.
- Adopting a more strategic approach is paramount across all levels—educational institutions, policy frameworks, and industry—when addressing the imperative of supplying advanced digital skills to satisfy the surging demand. In this regard, it is incumbent upon each company to delineate its individual strategy and prerequisites for acquiring talent from both HEIs and VET programmes.

Appendix B. Top Leading Question 2. How can education and training meet demands for advanced digital skills?

B.2. Scope

LEADS have already pinpointed significant challenges for equipping individuals with advanced digital skills, essential for their successful integration into the labour market. Some of these challenges encompass the need to develop curricula that remain adaptable in the face of rapid technological evolution. Additionally, there's a demand for embedding real-world, problem-solving abilities into the curriculum to better prepare students for the challenges they will inevitably encounter once they transition into the workforce. Meeting these challenges requires innovative pedagogies and learning methodologies to provide learners with an experience that combines theoretical knowledge and practical skills training.

Trinity College Dublin conducted Workshop 5 in which several experts discussed best practices and provided solutions to educating and training individuals to meet demands for ADS (LQ2). The event titled "Advanced Digital Skills: Meeting the Education and Training Challenges" was held at Trinity College Dublin on 1st December 2023 with a select group from academia and industry. Figure 11 summarizes the workshop planning.

The main objectives of the workshop were to address the following questions:

- How can educators use innovative pedagogies and learning methodologies to deliver core advanced digital skills and promote creativity, problem-solving, and experimentation to prepare students for the dynamic ADS landscape?
- How can collaboration with industry enhance ADS education and training?
- What lessons can be learned from those education and training providers actively delivering advanced digital skills?

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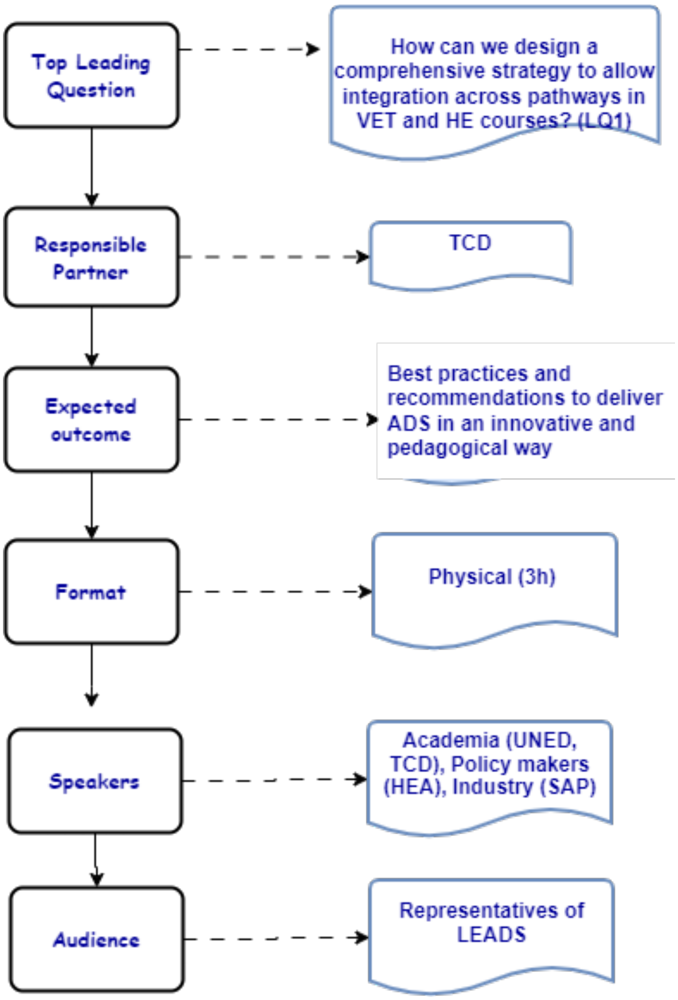

Figure 11. Planning results for the fifth workshop in WP3

During this event, six experts was convened face to face in Trinity Business School, Dublin, for three hours. This small number of participants was intentional, as it was anticipated that a smaller group of high-level selected experts could contribute more than a wider range of participants. The experts consisted of industry representatives, industry technical skills providers, and academics closely involved in the topic area. The voice of the student was also heard in this session as a student representative was invited to participate in the discussion and input their views and experiences. In particular the experts that participated in the event were the following:

The expert participants who joined the panel at Trinity College Dublin were the following:

- Alan Fahey, Senior Vocational Trainer at SAP SSC Ireland
- Prof. John Goold, Associate Professor in Quantum Technologies at Trinity Business School
- Prof. Covadonga Rodrigo, Deputy Director for Transfer, Research, and Innovation at the School of Computer Science and Telecommunications Engineering at UNED
- Prof. Dr. Horacio González-Vélez, Professor of Computer Systems and Founding Head of The Cloud Competency Centre at the National College of Ireland
- Catherine Arnold, Education Officer and Deputy President at the Trinity College Dublin Students' Union
- Vivienne Patterson, Head of Skills and Engagement at Higher Education Authority (Ireland).

