PROJECT REF. NR.: 101054872 — DELIVERABLE 2.4 — E4E — ERASMUS-EDU-2021-PI-ALL-INNO

ENGINEERS 4 EUROPE

ENGINEERS 4 EUROPE

SKILLS STRATEGY

ANTICIPATING SKILLS REQUIREMENTS FOR THE ENGINEERING PROFESSION

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List of Abbreviations

AI	Artificial Intelligence
BIM	Building Information Modelling
CPD	Continuing Professional Development
CTF	Common Training Framework
DG	Directorate-General
ECTS	European Credit Transfer System
EEED	European Engineering Education Database
EHEA	European Higher Education Area
ENAEE	European Network for Accreditation of Engineering Education
EQF	European Qualifications Framework
HEI	Higher Education Institution
IEA	International Engineering Alliance
ICT	Information and communications technology
IoT	Internet of Things
LLL	Lifelong Learning
LRC	Lisbon Recognition Convention
OECD	Organisation for Economic Co-operation and Development
SDG	Sustainable Development Goal
SME	Small or Medium-sized Enterprise
STEM	Science, Technology, Engineering and Mathematics
VET	Vocational Education and Training

1. PREFACE

This document contributes to the overall objective and vision of the "Engineers for Europe" (E4E) ERASMUS+ project, which has been outlined as follows in the project application:

> ***The objective of E4E is – geared by the new requirements of the world of work – to prepare better equipped engineers through the acquisition of new competences, covering new knowledge, attitudes and leadership skills while focusing on digital, green, resilient and innovative entrepreneurship. E4E will bridge the gap between education and industry while operationalising EU competence frameworks (Dig Comp, Life Comp, Entre Comp, Green Comp) for engineers.***

The project is being coordinated by **ENGINEERS EUROPE AISBL** as Project Leader and consists of a consortium of 13 partners, representing the whole spectrum of Higher Education (HE), Vocational Education Training (VET) and Industry representatives. The consortium partners of the project are:

1. Higher Education Institutions

- Faculdade de Engenharia da Universidade do Porto (FEUP)
- Technological University Dublin (TU Dublin)
- Katholieke Universiteit Leuven (KU Leuven)

2. Vocational Education and Training

- Institute of Industrial and Business Education & Training (IVEPE-SEV)
- Newport Group S.A. (NG)

3. Industry and Engineering Organizations

- Verein Deutscher Ingenieure (VDI)
- Engineers Ireland (EI)
- Ordem dos Engenheiros (OE)
- European Council of Engineers Chambers (ECEC)
- Association of European Civil Engineering Faculties (AECEF)
- Federation of European Heating, Ventilation and Air Conditioning Associations (REHVA)

Picture 1: *Inauguration of the European Engineering Advisory Group, Residence Palace – Brussels, 11 September 2018: the informal start of the E4E Project.*

4. Quality Assurance

- National Agency for Quality Assessment and Accreditation of Spain (ANECA)

Next to those E4E-consortium partners, there was also valuable input from other stakeholder representatives, such as the European Board of Engineering Students of Technology (BEST), the European Young Engineers (EYE), the European Association of Manufacturing Technologies (CECIMO) and a number of represented companies like TÜV North (Germany), PROTECNA (Portugal) and the Electricity Supply Board ESB (Ireland). Together they established the European Engineering Skills Council to which we refer under items 3.5 and 5.4 further on.

The below mentioned people and institutions have contributed to the attached draft strategy through their primary and secondary research as well as by their expert advice and contributions made during various digital and in-person meetings held in the light of the E4E Project in the time September 2022 to August 2024. In this respect, a special thanks also needs to go to Prof. Marta KOSIOR-

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Picture 2: *E4E Consortium Meeting and Establishment of the European Engineering Skills Council, Brussels, 21-22 September 2023*

KAZBERUK, Rector of the Bialystok University of Technology (Poland), who captured the major findings of the primary and secondary research into a summary which was the basis of this E4E Skills Strategy.

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The attached Skills Strategy is the result of joint actions of all these partners. The development (and improvements) of this document required numerous events allowing for discussion, exchange of experiences and establishing common opinions. The events also served to explain the E4E project and to disseminate the contents of the Strategy, because this document is intended to serve many beneficiaries, also outside of the project. A short overview of the events in which (merely) **ENGINEERS EUROPE** took part over the last two years is added as Annex 2. Project implementation, strategy development and survey research required the development of extensive and wide

relationships. In addition, the E4E dissemination events are also largely presented on the E4E LinkedIn account, which at the time of issue of this document, has **6.712 + followers**.

This Skills Strategy is constructed on the input resulting from **Primary and Secondary Research** that was conducted in two rounds by all consortium partners of the project. Surveys (primary research) and literature/data reviews (secondary research) have been undertaken to acquire qualitative data as the basis for definition of skills gaps/ competence requirements.

ENGINEERS EUROPE and its 32 National Members conducted **primary research by developing and implementing two European-wide on-line surveys** between 15 May and 15 July 2023 and between 7 May and 30 June 2024. The first survey consisted of 33 closed questions, whereas the second survey consisted of 10 questions of which some were open. In total these two surveys received **7.757 completed replies** from professionally active engineers and engineering students. The results provide significant input about the current trends and major challenges when it comes to engineering competencies for the future.

The methodology used for **the secondary research involved a bibliographic review of various sources**: publicly available reports on the internet, conference presentations and their outcomes and conclusions, digital press releases, interviews, publications of public agencies and authorities at national and European level related to the subject and taking into account the various stakeholder groups as developed by the OECD (industry, professional organizations representing the engineering profession, universities and higher education institutions as well as public authorities). The literature review provided an insight into the trends and directions of discussions about engineering education throughout Europe. An extensive list of References is presented at the end of this document in the Bibliography. **None of the sources cited predate the year 2020**.

The following pages are a direct reflection of the hard work and commitment the E4E-consortium partners and the Skills Council members have demonstrated and brought to the table over the past two years. Their contributions have not only made the attached document possible, but also ensured a strong foundation for the future work

Picture 3: *Chairman of the European Engineering Skills Council, Mr Hannes TREIER, Member of the ENGINEERS EUROPE Executive Board, Member of the Swiss National Committee in ENGINEERS EUROPE, Partner REFLECTA AG, Bern (CH).*

of the Engineering Skills Council. We wish to thank them for their commitment and support and for being such valuable partners. Thanks to their dedication, expertise and collaborative spirit – which were instrumental to build this partnership – we have been able to achieve this significant result.

Dirk G. BOCHAR
Secretary General
ENGINEERS EUROPE
E4E Project Coordinator

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living room
kitchen
meeting room
30 x 10
Bathroom
Bedroom

2. INTRODUCTION

The European Engineering Skills Strategy, as outlined by the E4E project, establishes the framework for the operation of the European Engineering Skills Council. The objective of this document is therefore to provide an answer to the following questions that are at the core of the E4E project:

- What is the current situation concerning the competence requirements of engineers, the existing skills mismatch, and activities/measures of companies/individual engineers to facilitate competence developments?

- What are the future needs concerning technical and non-technical skills of engineers before the background of global megatrends, i.e. digitalisation, decarbonisation, demographic change, and internationalisation/ globalisation?

As the competence requirements of engineers are currently undergoing a major change, the focus of the project is on two major competence areas:

- Technical skills, e. g. green skills, digital competences, data literacy
- Non-technical skills, e. g. communication skills, entrepreneurial skills, interdisciplinarity, life-long learning, intercultural skills, interpersonal skills

This document caters to several **Key Stakeholder Groups**.

- **Higher Education Institutions** (HEI) play a pivotal role in delivering essential engineering curricula and attracting future engineers. In addition, they are more and more developing into providers of continuing professional development (CPD).

- **Employer associations** provide crucial input on the competencies required by industry.

- **Professional associations**, chambers, and engineering federations serve as platforms for communication, discussion, and feedback, liaising with political decision-makers.

- **Training providers** focus on competence development, encompassing secondary education and vocational training.

- Finally, **political decision-makers** hold the authority to transform recommendations into legislation, shaping the engineering landscape.

This document and the established Skills Council is relevant to all of these for the following reasons:

- The document provides Higher Education Institutions (HEIs) with insights from industry considering the necessary continuous alignment of curricula and labour-market demands.

- The document grants professional associations, federations, and chambers access to the latest information from HEIs and companies on current competence and curricula developments and enables them to communicate current trends towards their members, partner organisations and political decision-makers.

- The document presents political decision-makers with a concise overview on current trends in the development of engineering competencies, enabling them to base political decisions on information from a wide variety of relevant stakeholders.

- This Skills Council offers a way for engineering companies to continuously channel their competence requirements to the entire Higher Education sector and at the same time receive feedback on current trends in Higher Education in the field of engineering and technology.

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- The Skills Council will give training providers an idea of current and future market demands, thus enabling them to develop up to date CPD activities/programs.

By gaining insights into the evolving nature of the engineering profession, our research addressed several key aspects.

- **Firstly**, it aimed to identify emerging trends in the industry, such as the increasing demand for digital skills, the integration of sustainable practices, the need for resilience in the face of unforeseen events, and the importance of fostering an entrepreneurial mindset among engineers. These trends shape the engineering field's skill requirements, educational strategies, and professional development needs.

- **Secondly**, our research provided information about the state of the engineering profession across industries, functions and countries.

Understanding the dynamics of the engineering profession will help policymakers, educational institutions and industry leaders to align their strategies and resources to better support engineers.

It did not come as a surprise, that the green and digital transitions, as well as the development of specialized materials are main impact factors that have a tremendous effect on the expert knowledge that will be required by future engineers. In addition, it has become clear that while engineering in the future will still have to be based on a high-quality basic engineering/technical education, the importance of non-technical skills will grow. Interdisciplinarity, entrepreneurial skills, multi-cultural competences, holistic approaches and an understanding of the need for life-long learning, are just a few examples.

Especially the last aspect, the need for continuous professional development (CPD), is identified as a major challenge but also a major opportunity for individual engineers, companies, Higher Education Institutions and engineering training providers.

The research also highlighted that before the background of a general lack of highly qualified personnel in engineering, there is a clear need for the diversification of the engineering workforce, i.e. not only by bringing more women into engineering (gender), but also by stimulating the inflow of qualified technical personnel from non-EU countries (ethnicity) and by creating a higher permeability of the educational systems (social).

The structure of this document is in accordance with the overall goals of the E4E project.

3. ANALYSIS OF THE DEMAND SIDE

1. Demand of Engineers per Industry Sector and Profiles

1) Current Landscape: The engineering profession in Europe stands at a crossroad. While there is a burgeoning demand for engineers, particularly in innovation, technology and renewable energy sectors, there's a concerning trend: the profession is losing its allure among the younger demographic. Despite the anticipated need for millions of skilled professionals by 2030, the appeal of engineering as a career choice is on the decline.

2) Skills Evolution and Emerging Profiles: Many of the anticipated jobs by 2030 demand higher skill levels, with a significant portion being in the realm of science and engineering. As technology evolves, so do the profiles in demand. Specialized areas like artificial intelligence (AI), data analytics, cybersecurity and renewable energy, are facing a shortage of qualified engineers.

3) Transformations and Challenges: The engineering field is undergoing transformative changes, driven by technological advancements, sustainability goals and digitalization. Challenges such as skills shortages coexist with opportunities in infrastructure development and research. Traditional disciplines remain vital, but emerging fields like AI, data science and robotics, are gaining prominence.

4) Identified Concerns and Sectors in Demand: Serious concerns about shortages are identified in electrical/electronic engineering, information and communications technology (ICT), and agronomic/environmental engineering. Sectors experiencing increased demand include:

- Technological Advancements: Engineers play a pivotal role in leveraging technologies like AI, the Internet of Things (IoT), robotics and automation to enhance productivity and drive innovation across sectors.
- Sustainability and Renewable Energy: With a focus on sustainability and renewable energy sources, engineers are crucial in developing green technologies and contributing to climate goals. High-quality engineering services are essential for achieving the targets of the EU's Green Deal.

5) Future Trends (2023-2027): The next five years present significant changes, with sustainability and environmental concerns taking centre stage. Engineers must adapt to the increased emphasis on sustainability, automation and AI, with major areas of innovation in Renewable Energy and Green Infrastructure. Technical competencies related to sustainable design and circular economy principles will be paramount.

6) Preparing Engineers for the Future: Preparation for future graduates and active engineers should focus on instilling a mindset aligned with UN Sustainable Development Goals (SDGs). The industry will prioritize energy efficiency and sustainability, requiring engineers to implement new technologies and provide expertise to promote sustainable practices, especially among SMEs.

> ***In conclusion, the demand for engineers in Europe is robust, with a particular emphasis on emerging fields and sustainability. While challenges exist, the profession is evolving, offering numerous opportunities for those ready to embrace the transformative journey ahead. The role of engineers is not only in meeting current demands but in shaping a sustainable and innovative future for the continent.***

2. Skills Gaps Within Sectors

1) Skills Shortage and its Implications: One of the primary challenges faced by the engineering profession is the shortage of skilled professionals. This shortage is perceived as a more significant barrier to business transformation (60%) than a shortage of investment capital (37%) across various industries. The insufficient number of professional engineers poses a considerable challenge to meeting the demands of the labour market.

2) Technical Skills: Hard skills provide the technical foundation needed to perform engineering tasks and solve

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complex problems. Within this context, energy efficiency and sustainability stand out as crucial areas of expertise. The development of sustainable engineering is driven by understanding sustainable design principles, circular economy principles and knowledge of renewable energy sources. Respondents emphasize the importance of skills related to green building, energy efficiency, climate adaptation and resilience planning. As systems become more interconnected and intelligent, engineers are urged to familiarize themselves with smart technologies such as IoT, smart systems and devices, data analytics and ICT skills.

3) Non-Technical Competencies: There's a growing consensus that engineering education should encompass not only science and engineering but also social, ethical, and organizational aspects of engineering practices. The term "professional competences" encompasses a range of skills, with communication, teamwork and organizational skills being highlighted in various sources as critical for success. Despite the traditional focus on technical problem-solving, employers increasingly expect engineers to possess a broader set of skills. This includes effective communication, teamwork, critical thinking, problem-solving and adaptability.

4) Soft skills are considered equally important for thriving in dynamic work environments and include leadership, entrepreneurship, planning and organization, innovation/ creativity and empathy. Interdisciplinary approaches are gaining prominence, with engineers seen as communicators and facilitators. Interdisciplinary competencies, adaptability to change, resilience, creativity and problem-solving skills are identified as key competencies in the face of a changing environment and as crucial for the future. Enhancing communication and collaboration skills is essential for successful project execution and collaboration skills involving interactions with colleagues are highlighted.

5) Entrepreneurship is recognized as a key competence for improving European competitiveness and a focus on social and green economy development needs to be emphasized.

In the results of the second Engineers4Europe survey, approximately 20% of respondents emphasize the need for soft and non-technical skills when asked about gaps in engineering curricula. The word cloud on the above visualizes the most frequently mentioned terms in these responses, with word size reflecting the frequency of mentions.

> ***In conclusion, addressing skills gaps within the engineering profession is essential for meeting the demands of a rapidly changing market. Balancing technical and non-technical competencies is crucial for the success of engineers in the contemporary landscape. The evolution towards interdisciplinary approaches, soft skills and a focus on sustainability will be pivotal in shaping the future of the engineering profession.***

3. Demand for Continuous Professional Development (CPD) and Impactful Skill Interventions

1) The Necessity of Continuous Learning: The engineering profession, driven by rapid technological advancements, is undergoing significant changes in content and skill requirements. As university curricula may not fully equip engineers for a professional lifetime, the concept of lifelong learning (LLL), coupled with professional experience, is becoming increasingly vital. The cooperation of universities, professionals, VET institutes (formal, informal, non-formal) and industry is crucial to ensure that different forms of education complement each other.

2) Technological Transitions and Upskilling: The green and digital transitions necessitate the upskilling of engineers in new technologies and processes such as building information modelling (BIM), cloud computing, artificial intelligence, 3D printing, virtual reality, IoT and blockchain technology. Competency-based learning is identified as the most effective approach for engineers.

3) Lifelong Learning in Engineering: The engineering profession is at the forefront of the universal tendency towards LLL. With modern technologies evolving rapidly, mandatory courses for professional engineers are deemed critical to maintaining high levels of expertise. Future engineers must continually upskill themselves to adapt to emerging technologies and interdisciplinary demands.

4) Integration of Sustainability Principles: To prepare engineers for the challenges of the 21st century, sustainability principles must be incorporated into formal engineering education and continuous professional development. Changes in education curricula and CPD programmes are essential to support the integration of Sustainable Development Goals (SDGs) into engineering practice.

5) Collaboration for Curriculum Development: Universities and technical schools, in collaboration with industry, play a vital role in developing formal or informal curricula aligned with job market needs. The close cooperation of all stakeholders in engineering education and the profession is necessary to ensure that curricula are relevant and responsive to industry requirements.

