ENGINEERS EUROPE

International Association for the Continuation of Engineering Education

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Workshop 1: Shaping the Future of Engineering Education and Practice in Europe

Introduction :

In today's global manufacturing industry, the engineer is no longer merely a machine builder or process optimizer, but a designer of sustainable, intelligent production systems. His or her expertise is no longer limited to mechanical or electrical engineering, but now also encompasses digital systems. Knowledge of AI is no longer optional but essential; the learning process is no longer intermittent but continuous; and, ideally, thinking is no longer linear but systemic and supply-chain-oriented. It is no longer a matter of optimizing processes and machines, but rather of being able to think and act systemically. That is, proactively anticipating malfunctions and deviations in production processes, utilizing AI-driven quality control and understanding its results, and translating those results into process optimization—including time, materials used, energy, sustainability, etc. In other words, there is a discernible shift from "*experience and following the rules*" to "*data and decision-making*". In manufacturing, it is no longer just speed, output and cost that matter, but now also the origin of materials, CO2 intensity, recyclability, and the energy sources used. In short, the shift is moving from "*efficient production*" to "*responsible production*" and this places a much greater social responsibility on engineers: they must design for the circular economy (with an eye toward reuse in any application); they must justify material choices based on environmental impact; and they must design energy-efficient processes. This therefore requires "*systems thinking*": specifically, how does my work fit into the bigger picture of the value chain. This means not only more intensive interaction with colleagues, customers, and suppliers, but also the need for critical scenario analyses combined with a constant balancing of technology, economics and the environment. Of course, this has repercussions for higher education institutions. Based on the "Engineers 4 Europe" research (September 2022 – August 2025), several recommendations have been formulated for each involved stakeholder group :

I. Academia :

We must require from our elementary and secondary education providers that they *place a stronger emphasis on numeracy, science, reading, writing*, thereby providing a solid foundation for the transition to higher education. Basic competencies are lacking; today, too many "competence goals" stand in the way of deep learning. Reading on paper, literacy, concentration, perseverance and similar skills should be prioritized in education at these elementary levels. From the perspective of higher education and engineering, we must place emphasis on *curriculum modernisation*, digital and AI literacy. Curricula are increasingly shifting, albeit too slowly, from discipline-based programmes to competence- and system-based curricula. This is in line with European frameworks such as the Bologna Process and the European Qualifications Framework, but now requires a substantive reassessment due to digitalisation, AI and the green transition. In other words, less mathematical depth is required,

but *more application and interpretation*; no longer ethics, computer science, mechanics or AI as separate, stand-alone subjects, but integrally interwoven into new continuous courses now referred to as '*learning pathways'*, such as the 'Data & AI', where students progress from data acquisition to data analysis and decision-making; or the 'Sustainable Design' learning pathway, where students begin with material selection, move through life-cycle assessment, and progress to circular systems. These vertical learning pathways or curriculum tracks, which span several years, enhance coherence and transparency regarding the learning outcomes to be achieved.

ENGINEERS EUROPE advocates interdisciplinary and multidisciplinary curricula, precisely because modern production processes are too. Let students work on multidisciplinary team projects, give them realistic real-world industry cases, and provide them with opportunities through internships to collaborate with companies. Or – just as importantly – when it comes to communication, give them tasks such as "*Present your solution to the management of company XYZ"*; "*Justify your choice to a national or European regulator or European government body*"; "*Explain your system to the customer/operator*". This brings us to the soft skills that must turn the engineer – as a technical expert – into a technical "liaison officer". They must be able to manage change, lead multidisciplinary teams, ensure safety and, above all, make the technology understandable to operators and customers. This is leadership and communication: two areas in which engineers do not necessarily excel.

In this context, we must refer to the concept of 'lifelong learning' (LLL) which is crucial for engineers, just as it is for lawyers, doctors, surgeons and other professions. This is – or could also be – a lucrative business model for universities to strengthen their ties with alumni. Modular continuing professional development, particularly through micro-credentials recognised within the EQF, as well as hybrid, dual learning (work + study), are absolutely essential for a career spanning over 40 years. Engineers face particularly rapid skills obsolescence and therefore modular, flexible LLL pathways such as microcredentials, stackable courses and industry-aligned certification will allow engineers to reskill and upskill throughout their careers. To prepare engineers for the challenges of the 21st century, sustainability principles must be incorporated into formal engineering education and CPD. This is essential to support the integration of the Sustainable Development Goals (SDGs) into engineering practice. Green and digital skills must become core elements of all vocational education programmes by 2030.

A systematic approach to the *training of lecturers* (skills development) in the field of new technologies and teaching methods tailored to the perceptions and expectations of today's students is also recommended. Universities should support lecturers in gaining experience in the business world (or recruit them from there). In this respect, ERASMUS is a success story because it fosters cooperation with foreign institutions with a view to the cultural integration of students and academics, and promotes working in international and intercultural environments.

II. Industry :

Although there is high demand for engineers in the fields of energy, electricity and digital technology, the supply of skilled professionals is not keeping pace with the sector's needs. Demand for specialised talent far exceeds supply, creating recruitment challenges. Global competition, demographic shifts and rapid technological change have exacerbated these issues, forcing companies to rethink how they attract, develop and retain their workforce. The labour market is evolving and demands adaptability, with newly created roles and transformed existing professions. Changes in the environment are inevitable and will occur rapidly, which also have

an impact on the professional activities of engineers. These changes are driven by technological developments, but also by unforeseen needs arising from global crises. This evolution is changing the expectations and responsibilities of engineers, who are no longer expected to be merely technical experts, but also innovators and leaders capable of addressing complex social and environmental issues.