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B.3. Workshop Results

During the event different challenges and best practices provided by the experts were discussed. The thematic analysis of solutions provided results in the recommendations and action points detailed in Table 8. The matrix provides a grid to show the stakeholders and the role they play in generating the solutions. The key role player for each solution is indicated in bold.

Recommendation	Action point
Promote an industry guided evolution in ADS training	• Transition to a skills-focused education. Input from industry is essential. Currently, the industry is moving from traditional profiles to skills-focused profiles and universities and education authorities need to understand this transition and reflect it in their programmes.
	• Enhancing Industry Engagement through Scholarship Creation. There is a need for more industries to be involved in providing scholarships to create real impact. These scholarships should then be specifically linked to creating job opportunities for those involved.
	• Recognition of experiential learning. Within industry a stronger focus on portfolios of experiential learning could increase the talent pool. People may not have formal education but could be working in computing and now require qualifications. Recognition of their portfolio and suitable in house or external conversion courses could be beneficial.
Build transversal skills	• Integrating Transversal Skills into Digital Education Curricula. Transversal skills need to be clarified and incorporated into third level digital skills curricula. This would enable those with digital skills to become proficient in the softer skills needed to communicate initiatives, collaborate to enhance innovation and socialise new concepts.
Set specific policy interventions to promote ADS training	• Incentivizing STEM Education with Hybrid Civil Servant Roles. To attract and retain STEM teachers into the educational system, consider a new 'hybrid civil servant' role with increased remuneration packages for those taking employment in STEM education. • Establishing European-wide Skills Recognition Programmes with Digital Ethics Focus. Create European wide recognition programmes. For example, a skills passport which will include ethics around digital technologies. • Setting Inclusive Learning Targets for Marginalized Communities. Create targets, especially for those marginalised and not participating due to lack of accessibility and flexibility of learning
Build flexibility in delivery, learning methodologies and programmes	• Transitioning to Flexible and Open Learning Pathways for Workforce Empowerment: Need to move to more open type courses with open access. The University model makes it hard to achieve this. Workers want micro credentials because they may be unable to commit to four years study. From an industry perspective, there is a desire for shorter courses, such as the accreditation of 6-week activities.
	• Streamlining Accreditation for Micro-Credentials to Enhance Learner Mobility. There is a need to increase micro-credentials and appropriate branding to ensure they are attractive and recognised. Although accreditation of micro learning is not a priority for industry, the participants perceived that learner motivation and mobility is important and accreditation plays a crucial role in that. Medium term

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	value is important and for learner's accreditation offers that value. A method of accreditation that is less cumbersome is needed.
	• Promoting Lifelong Learning through Agile, Learner-Centric Modular Formats. Overall, there is a need to move to a concept of lifelong learning in modular or micro-credential /diploma formats. These need to be constructed in a more agile way and in a learner centred delivery structure. For example, online classes not conflicting with parental responsibilities, to allow learners to access courses.
	• Facilitating Re-Entry - Prior Learning Recognition and Streamlined Application Processes. Recognition of prior learning by universities would facilitate engagement of learners for re-skilling and up-skilling. This would enable people to return to the workforce after career breaks/maternity leave/ life events.
Foster Industry/Academic Collaborations	• Encouraging Corporate Engagement in Education. Companies could be encouraged to give time to teaching in universities and schools as a form of giving back. Companies are supported by funding to send employees back into teaching, e.g., 50% funded and do it the other way with academics coming into the industry.
	• Enhancing Internship Opportunities for Talent Identification and Diverse Recruitment. More and longer placements from employers to interns are needed. This would increase the chance of employers identifying those suitable for later recruitment. These internships could also come from a broader subject base, this way employers could assess the ability of students from non-digital backgrounds to adapt.
	• Enriching the pool of ADS teachers with practitioners. To address the shortage of teachers, initiatives such as the Teach First programme in the UK should be explored or the 'Teach Last' suggestion.
Increase participation from under-represented groups	• Empowering Women in Career Pathways with Specialized Internships and Visible Role Models. Implement more visible career pathways for women including targeted clustering of females into courses in education and then into industry. This could be in the form of specialist female internships. Thus, creating visible role models and clear pathways for advancement.
	• Leveraging Corporate Responsibility Budgets to Promote Diversity and Role Modeling. There is a need to tap into the Corporate Responsibility Budgets within companies and these could be utilised to attract more females or marginalised communities, thus having a cluster effect, i.e., creating role models that attract others from the same demographic.
Foster Collaboration within education	• Enhancing Collaboration between Higher and Vocational Education for Agile Response. More formal and informal coordination between higher and vocational education in general is needed. Established coordination methods and practices makes it easier to respond to emergent challenges like ADS.

Table 8. Recommendations for LQ2: How can education and training meet demands for advanced digital skills?

All these recommendations and action points are defined around a set of relevant ideas that can be summarised as follows:

- Universities should adopt an **entrepreneurial focus** to attract interest and investment from industry. Demonstrating a commercial orientation and presenting a solid business case are crucial. Industry will invest, but universities must exhibit the same level of rigor seen in commercial operations.
- **Governance** is key, with diverse advisory boards linked to industry being essential. Informal connections between universities and businesses are also valuable. Maintaining alumni engagement is pivotal.

