
“How to promote, based on education and training, from a lifelong learning perspective, the skills needed for Europe to establish a more just, more cohesive, more sustainable, more digital and more resilient society”

The strategy for engineering education and training for ‘new generation’ engineers should strengthen the synergy between *formation* and *realisation*. Such a strategy should involve a universal framework for the educational formation of an engineer and seamlessly meld into his/her continual professional development (CPD), such that life-long learning (LLL) becomes a way of life rather than a duty.

It is believed that professional engineering societies (bodies) need to be at the heart of this synergy and in that regard, the formation and realisation requires a universal and international framework that facilitates inter-disciplinary cohesion as a driver for multi-disciplinary (digitally sustainable) resilience. In other words, the professional bodies act as the channel between formal education and continuing (life-long) professional development.

1. Engineering Training

What is most striking and what differentiates engineering from many other disciplines is that there is a common understanding throughout the world of what an engineer is supposed to know and be able to do. However, such understanding needs international formalisation so that appreciation can be realised into careers that are future ready and based on common foundations. Internationalised formation in this regard, facilitates the use of standards through which engineers can address global problems.

For instance, the ERASMUS+ funded project, CALOHEE (www.calohee.eu), developed a qualification framework for five academic domains, one of which was Engineering (Civil). In this regard, a sectoral qualifications framework of general descriptors for engineering was developed aimed to address three questions: **1) Do students enrolled in higher education around Europe develop the competences they need? 2) Are study programmes delivering their promises? 3) Can we learn to compare student’s achievements in different countries in a meaningful way?** The qualification framework approach facilitates the terms of reference of engineering programs learning outcomes and respective assessment.

Another European example is the EURACE framework and accreditation system (www.enaee.eu) that provides a set of standards that identifies high-quality engineering degree programmes in Europe and around the world. The framework is further supported by several stakeholders such as FEANI (www.feani.org), the European Federation of Engineering Societies (in 33 European Countries and wider Europe). The engineering programmes with the EUR-ACE label have engineering programme outcomes that ensure accepted quality of the competences of the graduates. Separately, the FEANI EUR ING professional title, reflects the established competence requirements of its membership.

Recommendation 1

Currently, there is the urgent need to have an accepted European approach that presents the set of **engineering competences** for first and second cycle graduates that satisfy engineering quality standards. It is necessary for stakeholders (society, companies, engineering professional bodies, employers, and engineering schools) to have engineers with competences (knowledge, skills, attitudes) that foster trust in engineering activities and ensure the **proper qualification** of engineers.

2. Continual Professional Development (CPD)

Concerning the working engineers, it is necessary to guarantee that their competences are updated and ready to face future challenges. New technologies including artificial intelligence (AI), robotics, nanotechnology, 3D printing, blockchain and digital healthcare – brought about by the Fourth Industrial Revolution – are changing jobs, career paths and the ways that people work¹. About 9% of occupations in 2030 will be new and do not exist at present².

Lifelong learning in engineering is called by various names, the most common of which are continuing professional development (CPD) for engineers and continuing engineering education (CEE). CEE/CPD engagement, such as what Engineers Ireland advocate³, is an under-pinning ethos, the professional obligation to learn that is a decisive contributor to the credibility in society of the engineering professional and the engineering profession. Best practice for CEE/CPD engagement involves planning, recording and reflecting on CPD activities, with obligatory periodic time investment.

Some European countries, such as Denmark, Finland, France, Germany, Ireland, Sweden and United Kingdom have traditionally invested in the CEE/CPD of engineers⁴. There is no standard European approach on how to ensure that type of training for engineers. Professional competencies of engineers are generally established by professional associations in a European context, the *Federation of European National Engineering Organizations* (FEANI – www.feani.org) adopted a system of measuring CPD in terms of credits and a process to record those achievements. FEANI also created the Engineering title EUR ING that provides information about an engineer's CPD. As such, it defines the group of competencies acquired by each engineer in terms of CEE/CPD and proposes an e-portfolio system to record evidence of competencies acquired. This system of registering and recognizing CPD for engineers by FEANI is voluntary and is used by the professional organizations of FEANI members⁵. CPD, however, is a mandatory requirement to obtain and maintain the EUR ING title.

In addition to a standard set of competences, many professional engineering organisations and regulation bodies mandate ongoing competence development, sometimes in particular areas with regard to maintaining standards for the safety of citizens.

Recommendation 2

It is fundamental that there is a European system to **recognize and register** CEE/CPD achievements of each engineer. The disclosure of that CPD could be achieved by a European title identical to the FEANI EUR ING title and it would allow to verify the updated qualification of each engineer. A European system to **measure and quantify** the periodic CPD should be adopted allowing comparison of engineers' qualification across borders. Periodic CEE/CPD should be **mandatory** for engineers in Europe given the social responsibility of the activities and the legal and economic consequences of underperformance.

¹ Schwab, K. 2017. *The Fourth Industrial Revolution*. New York, NY: Crown Business

² Bughin, J. Hazan, E., Lund, S., Dahlstrom, P., Weisinger, A. and Subramaniam, A. 2018. 'Skill shift: Automation and the future of the workforce'. McKinsey Global Institute

³ Engineers Ireland (2018), *Continuing Professional Development Policy*. Retrieved from <https://www.engineersireland.ie/listings/resource/334> on 02 January 2021

⁴ Dutta, D., Patil, L. and Porter, J.B. Jr. 2012. *LLL Imperative in Engineering: Sustaining American Competitiveness in the 21st Century*. National Academy of Engineering. Washington, DC: National Academic Press

⁵ See www.feani.org/site/index.php?id=287.