6) Effective Learning Strategies: Effective learning strategies, such as problem-based learning and practice/ experiment-based learning, are crucial for preparing engineers to tackle the complex challenges posed by sustainability and technological advancements. The development of skills such as critical thinking, effective communication, and teamwork was in the research highlighted as essential.

7) Addressing Shortages and Embracing Change: There is a need for more practical and hands-on activities in training curricula to bridge the gap between theoretical knowledge and real-world application. Microcredentials, post-graduate programmes and education initiatives should be designed to address skill shortages and equip engineers with the latest trends and developments.

8) Soft Skills and CPD Courses: Soft skills such as collaboration, communication and adaptability are identified as vital for success in the engineering profession. Entrepreneurship, leadership and ethics in engineering are ranked highest when considering CPD courses, indicating the importance of holistic skill development.

9) Integration of Non-Technical Skills: Engineering education should extend beyond science-based tasks, incorporating non-technical skills from the first day. Integrated projects, hands-on problem-solving, and exposure to emerging technologies are proposed as effective methods to bridge the gap between theory and practice.

10) Active Engagement in Continuous Learning: Engineers are urged to actively engage in continuous learning through attendance at conferences, workshops and training programmes. This proactive approach ensures they stay updated on the latest trends, best practices and technological advancements in their rapidly evolving sectors.

11) Ethics and Multi-Stakeholder Cooperation: Ethics-related CPD measures, along with a focus on interdisciplinary approaches, are essential for the evolving nature of engineering work. Multi-stakeholder cooperation is highlighted as a crucial component of addressing the complexities and ethical considerations in the field.

> ***In conclusion, addressing the demand for continuous professional development is pivotal for equipping engineers with the skills needed to navigate the evolving landscape of the engineering profession. From technological transitions to sustainability integration, a holistic and proactive approach to LLL is essential for the sustained excellence of engineers.***

4. Under-represented groups in engineering

1) Under-Representation and its Implications: Our research indicated that there are proportionally underrepresented groups in engineering, leading to a

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deficit in the diversity of ideas, perspectives, creativity, and overall balance in the profession.

2) Strategies for attracting Diverse Talent: Scholarships are identified as effective tools to attract diverse talent, providing financial support and breaking down economic barriers. Additionally, the development of mentorship programmes proves instrumental in providing guidance, support and a sense of belonging for individuals from under-represented groups. Diversity and inclusion training for both professionals and organizations is recognized as a vital step toward creating inclusive environments that welcome diverse perspectives.

3) Equality and Diversity for Sustainable Solutions: Enhancing equality in the engineering profession yields a range of positive effects. Firstly, it addresses the shortage of qualified engineers by tapping into a wider pool of talent. Secondly, it introduces diverse approaches that are essential for reaching sustainable engineering solutions. By incorporating a variety of perspectives and experiences, engineering teams are better equipped to tackle complex challenges and develop innovative solutions.

4) Increasing Female Representation: The gender gap in engineering has long been acknowledged as a significant issue. Encouraging more women to pursue careers in engineering not only addresses gender inequality but also enhances the diversity of thought within the profession. Strategies such as mentorship, targeted recruitment efforts and creating inclusive environments are essential in this pursuit.

5) Diversity and Inclusion as Catalysts for Innovation - The importance of building diverse and inclusive teams of engineers: beyond addressing issues of representation, diversity and inclusion contribute to the generation of fresh ideas and increased creativity within engineering projects. This diversity of thought is critical for providing effective answers to societal challenges and driving innovation.

> ***In conclusion, the under-representation of certain groups in engineering is a challenge that requires proactive measures above-mentioned.***

5. Actionable Recommendations for the Skills Council

In translating our comprehensive analysis into actionable recommendations for the European Engineering Skills Council, several key areas emerge as critical focal points to address the evolving demands and challenges within the engineering profession.

1) Positioning Statement and Recruitment: Develop a robust positioning statement that clearly articulates the significance and impact of the engineering profession, aiming to inspire young minds. Establish initiatives to expose students to engineering concepts early on, fostering interest and understanding of the profession's real-world contributions.

2) Green and Digital Transition: Integrate the GreenComp framework and Sustainable Development Goals (SDGs) into engineering education to align with megatrends like green and digital transition. Adapt teaching programmes to bridge the skills gap, ensuring relevance to the dynamic demands of the job market.

3) Holistic Education and Transversal Skills: Advocate for continuous re-evaluation of engineering education, emphasizing a holistic approach that considers the societal and environmental impacts of engineering innovations. Set up innovative approaches for the development of transversal skills, integrating hands-on experiences and collaborative learning throughout the education process.

4) Collaboration and Partnerships: Foster partnerships between industry and educational institutions, leveraging collaborative efforts to address skill shortages. Encourage collaboration through networking events, conferences and knowledge-sharing platforms to enhance the intersection of academia and industry.

5) Continuous Learning and Skill Development: Promote continuous learning through engagement with professional societies, facilitating knowledge-sharing among peers. Implement strategies to monitor and contribute to the ongoing evolution of skills required in the engineering profession and give input to CPD upskilling/reskilling training structures.

6) Entrepreneurship and Innovation: Encourage an entrepreneurial mindset among engineers through workshops, seminars and short training courses. Support engineering entrepreneurship by providing financial assistance, mentorship programmes and access to networks and resources.

7) Diversity and Inclusion: Prioritize initiatives to reduce implicit bias in the hiring process and provide diversity and inclusion training for engineering professionals and organizations. Support gender balance, ethnic diversity and equal opportunities to enhance diversity within the engineering profession.

8) Environmental Sustainability and Skill Development: Prioritize investment in education and skills development, particularly in STEM fields, to support the transition to reduced greenhouse emissions. Develop educational programmes covering emerging fields like renewable energy, artificial intelligence, data science and robotics to prepare graduates for the evolving job landscape.

6. Identifying areas where data and information are lacking

Whereas we believe that ENGINEERS EUROPE and the E4E partners have launched a very important initiative of which the goal is to formulate a robust strategy that will have a complete picture of the existing situation, this effort must be continued and intensified in order to meet the needs of the future. Some suggestions that will give us more input and feedback for the future modification and formulation of our strategy are:

1) Current Skill Set of Engineers: Continuous gathering of detailed information on the current skills possessed by engineers in different sectors and specializations. Data should be collected on the proficiency levels of engineers in emerging technologies (e.g., AI, blockchain, IoT) and their application in real-world scenarios.

2) Future Skill Requirements: This document reflects the first attempt of the Skills Council to collect and interpret data and formulate a strategy. Maybe there is a limited foresight into the evolving demands of industries, especially regarding technological advancements and the emergence of new engineering disciplines. Nevertheless, future efforts will need to be focused on collecting data about the anticipated skill requirements for engineers in the context of green and digital transitions, sustainability goals and other megatrends compiling them with the EU guidelines and frameworks, such as GreenComp, LifeComp, DigiComp and EntreComp.

3) Regional Disparities: Focus on understanding of regional variations in skill demands and shortages across European countries remains a challenge. There is still lack of data on specific regional challenges and opportunities that could influence skill requirements.

4) Soft Skills and Interdisciplinary Competencies: There is a need to conduct even more research on the importance of soft skills and interdisciplinary competencies in different engineering roles. There is still limited data on the correlation between soft skills and project success, innovation and adaptability in the engineering profession.

5) Under-Represented Groups: More intensive research and data collection on the representation of women and other under-represented groups in the engineering workforce. Lack of information on the barriers faced by these groups in pursuing engineering careers and potential actions to address these challenges remain subject of further study.

6) Continuous Professional Development (CPD) Needs: Future research needs to be expanded to get more insights into the specific areas where CPD is most needed among engineers. Although there is awareness of several good practices, there is a lack of evidence on the effectiveness of existing CPD programmes and engineers' preferences for CPD.

7) Collaboration Between Industry and Education: Lack of data on the extent and effectiveness of collaboration between engineering education institutions and industry partners and the VET world. Insufficient information on successful models of industry-academia partnerships that contribute to skill development.

8) Entrepreneurial Skills and Innovation: Enhance understanding of the entrepreneurial skills needed by engineers to drive innovation and contribute to the growth of startups. Inadequate data on the success rates of engineering entrepreneurs and the impact of entrepreneurial training programmes.

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9) Impact of Global Trends: Although we recognize the global trends (such as climate change, digitalization and geopolitical shifts) and the common belief that engineering will play a serious role in these, we have a lack of comprehensive data on the impact of these trends, on engineering skill requirements and insufficient information on the adaptability of the engineering workforce to navigate these global challenges.

10) Evaluation of Existing Educational Programmes: There is an awareness that to some extent existing skills are not aligned between academia and the labour market. But there are still limited data on the effectiveness of existing engineering education programmes in meeting industry demands and insufficient information on the alignment between educational curricula and the skills needed in the job market.

7. Need for further research and insights to inform future decision-making.

To address these data gaps, a combination of surveys, interviews, industry reports and collaboration with professional organizations, industry, academia and policy makers within the European Engineering Skills Council - as an ongoing monitoring mechanism - must be continued and employed to ensure relevant information continues to be gathered for a future robust skills strategy for European engineers.

4. CURRENT SKILLS CHALLENGES FOR EMPLOYERS

1. Requirements for employers to transform the workforce

A key issue is finding a balance between technical expertise and professional skills. Engineers are expected to possess a strong understanding of mathematics, physics and the specific technical knowledge relevant to their field of specialisation. One common form of skill mismatch is a shortage of specific industrial skills. As industries adopt new technologies and practices, engineers may find themselves lacking the necessary expertise in emerging areas. As opposed to the postulate of a high degree of specialization, there is the expectation of the interdisciplinary nature of engineers. Evidence indicates that many graduates lack essential practical skills, especially in communication and strategic thinking, leading to a mismatch between academic outputs and industry requirements. Additionally, engineers must develop global competences, which includes an awareness of- and sensitivity to cultural diversity, enabling effective collaboration in international projects.

Employers struggle to align engineering education with industry needs, emphasizing the importance of transferable skills such as teamwork and problem-solving. This situation calls for enhanced cooperation with educational and professional bodies to ensure that curricula are relevant and prepare students for practical challenges. Additionally, employers need to keep up with evolving competencies in areas like computer-aided design, app development and data management. Skills in navigating extensive databases, often underestimated, are becoming crucial in professional roles, highlighting the need for targeted professional development programs.

Employers must implement short-term and long-term measures in parallel in order to meet current and future challenges. In the short term, engineers must be able to concentrate on core technical tasks and be relieved of administrative tasks (for example, the examination and use of new assistance models and AI tools). Aligned with this is more effective succession planning. Promoting targeted upskilling of career changers and employees as well as the participation in existing programs for the integration of foreign specialists are also acknowledged as short-term imperatives. In addition, employers must recognize that even where the employees wish to continue to work in their current fields of expertise and where this suits the employer, the employees still need to upskill as the roles, tools and methods of working, change around them. Finding ways to provide these employees with appropriate learning opportunities which keep them highly productive, is both a short- and long-term challenge, particularly where there may be resistance to change and / or where shortage of resources hinders releasing such productive employees from their current work to spend time on personal development.

2. Digital Skills Competencies

Digitisation is relevant to all work areas and means a lot more than data analytics, AI and using Teams and SharePoint effectively. It is critical that work can be done faster and more efficiently - particularly as it gets more complex and the demand for output continues to grow while the resources available shrink. Companies must upskill their current workforce to empower them to tackle the challenges of digital transformation. Preparing an already-existing team for digitalisation means utilising a current skill set that already understands the organisation, thus boosting efficiency while retaining and developing talent.[1]

As with many industries, people skills remain critical. Innovation within the technology sector has been fuelled by collaboration; teams using critical-thinking and problem-solving skills in agile configurations to address issues as they arise. Tech graduates nowadays need more than just acumen in the latest technologies, they need to be problem-solvers with conceptual awareness, in an environment that delivers ethical as well as commercial context for their choices.
The European Digital Competence Framework identifies key

1 DigComp: the European Digital Competence Framework

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elements of digital competence and skill development in 5 areas: Information and Data Literacy, Communication and Collaboration, Digital Content Creation, Safety and Problem Solving.

3. Green Skills Competencies

At the European level, the European Union has produced a comprehensive conceptual framework under the name GreenComp[2], the European sustainability competence framework. The timing of the document also adds to the urgency that sustainability needs to be adapted in existing industries as well as building a more responsible way of life both as individuals and professionals.

GreenComp rather focuses on describing the areas that need attention and describing competencies under those areas. In general, within the framework, we can find four thematic areas, including embodying sustainable values, enhancing complexity in sustainability, envisioning sustainable futures and acting for sustainability. It is apparent from the framework that the underlying principle is for a holistic approach. It is also apparent that these competencies are not "stand alone".

The GreenComp framework cannot exist without a link to other competencies and frameworks. The competencies defined within the framework are not in the traditional sense trainable as they tend to reflect the change of mindset and point of view towards the existing situation. The familiarization, training and building on the GreenComp competencies is a long-term process, that includes a cognitive decision from each individual/organization to commit in the matters related to the Green transition and sustainability and to incorporate the principles in both personal and professional capacities.

4. Life Skills Competencies

The European Framework for Personal Social and Learning to Learn Key Competence[3] (LifeComp) outlines a framework for developing key life skills, essential for thriving in the 21st century. Key skills highlighted in the framework include Personal (self-regulation, flexibility, and wellbeing), Social (empathy, communication, and collaboration; to work effectively in diverse teams and communicate clearly) and Learning to Learn (a growth mindset, critical thinking, and managing learning). For engineers, who often work in dynamic, interdisciplinary environments, this framework can be particularly relevant.
Employers have a role in developing employee's life skills such as teamwork, communication, problem-solving and adaptability. Their investment contributes to a more innovative, efficient and adaptable organization, which in turn increases employee engagement and loyalty, reducing turnover and enhancing the overall work environment. Digital tools can help promote and facilitate the acquisition of these LifeComp competencies.

5. Entrepreneurship Competencies

Looking ahead, the importance of entrepreneurial skills for engineers is expected to increase[4]. Globalisation will require them to understand and engage effectively with international markets. As the engineering sector becomes more interdisciplinary, entrepreneurial skills will be essential for effective collaboration across disciplines and industries. Engineers will also be challenged to develop solutions that are not only technically feasible, but also environmentally sustainable and ethically sound. At this point, engineers will also need a high level of financial and business literacy to be able to make an even greater contribution to the business success of companies. Finally, an entrepreneurial mindset will be critical to driving innovation, whether in start-ups or established organisations, to develop new solutions and business models. Our research revealed the following main competencies required by future engineers:

2 GreenComp: the European Sustainability Competence Framework
3 LifeComp: The European Framework for Personal, Social and Learning to Learn Key Competence
4 EntreComp-The entrepreneurship-competence-framework_en

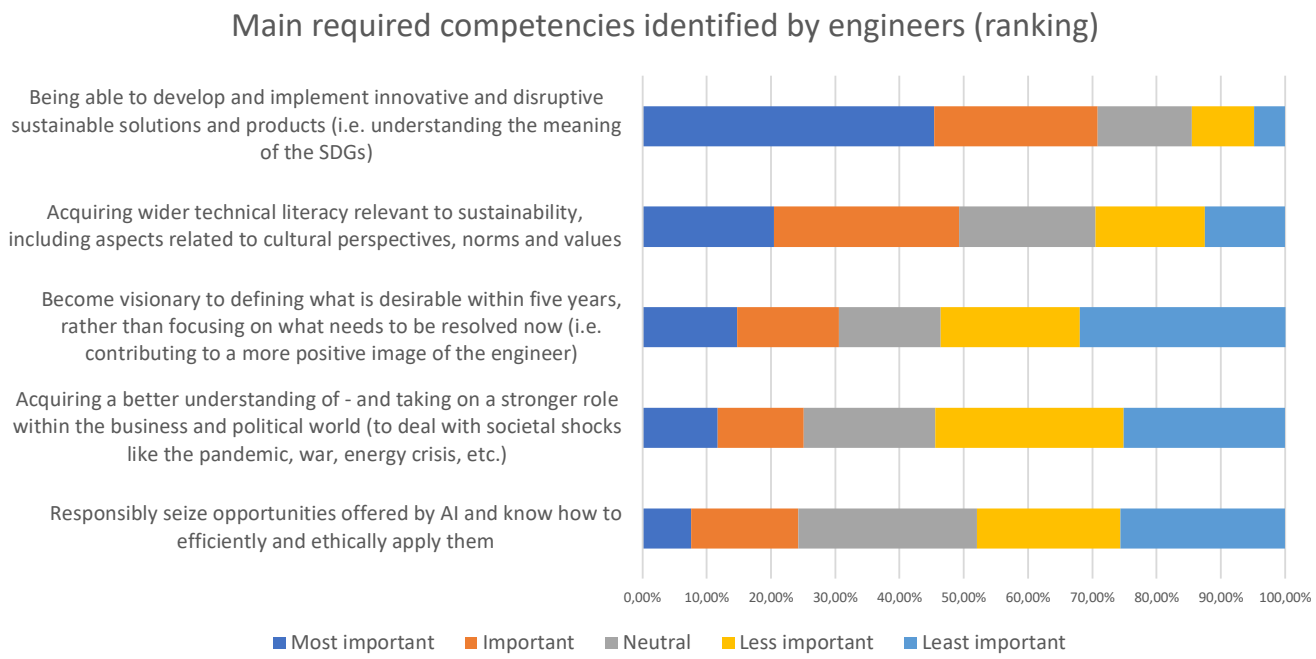

Figure 2: *The main competencies essential for the future of the engineering profession, Engineers4Europe second survey*

5. ASSESSMENT OF CURRENT SUPPLY

1. Introduction

Skills shortage is more than discipline capability, it is also exacerbated by a shortage based on quality in the graduate arena. Moreover, focus is also required with regard to the supply of further learning (including micro-credentials) to maintain the existing engineering population at the cutting edge.