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- **Micro-credentials** play a vital role in addressing the skills gap. They need to be properly branded and accredited to ensure attractiveness and value. Moreover, delivery methods should be accessible to encourage broad participation.
- Industry can contribute more to **diversity and inclusivity** efforts. Significant funding from corporate social responsibility initiatives can support STEM and increase digital literacy. More altruism is needed, especially for underrepresented demographic groups.
- Increasing **gender balance** requires more scholarship programmes to boost female participation and create role models, fostering interest among others. Achieving greater gender balance in product creation benefits both society and industry.
- Educators should develop programmes that cultivate **professional skills** such as communication, collaboration, and self-presentation. This enables graduates to make fuller contributions and create meaningful impacts.
- More companies should offer **internship** opportunities. Apprenticeships benefit both students and industry, highlighting the need for more effective internship models.
- Creating **experimentation and sandbox opportunities** fosters innovation. Establishing "digital playgrounds" where interns and new graduates can experiment and innovate in safe environments is crucial.

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APPENDIX C. TOP LEADING QUESTION 3. HOW TO ENSURE THE AVAILABILITY OF APPROPRIATELY RECOGNISED MICRO-CREDENTIALS, SHORT-TERM COURSE AND ONLINE LEARNING OPTIONS TO MEET INDUSTRY AND LEARNER DEMANDS?

C.1. Scope

The need to provide flexible and short-term ADS training is an issue has been pointed out through all the LEADS project. Cutting-edge methods like micro-credentials are poised to facilitate the swift adaptation of educational programmes to meet the emerging and rapidly changing demands of the contemporary job market. They allow professionals to acquire new skills, validate existing knowledge, and crucially, stay relevant in their respective industries. In this context Workshop 6 is aimed to go deeper in LQ 3, discussing different innitiatives to improve the positive impact of microcedentials in the context of reskilling and upskilling in ADS. Figure 12 summarises the workshop plan.

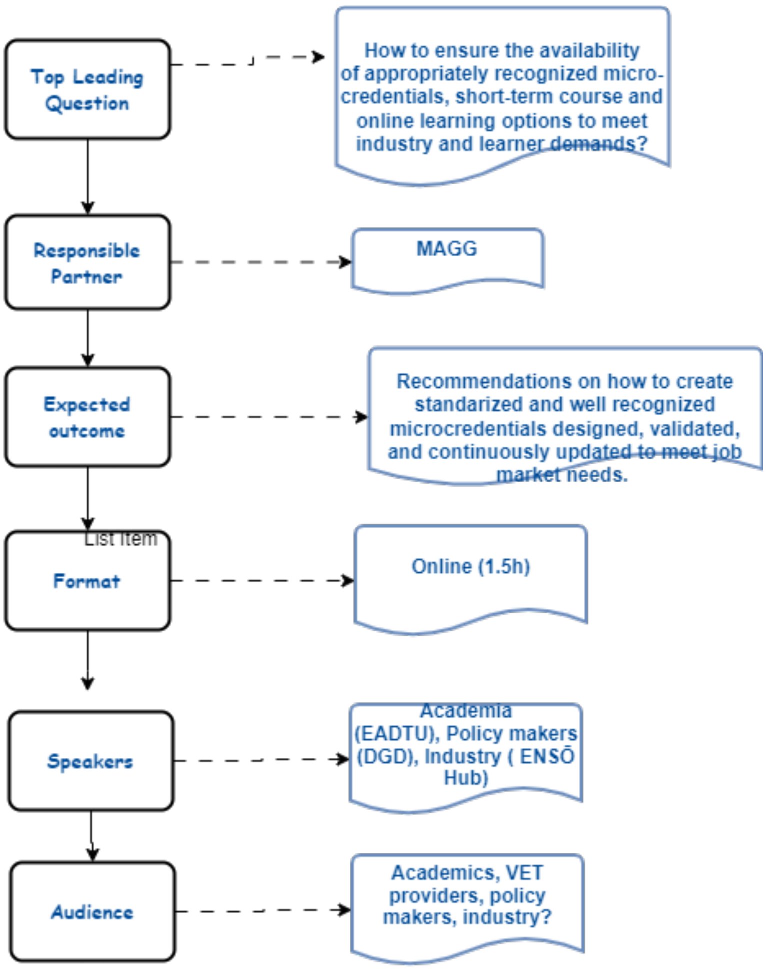

Figure 12. Planning for the sixth workshop in WP3

The workshop was held online leaded by Maggioli Spa on November 23rd, 2023, for one and a half hour. Three invited speakers were specifically chosen for their profound expertise and insights related to advanced digital skills within organisations:

- George Ubachs, Managing Director European Association of Distance Teaching Universities (EADTU). He is responsible for the development and support of the EADTU network, policies, and execution of its goals in online, open, and flexible higher education. He is coordinator of international academic cooperation networks on the digitalization of higher education, micro-credentials, international curricula and virtual mobility, and on business models for lifelong learning.
- Aikaterini Kyprianou, Head of Digital Skills Development of the department of Digital Transformation & Digital Skills GRNET S.A. – National Infrastructures for Research and Technology, GR-Digi-GOV-Inno HUB / EDYTE. He is responsible of specializing the strategy of the Greek Ministry of Digital Governance (DGD) for investing in the country's human resources by leveraging and strengthening its institutional initiatives, services, networks, technological infrastructures and applications.
- Vana Karagianni, People Architect, Co-Founder at ENSŌ Hub. As People Architect she works with individuals, teams and organisations to challenge and support them in achieving higher levels of performance while allowing them to bring out the best in themselves and those around them.

