ENGINEERS 4 EUROPE

E4E

Engineers for Europe

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E4E Skills Strategy: Anticipating Skills Requirements for the Engineering Profession

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I. 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 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?*

By providing answers to these questions, this document works towards the overall objective and vision of the 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 (DigComp, LifeComp, EntreComp, GreenComp) for engineers.

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

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

- ***Higher Education Institutions***
  - *Faculdade de Engenharia da Universidade do Porto (FEUP)*
  - *Technological University Dublin (TU Dublin)*
  - *Katholieke Universiteit Leuven (KU Leuven)*
  - *Association of European Civil Engineering Faculties (AECEF)*
- ***Vocational Education and Training***
  - *Institute of Industrial and Business Education & Training (IVEPE-SEV)*
  - *National Agency for Quality Assessment and Accreditation of Spain (ANECA)*
  - *European Council of Engineers Chambers (ECEC)*
  - *Newport Group S.A. (NG)*
- ***Industry and Engineering Companies/Representation***
  - *Verein Deutscher Ingenieure (VDI)*
  - *Engineers Ireland (EI)*
  - *Ordem dos Engenheiros (OE)*
  - *Federation of European Heating, Ventilation and Air Conditioning associations (REHVA)*

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 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 is relevant to all of these for the following reasons:

- *The document provides Higher Education Institutions (HEI) with insights from industry considering the necessary continuous alignment of curricula and labour-market demands.*
- *The Skills Strategy 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.*
- *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, et al.*
- *The Skills Strategy gives training providers an idea of current and future market demands of, thus enabling them to develop up to date CPD activities/programs.*
- *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 Strategy is constructed on the input of the extensive **Primary and Secondary Research** that was conducted by all partners in the first year 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 conducted an on-line survey between 15 May and 15 July 2023. The results provided a first general idea of the current trends and major challenges when it comes to engineering competencies for the future.

It did not come as a surprise, that digitalisation and decarbonisation are main impact factors that have a tremendous effect on the expert knowledge that will be required by future engineers. In addition, however, 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), has been identified as a major challenge but also a major opportunity for the individual engineers, companies, Higher Education Institutions, and engineering training providers.

The research has 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).

Consistent with the research conducted by the other partners and literature reviews, the following important conclusions and recommendations can be drawn.

- 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.
- In the coming years (2023-2027), **sustainability and environmental considerations**, coupled with the increased adoption of **automation and AI (Artificial intelligence)**, 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 Continuous Professional Development (CPD) must align with the **Sustainable Development Goals (SDGs)**. Practical experience through **internships and apprenticeships** is a recognized need for engineering students. 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. Scholarships, mentorship programs, and diversity/inclusion training are key tools for attracting underrepresented groups to engineering. 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[1].

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

[1] A useful starting point for this strategy is 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

II. Analysis of the demand side

II.1 Demand of Engineers per Industry Sector and Profiles

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.

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 AI, data analytics, cybersecurity, and renewable energy are facing a shortage of qualified engineers.

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 artificial intelligence, data science, and robotics are gaining prominence.

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, IoT (Internet of Things), 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 European Commission's Green Deal.

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.

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.

II.2 Skills Gaps Within Sectors

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.

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

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. 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.

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.

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

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, 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.

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.

Lifelong Learning in Engineering: The engineering profession is at the forefront of the universal tendency towards lifelong learning. 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.

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.

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.

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 is highlighted as essential.

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. Micro credentials, post-graduate programmes, and education initiatives should be designed to address skill shortages and equip engineers with the latest trends and developments.

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.

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.

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.

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 lifelong learning is essential for the sustained excellence of engineers.

II.4 Under-represented groups in engineering

Under-Representation and Its Implications: Research indicates that there are proportionally underrepresented groups in engineering, leading to a deficit in the diversity of ideas, perspectives, creativity, and overall balance in the profession.

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.

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.

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.

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.

II.5 Actionable Recommendations for the Skills Council

In translating our comprehensive analysis into actionable recommendations for the 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.

II.6 Identifying areas where data and information are lacking

A very important initiative has been launched by the Engineers Europe and the E4E project partners. But as the goal is to formulate a robust strategy that will have a complete picture of the existing situation, future trends and will work predictively to meet the needs of the future, the effort must be continued and intensified. Some suggestions that will give us more input and feedback for the 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., artificial intelligence, blockchain, IoT) and their application in real-world scenarios.
2. Future Skill Requirements: This was the first attempt of the council to collect data. Maybe there is a limited foresight into the evolving demands of industries, especially regarding technological advancements and the emergence of new engineering disciplines. More effort needs to be focused on collecting data on 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. 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 are 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 strategies to address these challenges.
6. Continuous Professional Development (CPD) Needs: The research needs to be expanded to get more insights into the specific areas where continuous professional development 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 continuous learning.
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.
9. Impact of Global Trends: Although we recognize the global trends, such as climate change, digitalization, and geopolitical shifts and it is a 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.