This chapter considers the challenges and priorities for an effective engineering graduate supply, culminating into a methodology to be employed towards the development of a strategic framework that the Skills Council can utilize in strategizing (iteratively) for better alignment between the demands of industry and the supply capabilities of HEI and VET providers.

2. Challenges in ascertaining the supply of engineering professionals

The prioritization of skills and related competency requirements should facilitate an understanding of the different skills, the level of competency a role needs and what steps may be required to help upskill individuals in specific areas, at (inter)national level or organization level. Such a prioritization is a challenge on the supply side. However, if (soft) professional skills are to be provided without compromise, within more condensed programs along with the core technical skills, there is a significant challenge because there are requisite credit demands and limited time available. However, employers are reporting that a lack in (soft) professional skills in recent graduates, manifests in difficulties in all aspects of communication (oral presentation, written and even discussion).

Further to skill gaps there is a labor shortage challenge as well. The quantity of quality graduates as well as the skill sets of those being produced. The skills gap is affecting all sectors, even the climate crisis. The Skills Council should have a role in influencing the EU in initiatives such as subsiding technical education places to address skill shortages and encourage more people to enter the industry.

3. What kind of engineering professional, as a supply output, is required?

In the context of anticipating skills requirements for the engineering profession, there is a growing emphasis on a combination of technical expertise and broader competencies to meet the evolving needs of the industry. The following are key areas in the E4E Skills Strategy.

1) Technical proficiency in core technical skills related to their specific field of expertise, including a deep understanding of engineering principles, mathematics and relevant technologies.

2) Digital and technological literacy so that engineers are digitally literate with skills in data analysis, programming and familiarity with emerging technologies such as AI and IoT, are increasingly important.

3) Interdisciplinary collaboration and the ability to work collaboratively across disciplines is crucial as engineers often engage in projects that require collaboration with professionals from diverse backgrounds. Effective communication and teamwork skills are essential.

4) Innovation and creativity so that as industries evolve, engineers are equipped to contribute to innovation; fostering creativity, analytical thinking, critical thinking and problem-solving skills, to address complex challenges and develop novel solutions.

5) Adaptability and continuous learning so that engineers possess a mindset of adaptability and a commitment to continuous learning to stay abreast of industry changes. CPD also includes improving soft skills.

6) Soft skills beyond technical expertise for effective communication, leadership, teamwork and project management skills, that contribute to successful work execution and career advancement.

7) Ethical and Social responsibility, so that engineering professionals understand the ethical implications of their

work and consider the social impact of engineering projects, including an appropriate awareness of sustainability, environmental responsibility and ethical decision-making.

8) Global and cultural awareness because in an increasingly interconnected world, engineers may work on projects with global implications. Furthermore, engineers need to possess cultural awareness and the ability to navigate diverse working environments.

9) Entrepreneurial mindset that encourages engineers to think innovatively and consider business aspects when developing and implementing engineering solutions.

10) Environmental and sustainable awareness so that engineers are familiar with and incorporate environmentally sustainable practices into their work.

11) Comprehensive risk assessment skills to evaluate the vulnerability of infrastructure and communities to climate-related hazards and other crises. This involves incorporating climate projections, modelling techniques and resilience strategies into engineering practices to enhance preparedness, response and recovery.

3.1 Focused Change – 'pillars' within (engineering) 'disciplines'

Educational offerings must prioritize the necessary basic sciences and pillars (priority subjects) within each engineering discipline. Such prioritization should be considered in conjunction with employers, and engineers associations and mindful of the space requirements necessary to facilitate new skills and the increasingly essential professional skills.

Companies/industry are fundamental in the development of young engineers and in that regard, they need to have greater responsibility in an engineer's growth. One way is to mandate curricular internships within degree programs to facilitate the acquisition of some of the essential professional skills. Such initiatives represent a way to motivate engineering students to further deepen technical skills.

Another approach to bridge any gaps is to foster working conditions such that young engineers can pursue a master's or a postgraduate degree. It is at the level of these training courses that the most specific and technical subjects are taught, and which allow for an acceleration of knowledge and skills in specific areas of engineering. In 4/5 years of higher education young engineers will have scientific knowledge that will help them to be more successful in their tasks. Such an initiative should be synchronized with LLL strategies, incorporating CPD requirements.

3.2 Strategic Postgraduate / Post-qualification Considerations

Addressing the skills mismatch in the engineering sector requires a multi-faceted approach. By combining strategies and "good practices" that we present below, HEIs, VET providers, professional bodies, industry stakeholders and policymakers are working together to bridge the skills gap in the engineering sector and better prepare engineers for the challenges of the modern workplace.

1) A shift in the educational paradigm to 'Competency-based Education' provides clear and measurable learning outcomes. An educational paradigm based on competencies also fosters a greater diversity of career opportunities, as engineers will find themselves equipped with a versatile skill set that expands their range of professional options. Several, internationally recognized, skills frameworks provide a comprehensive understanding of what generic and transversal skills should be developed in each engineering cycle. It was recently launched from the EC, as ResearchComp[5].

2) Diversity, Inclusion, and Social Responsibility to ensure that engineering education is based on the assumptions of diversity and inclusion (race, country, culture, disabilities, gender, and sexual orientation), as well as to promote initiatives to attract underrepresented groups (such as women) to pursue engineering careers. A diverse and inclusive learning environment fosters open-mindedness, empathy and communication skills, much needed for team working. Such qualities also foster innovation and creativity, which are crucial elements for the engineering profession where novel solutions are often required. Literature has been pointing out the need to rethink engineering programs, introducing intentional and formal opportunities to develop **transversal skills** (non-specific to engineering) that can be transferred beyond academia.

5 ResearchComp: The European Competence Framework for Researchers

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3) Industry-Academia Collaboration that fosters stronger collaboration (HEIs and industry/companies/business) can be achieved through partnerships, joint research projects, internships and advisory boards. Industry placements are also helping students develop a better understanding of the skill set required in the workplace. On one hand, it motivates students to develop such skills and on the other, enhances a better understanding of the different career paths of the engineering profession. To the industry, these collaborations represent an opportunity to assess the supply and motivate students to develop the skills needed.

4) New pedagogical methods to develop skills such as **Challenge-based Education** exposes engineering students to real-world problems, bridging the gap between theoretical knowledge learned in academia and its practical application.

5) Regular Curriculum Reviews/Reforms to incorporate the latest industry trends, technologies and skills requirements. Continuous evaluation of the educational offer is an important aspect to mitigate the skills gap and better align the supply with the demand. Such reforms should include beneficiaries (students) but also employers and professionals to ensure all can dialogue on the relevance of the educational offer.

6) Establishing **Mechanisms for Continuous Feedback from Industry professionals** to identify emerging skill needs is crucial for HEIs and VET providers. Industry representatives can contribute to curriculum development, by sharing with HEIs and VET providers the current and future needs, as well as expectations for the engineering workforce, so that these can be incorporated into the curricula. This dialogue is critical to maintain the relevance of the curricula and align job market needs with the educational providers' mission.

7) Professional Bodies should work with industry to identify the competencies needed for diverse engineering roles. They should also clearly identify and promote the needed skills to practice engineering in each specific area. On the other hand, they should also dialogue with HEIs and VET providers to ensure that the skills they (professional bodies) validate as core to the engineering profession, are supplied by educational providers.

8) VET providers can offer specialized, practical and short-duration training postgraduate programs that directly address the competencies required in the engineering workforce. Their educational offer emphasizes hands-on/practical training, through online courses, workshops, or seminars and this potentially motivates professionals who are already working in the field and need to balance their learning with work commitments. VET providers are thus, fostering a culture of continuous learning among both students and professionals for them to develop a mindset of "reskilling" and "upskilling" throughout their entire careers, according to the needs of the labour market.

9) Industry-endorsed Certifications with HEIs and VET providers working with the industry to develop micro-credentials (short-duration, often delivered online, focused educational units that offer learners the opportunity to acquire/develop a particular competency).

10) Government and Policy Support through the provision 77 regulations that guide educational providers to continuously adapt their curriculum, is also fundamental. The existence of a European Engineering Skills Council will provide a forum to debate the necessary skills for all engineers working in Europe, considering the European job market trends and provide guidelines for all European HEIs and VET providers. Funding is also crucial to promote initiatives that facilitate collaboration between industry and educational institutions.

4. A 'Supply' strategy: Priorities for the Skills Council

Following on from the considerations presented and the opportunities described above, a methodology is proposed in Figure 2 for the Engineering Skills Council to prioritise and subsequently recommend educational/training curricula reviews that can also facilitate better resource allocation for CPD offerings.

The methodology continues to build on the approach to engage with relevant stakeholders and cross-reference with secondary (literature) research to identify skills gaps (stage 1). The gap analysis must be cognisant not just about missing competencies; it must be about shortage of numbers too.

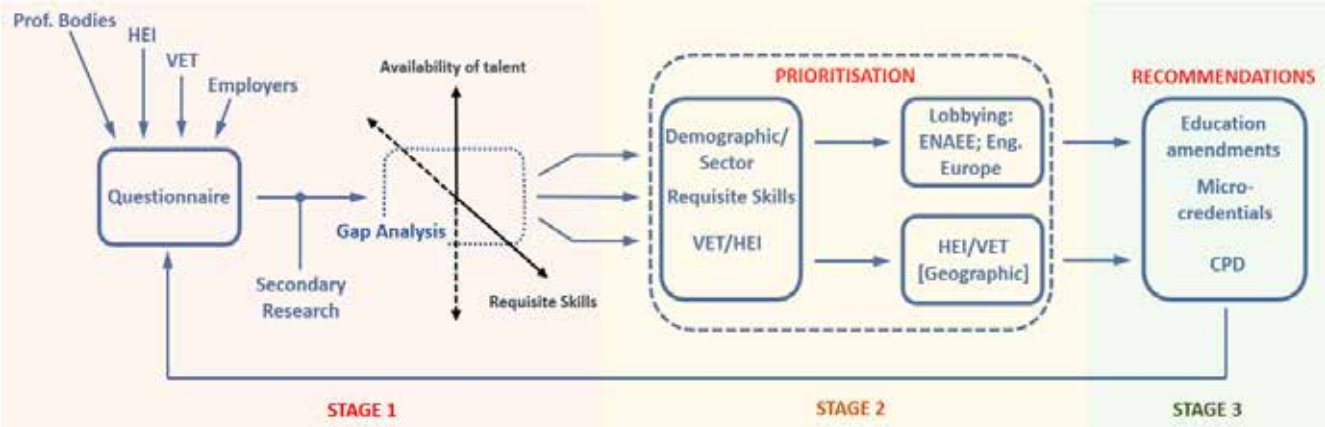

Figure 3: *Methodological approach to better align educational opportunities with professional demands for engineers.*

In stage 2, the Engineering Skills Council will prioritize the identified skills gap (acquired in stage 1) in terms of industry sector/demographic imperatives, required (priority) skills and HEI/VET capabilities. This prioritisation allows a sector/discipline specific emphasis to be achieved.

Then by engaging with professional engineering Organizations (ENGINEERS EUROPE, SEFI, etc.) and Faculties of Engineering, a subsequent focus on HEI/VET is possible (and could be geographically assigned.

Finally, in stage 3, the focus acquired in stage 2 will facilitate recommendations in terms of (potential) educational (First Cycle Degree/Second Cycle Degree) amendments; to better align with professional (industry) needs (demands).

Mindful of inherent inertia within HEIs, micro-credentials can bridge gaps within curricular review cycles (primarily through VETs, but with participation by HEIs where relevant). Finally, the focused prioritisation by the Skills Council will facilitate CPD design that optimises resources with necessary skills, thus closing the circle between education, training and life-long learning.

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6. SCENARIO ANALYSIS

1. Introduction

This section explores the various dimensions of inter-regional and cross-border mobility for engineers. Our objective is to critically examine the feasibility, challenges and potential benefits of engineers working in- and originating from different regions of the EU and beyond. In our pursuit of facilitating cross-border mobility for engineers beyond the European Union, we have outlined a comprehensive approach.

First, we propose to develop tailored CPD programs for non-EU engineers. These programs will be specifically designed to help these engineers bridge potential skill gaps and adapt effectively to diverse work environments.

Secondly, we emphasize the importance of collaborating with business and professional organizations to define specific skill needs for engineers seeking international opportunities. This collaborative effort will enable engineers to align their expertise with the demands of their desired destinations, ultimately enhancing their success.

Lastly, we aim to establish transparent and standardized recognition of non-EU engineering qualifications, with a particular focus on leveraging the International Engineering Alliance (IEA). This recognition will provide clarity and assurance to both engineers and employers regarding the equivalency of qualifications, fostering greater confidence and mobility in the international engineering sector.

2. Qualification Portability

The Human Resources Development Recommendation, 2004 (No. 195) of the International Labour Organization addresses the portability of skills and qualifications referring to employability and recognition. Skills visibility refers to the existence of formal and informal means to certify that a worker acquired a set of skills and competencies.

In the European Union context there are several instruments that promote and regulate the recognition and portability of qualifications. Article 53 of the Treaty of Lisbon stipulates that:

> ***"In order to make it easier for persons to take up and pursue activities as self-employed persons, the European Parliament and the Council shall, acting in accordance with the ordinary legislative procedure, issue directives for the mutual recognition of diplomas, certificates and other evidence of formal qualifications and for the coordination of the provisions laid down by law, regulation or administrative action in Member States concerning the taking-up and pursuit of activities as self-employed persons."***

The Lisbon Recognition Convention" (LRC), jointly drafted by the Council of Europe and UNESCO and adopted in 1997, is the main legal instrument on the recognition of qualifications in Europe. It has, to date, been ratified by more than 50 states. According to the LRC, qualification portability of qualifications is the default and only when significant differences between educational systems apply, should the recognition be refused.

The EU Council Recommendation of 26 November 2018 on promoting automatic mutual recognition of higher education and upper secondary education, and the outcomes of learning periods abroad, refers to the European Qualification Framework (EQF) as a way to foster transparency and build trust between national education and training systems. With the Council Recommendation, EU Member States make a political commitment to take steps to introduce automatic recognition by 2025. It remains to be seen if that will happen.

The European Union has built a system of qualifications recognition which is based on high quality standards, trust and transparency. The legal framework for the recognition and portability of higher education qualifications in the European context is one of the most advanced in the world. Nevertheless, the practical application of European legislation and international agreements is not uniform across Europe. Even though the LRC, as an international treaty, obliges the countries that ratify it to update the national legislation accordingly, the reality is that this is not always the case.
The Bologna Process Implementation Report 2020

addresses the developments toward implementation of the automatic recognition of academic degrees as envisioned by the above mentioned Council Recommendation .

3. Systems of Acceptance and Academic Recognition

The improvement of inter-regional and cross-border mobility for engineers can be considered in various dimensions:

1) The European Qualifications Framework (EQF) as a translation tool to make national qualifications easier to understand and more comparable.

2) The Bologna Declaration (European Ministers of Education, 1999) with the main goal of deepen relations between European nations to establish a Europe of Knowledge.

3) The European Network for Accreditation of Engineering Education (ENAEE) promotes quality engineering education across Europe and beyond, so that engineering graduates are fully equipped to tackle the issues and rigor that is demanded by modern engineering projects. ENAEE does this by authorising accreditation and quality assurance agencies to award the EUR-ACE® label to accredited engineering degree programmes.

4) The EUR ING Certificate was created by ENGINEERS EUROPE to help promote mobility in Europe. Candidates must meet certain requirements, both in terms of education and professional experience, in order to be awarded the EUR ING Certificate, in particular, the candidate's course must be part of the EEED (European Engineering Education Database), and the candidate must have minimum professional experience, depending on the level of education. The EUR ING Certificate has a validity of five (5) years, but can be renewed upon the provision of CPD-evidence, after those five years.