The workshop drew a diverse audience comprising various stakeholders deeply engaged in the realms of education, policy-making, and industry, all united by a shared interest in advancing digital skills. Among the participants were Policy Makers and Government Representatives from the higher education sector (e,g, Hellenic Open University, University of Patras), including government officials and policymakers responsible for shaping educational policies (members of EDYTE – Greek National Infrastructures for Research and Technology, GR-Digi-GOV-Inno HUB). Educators and Trainers from HEI and VET Providers (e.g. Training and Lifelong Learning Center - KEDIVIM representatives) constitute another segment. Private sector representatives from companies and organisations aiming to explore ways to incentivize the development of courses and micro-credentials were also invited. In essence, the workshop engaged a multifaceted audience, fostering a collaborative and comprehensive dialogue on the challenges and opportunities inherent in the dynamic landscape of advanced digital skills.

The workshop was run around several intermediate questions, which contribute to address LQ3. Most relevants are:

1. How can HEIs and VET providers effectively integrate micro-credentials and MOOCs into their existing curriculum and programmes? (challenges and barriers, and ways to overcome them)
2. Which are the stakeholders and how can they ensure that the skills acquired through micro-credentials and MOOCs are recognised and valued by employers in the job market?
3. Which is the role played by micro-credentials in supporting labour-market-related and employment-relevant education, training and learning for ADS skills?
4. How can micro-credentials be designed to align with industry needs and provide learners with practical, job-relevant ADS skills?
5. How can the public and the private sector provide incentives for the wider development of such courses and micro-credentials?

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C.2. Workshop Results

The workshop generated a rich discussion around the previous questions. Different topics and issues came to the arena to discuss the most effective strategy to generate micro-credential programmes.

One of the topics consider of higher relevance was how to handle the lack of quality assurance, standardization and recognition of micro-credential programmes. The collaboration between key stakeholders so as to develop comprehensive frameworks that define quality standards for micro-credential programmes appears to be of high importance. Accreditation models should be also developed, balancing between flexibility and rigor. Employing the aforementioned models will support transparency, trust, recognition and international collaboration between institutions. Overall, the accreditation process could be undertaken by dedicated bodies orienting to micro-credentials, involving in a degree the market. It is also important to be aware of the different recognition processes, educational systems, cultural contexts, and regulatory frameworks across countries, difficulting the route towards the needs for standardized criteria in issuing micro-credentials. Solution to these challenges may unfold from the common development of standardized criteria for the assessment and accreditation of micro-credentials, and transferability frameworks. Creating awareness and incentives, international collaboration among key stakeholders, regulatory alignment, and integration of feedback mechanisms for continue improvement would facilitate the acceptance of the micro-credentials. Table 9 shows a summary of the recommendations arisen about this issue.

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Challenges about quality assurance, standardization and global recognition in micro-credential programmes	
Recommendation	**Action Point**
Collaborative framework development	• Foster collaboration among institutions. Promote collaboration among educational institutions, industry representatives, and accreditation bodies to develop comprehensive frameworks that define global and universal quality standards for micro-credential programmes.
Flexible yet rigorous accreditation models	• Design accreditation models that strike a balance between flexibility and rigor. Flexibility accommodates the diverse needs of learners and industries while upholding educational excellence.
Continuous monitoring and review	• Periodic assessments. Ensure that the training content remains current, relevant, and aligned with global industry needs.
Transparency and information accessibility	• Promote transparency by providing clear and accessible information about the accreditation process, criteria, and outcomes. This transparency builds trust among learners, employers, and educational institutions, enhancing the perceived value of micro-credentials.
Establishment of accreditation bodies	• Establish international dedicated accreditation bodies specifically focused on micro-credentials. These bodies can develop expertise in evaluating the unique characteristics of micro-credential programmes and contribute to the refinement of accreditation models tailored to this educational format, addressing legal and regulatory challenges that hinder the recognition of micro-credentials.

Table 9. Recommendations to address challenges about quality assurance, standardization and global recognition in micro-credential programmes

On the other hand, recommendations about government policies and supporting actions to reinforce the pool of high quality and recognised micro-credentials came to the arena. Government policies and support for development and recognition of micro-credentials should provide flexible and transferable regulatory frameworks based on quality and accountability, accepted by the market. In parallel, serious effort should be invested in the provision of incentives guidelines and campaigns fostering the adoption of micro-credentials.

Table 10 summarize the recommendations in this area.