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

To address these data gaps, a combination of surveys, interviews, industry reports, collaboration with professional organizations, and ongoing monitoring mechanisms must be continued/ employed to gather relevant information for a robust skills strategy for European engineers.

III. Current skills challenges for employers

III.1 Requirements for employers to transform the workforce

A key issue is finding a balance between technical expertise and professional skills. Evidence indicates many graduates lack essential practical skills, especially in communication and strategic thinking, leading to a mismatch between academic outputs and industry requirements.

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 their 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. Relatedly, participating in the development of programs for the integration of foreign skilled workers is also strategically important.

III.2 Digital Skills Competencies

Digitisation is relevant to all work areas and means a lot more than data analytics, AI and using Teams and Share-Point 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.

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

III.3 Green Skills Competencies

At the European level, 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 4 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/organisation to commit in the matters related to the Green transition and sustainability and incorporate the principles in both personal and professional capacities.

III.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.

III.5 Entrepreneurship Competencies

Looking ahead, the importance of entrepreneurial skills for engineers is expected to increase. 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.

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[2] GreenComp: the European sustainability competence framework

[3] LifeComp: The European Framework for Personal, Social and Learning to Learn Key Competence

IV. Assessment of current supply

IV.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 that 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.

IV.2 Challenges in ascertaining the supply of engineering professionals

The prioritization of skills and related competencies needs 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 skills, 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; 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 skills gaps there is a labour 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 has a role in influencing the EU in initiatives such as subsiding technical education places to address skills shortages and encourage more people to enter the industry.

IV.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 artificial intelligence and the Internet of Things (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, 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.
6. Soft skills beyond technical expertise for effective communication, leadership, 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. Further, 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 practices awareness so that engineers are familiar with and incorporate environmentally sustainable practices into their work.

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

Educational offerings must prioritise 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.

As an alternative approach discipline (pillar or professional skills) gaps can be 'bridged' as engineering (professional) experience. 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 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 lifelong learning strategies incorporating CPD requirements.

IV.3.2 Strategic Postgraduate / Post-qualification Considerations

Addressing the skills mismatch in the engineering sector requires a multi-faceted approach. By combining the strategies/Good Practices that we present below, HEIs, VET providers, professional bars/charters/chambers, 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.

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 EC, the ResearchComp[4].

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

[4] ResearchComp: The European Competence Framework for Researchers

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.

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 needed skills.

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.

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 so all can dialogue on the relevance of the educational offer.

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 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 educational providers' mission.

Professional bodies (orders/bars/charters/chambers) 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 (orders/charters) validate as core to the engineering profession, are supplied by educational providers.

VET providers can offer specialized, practical and short-duration training postgrad 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 labour market.

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).

Government and Policy Support through the provision of regulations that guide educational providers to continuously adapt 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.

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

Following on from the considerations presented in chapter 3 and the opportunities described in chapter 4 (and more specifically in section 4.3), a methodology is proposed in Figure 1 for the Skills Council to prioritise and subsequently recommend in the educational/training curricula reviews that can also facilitate better resource allocation for CPD offerings. The methodology builds 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.

The first decision required at Skills Council is in respect to Stage 2 and in the **prioritisation** of the identified skills gap (acquired in stage 1 of the methodology) in terms of industry sector/demographic imperatives, requisite (priority) skills and HEI/VET capabilities (i.e. in terms of priority technical-skills/skills-as-a-resource). This prioritisation allows a sector/discipline specific emphasis to be achieved. Then by engaging with professional body groups such as ENAE and Engineers Europe, a subsequent focus on HEI/VET focus engagement 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 (FCD/SCD) 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.