5) The European Diploma Supplement for all higher European education degrees that contain information to be used in different countries for Europe-wide processing, standards, and recognition of qualifications,

6) The Washington, Sydney and Dublin Accords are international agreements among bodies responsible for accrediting engineering degree programs. They recognise the substantial equivalency of programmes accredited by those bodies at three different education levels and recommend that graduates of approved programs be recognized by the other bodies.

4. Mobility for Engineers

Besides career-related benefits, mobility contributes to the holistic development of engineers, which in turn contributes to the development of society, as engineers enhance their inter-cultural communication skills and their understanding of the world.

There are a series of options that can be strongly recommended, such as spending one semester of practice abroad during a PhD or undertake a bachelor semester designated to expand their education in a different field or to apply their knowledge in cross-border projects. Short-term internships and projects in companies as part of the master's degree, are other suggestions.

However, while these measures are easier to implement and promote between European countries, the feasibility decreases rapidly while trying to implement such projects with non-European countries.

Finally, an important aspect to ensure an easy and encouraging process for engineering cross-border mobility would be a centralized platform similar to the one of Erasmus+, where EU-employers can attract non-European engineers and vice versa. This could be a further development of the recently developed EU Talent Pool.[6]
The Directive 2013/55/EU of the European Parliament and of the Council of 20 November 2013 amending Directive 2005/36/EC on the Recognition of Professional Qualifications[7] introduced three mechanisms that can facilitate the mobility of engineers:

6 EU Talent Pool
7 https://eur-lex.europa.eu/eli/dir/2013/55/oj

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- **European Professional Card:** This "card" simplifies the process of recognizing professional qualifications, allowing professionals to temporarily practice in another EU country without undergoing complex recognition procedures.

- **Partial Access:** Given the varying scope of professions across different countries, partial access is allowed when significant differences between them require substantial additional studies.

- **Common Training Framework (CTF):** which could provide a pathway to automatic recognition for professions that currently do not have it, such as engineers.

This CTF (could be a path to harmonize the minimum training requirements needed to practice the engineering profession in Europe, in congruence with international agreements, such as the Washington Accord, Sydney Accord, and Dublin Accord. This way, it could facilitate the mobility of engineers worldwide.

5. Promote Professional Activity and Professional Development

The professional development of engineers, their skills and their ability to be mobile, are linked. This section describes a number of other opportunities that engineers, engineering bodies and employers might consider and adopt.

1) Mobility in the end, can also be promoted by highlighting the importance of the engineering profession in society through reach-out opportunities such as visits to schools by professionally active engineers from different disciplines who share their daily professional experience with young people. Engineering is embedded within many things in our daily lives.

2) There are also initiatives that can be explored to address the gender imbalance in the engineering workforce. These could include active identification of female role models so that girls get inspired to pursue a career in engineering, addressing the gender pay gap, etc.

3) Industry could also offer complementary LLL and CPD, for instance by companies offering inhouse training, which would be beneficial for both employer and employee. This includes regularly promoting the re-skilling of engineers who need to update their skills.

4) The creation of a certification system for advanced training provided by HEIs, VET providers or other private entities. These courses could (or could not) correspond to ECTS which, when carried out within the same scientific area, be counted towards a possible postgraduate or specialization degree. This would motivate continuous training and give HEIs a new dynamic.

5) Another undervalued issue relates to engineers and their encouragement to exercise political influence and engage in exercising political power, especially when it relates to law-making and regulations affecting their profession (engineers know their profession best, not other professionals), but also the society at large. Political decision-making should in some societal domains be based on the technical expertise, advice and recommendations of engineers. A "liaison group" at EU-level, consisting of experienced engineers from various disciplines, could facilitate and improve political decision-making processes.

6. Micro-credentials

The European approach to micro-credentials for LLL and employability was approved in mid-2022. It is clear that micro-credentials can add enormous value for lifelong learners. A growing number of people need to update and improve their competencies to fill the gap between their formal education and training and the needs of a fast-changing society and labour market. Europe is convinced that micro-credentials can help in this regard. Micro-credentials could be designed and issued by a variety of providers in different learning settings (formal, non-formal and informal learning settings. The procedures for recognition however still have to be developed. Not only is a European procedure for recognition still missing, but also a structure to make engineers aware of the huge range and differences between different micro-credentials. Many providers are already developing tools, but there is no methodology yet to pinpoint the essential characteristics, to publish them and to develop procedures for recognition?

7. ACTION PLAN FOR STRATEGY IMPLEMENTATION

1. Scope of Action for Strategy Implementation

Whereas in the previous chapter we identified recommendations and opportunities without concrete timelines and requirements (e.g. long-term thinking or financing), in this chapter we formulate a simple action plan for how the recommendations could be implemented. This document aims at setting tools to assist employers and industries and to establish terms of reference (not requirements as written) for HEIs.

The active set of actions includes defining stakeholders with a justification for having that status. These may have national, regional, European or global areas of influence. The group includes, without being exhaustive, HEIs, professional engineering organizations, student bodies, employers, industry associations and government agencies. Relevant contacts should be collected and stored in the project Observatory. Management of these active stakeholders will be done by ENGINEERS EUROPE during and after the project conclusion.

The passive actions should be based on the provision of information to all stakeholders. This will include data about the engineering profession. It can have academic, professional, social or regulatory components. Again, it is intended to have it made available on the "project Observatory" and managed by ENGINEERS EUROPE. This data could include issues like CPD, provision of engineers, remuneration of engineers, qualification frameworks (professional and academic), current trends in engineering development, international agreements, events relevant to the engineering profession, mobility schemes/tools, predicted future employment scenarios, etc.

2. Stakeholders

There are a significant number of stakeholders involved in the education, employment, development and professional aspects of engineering education and engineers. These include universities, national engineering academic and professional bodies, VET providers, online engineering course providers, military industry companies, construction companies, European engineering alliances, manufacturing industries, public companies, services, transport and communications, mining and agriculture, research companies, DGs of the European Commission, UNESCO, etc. These organizations and associations can be contacted by email, by personal meetings or by using social tools like LinkedIn. The purpose of this stakeholder list is to try to encompass all relevant stakeholders. See also Annex 1.

3. Communication and Outreach

The platform or Observatory has been created, updated and maintained by ENGINEERS EUROPE and will include pertinent documents and prior research. It shall be considered a beacon for engineering.

For most questions there are already tools in existence. For instance, in terms of the Skills Passport the European Commission has already several approaches (and is no longer pursuing it). Some of these approaches or tools relate to the European Professional Card and the Europass CV.

Several world bodies have also already addressed the question of integration of non-European engineers. The latest is from the IEA and WFEO regarding the "***Graduate Attributes and Professional Competencies (GAPC) Framework***".

Regarding the future, this Observatory may help prioritizing actions like the sustainability response of engineers as prescribed by the UNESCO II Engineering report (Engineering for Sustainable Development).
Presenting examples of CPD training for engineers could also be collected. Questioning if this type of competencies should be mandatory for all active engineers, could be a topic. The Observatory could amass concrete data for engineers to use in their actions while trying to be more sustainable.

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Picture 4: *E4E at the EuroTeQ Presidential Strategy Forum, TU Munich, 22 November 2023, Mrs Antoaneta Angelova-Krasteva, EU Commission's Director on Innovation, Digital Education and International Cooperation with the ENGINEERS EUROPE Secretary General (Photo @ Andreas Heddergott / TUM)*

4. Proposed Actions

4.1 HEIs / Curriculum Design Proposed Actions

1) Design a well-organized EU-platform where engineers can find opportunities for CPD.

2) Identify opportunities to improve implementation of Bologna for engineering education.

3) Identify incentives to speed up the Bologna process.

4) Intensify the collaboration between HEIs and the working field to reduce the skills gap.

5) Make internships obligatory in engineering curricula.

6) Recognise the added value of professional competencies and integrate them in authentic tasks.

7) Make engineering curricula attractive for all students with the necessary minimal potential.

8) In order to promote mobility and improve the qualification of engineering programs throughout Europe, a reformulation of curricular units would be very helpful. For this, the following proposals are made:

1. Teach the units strictly necessary in the bachelor's degree, creating space for other curricular units for soft skills.
2. The space created before can be used for curricular units of soft skills corresponding to 1.5 ECTS with several options, so that each student can work on their weaknesses.
3. In each semester, up to 1/3 of the curricular units could be taught in English, allowing young graduates to use technical language so that they feel more comfortable working abroad, reducing the language barrier.

4.2 Portability of Academic and/or Professional Qualifications

1) Identify opportunities to improve widespread adoption of Washington/Sydney/Dublin accords.

2) Obtaining the EU Commission's recognition of the EUR ING Certificate and its advantages for engineers, facilitating their mobility.

3) Expansion of the EUR ING Certificate reach (not restricted to merely the European Higher Education Area), so that engineers from across the world can apply more easily for it (this needs to be carried out in conjunction with the expansion of the EUR-ACE label, since one of the conditions for obtaining the EUR ING Certificate is that the engineering programme of the candidate must be a part of the EEED and EUR-ACE programmes get included in EEED automatically.

4) Identify opportunities for streamlining the automatic recognition of academic qualifications at European HEI level.

5) Disseminate the results of European funded projects addressing shortcoming and deficiencies of the application of the Lisbon Recognition Convention (LRC), such as the "Spotlight on recognition" project self-assessment tool, LIREQA's practical recommendations, Focus on Automatic Institutional Recognition (FAIR) report and the ENIC-NARIC online training platform from the 'Streamlining Institutional Recognition: a Training Platform for Admissions Officers' (STREAM) project;

6) Expand the application of the LRC, addressing the governments of countries where the implementation is incomplete.

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8. CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions

Consistent with the research conducted by the E4E consortium partners and their literature reviews, the following important conclusions can be drawn:

1) The engineering profession is on the verge of an important transformation in the future and a clear, compelling positioning statement is needed to communicate its significance to the public. Engaging the younger generation in engineering will require active participation from engineers themselves. Competency-based learning and the assessment of learning outcomes are crucial for engineers, encompassing knowledge, skills, and broader competencies. It is worth paying attention to the ranking of the main competences required on the basis of the results of the Second E4E Survey and as presented in Figure 1.

2) In the coming years, sustainability and environmental considerations, coupled with the increased adoption of automation and AI, will shape the engineering landscape. Renewable energy and green infrastructure will be key areas of innovation, demanding engineers with a deep understanding of sustainable design and circular economy principles. Defining the role of an "engineer" is a challenge this Skills Strategy aims to tackle. Curriculum changes and CPD must align with the Sustainable Development Goals (SDGs). Practical experience through internships and apprenticeships is a recognized need for engineering students. Focusing on projects and real work-related situations, along with applicable regulations and technical standards, is suggested as a way to gain more hands-on experience. Universities and the industry must collaborate on tailored curricula to meet market demands, with businesses taking a lead role in reskilling and upskilling efforts. Soft skills like critical thinking, collaboration and communication are identified as essential for a successful engineering career. Diversity and inclusion policies, along with problem-based learning opportunities, foster ethical decision-making skills and broader talent representation.

3) An increasingly widely articulated expectation regarding professional skills is inter- or multidisciplinarity, with the importance of the interplay between technology and other disciplines such as social sciences and economics being emphasized. An interdisciplinary approach allows for a better understanding of social trends as well as new and changing technologies, e.g. the use of AI in broadly understood engineering. Additionally, working or studying in multidisciplinary teams is suggested as a method to broaden engineering students' viewpoints. Open-mindedness and "thinking outside of the box" are considered by some respondents to be beneficial for the engineering curriculum, as well as a holistic approach to projects.

4) The evolving job market calls for adaptability, with newly created roles and transformed existing occupations. The engineering disciplines of electrical/electronic, ICT, and agronomic/environmental engineering face significant future challenges due to engineer shortages. Skills gaps in the local labour market are considered a more substantial barrier to business transformation than a lack of investment capital. Lastly, partnerships between industry and educational institutions, coupled with increased R&D investment in emerging technologies, offer effective solutions to address digital, green, resilience, and entrepreneurship skill shortages in engineering. Professional Engineering Organizations can foster an entrepreneurial mindset among engineers by advocating interdisciplinary collaboration, offering entrepreneurship training, workshops and seminars[8]. Scholarships, mentorship programs and diversity/inclusion training are key tools for attracting underrepresented groups to engineering. Moreover, the diverse and inclusive

8 A useful starting point for this strategy has been the Education and Innovation Practice Community (EIPC), a joint effort of the OECD and European Commission to build a platform of education policymakers and practitioners across the OECD and EU to advance the understanding of the competencies that help trigger and shape innovation for the digital and green transitions, as well as "deep-tech" innovation, and the mechanisms through which higher education can contribute to developing these competences, https://education.ec.europa.eu/event/education-and-innovation-practice-community-webinar-on-digital-and-green-competencies

environment benefits everyone and could potentially address part of the labour shortage. Equal treatment of diverse talent in the workplace, better communication about the profession and motivating children from a young age were identified as effective strategies. It is also important to ensure training and inclusion programs tailored to engineers with long careers.

5) It is necessary to be prepared for the fact that changes in our environment are inevitable and will occur quickly, which will be reflected in the professional activity of engineers. We should be aware that changes will be caused by technological development, but also by social needs such as the expectation of greater comfort, but on the other hand also unforeseen needs caused by global crises. This evolution is reshaping the expectations and responsibilities of engineers, who are now seen - not only as technical experts - but also as innovators and leaders capable of addressing complex social and environmental issues.

6) The green and digital transitions require unprecedented innovation with new technologies, processes and practices to drive positive change, as well as more advanced and widespread levels of knowledge and skills, nurturing awareness, engagement and responsibility of learners. To fulfil its mission and to respond adequately, sustainable funding for higher education, enhancement and adjustment of existing policies and instruments, and the development of new ones are needed. This includes new modalities of education provision, such as micro-credentials, the enhanced use of joint programs, and support for the entrepreneurial and innovation capacities of higher education institutions. Success in engineering education requires collaborative, joined-up efforts by all stakeholders. To address skill mismatch, it is crucial for engineering professionals, educational institutions and industry stakeholders to collaborate and adapt to changing skill demands by updating curriculums, creating and disseminating courses, expanding engineering networks and engaging policymakers. The European Engineering Skills Council exactly aims at this joint work, with a large representation of all stakeholders, because identification of current requested skills and future upgraded skills are extremely important, especially in the context of curriculum modernization. Cyclic verification of expected hard and soft skills for specific industries is also desirable.

The European Engineering Skills Council can by deploying its network assist in providing insights and advice regarding engineering related subjects in these fields.

2. Recommendations

Based on two rounds of Primary and Secondary Research the following recommendations per stakeholder group can be formulated:

2.1 Higher Education Institutions

1) Modernizing and reforming the academic curriculum on a regular basis to align with technological advancements and new emerging standards. These curricula should incorporate emerging technologies such as AI, machine learning, IoT and advanced manufacturing techniques. At the same time soft skills require emphasizing, such as communication, teamwork, problem-solving, critical thinking and project management, all of which are crucial in the workplace. Competence frameworks should harmoniously encompass all the competencies necessary for an engineer.

2) Entering into partnerships with engineering companies in order to create lasting forms of practical education for students that can involve study visits, knowledge sharing through voluntary associations, or spending time at different employers or in associations. Such initiatives are particularly relevant for skill sets that draw expertise from multiple sectors.

3) Searching for the opportunities to introduce the new pedagogical frameworks such as Education 4.0, which integrates digital tools and active learning strategies to enhance student engagement and learning outcomes, preferably in cooperation with industry. The teaching process should shape the competences of engineers and not only the content of the program.

4) Systemic approach to training (increasing competences) of teachers in the field of new technologies as well as in the field of didactic methods adapted to the perception and expectations of contemporary students. Supporting teachers in gaining experience in industry and business (or acquiring such teachers from the industrial environment).

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5) Promoting cooperation with foreign institutions for the purpose of cultural integration of students and faculties to facilitate work in an international and intercultural environment.

6) Development of student and teacher exchanges to foster cooperative networks and facilitate the sharing of best practices across Europe, e.g. through the European Universities project.

7) Involving student organizations in the process of implementing joint projects with enterprises, as well as in the process of intensive promotion of the engineering profession among potential study candidates.

2.2 Professional Organizations, Vocational Education and Training Providers

1) Promoting LLL, continuous improvement of professional competences under the conditions of changing needs, promoting upskilling and reskilling, by organizing and coordinating specialized (tailor-made) trainings for engineers from various industries, including certified trainings.

2) Organizing industry conferences and seminars to stay updated on the latest trends and advancements in engineering. Creating and moderating discussion forums on the needs in the scope of current and future engineering competences.

4) Provision and recognition of new forms of education, such as micro-credentials. New learning paths need to be flexible, properly delivered and quality assured.

5) Professional Engineering Organizations should be in a position to play a role in the transnational mobility of engineers by assessing their knowledge, skills and competencies and thus determine who can be considered a qualified engineer.