Recommendations about government policies to reinforce the pool of micro-credential programmes	
Recommendation	**Description**
Incentives for lifelong learning	• Rewards upskilling and reskilling. Encourage employers to value ongoing skill development through micro-credentials, creating a culture that recognizes and rewards individuals who proactively engage in upskilling and reskilling initiatives.
Incentives for educational institutions	• Provide incentives for micro-credential programmes creation. Provide incentives, such as grants or tax benefits, to educational institutions engaged in developing innovative and industry-relevant micro-credential programmes.
Government incentives for collaboration	• Advocate for government incentives that encourage collaboration between educational institutions and industries. These incentives may include grants, tax benefits, or funding programmes that support joint initiatives aimed at enhancing workforce skills through micro-credentials.

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Transferability frameworks	• Create frameworks that facilitate the seamless transferability of skills acquired through micro-credentials. Governments can collaborate with industry stakeholders to establish systems that recognize and value micro-credential-acquired skills across educational institutions and industries.
Public awareness campaigns	• Promote the value of micro-credentials. Launch public awareness campaigns to Educate employers, learners, and the general public about the significance of these credentials in enhancing employability and addressing the evolving needs of the job market.

Table 10. Recommendations about government policies to reinforce the pool of micro-credential programmes

Micro-credential programmes need to be designed to cover industry demand. During the workshop specific actions were discussed in this direction. Many of them directly related to the need to encourage active participation and engagement from employers in the design and validation of these programmes. Table 11 contains the specific recommendations discussed in this field.

Recommendations for aligning micro-credentials with industry needs	
Recommendation	**Description**
Establish industry-academia partnerships	• Foster strong collaborations with industry partners to gain valuable insights into current and emerging needs. Regular input from industry professionals ensures that micro-credentials are aligned with the practical requirements of the job market.
Incorporate practical application	• Design micro-credential courses with a strong emphasis on practical, hands-on application. Including guest lectures, real-world projects, case studies, and simulations ensures that learners acquire practical skills that are directly transferable to their professional roles.
Continuous industry feedback loop	• Establish a continuous feedback loop with industry professionals who can provide ongoing input on the relevance and effectiveness of micro-credential programmes. Regular feedback helps in making timely adjustments to course content and delivery methods.
Offer workplace learning opportunities	• Provide opportunities for workplace learning, such as internships, apprenticeships, and industry placements. These experiences allow learners to gain practical insights and skills directly aligned with industry needs, enhancing the overall effectiveness of micro-credentials.
Professional development for educators	• Invest in ongoing professional development programmes for educators to stay updated on industry trends. This ensures that educators are well-informed about the latest developments and can integrate relevant insights into micro-credential programme design.
Employer-led certification	• Develop employer-led certification processes tied to micro-credentials. This involves employers actively participating in the validation and endorsement of acquired skills, enhancing the credibility and industry recognition of micro-credential programmes.
Digital badges for skill verification	• Implement digital badges or micro-certifications tied to specific skills acquired through micro-credentials. These badges serve as verifiable proof of skills and are recognised by employers, contributing to the credibility and market value of micro-credentials.

Table 11. Recommendations for defining micro-credentials aligned with industry needs

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Finally, different proposals to make micro-credentials more accessible to a diverse range of learners were also discussed, their finantial cost and geographical limitations are some of the drawbacks to address. Inclusion is also a challenge, typical related to the different training needs and cultural differences; this limitation should be considered when designing strategies and processes for micro-credentials adoption (e.g. employment of financing schemes, exploiting online means, support networks, etc.). Recommendations to address these issues are summarised in Table 12.

Recommendations to address learner accessibility and inclusivity in micro-credentials	
Recommendation	**Action Point**
Implement affordable pricing models	• Set a pricing strategy. This may include tiered pricing structures, discounts, or installment plans to make these programmes more accessible to learners with varying financial capacities.
Offer financial aid and scholarships	• Create financial aid programmes and scholarship opportunities to support learners facing economic constraints. This can alleviate the financial burden and enable a broader range of individuals to participate in micro-credential programmes.
Expand online delivery formats	• Embrace online delivery formats to overcome geographical limitations. Offering micro-credentials through online platforms ensures that learners worldwide, including those in remote or underserved areas, can access the programmes without facing geographical barriers.
Utilize universal design principles	• Apply universal design principles in the development of micro-credential programmes to ensure inclusivity. Designing courses that consider diverse learning needs, including accessibility features for individuals with disabilities, enhances the overall inclusivity of the learning experience.
Localize content and cultural representation	• Localize content to cater to diverse linguistic and cultural backgrounds. Ensure that examples and case studies used in micro-credential programmes represent a variety of cultural perspectives, promoting inclusivity and relatability for learners from different backgrounds.
Flexible learning paths	• Provide flexible learning paths, allowing learners to progress at their own pace. This accommodates individuals with varying levels of expertise, work schedules, personal commitments, or learning preferences, making micro-credentials more adaptable to diverse learner needs.
Establish employer-sponsored programmes	• Encourage employers to sponsor or support employees in enrolling in micro-credential programmes. Employer-sponsored initiatives can alleviate financial constraints for learners and align educational goals with professional development objectives.
Collaborate with industry for relevance	• Foster collaborations with industry partners to ensure the relevance of micro-credential programmes. Industry input enhances the applicability of acquired skills, making the programmes more attractive and valuable to learners seeking immediate career benefits.
Set digital certification for visibility	• Provide digital certification options for micro-credentials to enhance visibility and shareability. Digital badges and credentials empower learners to showcase their achievements on various platforms, aiding in job searches and career advancement.