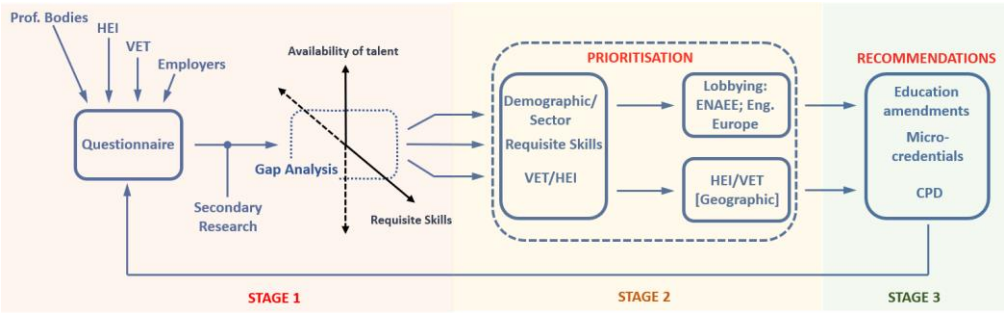

Figure 1: *Methodological approach better align educational opportunities with professional demands for engineers.*

V. Scenario analysis

V.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 different European Union regions 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 Continuous Professional Development (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. Second, 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.

V.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 Council Recommendation of 26 November 2018 on promoting automatic mutual recognition of higher education and upper secondary education and training qualifications and the outcomes of learning periods abroad refers to the 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.

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 Council Recommendation of 26 November 2018.

V.3 Systems of Acceptance and Academic Recognition

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

- **the European Qualifications Framework (EQF)** as a translation tool to make national qualifications easier to understand and more comparable,
- **the Bologna Declaration** (European Ministers of Education, 1999) with the main goal of deepen relations between European nations to establish a Europe of Knowledge,
- 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,
- the **EUR ING Certificate** was created to help promote mobility in Europe, among other objectives. 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 needs to be renewed every 5 years,
- **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,
- **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.

V.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 they enhance their inter-cultural communication skills and understanding of the world.

There are a series of options that can be strongly recommended or required: 1 semester of practice abroad during the PhD, 1 bachelor semester designated to expand their education in a different field or to apply their knowledge in cross-border projects, or short-term internships and projects in companies as part of the master's degree. 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 employers from outside the EU can attract European engineers and vice versa. This could be a further development of the recently developed EU Talent Pool.

In 2013 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 and Regulation. This amendment has introduced three mechanisms that can facilitate the mobility of engineers:

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: This aspect is important as it provides a pathway to automatic recognition for professions that currently do not have it, such as engineers.

This CTF (Common Training Framework) could be the appropriate path to harmonize the minimum training requirements needed to practice the engineering profession in Europe with international agreements, such as the Washington Accord, Sydney Accord, and Dublin Accord. This way, it could facilitate the mobility of engineers worldwide. Even EUR-ACE could play a significant role in the assessment of the programs that are align with this CTF.

V.5 Promote Professional Activity & Professional Development

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

Mobility can be promoted by highlighting the importance of engineering in society through reach-out opportunities such as a programme of visits to schools by engineers from different disciplines, sharing their daily professional experience with young people; launching advertising campaigns, showing that engineering is embedded within so many things in our daily lives.

From the perspective of the working engineer, one can propose a set of guidelines, or measures, for industry to examine and adopt. Some examples could include: enduring bonus payments (e.g. after a certain number of years of working for the company), profit sharing, or by complementary benefits such as: support for transport, childcare, housing, meal plans, gym memberships, etc.

There are initiatives that can be explored to address the gender imbalance in the engineering workforce. These could include, active identification of female role models, addressing the gender pay gap, etc.

Industry should support complementary lifelong learning and continuous professional development. This includes regularly encouraging and promoting the re-skilling of engineers who need to update their skills. The creation of a certification system for advanced training should be provided by higher

education institutions or private entities. These courses should correspond to ECTS which, when carried out within the same scientific area, could be counted towards a possible postgraduate or specialization degree. This would motivate continuous training and give higher education institutions a new dynamic.

Promoting more influence by engineers in political power in:

- Regulating the profession (engineers know their profession specifically, not other professionals);
- Political decision-making based on the technical decisions of engineers.
- Creating a Working Group of engineers in the European Commission/Assembly of the Republic, appointed by the Professional Associations, in order to enhance the profession and the technical decision-making of engineers at European/national level (e.g. European Parliament). These WGs could also be consulted for decisions involving technical knowledge/opinions.

Promoting the importance of engineering in society through:

- Visits to schools by engineers from different specialties, sharing their daily professional experience with young people;
- An advertising campaign, showing that engineering is in the simplest things in our daily lives.