2.3 Industry and Engineering Companies

1) Implementation of collaborative projects with HEIs and VET providers, concerning practical education of engineers as well as innovative R&D projects, involving students.

2) Continuous improvement of the system of professional internships, e.g. by establishing mentorship programs where experienced industry professionals guide and support students and new graduates.

3) Creation of university labs together with HEIs by providing them with industry-grade equipment and tools to ensure realistic up-to-date training environments and constant update of labs resources.

4) Promoting engineering education and professional development successfully among young people, in particular among candidates for studies.

5) Organizing competitions for students for solutions/ concepts needed by the company to engage students in professional skill development, with funding scholarships for the most talented students of the selected engineering branch.

6) Encouraging, incentivizing and promoting their employees to enter into upskilling, reskilling and knowledge updating programs, in cooperation with HEIs and VETs.

2.4 Policymakers

1) Systemic support for engineering fields of study, e.g. through projects for HEIs in cooperation (consortium) with industry, encouraging to undertake studies in engineering fields, counteracting the phenomenon of "drop out" - abandoning studies before obtaining a diploma, supporting the development of dual studies.

2) Continuous popularization of the engineering profession and STEM education in society, including at the early stages of education. Awareness campaigns showing the importance and opportunities within the engineering profession.

3) Stimulating and supporting entrepreneurs in mobilizing them to take the risk of investing in education and in the development of new engineering staff.

4) Systemic support for quality education in the scope of current and future trends in technology development, as well as directions related to social expectations (e.g. UNSDGs, green transition, automation and AI), applies to HEIs and VETs.

5) Regular monitoring of legal conditions that are conducive to/can be used to fine-tune and promote educational curricula and training methods.

6) Creating legal conditions for the full use of the results of such international projects as European universities (e.g. ERASMUS Mundus Joint degrees).

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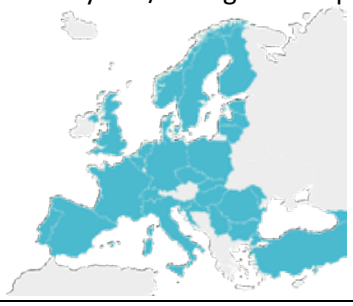
ANNEX I:
BEST PRACTICE EXAMPLES

1. Digital & Green Skills (Cross-border)

Country	European countries	Country and/or Region - Map 
Region	Cross-border	
Name of Institution/Initiative:	REHVA	
URL:	https://www.rehva.eu/	
Focus Area of Skills Acquisition:	Digital Skills/Green Skills	
Nature of Institution/Initiative:	Private	

Contextual Snapshot:	
Relevance of the Focus Area:	In the context of today's rapidly evolving technological and environmental landscape, both Digital Skills and Green Skills have become of paramount importance for REHVA its members, and its stakeholders. 1. Digital Skills: • Digitalization is transforming the HVAC industry by introducing adv*anced* technologies that enhance efficiency, comfort, and sustainability. Digital skills encompass a range of abilities related to working with digital tools, technologies, and data. Here's how they are relevant to REHVA: • Smart Building Systems: The integration of sensors, automation, and data analytics into HVAC systems requires professionals with digital skills to design, install, and maintain these systems effectively. • Building Information Modeling (BIM): BIM involves creating digital representations of buildings, enabling collaboration and efficiency in design, construction, and operation. HVAC professionals need to understand BIM processes to coordinate their work with other disciplines. • Energy Management Systems: Digital skills are crucial for implementing and managing energy-efficient HVAC systems, which play a vital role in reducing energy consumption and greenhouse gas emissions in buildings. • Data Analysis and Visualization: HVAC professionals must be capable of analysing large amounts of data generated by building systems to optimize their performance and identify potential issues. • Remote Monitoring and Maintenance: Digital skills enable remote monitoring and predictive maintenance of HVAC systems, improving their reliability and minimizing downtime. 2. Green Skills: With the growing emphasis on environmental sustainability and energy efficiency, Green Skills have gained immense importance. These skills focus on promoting practices that are environmentally

	responsible and aligned with the principles of circular economy and low-carbon development. Here's how Green Skills are relevant to REHVA: • Energy-Efficient Design: HVAC professionals with green skills can design systems that maximize energy efficiency, reduce resource consumption, and minimize environmental impact. • Renewable Energy Integration: Green skills are essential for integrating renewable energy sources, such as solar panels and heat pumps, into HVAC systems to reduce reliance on fossil fuels. • Indoor Air Quality and Health: HVAC systems play a crucial role in maintaining indoor air quality. Professionals with green skills understand how to design systems that provide adequate ventilation and filtration while minimizing energy use. • Regulatory Compliance: Green skills encompass knowledge of energy and environmental regulations, helping professionals ensure that HVAC systems meet relevant standards and contribute to sustainability goals. • Lifecycle Assessment: Professionals with green skills understand the lifecycle impacts of HVAC systems, considering factors like manufacturing, installation, operation, and disposal.
Current Status of the Focus Area:	Digital Skills: The push for digital transformation has led to increased adoption of technologies like Building Information Modeling (BIM), energy management systems, data analytics, and smart building solutions. Many European countries have been investing in training programs, workshops, and certifications to equip professionals with the digital skills needed to design, operate, and maintain modern and efficient HVAC systems. The focus is on improving energy efficiency, optimizing building performance, and integrating advanced technologies. Green Skills: The building sector, including HVAC professionals, is undergoing a significant shift towards incorporating green skills. This includes knowledge of renewable energy integration, energy-efficient design principles, indoor air quality optimization, and adherence to environmental regulations and standards. Many countries have been implementing stricter energy performance requirements for buildings, driving the demand for professionals skilled in green practices and technologies.
Key Challenges:	• Rapid Technological Advancements: The fast-paced evolution of digital technologies, such as IoT, data analytics, and AI, can make it challenging for professionals to keep up with the latest tools and techniques. • Skill Shortages and Mismatches: There might be a shortage of professionals with the necessary digital skills, leading to a gap between industry demand and the available workforce. • Training and Education: Ensuring that educational institutions provide relevant and up-to-date digital skill training can be a challenge, as traditional curricula might not always align with rapidly changing technology trends. • Complexity and Multidisciplinarity: Green skills require knowledge in various fields such as energy efficiency, renewable

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	energy, environmental regulations, and sustainable design. This multidisciplinary nature can make training and education more challenging. • Changing Regulations: Keeping up with evolving environmental regulations and standards can be demanding for professionals, especially when they differ across countries and regions. • Limited Awareness: Some professionals and industries might not fully understand the benefits of green practices or might underestimate the urgency of addressing environmental concerns. • High Initial Costs: Integrating green technologies and practices can involve higher upfront costs, which might deter adoption, despite the long-term benefits in terms of energy savings and sustainability. • Lack of Incentives: In some cases, there might be insufficient incentives, such as government subsidies or tax breaks, to encourage businesses and individuals to invest in green technologies and practices. • Skills Gap: As green technologies evolve, there could be a gap between the skills demanded by the industry and those possessed by the workforce, leading to challenges in implementing new practices.
Government or Institutional Initiatives:	The European Commission has been actively involved in promoting digital and green skills as part of its broader initiatives to drive digital transformation and address environmental sustainability. An example is the Horizon Europe fund: The European Commission's research and innovation framework program, Horizon Europe, includes funding opportunities for research projects related to digital technologies, fostering collaboration between academia, industry, and research institutions.

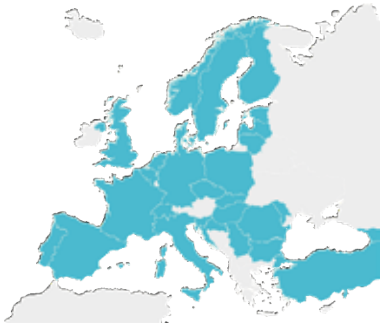
Brief Description of the Institution/Initiative:

- REHVA actively participates in different EU projects that are promoting digital and green skills across various sectors.
- REHVA Guidebooks: elaboration of practical guidebooks on the latest technologies, and knowledge for professionals within the REHVA Task Force.
- REHVA Networking Events: REHVA organizes events, conferences, and workshops that bring together experts, practitioners, and researchers to share insights and advancements in different skills and sustainable building services.

Examples of Effective Practice in Skills Acquisition:

- REHVA Events, conferences, workshops and experts' talks.
- REHVA EU policy issues, position papers and advocacy
- REHVA Publications and Journals

2. Challenge-based Learning in an Interdisciplinary Environment (Cross-border)

Country	European countries	Country and/or Region - Map
Region	Cross-border	
Name of Institution/Initiative:	EuroTeq Engineering University	
URL:	https://euroteq.eurotech-universities.eu	
Focus Area of Skills Acquisition:	intercultural and multilingual competences, an entrepreneurial mindset, leadership, sustainability, active engagement within local eco-systems; interaction with different societal actors etc.	
Nature of Institution/Initiative:	Alliance of 6 technical Universities and around 50 associate partners / engineering stakeholders	

Contextual Snapshot:	
Relevance of the Focus Area:	Shared value creation and a common understanding of technology is a relevant factor for societal cohesion in regions, nations and across Europe and extremely important for the provision of excellent responsible engineering services.
Current Status of the Focus Area:	The funding of the project has been prolonged till 2027 which allows for further development/broadening of the initiatives.

Brief Description of the Institution/Initiative:
The EuroTeQ Engineering University brought together six leading universities of science and technology in Europe (Munich, Prague, Eindhoven, Tallin, Paris and Copenhagen), situated in innovation eco-systems and with great collaboration experience, with the aim to introduce a paradigm shift in the engineering education of the future, aspiring to responsible value co-creation in technology.

Table of Services/Programs provided focusing on the Acquisition of Specific Skills:
EuroTeQ course catalogue https://euroteq.eurotech-universities.eu/initiatives/building-a-european-campus/course-catalogue/

Examples of Effective Practice in Skills Acquisition:
Collider: As a key initiative of the EuroTeQ Engineering University, the **EuroTeQ Collider** offers students the opportunity to work alongside industry partners on specific challenges and acquire new competencies. This innovative, challenge-based learning experience invites participants to work in an international and interdisciplinary environment and contribute in developing solutions to real-life challenges.

Internationalization in the Skills Acquisition Process:
The Alliance itself enhances cross-border approaches and exchanges / Building of a European Campus / EuroTeQ Collider etc.

Partnership models:
The partnership in the alliance is organized by the following structure: Presidential Strategy Forum / Management Board / Secretariat / Students Council /Local and European Advisory Boards and numerous Working Groups.

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3. Diversity and Equality in Engineering (Cross-border)

Country	European countries (France, Germany, Austria, Slovenia, Spain)	Country and/or Region - Map
Region	Cross-border	
Name of Institution/Initiative:	YesWePlan!	
URL:	https://www.yesweplan.eu	
Focus Area of Skills Acquisition:	Measures to enhance equality and diversity in the profession	
Nature of Institution/Initiative:	Alliance of 5 professional organisations and Universities supported by different European and International stakeholders	

Contextual Snapshot:	
Relevance of the Focus Area:	Diversity and equality in the profession needs to be strongly enforced in the profession on different levels (education, professional representation, employment), therefore the understanding of this topic must be integral part of the understanding of engineers.
Current Status of the Focus Area:	The project finished in 2022 and several of the measures and/or collected best practice examples are currently in implementation / have already been implemented.

Brief Description of the Institution/Initiative:

The EuroTeQ Engineering University brought together six leading universities of science and technology in Europe (Munich, Prague, Eindhoven, Tallin, Paris and Copenhagen), situated in innovation eco-systems and with great collaboration experience, with the aim to introduce a paradigm shift in the engineering education of the future, aspiring to responsible value co-creation in technology.

Table of Services/Programs provided focusing on the Acquisition of Specific Skills:

https://yesweplan.eu/intellectual-outputs/recommendations/

Examples of Effective Practice in Skills Acquisition:

Raising awareness of the importance / benefits of diversity and equality approaches in engineering as a part of engineering skills acquisition still lacks the urgently needed best practice examples.

Internationalization in the Skills Acquisition Process:

The project itself enhances cross-border approaches and exchanges and the YesWePlan! career tracking survey was based on answers from all over Europe. The YesWePlan! Recommendations were discussed in several European Professional Organizations (ACE, ECCE, ECEC).

Partnership Models:

The project partnership mainly worked on the basis of a steering group supported by different internal and external stakeholders and experts.

Impacts and Outcomes:

Several best practice examples (Female Engineering Awards, Mentoring projects, Awareness raising projects for the public, professional compliance regulations including equality aspects etc.) have been/ are transferred, showing also that awareness/knowledge of students and professionals must be combined with concrete educational, institutional, political measures. Nevertheless, raising awareness of the importance / benefits of diversity and equality approaches in engineering still lacks the urgently needed best practice examples in engineering skills acquisition processes.

4. Debate with Engineering Students (PT)

Country	Portugal	Country and/or Region – Map
Region	Portugal	
Name of Institution/Initiative:	Socratic Debate at CISPEE 23	
URL:	https://cispee2023.uminho.pt/	
Focus Area of Skills Acquisition:	Digital Skills/Green Skills	
Nature of Institution/Initiative:	Academic - Sociedade Portuguesa de Educação em Engenharia SPEE	

Contextual Snapshot:	
Relevance of the Focus Area:	Debate with BEST, ESTIEM and University of Coimbra students their experiences in their university education.
Current Status of the Focus Area:	Using E4E survey questions about the Focus areas Digital and Green skills the opinions about their training.
Key Challenges:	The difficulty was in obtaining suggestions on which were the recommendations for Engineering teachers.
Government or Institutional Initiatives:	Some initiatives were mentioned by students in policy declarations from their universities: UMInho (PT) and TUEindhoven (NL).

Brief Description of the Institution/Initiative:
SPEE accepted, following AECEF SG suggestion, to have in its congress of 2023 a socratic debate with students representing European student associations suggestions about the future. Topics addressed were the DS and GS with questions extracted from the E4E survey. Major outcome was an unanimous recommendation for Engineering teacher training on the topics: https://sigarra.up.pt/feup/pt/pub_geral.pub_view?pi_pub_base_id=634325

Table of Services/Programs provided focusing on the Acquisition of Specific Skills:
Promotion of E4E project was made to underline the needed competences and skills around the DS and GS. The GreenComp competence framework was presented and the use of DigiComp framework was discussed as a guidance for all Engineering students. Another subject that was addressed involved the Ethics education in Engineering and the use of AI tools by teachers and by students in Engineering.

Examples of Effective Practice in Skills Acquisition:
Since major recommendation from students was Vedic aged to the specific training of Engineering taker so they could prepare properly their students one can say that teachers present and SPEE became conscious of these gaps in the institutional and personal training. One major consequence was the verbal compromise from SPEE managers to repeat this debate in future events: https://www.linkedin.com/posts/sociedade-spee_homepage-activity-7018889441494675456-A5L6/.

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Internationalization in the Skills Acquisition Process:
It was evident from the discussion of the students is that these are lacking proper training, are looking forward to acquire these competences and were clearly fostering training for their Engineering teachers. The associations present (BEST, ESTIEM) maybe a great platform to define future pathways to improve their preparation for the future of their Engineering professions. And it has to be done as soon as possible.

Partnership Models:
Clearly from the debate it was concluded that students or their associations are crucial to define gaps in terms of their DS and GS education and to provide solutions to change institutions actions, teacher preparation and learning outcomes expected. As mentioned at least SPEE is interested in continuing to debate these issues and to try to influence institutions to change.

Impacts and Outcomes:
Conscience by participants of the urgency to change and to train Engineering staff in DS and GS. It was also evident that students are eager to learn more about these subjects and be better prepared to the Engineering challenges.

5. SDGs in Spanish universities (ES)

Country	Spain	Country and/or Region - Map
Region	Aragón	
Name of Institution/Initiative:	EINA (School of Engineers and Architects)/ University of Zaragoza	
URL:	Https://eina.unizar.es	
Focus Area of Skills Acquisition:	Sustainable Development Goals (SDG´s)	
Nature of Institution/Initiative:	Public and Academic	

Contextual Snapshot:	
Relevance of the Focus Area:	Spain, as a European country, is committed with the development of the SDG´s. Aragon is a region of Spain where the University of Zaragoza is placed and the government of Aragon is strongly committed with the development of the SDG´s
Current Status of the Focus Area:	All areas of the government of Aragon are working in the implementation of the SDG´s and Administration and Companies need engineers compromised with the development and implementation of the SDG´s
Key Challenges:	The main objective of the Government of Aragon with respect to the 2030 Agenda is the improvement in all aspects of the administration with respect to the 2030 Agenda. In particular, three challenges are - Industrial activity - Renewable energy - Education, Research and Innovation These areas are very important in the activity of the School of engineers (EINA)
Government or Institutional Initiatives:	Related with the challenges of the Government of Aragón, they are: - Facilitate the introduction of the SDG´s in industries with economic aids and consulting. - Facilitate the installation of renewable energy production plants. (Aragon is one of the stronger producers of green energy in Spain) - Help the University and in particular the EINA the implementation of studies oriented to the implementation of the SDG´s

Brief Description of the Institution/Initiative:

The EINA is the only public School of Engineers and Architects placed in the region of Aragon. The EINA belongs to the University of Zaragoza in Spain.