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Promote community building and support networks	• Foster community building and support networks for learners. Establishing peer support systems and mentorship programmes creates an inclusive environment where learners can connect, share experiences, and receive guidance throughout their micro-credential journey.

Table 12. Recommendations for micro-credentials to deal with learner accessibility and inclusivity

Overall, micro-credentials have a lot to offer in the context of continuous and lifelong learning, this workshop has generated a series of interesting outcomes to reinforce their role in ADS talent provision.

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APPENDIX D. TOP LEADING QUESTION 4. HOW CAN GENERATIVE AI REVOLUTIONIZE ADS CURRICULUM DEVELOPMENT AND LEARNING SUPPORT SYSTEMS, PROPELLING EDUCATION INTO A NEW ERA?

D.1. Scope

As we have already seen, the need to improve ADS education and training to make it more effective and efficient is in the background of LEADS outcomes. In fact, as we have seen in the previous section, LQ3 specifically focus on this topic. LQ4 explores a particular direction in this area, recognizing AI's exponential growth and its far-reaching implications for ADS education. AI's ability to access, analyze, and synthesize vast amounts of information surpasses human capacities, possibly presenting a game-changing opportunity in curriculum development. By harnessing AI, educators might navigate through a dynamic ecosystem of resources, ensuring curricula remain current, relevant, and reflective of the latest trends and developments in their fields. Beyond curriculum design, AI's potential in personalizing the educational journey of students is immense. It promises a new era of learning experiences, where education is not just about information dissemination but about fostering a collaborative, interactive, and engaging learning environment. This workshop aimed to explore these opportunities while also addressing the challenges and ethical considerations inherent in integrating AI into education.

The "Generative AI in University Education" workshop was a seminal event that brought together a diverse group of experts to discuss the intersection of AI and education. It was held online in mid-January, during 1,5 hour, and it was organized around the following key questions:

- How can Generative AI aid curriculum development?
- Can Generative AI solutions be tailored for advanced digital skills education?
- How might AI help students/trainees optimize their advanced digital skills learning paths?
- Do we expect the emergence of curricula and courses focused on prompt engineering, and if so, to which extent?

Four experts were invited to share their views about these questions. They were:

- **Marco Scirea**, Associate Professor at Southern University of Denmark with extensive experience in AI in creative domains, and its application in education
- **Luca Schirru, Researcher at CiTiP KU Leuven,** researcher specialised in IT and intellectual property law who added a legal dimension to the discussion.
- **Luca Malinverno, Data Scientist at Porini provided his view about** the practical applications of AI in educational settings.
- **Andrea Maurino, Professor at University of Milano-Bicocca,** provided valuable insights into the real-world usage of AI tools like ChatGPT in educational settings.

The workshop plan is shown in Figure 13. The workshop boasted a high attendance rate of 64, indicating a strong interest in the topic among academics and industry professionals. The interactive format and diverse range of topics ensured that the workshop was not only informative but also engaging, culminating in a rich exchange of ideas and perspectives.