An increasingly common expectation regarding professional skills is the aforementioned *inter- or multidisciplinary approach*, which emphasises the importance of the interaction between technology and other disciplines, such as the social sciences and economics. An interdisciplinary approach enables a better understanding of societal trends and new and evolving technologies. It is a method for broadening one's perspective. Our research also revealed that there is a shift in the perception of entrepreneurship, from a purely soft skill to a more integrated and accepted competence, often linked to business acumen. This evolution reflects a greater understanding of the value of entrepreneurial thinking and skills for engineers in a changing world. In this context, offering *internal structured CPD programmes* can encompass multiple disciplines to *prepare engineers for hybrid roles* that combine technical and management expertise, leading to the development of management skills (to meet the growing demand for leadership within technical industries).

Entrepreneurship education, particularly through practice-oriented learning projects, will strengthen the mindset and aspirations of engineering students. Integrating practical assignments, such as work placements at start-ups or established companies, helps to *cultivate a robust entrepreneurial mindset*. Partnerships between industry and educational institutions can provide effective solutions to the shortage of digital, green, resilient and entrepreneurial skills in engineering. Given the pace of technological change, engineers halfway through their careers need quick, accessible ways to hone their skills. *Microcredentials* – a system of short, verified learning units – can complement full qualifications and enable continuous learning.

Another recommendation relates to *retaining employees* for longer. Keep them at work after retirement through flexible retirement models, part-time roles and targeted training programmes, so that experienced professionals can keep abreast of technological developments and act as mentors to newly recruited staff.

Finally, *recruitment channels can be expanded* to include under-represented groups, and CPD can be utilised to support their integration and progression within the sector. Increase women's participation in STEM careers through targeted outreach programmes, mentoring initiatives and structural changes in the workplace, such as family-friendly policies and equal pay measures.

III. Policymakers :

Despite its strategic importance, vocational education and training (VET) often faces an image problem in many EU countries, as it is seen as a second-rate option compared to academic pathways. If the EU is to meet future skills needs – particularly in technical professions such as engineering – VET must become a more visible, flexible and ambitious part of the LLL system. To tackle technical skills shortages, VET systems must serve not only as effective training platforms, but also as ambitious, forward-looking drivers of professional development. By *improving the image*, ensuring cross-border recognition, integrating green and digital skills, and supporting LLL, vocational education can also become a powerful tool for attracting talent to the technical sector. Progressive policy measures, sustainable funding and close collaboration with the business community remain essential to realising this potential.

Another recommendation relates to the creation of *a platform for engineering-specific microcredentials* that are stackable, recognised by industry and linked to the EQF. We also recommend finalising the conceptual AI competence framework by 2026, alongside the existing 'EU Competence Frameworks' of DigiComp (2013 – 4th version in 2022), EntreComp (2016), GreenComp (2022) and LifeComp (2020), to finalise the conceptual AI competence framework by 2026. This will also be crucial to adequately prepare new learners for the future AI-driven labour market. Furthermore, this must become a key priority in adult education and continuing vocational training.

IV. Professional bodies :

Awareness campaigns highlighting the importance and opportunities within the engineering profession, as well as communication about the profession and motivating children from a young age, are effective strategies. Equally, offering and *promoting further training and reskilling* is an important objective, through the organisation and coordination of specialised (tailor-made) training programmes for engineers from various sectors, possibly via microcredentials. Setting up and moderating *discussion forums* on the requirements for current and future technical skills also remains one of the key objectives of federations such as ours. A neglected topic relates to *encouraging engineers to exert political influence* and acquire political power, particularly when it comes to legislation and regulations that affect their profession but also society in general. Political decision-making in certain areas of society should be based on the technical expertise, advice and recommendations of engineers. An international contact group comprising experienced engineers from various disciplines could facilitate and improve political decision-making processes at EU level. The engineering profession also needs a clear, compelling *positioning statement* to convey the importance of the profession to the public. To engage the younger generation in engineering, the active participation of engineers themselves is required.

Conclusion :

In the future, the success of the engineering sector will depend on its ability to embed a culture of continuous learning whilst remaining aligned with broader economic and environmental objectives. In this way, engineers will not only be able to meet today's challenges but also shape a future characterised by sustainable growth, technological excellence and global leadership. To address the skills mismatch between supply and demand, it is crucial that engineers, educational institutions and industry stakeholders collaborate and adapt to changing skills requirements by updating curricula, developing and disseminating courses, expanding engineering networks and engaging policymakers. The "European Engineering Skills Council" focuses precisely on this joint effort, with broad representation of all stakeholders, as identifying current in-demand skills and future enhanced skills is of paramount importance, particularly in the context of curriculum modernisation. Cyclical verification of the expected hard and soft skills for specific industries will also be addressed. Producing and maintaining a supply of competent, professional engineers requires a joint effort from all stakeholders. This wonderful profession is evolving and offers numerous opportunities for those who are ready to embrace the transformative journey that lies ahead. With due pride, drive, inspiration, skill, determination and a commitment to excellence, the role of engineers is, after all, to continue shaping a sustainable and innovative future for the society in which we all live.