Table of Services/Programs provided focusing on the Acquisition of Specific Skills:

The EINA is the responsible of the teaching of 11 degrees in engineering and architecture, 14 masters and an important number of courses of specialization in different areas of engineering and architecture. As well the School is responsible for research and innovation in all areas covered academically, with lots of European projects supported by the personnel as well as contracts with companies, in the region and abroad.

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Examples of Effective Practice in Skills Acquisition:

Examples of good practice are:

- The impetus and interest of the School's educational community in the 2030 Agenda. There are efforts to equip the personnel with the necessary tools to define actions aimed at implementing the SDGs with the involvement of all stakeholders.
- High number of concrete actions carried out by the School over time related to the SDGs.
- EINA announces the award "Actions to transform the world from EINA" which seeks to recognise the contribution to the 2030 Agenda.
- The teaching guides for Bachelor's and Master's degree final projects explicitly include the commitment to the SDGs and in external internships the direct relationship with the SDGs is indicated both by the students and the internship tutor

Internationalization in the Skills Acquisition Process:

The EINA, as European university, exchange students all over Europe with the Erasmus program and with other international countries like USA, Canada or Japan, so the students visiting our School reach the same skills of the EINA students.

Research programs oriented with the spirit of the SDG´s are carried out with researchers from over Europe or even in worldwide area.

Partnership Models:

• The Mobility Plan of the University of Zaragoza is drafted under the collaboration agreement: Zaragoza Metropolitan Transport Consortium + University of Zaragoza. The EINA, through several of its members and as a centre, is considered a fundamental stakeholder in this plan, having already participated in several meetings
• A working group or expert group.
• Organisation of an international meeting on SDGs “The Circe Institute and the Ecological Transition”. CIRCE in the Technological Centre for the Resources and energetic consummation and is placed in the vicinity of the School and with strong links in projects and personnel
• Volunteering opportunities for students through the EINAmOtivaD@S student group/association
• Volunteering opportunities for students.
• Brial Chair in Renewable Energies, Brial is a company/funding entity formed with a group of companies (BRIAL).
Relevance to SDGs: Focused on renewable energies and the SDGs.

Impacts and Outcomes:

The EINA has stablished an Internal Quality Assurance System (IQAS) that collects and analyses data on the satisfaction of the different stakeholders (students, teaching staff, graduates, employers, administrative and service staff, society, etc.) with the degree of fulfilment of the SDGs set in the centre's strategic plan.

The IQAS has designed and implemented a system for evaluating the degree of satisfaction of the different stakeholders with the training programmes.

In order to know, from a general perspective, the perception, priorities and willingness to actively contribute to the 17 SDGs to all students, PDI and PAS of the School, a survey has been developed and applied by the Vice-rectorate for Prospective, Sustainability and Infrastructure of the University of Zaragoza. The EINA has gained the Certification ALCAEUS, certification of Schools or Universities that shows the compromise with the United Nations 2030 Agenda.

6. CPD Certificate in Professional Engineering (EI)

Country	Ireland	Country and/or Region - Map
Region	North	
Name of Institution/Initiative:	Engineers Ireland/CPD Certificate in Professional Engineering	
URL:	https://www.engineersireland.ie/Professionals/CPD-Careers/CPD-training-offerings-and-services/CPD-Certificate-in-Professional-Engineering-NQF-Level-9-5-ECTS	
Focus Area of Skills Acquisition:	Resilience Skills	
Nature of Institution/Initiative:	Partnership between Professional Body, Third-level Institution and Industry	

Contextual Snapshot:	
Relevance of the Focus Area:	The transition from university or college life to the world of work requires substantial application and attention. Graduates need to understand what is expected of them, how they should behave and what they can do to perform their role, accelerate their professional development and career prospects.
Current Status of the Focus Area:	Employers have observed that whilst engineering graduates demonstrate strong technical knowledge and skills when leaving university many are lacking the non-technical skills and behaviours, such as time management, communication or report writing skills, required to excel as a professional engineer.
Key Challenges:	For many employers, developing their own programme of non-technical skills modules that meets the needs of graduate engineers can be challenging in terms of the cost and time required to design, develop and evaluate a suitable programme.
Government or Institutional Initiatives:	We are not familiar with any significant initiatives undertaken by the government or other institutions in the specific skill area for graduate engineers

Brief Description of the Institution/Initiative:

Following consultation with industry, Engineers Ireland developed a CPD Certificate in Professional Engineering, a six-module program undertaken over six months designed to support employers and graduate engineers in the transition from university to professional life. The modules focus on the core non-technical skills engineers need to develop to successfully perform and develop. Each module includes a learning contract assignment to ensure learning is transferred from the classroom to the workplace. To ensure standards, the program is accredited by TU Dublin at NQF level 9, counting for 5 ECTS.

Engineers Ireland also offers a CPD Diploma in Engineering and Leadership and Management, a 12-month program at NQF level 9, counting for 30 ECTS, and many delegates have completed the CPD Certificate in Professional Engineering before undertaking the CPD Diploma.

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Table of Services/Programs provided focusing on the Acquisition of Specific Skills:

The six modules are:
Essential Skills of a Future Professional
Time Management & Organizational Skills
Communication & Presentation Skills
An Introduction to Project Management
Innovations in Excel for Engineers
Technical Report Writing Skills

Examples of Effective Practice in Skills Acquisition:

The CPD Certificate in Professional Engineering has been delivered to employers and graduate engineers for over ten years now, with programs delivered both exclusively to individual employers and as an open program open to graduates working for different employers. It can be delivered in-person or online. In 2022 there were 13 programs delivered with 190 graduate engineers completing the program. Feedback from both employers and delegates has been extremely positive with most employers using the program each year as part of the graduate development programs.

Internationalization in the Skills Acquisition Process:

As many of the employers concerned are involved in international projects, some of the participants who have benefited from the program have been based outside Ireland while delivering projects.

Partnership Models:

Engineers Ireland has strong connections with engineer employers through our CPD Accredited Employer standard. This has allowed Engineers Ireland to identify industry needs, and in this example a gap with regards to the skills of graduate engineers entering the workplace. Working with industry we were able to design and develop an appropriate program to meet the needs of employers and graduate engineers alike. Engineers Ireland also has a close relationship with TU Dublin, and this facilitated the accreditation of the program, satisfying a need from certain employers and graduate engineers that the program be accredited by a third level institution and count for ECTS.

Impacts and Outcomes:

The success of the programme can be measured by both the repeat business from existing clients as well as the growth in the number of new programmes year on year to meet growing demand. Module evaluation has allowed Engineers Rieland to maintain the high level of delivery of the programme with continuous improvement based on employer, delegate and trainer feedback. The learning contract assignments ensure the skills and knowledge learned in the classroom are transferred and employed at the workplace.

Feedback from both employers and delegates has been extremely positive with most employers using the program each year as part of the graduate development programs. Many positive employer and graduate testimonials are available to confirm the success of the program.

7. Cross-Universities-Business (CUB) platform (DE)

Country	Germany	Country and/or Region - Map
Region		
Name of Institution/Initiative:	TU Dortmund	
URL:		
Focus Area of Skills Acquisition:	Business-university interaction through a web-platform	
Nature of Institution/Initiative:	University	

Contextual Snapshot:	
Relevance of the Focus Area:	Today's world is rapidly changing, and educational institutions face many challenges that have yet to be solved. One of these tasks is the optimal organization of support for students in the matter of their future employment. Possible solutions to this issue could be the development and implementation of the Cross-Universities-Business (CUB) platform for direct communication between students and potential employers. The current initiative is an example of the possible multi-stakeholder partnership model which can help businesses to find potential employees with the skills that best meet their expectations and to avoid skills mismatches.
Current Status of the Focus Area:	Despite the proposed solution is not widely used in the current moment, some of the European universities and other organisations have already implemented using of similar web-platforms into the practice. Some examples of CUB platforms are described below.
Key Challenges:	- the dilemma exists about how to support novice specialists in the issue of their future employment and at the same time to give them maximum freedom in choosing their future professional pass or role. - implementation and subsequent support of the CUB platform will need additional financial and human resources from the universities' side, which also can be challenging.
Government or Institutional Initiatives:	The University of Applied Sciences and Arts (Dortmund) is providing research about the relevance of the development and implementation of the similar CUB platform on the base of the Digital Education Ecosystem (DEE). Some European universities have already developed special platforms for the universities-business cooperation.

Brief Description of the Initiative:

Creating of the cross-university-business (CUB) web-platform for the direct communication of students and employers can improve the quality of university-business cooperation significantly, facilitate the search of needed specialists by employees and help students to find perspective jobs. The CUB platform model should be based on the principle of a social network with a professional focus, including pages of applicants, universities, and employers, with an internal messenger to communicate between participants.

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Table of Services/Programs provided focusing on the Acquisition of Specific Skills:

A unique feature of the CUB platform will be the presence of portfolios of projects on the webpages of universities and companies in which qualified students and graduates can take part, interchanging traditional professional practice with project-based practice.

Examples of Effective Practice:

It should be noted that such platforms are already being developed by individual universities in Europe. However, in order to understand the differences between today's web solutions, we first need to understand what business processes include the interaction between universities and business today. Thus, V. Galan-Muros and T. Davey distinguish the following main areas of interaction:

- "education (joint development of curricula and training of students in cooperation with business partners; continuous education and training of company employees, further employment of students);
- research (staff mobility between universities and companies; joint research and development);
- valorisation (entrepreneurship among university staff and students, as well as the commercialization of university research and development);
- management (reflects the strategic nature of cooperation between universities and business; however, this area of collaboration is the least developed, since it requires long-term cooperation between universities and enterprises, as well as a high degree of their transparency)" [1].

Depending on which of the above business processes underlies the creation of the platform (except for management, since this type of interaction is the least developed and, as a rule, is not a priority), CUB platforms are divided into the following types [2]:

- "educational platforms, the main purpose of which is to teach students to perform real-life tasks that they will face while working in companies. Such, for example, are the platforms Poliunibus [3], Edusourced [4], Telanto [5] and Ninblebee [6];
- platforms, which main purpose is to commercialize research conducted at universities, such as In-part [7]; Leadingedgeonly [8] or Seedspint [9].
- platforms, the main purpose of which is partnership between the university and business, as well as the possibility of subsequent employment of students. Examples of such platforms are Konfer [10], Knowledgetransferireland [11] and Oipec [12]" [13].

Internationalization in the Skills Acquisition Process:

The CUB platform can give the opportunity to communicate for representatives of universities and businesses from different countries without any borders. It also gives an opportunity for students to search for jobs in companies not only from their original country but all over the world. Representatives of business at the same time can also search for potential employees in universities from different countries.

Partnership Models:

In general, the CUB platform should be modelled on the principle of a social network with a professional focus, including pages of applicants, universities and employers. Also, this platform must have an internal messenger to enable communication between participants. In addition, it is assumed that a unique feature of this platform will be the presence on the pages of universities and companies of portfolios of projects in which students and graduates, whose qualifications correspond to the tasks that must be performed during the project, can take part. Participation in such projects can even become a full-fledged alternative to traditional professional practice since it gives them experience in managing real-life working tasks.

Impacts and Outcomes:

According to the results of the research which took part in the frame of the DAAD program "Eastern partnership from 2020" European employers are very open to the initiative of development and implementation of the CUB platform [14]. Students and universities representatives, who took part in the research also supported the initiative since it can improve the process of students' and graduates' employment significantly. Such an initiative also gives an opportunity for representatives of businesses to check information of potential employees' resumes and to choose professionals with the best qualities in their teams.

List of references:

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[10] T. N. C. for U. and Business, "Unlock R&D with konfer," *stage.konfer.online*. https://konfer.online/ (accessed May 07, 2022).

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[13] C. Reimann, O. Verenych, P. Repka "The role of the Cross-Universities-Business (CUB) platform in the issue of employment of university graduates". Dortmund International Research Conference 2022, Conference Proceedings, pp.21-33

[14] P. Repka, O. Verenych, C. Reimann "Cross-University-Business platform as a part of the Digital Education Ecosystem". The 12th IEEE International Conference on Intelligent Data Acquisition and Advanced Computer Systems: Technology and Applications, Dortmund, Germany, 2023

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8. Dual Education: a Bridge between Education and the Labour Market (SK)

Country	Slovakia	Country and/or Region - Map
Region	Slovakia	
Name of Institution/Initiative:	Dual education at upper secondary vocational schools – Company schools	
URL:	https://siov.sk/en/vzdelavanie/dualne-vzdelavanie/uvod-dualne-vzdelavanie/	
Focus Area of Skills Acquisition:	Entrepreneurial skills, industry-specific knowledge, readiness for work, soft skills	
Nature of Institution/Initiative:	Policy measure	

Contextual Snapshot:	
Relevance of the Focus Area:	Like many countries, Slovakia is grappling with mismatches between education and the needs of the labour market.
Current Status of the Focus Area:	Slovakia had been making efforts to address skill mismatches between education and the labor market. The dual education system was one of the approaches adopted to bridge this gap. The government and Industry and Employers stakeholders have been working to strengthen vocational education and training, aligning it with the needs of industries to enhance employability and workforce readiness.
Key Challenges:	Skills mismatch, involvement of stakeholders, connecting educational measures to labor-market needs, lack of implemental knowledge, lack of practice, the negative impact of not-well-equipped classes
Government or Institutional Initiatives:	The initiative required deep involvement of the government and relevant ministries; however, the initiative came from the part of the Employer´s associations, which lobbied for the reform. The actual system was based on the Austrian system of Dual education, inspired partially by German and Dutch systems of VET at secondary levels. Currently, the system is being established in VET in the school sector at the secondary level. But there are already apparent initiatives to spread its principles also to the system of life-long learning and the Higher-education sector.

Brief Description of the Institution/Initiative:

VET in school education is for the most part provided by public schools. These, however, do not possess the practical industrial production know-how, since production is done mostly by private companies. This causes a significant bridge between the two sectors, which affects the preparedness of the workforce for the labor market.

Dual education as such connects education with the labor market and enables the students to gain practical knowledge in the real-world environment during their studies. This enables them to be better prepared for the challenges of engineering professions. The major outcomes of dual education include enhanced employability, industry relevance, and the development of a skilled workforce adept at seamlessly integrating into the workforce.

Table of Services/Programs provided focusing on the Acquisition of Specific Skills:

Programs are provided in the study programs at secondary vocational schools, which participate in the System of Dual education (it is not mandatory). The institutionalization of the Dual Education system, based on the examples from West European countries is beneficial, especially for countries of Central and Eastern Europe, who had to overcome the economic transformation of industries and now need to implement the relevant transformation of their VET school systems in order to better reflect the needs of the industries and foreign investors. In other words, while Dual education anchored in legislation and at the institutional level may not be innovative in Old EU countries, it is a necessary requirement for further economic growth in new member states and the Slovak system is in this respect most progressive and may serve as an implementation best-practice in the environment of transforming economies of new member states.

Examples of Effective Practice in Skills Acquisition:

Dual education is a system that fosters a close partnership between education institutions and the practical sector, allowing students to gain real-world experience alongside their education. It enables swift responsiveness to employer needs and offers students valuable knowledge and skills that are hard to simulate within the confines of a traditional classroom. Moreover, students entering the labor market already have the necessary skills that they have earned through practice.

Internationalization in the Skills Acquisition Process:

Internationalization can occur when educational institutions collaborate with foreign manufacturers.

Partnership Models:

Educational institutions design the theoretical curriculum, while employers offer practical training and workplace experience. Government agencies often play a regulatory and financial role. This collaboration ensures that students receive relevant and up-to-date skills aligned with industry needs. Employers benefit from a pipeline of skilled talent, educational institutions gain insights into industry demands, and governments promote economic growth and reduced unemployment.

Impacts and Outcomes:

1. With practical experience integrated into education, graduates are ***job-ready*** without requiring further educational measures.
2. Students gain ***hands-on experience***, enabling them to apply theoretical knowledge to real-world scenarios effectively.
3. Dual education creates a ***seamless transition*** from academia to the workforce, reducing the time and resources spent on additional training after graduation. Employers value graduates from dual education programs for their immediate readiness and ability to contribute productively from day one.
4. The close collaboration between educational institutions and the practical sector allows students to build ***strong networks and connections within the industry***.