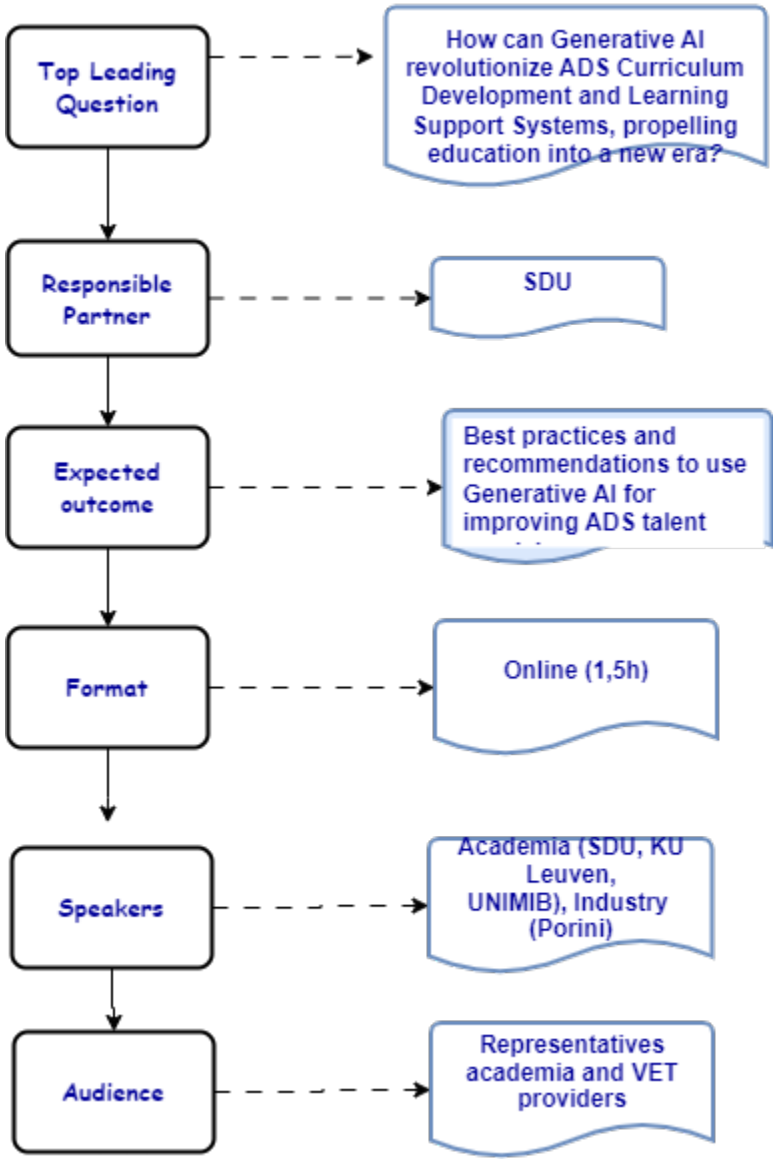

Figure 13. Planning for the seventh workshop in WP3

The panel collectively contributed to a multifaceted understanding of the role of generative AI in university education. Their discussions illuminated the ethical, legal, practical, and pedagogical aspects of AI in education, providing a comprehensive overview of the challenges and opportunities presented by this transformative technology.

D.2. Workshop Results

As mentioned the workshop was organized around four questions which have been listed above. The following tables outline universities' pivotal role in implementing the discussed solutions and serves as a framework to highlight how universities are central to addressing the challenges of integrating Generative AI into educational contexts. The workshop report provides an exemplification of how these recommendations can be implemented at the given institutions.

How can Generative AI aid curriculum development?	Policymaker	Industry	University
Generative AI can draft teaching slides and structure curricula, reducing preparation time for educators.			x

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It can enhance educational material quality and accessibility by acting as a teaching assistant.			x
AI can efficiently review and translate documents, aiding non-native speakers.			x
Generative AI facilitates the creation of fair tests and exams by producing multiple versions.			x
AI serves as an educational 'copilot', supporting the creation of tests, documents, and lessons.			x

Can Generative AI solutions be tailored for advanced digital skills education?	Policymaker	Industry	University
Customising AI for education faces challenges like data limitations and the need for advanced hardware.			x
Meta-prompting allows large AI models to be adapted for specific educational needs in ADS.			x

How might AI help students/trainees optimise their advanced digital skills learning paths?	Policymaker	Industry	University
The lack of research and best practices in Generative AI presents a severe challenge. More research on the area is therefore recommended, before more concrete recommendations on best practices can be established.	x		
Ethical considerations and student responsibility in AI use must be emphasised for responsible usage.			x

Do we expect the emergence of curricula and courses focused on prompt engineering, and if so, to which extent?	Policymaker	Industry	University
Universities, like the University of Denmark, are already integrating prompt engineering into curricula, recognizing its importance in the digital landscape.			x
The impact of prompt engineering courses varies by education level, being more significant in bachelor's programmes than in advanced degrees.			x

Is sum, the workshop discussed the supportive role AI can play, augmenting the capabilities of educators without replacing them. The participants emphasised the need for educators to guide and oversee AI's application to ensure the quality and relevance of the educational content.

On the other hand, the participants acknowledged that Generative AI could indeed be tailored in several ways to suit the specific needs of ADS education. This adaptability is key to its integration into various educational aspects, from curriculum design to learning methodologies. However, creating AI models based on individual requirements can be complex due to data limitations. There may not be enough relevant data to train these models specifically for ADS education. The discussion also touched on the technical demands of customizing AI for education, including the need for advanced hardware to process the information. This requirement underscores the resource-intensive nature of tailoring AI solutions.

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Appendix E. Top Leading Question 5. Is it possible for universities to overcome structural challenges and barriers to respond to the needs of advanced digital skill development? Is there a role for policy to support reforms in the HEI sector or change the expected roles for universities?

E.1. Scope

Ensuring an adequate number of ICT specialists was critical to Europe's competitiveness on the global stage and the realisation of the ambitions of the Twin Transition. Over the past two years, more than 36 initiatives have been funded within the DIGITAL Programme to support the development of advanced digital skills. Both within this portfolio and more broadly across engagements with the LEADS project, certain barriers were identified that hindered the development of novel, adaptive, and industry-relevant programmes. In particular, there was a need for flexibility in both systems and structures to meet the demands of Advanced Digital Skills.

To this end, LEADS organised a High-Level Policy Workshop (HLPW) convening 52 high-ranking attendees from 18 countries, to engage in insightful discussions on the internal and external factors limiting the supply of ADS and provide actionable recommendations to the problem at hand. The topics addressed in the HLPW include:

- The roles of HEIs and VETs, and opportunities for collaboration between the two.
- Novel approaches for supporting the scalable development of ADS across the EU.
- Successful case studies of training, upskilling and reskilling labour through innovative study programmes and relevant initiatives.

This workshop was organized as a high-level forum convened to explore the challenges faced by both HEI and VET providers in the dynamic and challenging environment of ever-shorter tech cycles, increasing demand for advanced digital talent, and limited planning horizons, all in the context of a shrinking EU labour force. The objectives were to:

- Discuss internal and external limitations in the supply of industry-relevant advanced digital talent.
- Identify the respective roles and points of collaboration between HEI and VET.
- Understand how policy can support the development of digital talent at scale across the EU through fostering collaborations and reforms.