Promote the attraction/retention of talent:

- The value of engineers needs to be recognized by society, not just civil engineers, but engineers from all fields. It is also necessary to improve the working conditions of engineers, offering more geographical stability, more social, family and monetary benefits, etc.;
- It is proposed to create a set of measures/guidelines for the private sector in order to promote their permanence. Examples: by a permanence bonus (e.g. after x months/years of working for the company, profit sharing, workers are rewarded) or by complementary support such as: support for paying rent, paying for childcare, paying for transport, offering meals, paying for gym memberships, etc.;
- Campaigning among young women, putting them in contact with role-models, so that younger women can be inspired to pursue a career in engineering;
- Tackling the gender pay gap;
- Complementary continuous training, promoting the re-skilling of engineers who are already in the job market and need to update their skills. This effort should be distributed equally between the training entity and the engineer, benefiting both the employer and the engineer (fear of the employer investing in the engineer and him changing jobs in the meantime; if this effort were global, this problem would be solved).

V.6 Micro-credentials

The European approach to micro-credentials for lifelong learning and employability was approved in mid-2022. The transparent recognition procedures for micro-credentials issued by different types of providers. 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.

However, not only a European procedure for recognition is 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, etc. Maybe this is a more feasible first step than developing procedures for recognition?

VI. Action plan for strategy implementation

VI.1 Scope of Action plan for strategy implementation

Whereas in the previous chapter we identify 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 aid employers and industries and to establish terms of reference (not requirements as written) for higher education institutions (HEI).

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

The passive actions should be based on the provision of information to all stakeholders. This should include data about the Engineering profession. It can have academic, professional, social or regulatory components. Again, it is recommended to have it on the project Observatory and managed by Engineers Europe (EE). This data could abridge issues like Continuing Professional Development (CPD) provision for engineers, salaries of engineers, qualification frameworks (professional and academic), current trends in engineering development, international agreements, events relevant for the engineering profession, mobility schemes/tools and predicted future scenarios.

VI.2 Stakeholders

There are a significant number of stakeholders involved in the education, employment, development and professional aspects of engineering education (EE) and engineers. These include universities, national engineering academic and professional bodies, VET providers, online engineering courses providers, military industry companies, construction companies, European Engineering Alliances, manufacturing industries, public companies, services, transport and communications, research companies, European Commission DGs, UNESCO, mining and agriculture. 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.

VI.3 Communication and Outreach

The platform to be created, updated and maintained by EE should comprehend pertinent documents and prior research. It should be considered as a beacon for Engineering.

For most questions there are already tools. For instance, in terms of Skills Passport the European Commission has already several approaches. Some of these are the European Professional Card and the Europass CV. It is necessary that a deep and thorough research is done about tools related with the problems and questions identified in the surveys and in this document. Several world bodies have also already addressed the question of integration of non-European engineers. The latest is the WFEO plus others called the Graduate Attributes and Professional Competencies (GAPC) Framework. Concerning the future, this Observatory may help prioritizing actions like the sustainability response of engineers as prescribed by the UNESCO II Engineering report (Engineering for a Sustainable Development). Presenting examples of CPD training for engineers could be collected and questioning

if this type of competencies should be mandatory for all active engineers could be a topic. Observatory could amass concrete data for engineers to use in their actions while trying to be more sustainable.

VI.4 Proposed Actions

VI.4.1 HEIs / Curriculum Design Proposed Actions

- Design a well-organized EU-platform where engineers can find opportunities for CPD;
- Identify opportunities to improve implementation of Bologna for engineering education;
- Identify incentives to speed up the Bologna process;.
- Intensify the collaboration between HEIs and the working field to reduce the skills gap;
- Make internships obligatory in engineering curricula;
- Recognise the added value of professional competencies and integrate them in authentic tasks;
- Make engineering curricula attractive for all students with the necessary minimal potential;
- 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 6 curricular units of soft skills can corresponding to 1.5 ECTS/each, total of 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.

VI.4.2 Portability of Academic and/or Professional qualifications

- Identify opportunities to improve widespread adoption of Washington/Sydney/Dublin accords;
- Dissemination of the EUR ING Certificate and its advantages for engineers;
- Expansion of the EUR ING Certificate reach, so that engineers across the world can apply more easily (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);
- Identify opportunities for streamlining the automatic recognition of academic qualifications at European HEI;
- Disseminate the results of European funded projects addressing shortcoming and deficiencies of the application the Lisbon Recognition Convention, such as the "Spotlight on recognition" project self-assessment tool, LIREQA's practical recommendations, Focus on Automatic Institutional Recognition (FAIR) report and the online training platform from 'Streamlining Institutional Recognition: a Training Platform for Admissions Officers' (STREAM) project;
- Expand the application of the LRC, addressing the governments of countries where the implementation is incomplete.