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9. Digital Transformation Classroom (ES)

Country	Spain	Country and/or Region - Map
Region	Andalucía	
Name of Institution/Initiative:	FIWARE Digital Transformation Classroom / University of Córdoba	
URL:	https://www.uco.es/atdfiware/	
Focus Area of Skills Acquisition:	Digital Skills	
Nature of Institution/Initiative:	Public/University/Academic	

Contextual Snapshot:	
Relevance of the Focus Area:	Spain, as a European country, is committed with the development of the Skills Digital, both through public and private initiatives. Examples of this are the following: Private Digital skills: training to transform - Telefónica https://www.telefonica.com/es/sala-comunicacion/blog/habilidades-digitales-formar-para-transformar/ Public National Digital Skills Plan https://portal.mineco.gob.es/es-es/digitalizacionIA/Paginas/plan-nacional-competencias-digitales.aspx Andalusia is a region in the south of Spain where the University of Cordoba is placed, which is strongly committed to the development of digital skills through various actions of different kinds, training courses, social and cultural projection classrooms, chairs, projects related to these skills, and other activities.
Current Status of the Focus Area:	The Government of the Junta de Andalucía, more specifically the Regional Ministry of University, Research, and Innovation, promotes activities and actions aimed directly at the development of all types of skills (Digital/Green/Resilience/Entrepreneurial). In addition, the Cordoba City Council and the Cordoba Provincial Council actively promote the development of these skills through programmes and grants. Therefore, the University of Cordoba is aligned with this policy by actively supporting it and collaborating through its research groups, university structures, teaching and research staff, administration and services staff, etc....
Key Challenges:	The Andalusian R&D&I Strategy (EIDIA), Horizon 2027, represents the Andalusian Government's firm commitment to R&D&I as the basis for economic growth in the region, a competitive, sustainable and inclusive growth, firmly based on science and knowledge. The plan is structured into three strategic objectives: 1: To increase the weight of science and technology in the Andalusian economy. 2: To increase the percentage of the population dedicated to R&D activities. 3: To increase the levels of knowledge transfer.

Government or Institutional Initiatives:	The Digital Empowerment Plan for Andalusia 2022-2025 establishes the roadmap to be followed by the Regional Government of Andalusia during this period for the design of its policies, initiatives and actions to improve the digital skills of the population. The Plan's mission is to help Andalusian society to acquire the digital knowledge, skills and competences necessary to be able to function normally in the digital world and to be prepared and able to face present and future technological challenges. To achieve this ambitious challenge, six strategic objectives have been established: 1. Improve the digital competences of citizens from a universal approach. 2. Facilitate access to and use of the digital world for those groups most at risk of digital exclusion. 3. To train professionals in Andalusian companies in the use and exploitation of technology. 4. To develop the advanced digital skills of ICT professionals. 5. To improve the digital skills of Andalusian Public Administration staff. 6. Stimulate and promote interest in technology at an early age.

Brief Description of the Institution/Initiative:

The FIWARE Digital Transformation Classroom of the University of Cordoba is an organizational structure of the University, which is composed of a multidisciplinary group of people who promote the use of FIWARE technology (https://www.fiware.org/) through the delivery of training courses, public-private collaborations, development of research projects, development of non-proprietary turnkey solutions, organization of conferences ...

Table of Services/Programs provided focusing on the Acquisition of Specific Skills:

The University of Cordoba has several classrooms where the development of digital skills is worked on:

- **FIWARE Digital Transformation Classroom.**
- Free Software Classroom.
- Cybersecurity and Networking Classroom.
- Sustainable and Digital-BIM Engineering Classroom.
- Classroom of Robotics and Free Hardware.

In addition, there are Chairs in which these skills are also developed, such as the EPRINSA Chair of Digital Transformation.

More specifically, the actions carried out by the FIWARE Digital Transformation Classroom can be consulted on its website https://www.uco.es/atdfiware/. Conferences, courses, collaborations, projects...

Examples of Effective Practice in Skills Acquisition:

Here are some examples:

- OnIndustry 2023 (https://www.onindustry.es/) - Presentation Platform fiUCO Powered by FIWARE.
- Conference 9 March 2023. Scientific and Technological Park of Cordoba. Rabanales 21 (https://ptcordoba.es/) - FIWARE Developments. New Business Ideas.
- 1st FIWOO (https://www.fiwoo.eu/)-IoT Challenge - Awarded the Classroom with a proposal on accessible mobility. Control of reduced mobility places.
- At the Centenary of the Patios of the City of Cordoba - Control of Aforos.

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Internationalization in the Skills Acquisition Process:

The Aula participates in several European projects contributing its knowledge and expertise. For example, in the field of photovoltaic solar energy, agriculture ... In addition, it has currently collaborated in the drafting of European project proposals related to sustainable construction. She is currently part of a project of ecological and digital transition at national level, but with international relevance, in which a smart trap for the olive fly pest is being built.

Partnership Models:

This is done through collaboration agreements that the University of Córdoba facilitates and that the Aula uses to establish relationships with companies interested in the services of the Aula, either for the development of projects, courses, conferences, etc ... For example, the Aula has agreements with FIWOO, NEC, FIWARE, Telefónica ... among others.

Impacts and Outcomes:

The best place to see the impact of this initiative is on the Aula's website:
https://www.uco.es/atdfiware/.
Awards received, projects developed, proofs of concept, conferences, training, research... everything is documented and updated on the website.

10. Transferable Skills Program (PT)

Country	Portugal	Country and/or Region - Map
Region	Lisbon and Porto	
Name of Institution/Initiative:	Ordem dos Engenheiros (OE) and Faculdade de Engenharia da Universidade do Porto (UPorto-FEUP)	
URL:	https://www.ordemengenheiros.pt/pt/ https://sigarra.up.pt/feup/pt/web_page.inicial	
Focus Area of Skills Acquisition:	Soft skills, micro credentials and accredited continuing education	
Nature of Institution/Initiative:	HEI and Professional Public Association	

Contextual Snapshot:	
Relevance of the Focus Area:	Engineering is a dynamic field that is constantly evolving in response to social, economic, and technological changes. Its challenges have transcended traditional boundaries, to encompass social, environmental, and ethical considerations. While technical expertise remains a foundation of engineering, the increasing complexity of today's challenges demands engineers to possess a broader set of skills that transcend specific disciplines. As a result, cultivating TTS (Transversal and Transferable Skills) throughout an engineer's career is paramount, so that they can succeed in an ever-evolving professional landscape.
Current Status of the Focus Area:	Several engineering HEIs in Portugal are actively working to provide formal opportunities to develop TTS for engineering students. Some are implementing active learning approaches (such as problem-based and challenge-based learning); others are being proactive in contacting industry and companies to collaborate (e.g.: MSc thesis done in company settings), others are creating, in their programs, courses that develop TTS. OE developed, in addition to CPD (Continuously Professional Development) in all regions, a Continuing Education Accreditation System for Engineers - OE+AcCEdE®, for companies and HEIs, with the goal of ensuring the quality of the training offer of interest to its members, encouraging our engineers to pursue CPD.
Key Challenges:	These efforts developed so far in our country need to be further explored and deepened. More HEIs need to embrace this effort, so that it becomes a general endeavour. Also, there's a difficulty in including more skills in HEIs programs, since a 1st cycle needs to be completed in 3 years and a 2nd cycle in 2 years. In regards to CPD, the challenge is to ensure the quality of the courses, post graduations, so that they can meet the expectations of the engineers that enrol. In general, continuous trainings of personal interest should be done in after-work hours, while continuous trainings of interest to companies are done partly in working hours.

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Government or Institutional Initiatives:	With the opportunity of the Decree-Law nº 65/2018 that stated the end of the national 5-year Integrated Master's programs in Engineering and the creation of 3-year 1st cycle graduate programs and 2-year 2nd cycle master programs, national HEIs have created TTS courses in their engineering programs. This clearly states that TTS are part of the skills profile of an engineer. Recently, the Portuguese government started a program, called "Cheque-Formação + Digital" (https://www.iefp.pt/cheque-formacao-digital), which aims to support and encourage the development of digital skills and competencies of workers, by opening applications for funding of up to 750 €. OE, through their courses promoted through the various regions of Portugal and the OE+AcCEdE® system, also contributes to this goal at an institutional level.

Brief Description of the Institution/Initiative:

UPorto-FEUP has its origins in 1837 and has 14 BS programs and 28 MSc. UPorto-FEUP is proactive in contacting industry and companies and collaborating with them to make learning more meaningful and engaging. It develops active learning methodologies to develop TTS such as challenge-based learning. It also integrated in its engineering programs, mandatory courses of TTS (soft skills, entrepreneurship, digital and green skills).

OE has accredited important courses for its members, since 2002, and created the OE+AcCEdE® System in 2014, in order to better assure the quality of the actions accredited. This system accredits courses for universities, such as post graduations from ISEL and FCT, and for enterprises since 8h - 150h formation, for instance EPAL and Comunilog.

Table of Services/Programs provided focusing on the Acquisition of Specific Skills:

UPorto-FEUPs transferable skills program is grouped into 4 types, in accordance with the project E4E taxonomy.

Skills group	Skills
Resilience	Communication, Conflict Management and Negotiation, Lifelong Employability, Leadership, Ethics, Philosophy
Green Skills	Decarbonize the Building Sector to achieve Energy Sustainability, Engineering for sustainability, Challenges of sustainable development, Electrical Power Systems for the Sustainability and Energy Transition
Digital Transformation Skills	Excel, Python, Introduction to Robotics, Mini projects on machine learning and control systems, Automated laboratory data acquisition
Entrepreneurship Skills	Opportunities for innovation, Strategic management of innovation

Since the academic year of 2021/22, Uporto-FEUP has registered 4.000 participations per year, in TTS courses integrated in its BS and MSc engineering programs. OE, only this year, has already accredited 12 courses and has the accreditation of more than 9 courses in progress, in the areas of facility management, HVAC, railways, water and sewage building networks, safety at work, renewable energy management, etc. OE also promotes some courses in soft skills, such as communication, leadership, management, emotional intelligence and wellbeing at work, etc. To be a member of OE, it's mandatory to attend a course in ethics.

Examples of Effective Practice in Skills Acquisition:

UPorto-FEUPs pedagogical model incorporates active learning approaches that favour the development of TTS such as challenge-based learning (UPorto-FEUP has created 10 TTS courses based

on challenges/competitions). UPorto-FEUP is also proactive in contacting industry and companies and collaborating with them to make learning more meaningful and engaging, for example, through MSc thesis done in company settings (UPorto-FEUP has 74 active protocols with companies and 35% of its dissertations are done in a company setting). UPorto-FEUP is focused in developing soft skills with a particular emphasis on "communication and collaboration skills" (UPorto-FEUP created a mandatory 1,5 ECTS course on "Professional Communication" offered to all undergraduate students in all its engineering programs).

TTS development can be achieved by infusing such skills in the engineering curricula, along with all other technical content of the courses program OR considering an integrating/embedded approach to TTS development by creating specific courses, in the engineering programs, devoted to develop such skills OR even the bolting-on approach with TTS learned extracurricular (UPorto-FEUP created 23 mandatory 1,5ECTS TTS courses offered in the scope of its BS and MSC engineering programs (integrating/embedded approach) and 8 extracurricular/bolted-on courses where students can enrol voluntarily).

By adopting these measures, our engineers are better prepared to face the professional landscape, being able to better adapt and face the challenges provided by technological, social and economic evolution. Our HEIs programs are increasingly more solid and balanced between soft and hard skills, providing a more solid foundation for professional engineers, that can complement their knowledge throughout their careers as needed with courses that are provided, for instance, by/through OE+AcCEdE® system or some of the courses/workshops organized by OE.

Internationalization in the Skills Acquisition Process:

Courses for the first and second cycle of studies at UPorto-FEUP are included in the curriculum of engineering BSc and MSc programs and are only offered for regular students. With a few exceptions, most are taught in Portuguese. Third cycle of studies course units are offered to PhD candidates and researchers and are, in general, taught in English.

The training provided by OE is shared with the professional associations of the Portuguese-speaking countries (Cape Green, Angola, Mozambique and Brazil), allowing their members to have continuous training. Since OE is an EURACE accreditation agency, we also contribute to core engineering training at national level, such as UPorto-FEUP, IPL, ISEP and other HEIs, and at international level, through the Lusophone countries.

Partnership Models:

HEIs are being proactive in contacting industry and companies to collaborate with them to make the learning process more meaningful and engaging, for example, through MSc thesis done in company settings. OE has a business exchange with over 200 companies, to which more than 500 CPDs have been accredited over the years.

Impacts and Outcomes:

Through the activities promoted by UPorto-FEUP and OE, it's possible for students of engineering to leave university better prepared for the demands of today's work world, and for those engineers who are already working, it's possible to adjust more easily to the demands of the working world by enrolling in a course correspondent to their needs that has a quality assurance from OE.

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11. Community of Practice (DE)

Country	Germany	Country and/or Region - Map
Region	Germany	
Name of Institution/Initiative:	„Stifterverband: Transformative Skills für Nachhaltigkeit“ (Transformative Skills for Sustainability)	
URL:	https://www.stifterverband.org/transformative-skills-fuer-nachhaltigkeit	
Focus Area of Skills Acquisition:	green skills, sustainability, interdisciplinarity	
Nature of Institution/Initiative:	Civil Society Institutions, Foundations, Companies, Higher Education Institutions	

Contextual Snapshot:	
Relevance of the Focus Area:	Before the background of sustainability as a (international) megatrend, the ability to develop sustainable solutions is becoming a conditio sine qua non for scientists in general and engineers in specific.
Current Status of the Focus Area:	Competences of students/graduates in the field of sustainability and interdisciplinarity are still on a low level and must be further developed.
Key Challenges:	The transfer of feedback from companies into the engineering curricula concerning the required mind- and skillsets of current/future scientist and practitioners is to slow.
Government or Institutional Initiatives:	Federal and state governments, engineering associations, employer federations, and foundations have over the past years started several initiatives to facilitate the flexibilization of curricula and support the adoption by students/young professionals of green skills and a sustainability mindset.

Brief Description of the Institution/Initiative:

The initiative aims at creating a „community of practice“ of 20 HEIs. Its goal is to drive the facilitation of transformative skills for sustainability in study programs to ensure the incorporation of these „future skills“ into the curricula.

Table of Services/Programs provided focusing on the Acquisition of Specific Skills:

All German universities were invited to participate in this network initiative. It works "challenge-based", i.e. HEIs identify challenges in the development and implementation of their teaching-learning concepts for sustainability competences and develop solutions. The spectrum is deliberately open. In concrete terms, the network initiative supports the selected HEIs in designing new teaching modules or further developing existing ones that are dedicated to teaching sustainability skills, with the aim that they are integrated into the curricula.

Examples of Effective Practice in Skills Acquisition:

The kick-off for the initiative was 26 June 2023, so it is in a very early phase. Four curriculum workshops are at the center of the work. In exchange with and supported by the know-how of sustainability experts, the universities work on individual solutions. The workshops are user-centered and oriented towards the needs of the stakeholders involved and work collaboratively on solutions. The university network that comes together in the curriculum workshops can also consult with each other in this framework on a peer-to-peer level.

Internationalization in the Skills Acquisition Process:
This is a national initiative that does not include any international activities. However, the HEIs that are part of the program will spread knowledge and experience via their international networks in research and teaching.

Partnership Models:
The basis of the initiative is a "community of practice" between Stifterverband and 20 German universities.

Impacts and Outcomes:
The planned outcomes are study programs that have competences for sustainability embedded in them. Thus, the competence development will have an impact on as many students as possible from a wide range of subjects.

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12. New Digitalisation/Green Energy and Microelectronic Skills (ES)

Country	Spain	Country and/or Region - Map
Region	Madrid	
Name of Institution/Initiative:	UNED / Projects/Educational Activities to Improve Digital Skills in the SMEs and Industry	
URL:	http://www.ieectqai.uned.es/ https://ecovem.eu/ http://ecovem.ieectqai.uned.es/moodle2/	
Focus Area of Skills Acquisition:	Digital Skills/Green Skills/ Entrepreneurial Skills	
Nature of Institution/Initiative:	Public/University	

Contextual Snapshot:	
Relevance of the Focus Area:	Inside the Spanish University for Distance Education (UNED) and as part of their social engagement and impact of those activities we are moving on in several synergized areas: SME workers education and green technologies and Industry 4.0/Connected Industry literacy and penetration. Those new areas are so important at Spanish Autonomous Community levels, National Spanish level and European Union level.
Current Status of the Focus Area:	Current state of microelectronics arena in Europe is highly dependent of outside technical industry and development, we had inside Europe several waves trying to upscale the knowledge and industry awareness, but we fail in all of them, and we need again to reinforce our presence and workforce/industry capability. Regarding mobility and Industry 4.0 awareness, as this is a newer technical approach and action oriented, our Industry is better positioned but we need to spread up the actions and education approach to increase to have a wide impact in all public and private sectors.
Key Challenges:	Major challenges in Europe in those technical areas are: 1, sensibility to sustainability and green technical impact, and 2, update knowledge on new techniques and social skills in SMEs.
Government or Institutional Initiatives:	We follow guidelines from: • the European Union Erasmus Plus initiative following KA3 proposals, Centres of Vocational Excellence. • the Spanish Mobility Ministry to gain access to the technical (and non-technical) workers (and unemployed) to the mobility, logistics and infrastructures as well as we have a grant to jointly efforts in the jointly course delivery.