Workshops speakers represent policy makers and HEI institutions representatives from different geographical areas in the EU:

- Theodor Grassos, Secretary General, European Association of Institutes of Vocational Training.
- Beatrice Boots, CEO, Platform Talent voor Technologie.

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- Olha Hunchak, Policy and Project Officer, European Association of Manufacturing Technologies.
- Martin Hayes, Professor of Digital Technologies, University of Limerick.
- David Metz, Senior Advisor of the Danish Accreditation Institution.
- Valerie Michaelis, Deputy Secretary General, fit4internet, Pact for Skills and Digital Skills and Jobs Coalition.
- Lydia Berrocoso Rufo, Spanish Ministry of Education, Vocational Training and Sports.
- Carlos García Crespo, Director, Mondragón University

Figure 14 summarises the workshop plan.

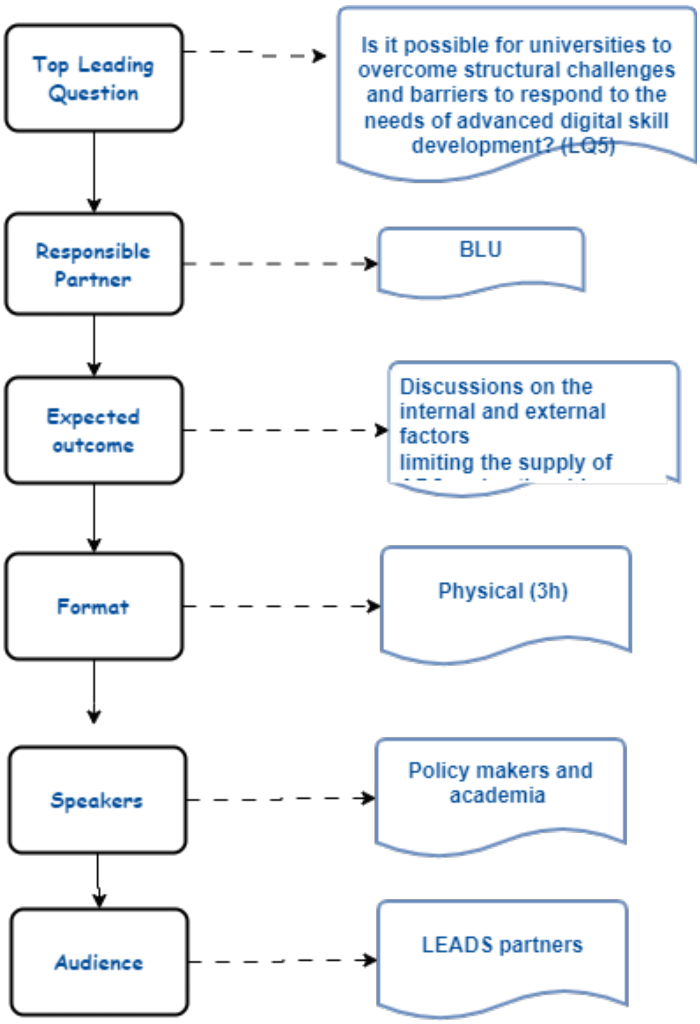

Figure 14. Planning for the eight workshop in WP3

E.2. Workshop Results

The workshop highlighted the importance of a coordinated approach between HEIs, VET providers, industry players, and policymakers to bridge the skills gap and meet the digital economy's evolving demands.

More specifically the outcomes can be grouped around the following topics:

- Collaborative ecosystem approach. A recurring theme throughout the workshop was the need to foster a collaborative ecosystem. HEIs and VET providers were encouraged to blur the traditional boundaries that separate them, to allow for more flexible educational pathways. This approach will support the flexibility required to adapt to the rapid technological changes and ensure that graduates are equipped with relevant skills, when those skills are needed.
- De-risking experimentation and innovation in HEIs and VETs. Innovation in educational approaches was another critical point of discussion. The concept of a "playground" or "safety net" for HEIs to experiment with new teaching methods and course offerings without the constraints of traditional accreditation processes was explored. In particular, Denmark's rapid accreditation model could serve as a blueprint for allowing educational institutions to adapt quickly to industry needs. This model has proven to reduce the burden of documentation and facilitates swift curriculum changes, helping training providers keep content current and aligned with market demands.
- Anticipating the return on investment. Investing in ADS development is not only beneficial for individual learners but also for the broader economy. Companies and educational institutions alike must recognise the value of training and upskilling programs as strategic investments. Initiatives like the European Commission's Cybersecurity Skills Academy and the Action Plan on Labour and Skill Shortages highlight the importance of aligning educational outputs with industry needs to maximise the efforts' return on investment.
- Key points for policy engagement. Policymakers play a pivotal role in shaping the landscape for ADS development. The workshop called for policy frameworks that support flexibility in education, encourage gender diversity in ICT and STEM fields, and facilitate the use of shared data spaces for skills assessment and planning. The involvement of companies and SMEs in these discussions is crucial to ensure that the developed policies cater to the needs of all stakeholders involved in the digital transformation.

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