Brief Description of the Institution/Initiative:

UNED is the Spanish University for Distance Education, the first and leading University institution in Spain (and in Spanish speaking countries) to incorporate Grade, Master and Doctoral Studies in a hybrid model during its 50 years history, starting as a post mail University and following evolution to a distance/online University global University.

Table of Services/Programs provided focusing on the Acquisition of Specific Skills:

New task-oriented courses for Green Electronics/Clean Energies/Microelectronics for the Microelectronics European Market.

New Master on Connected Industry for Spanish speaking students.

New Professional courses on Logistics/Mobility/Connected Infrastructures for Spanish speaking working and unemployed students.

Examples of Effective Practice in Skills Acquisition:

We focus on the acquisition of new digitalization/green energy and microelectronics skills. Those are done though lifelong learning and Master courses, following different approaches having in mind in all:

- Industry oriented courses,
- Task based education,
- Market oriented approach following the path of the public sector/companies regarding revitalization and new engagement of students in those sectors.

Internationalization in the Skills Acquisition Process:

The Electrical and Computer Engineering Department of UNED started 40 years ago the evolution and activities in international projects, that have focused on European Union academic groups/industry partners collaboration with more than 30 international research and educational projects. Before the pandemic time we were selected as one of the partners of the ECoVEM project, to revitalize and mold the microelectronics European sector to allow a new time of more workers and a new vision for this productive sector. During the pandemic time and having the Ukrainian war as a new unestablished international factor we are in the last part of this project deployment defining new models of governance and collaboration as well as new bunch of short courses to attract and reinforce the profiles of microelectronics workers that is of a mandatory need in Europe as the Chips Act shown in the last year. Our group have been in relation with more than 50 European groups (and more than 20 other worldwide groups) in the last 40 years in this process of research and educational activities collaboration, including in this last project several courses and actions regarding the green electronics importance, horizontal knowledge like circular economy or smart industry, interpersonal skills and activities, etc., or diversity and equity importance inside this technical area of Microelectronics.

Partnership Models:

We have two models to have the best partnership inside any of those projects,

1. Research and Educational International/Europe Union projects, we have a wide partnership with more than 50 partners in the European framework as well as more than 20 partners worldwide outside EU.
2. International and National technical Associations, like: IEEE (the largest worldwide engineering association with more than 400,000 members, having more than 20% of them as engineering students); TAEE (the Spanish Association of Electronics teaching); IGIP/IAoE (international Association of Teaching and Learning in Engineering), IFEES (International Federation of Education Engineering Societies), etc.

Impacts and Outcomes:

At this moment the more tangible outcomes are the courses deployed or under development,

- Microelectronics sector, may be found in the following URLs,
    - UNED repository, http://ecovem.ieectqai.uned.es/moodle2/
    - TUS repository, https://moodle-tus.ecovem.eu/
    - ECoVEM general course shell, https://courses-ecovem.eu/
    - ECoVEM website, https://ecovem.eu/
- Industry Connected Master website (in Spanish)
    - http://portal.uned.es/portal/page?_pageid=93,71749821&_dad=portal&_schema=PORTAL&idTitulacion=280701

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- UNED and Mobility Ministry courses (in Spanish),
    - Competencias digitales para el sector de la movilidad y el transporte, https://formacionpermanente.uned.es/tp_actividad/actividad/competencias-digitales-para-el-sector-de-la-movilidad-y-el-transporte
    - Digitalización sostenible en el sector del transporte, movilidad, logística e infraestructuras vinculadas. Automatización, marketing y aplicación, https://formacionpermanente.uned.es/tp_actividad/actividad/digitalizacion-sostenibleen-el-sector-del-transporte-movilidad-logistica-e-infraestructurasvinculada
    - Tecnologías y Herramientas claves para la transformación digital en el sector del transporte, movilidad y logística, https://formacionpermanente.uned.es/tp_actividad/actividad/tecnologias-y-herramientas-claves-para-la-transformacion-digitalen-el-sector-del-transporte-movilida

The impact on the courses of the Microelectronics sector will be starting to have a pilot courses report around November 2023. The Master will start on October 2023, and the courses for the Mobility Ministry will start on February 2024.

13. Rethinking Engineering Education in Ireland: REEdi (EI)

Country	Ireland	Country and/or Region – Map
Region	Province of Munster	
Name of Institution/Initiative:	**REEdI** - *Rethinking Engineering Education in Ireland*	
URL:	https://reedi.ie/ The Higher Education Authority (HEA) in Ireland also provides contextual information **here**.	
Focus Area of Skills Acquisition:	Digital Skills However, *as an educational initiative the approach could also be applied to sustainable engineering*	
Nature of Institution/Initiative:	University/Academic *The REEdI Industry partnership is comprised of manufacturing organisations across multiple sectors- AgriTech, MedTech, Pharma, Electronic, Automotive and General manufacturing.*	

Contextual Snapshot:	
Relevance of the Focus Area:	The REEdI is looking at how best to utilise state of the art technology in an educational/research/industry symbiosis. Where education is partnered with industry not only in the development of programmes but also in the delivery of the curricula. Moreover, the REEdI offers students more frequent opportunities to apply their learning through a work placement model that encompasses the final two years of their bachelor's degree where they can "*hone their technical or soft transversal skills*"[1].
Current Status of the Focus Area:	The REEdI is currently focused on digital skills that are applicable to mechanical engineering. However, the framework could also be applied to green skills and entrepreneurial educational initiatives.
Key Challenges:	To adapt the framework into one that is applicable to sustainability, the optimal educational approach for integrating SDGs needs to be better understood and appreciated.
Government or Institutional Initiatives:	The Human Capital Initiative (HCI) is delivering an investment targeted towards increasing capacity in higher education in skills-focused programmes designed to meet priority skills needs[2]. The Human Capital Initiative Pillar 3 funding has facilitated Munster Technological University to "*innovate and come up with a new model of not only engineering education, but also an educational model that can be adopted across a number of disciplines*"[3]

[1] HCI Pillar 3 (2022, 0:48) *HCI Pillar 3 – REEdI* [Video]. YouTube. https://www.youtube.com/watch?v=q6KxsNIaiao

[2] https://hea.ie/skills-engagement/what-is-human-capital-initiative-hci/

[3] HCI Pillar 3 (2022, 1:10) *HCI Pillar 3 – REEdI* [Video]. YouTube. https://www.youtube.com/watch?v=q6KxsNIaiao

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Examples of Effective Practice in Skills Acquisition:

The REEdI project is focused on the development of an agile and innovative framework for the design, development and delivery of engineering; transformative programs where self-directed and self-scheduled learning effectively equip the next generation of engineers.

One of the key outputs of the project was a Bachelor of Engineering (Hons) in Mechanical and Manufacturing Engineering- the "REEdI Engineering degree". This program is an agile and innovative blended 4-year degree where student engineers get to learn using immersive technologies, such as virtual and augmented reality, and cutting-edge models of engineering education. The student engineers' time is equally divided between on-campus activities and industry (enterprise) placement. Students will spend the first two years on campus and the final two years at a host industry partner gaining the essential industry skills and personal attributes an employer looks for in a graduate engineer. The industry partners include a variety of manufacturing sectors- MedTech, Pharma, Automotive, General Manufacturing and AgriTech.

The REEdI project will provide an alternative framework for engineering education and indeed, other undergraduate and post graduate programs.

Internationalization in the Skills Acquisition Process:

The educational framework being advocated through REEdI is applicable in an international context. The international academic partners on the project are Charles Sturt University (NSW, Aus) and Harper Adams University (Newport, UK).

Partnership Models:

The REEdI project has a consortium of 23 industry/ enterprise partners (to date), across a variety of manufacturing industries. Also involved is a network of research centers as key partners, including Science Foundation Ireland's Confirm Smart Manufacturing Centre, SFIs Lero Software Development Research Centre, the IMaR Research Centre, and the AgriTech Centre of Excellence (ACE).

Impacts and Outcomes:

The REEdI project capitalizes on its enterprise partners through their input on program design, development and delivery (e.g., program validation panels, guest lecturing), facilitating student taster days at their manufacturing facilities, hosting students on work placement, part of the REEdI steering committee, champions for the project, collaborative outreach initiatives, donation of production parts for "teardown analysis" for our students, and mentoring initiatives. Further, the project has established an industry/ enterprise mentorship network, which enables knowledge sharing of the strengths, weaknesses, opportunities and threats in relation to student work placement.

The approaches (framework) advocated through REEdI could be applied to education that is focused on sustainability and entrepreneurship. Moreover, the REEdI could be extended to integrate all three elements (digital skills, sustainability and entrepreneurship).

14. Professional Roles for young engineers – the PREFER project (BE)

Country	Belgium	Country and/or Region - Map
Region	Flanders	
Name of Institution/Initiative:	KU Leuven, European Project PREFER	
URL:	https://www.kuleuven.be/kuleuven https://iiw.kuleuven.be/english/prefer/prefer	
Focus Area of Skills Acquisition:	Transversal skills in general	
Nature of Institution/Initiative:	University	

Contextual Snapshot:	
Relevance of the Focus Area:	Not all professional engineers need the same skills set and the variety of engineering jobs is wide. How can universities prepare their students for the labour market?
Current Status of the Focus Area:	Engineering graduates are often unaware of the range of possibilities in the labour market. Moreover, they tend to underestimate the importance of certain professional skills for particular engineering positions. The PREFER-project aimed at facilitating the labour market entry of young engineering graduates in close collaboration with industry.
Government or Institutional Initiatives:	KU Leuven is the coordinator of the European project PREFER | Professional Roles and Employability for Future EngineeRs. With partners from industry and the engineering federations, we aimed to facilitate the labor market entry of engineering graduates. The PREFER role model is already implemented in three universities in Flanders and at some universities worldwide.

Brief Description of the Institution/Initiative:

Thanks to Dr. Craps' PhD work three professional roles were identified for young graduates (focus on innovation, optimization and customer-tailored solutions). Through a series of expert panels in different companies, essential non-technical competencies were identified that are required to be successful in each role. PREFER presents a model and two tests to get insight in the personal preferences and essential competencies.

In close collaboration with industry, the consortium within the European PREFER-project has developed 23 cases from the everyday professional practice. The student is asked to rate the appropriateness to different reactions to the situation.

Table of Services/Programs provided focusing on the Acquisition of Specific Skills:

Two tests were developed based on the 3 professional roles and identifying non-technical competencies, in close collaboration with BDO Human Capital. Prefer Explore is a personal preference test that initiates reflection on professional interest. Prefer Match is a set of 3 situational judgment tests (one per role) that gives feedback on role alignment and strengths and weaknesses. See https://iiw.kuleuven.be/english/prefer/instructor/prefer-tests

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Examples of Effective Practice in Skills Acquisition:
The tests are structurally implemented at the Faculty of Engineering Technology (KU Leuven), test cases are running at UAntwerpen and UGent and also the University of Beijing is implementing the PREFER model. The University of Melbourne is preparing the implementation.

Partnership Models:
These instruments are the result of an Erasmus+ project with partners from academia, industry and engineering federations.

Impacts and Outcomes:
"I find it reassuring that different types of engineers are needed on the job market. The model gives me more insight into what is possible when I graduate and what I would like to do most." (Master student in Electronics-ICT Engineering)
"The model can help to think about what you want in the future and to make the right choices to get there. It's not hard to find a job as an engineer, but I think it is hard to find a job that fits you best." (Master student in Chemical Engineering).

15. Identifying and Amplifying Non-Technical Skills in Software Engineering Education (BE)

Country	Belgium	Country and/or Region - Map
Region	Flanders	
Name of Institution/Initiative:	KU Leuven	
URL:	https://www.kuleuven.be/kuleuven https://set.kuleuven.be/LESEC/groups/study-career-guidance-of-steam-students/copy_of_template_project	
Focus Area of Skills Acquisition:	Transversal skills	
Nature of Institution/Initiative:	University	

Contextual Snapshot:	
Relevance of the Focus Area:	SOFTWARE ENGINEERING IS DEFINED as the systematic appliance of engineering methods to software development. These engineering methods are without a doubt technical: software engineers daily have to juggle techniques such as continuous integration, deployment pipelines, microservices, horizontal and vertical slice architectures, automated testing, load balancing, and so forth. As a result, in higher education, software engineering curricula are overflowing with technical courses to acquaint students with a multitude of engineering methods. And yet, according to industry experts, software engineering syllabi seem to be falling short of delivering great software developers. Several surveys, including our own, that ask professionals "what makes a great software engineer?" specify personal characteristics, communication, decision making, and creative problem solving next to technical knowledge as vital skills. It is clearly no longer sufficient to be technically proficient. Computing accreditation programs for higher education struggle to follow suit. Even with the attempts of task forces and institutions to improve software engineering education, the gap between academia and industry persists. The demand for software development talent is much higher than the number of graduates universities can deliver each year, putting even more pressure on the skill gap problem.
Current Status of the Focus Area:	This project aims to answer the following questions: 1. What are the non-technical industrial requirements of modern software engineers? 2. How big is the gap between those requirements and engineering education? 3. How can we improve upon education to reduce that gap?
Government or Institutional Initiatives:	KU Leuven, Campus Diepenbeek

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Brief Description of the Institution/Initiative:

In the dissertation of Wouter Groeneveld (KU Leuven), those non-technical industrial requirements of modern software engineers are identified. Focus is also on how big the gap between those requirements and software engineering education is, and how the educators can amplify students' non-technical skills in order to reduce that gap. We first focus on non-technical skills in general before zooming in on creativity as one of the key attainable skills to becoming a great software engineer. A framework for mastering seven creative problem-solving skills is developed: technical knowledge, communication, constraints, critical thinking, curiosity, creative state of mind, and creative techniques. A self-assessment tool called the Creative Programming Problem Solving Test was derived from that to help gauge your current creativity mastery level in context of a software development project. Finally, a practical approach to creativity in software development is explored, specifically geared towards software engineering professionals. This work contributes to computing education research by helping shed light on the non-technical academia-industry skill gap and by bringing research on creativity from the field of cognitive psychology closer to the field of computing education.

Table of Services/Programs provided focusing on the Acquisition of Specific Skills:

A practical guide can be found in the following book written by Wouter Groeneveld: https://www.manning.com/books/the-creative-programmer

ANNEX 2:
ENGINEERS EUROPE DISSEMINATION EVENTS
September 2022 – Augustus 2024

1.	**E4E 1st Consortium and Kick-Off Meeting**	Brussels, 22-23 September 2022
2.	**ENGINEERS EUROPE WG Future Engineers**	Brussels, 9 February 2023
3.	**ENGINEERS EUROPE General Assembly**	Cannes, 9 June 2023
4.	**Meeting at Consiglio Nazionale Ingegneri (CNI)**	Rome, 28 June 2023
5.	**E4E 2nd Consortium and 1st European Engineering Skills Council**	Brussels, 21-22 September 2023
6.	**EU STEM COALITION General Assembly**	Amsterdam 25 September 2023
7.	**WFEO World Engineers Convention**[9]	Prague, 11-13 October 2023
8.	**Joint International Conference EUCEET/AECEF**[10]	Pisa, 19-20 October 2023
9.	**Fifth World Congress of Education**	Sapporo, 15-17 November 2023
10.	**Technical University München: EuroTeQ Presidential Strategy Forum**	München, 22 November 2023
11.	**Deutscher Akademischer Austauschdienst - ERASMUS Mundus Conference**	Brussels, 30 November 2023
12.	**Conference of the Central Asian Association for Accreditation of Education**	Almaty, 8 December 2023
13.	**Ecole Nationale d'Ingénieurs Saint-Etienne (ENISE) Erasmus Mundus Joint Master**	Saint-Etienne, 5 February 2024
14.	**EU STEM COALITION: STEM for the Future of Europe**	Brussels, 29 February 2024
15.	**WFEO World Engineering Day**	Lisbon, 4 March 2024
16.	**E4E 3rd Consortium Meeting**	Madrid, 14-15 March 2024
17.	**OAV German Asia-Pacific Business Association: Engineering the Future**	Hamburg, 15 March 2024
18.	**ENGINEERS EUROPE WG Future Engineers**	Brussels, 16 April 2024
19.	**E4E 2nd European Engineering Skills Council Meeting**	Brussels, 16-17 May 2024
20.	**IACEE World Conference on Continuing Engineering Education**[11]	Comillas, 20 May 2024
21.	**ENGINEERS EUROPE General Assembly**	Dublin, 31 May 2024
22.	**SEFI Deans Convention**[12]	Sheffield, 12-14 June 2024

9 WFEO, World Federation of Engineering Organizations
10 EUCEET, European Civil Engineering Education and Training Association
11 IACEE, International Association for Continued Engineering Education
12 SEFI, European Society for Engineering Education

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