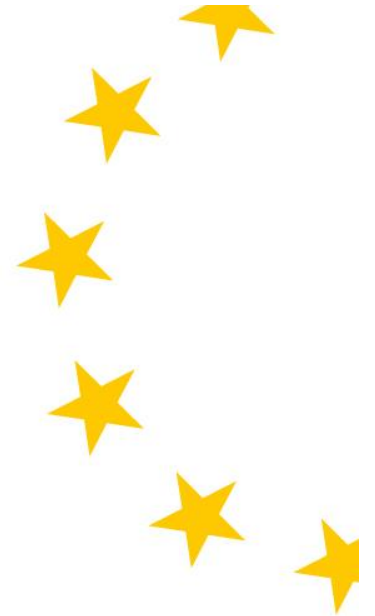


WHICH AND HOW MANY ENGINEERS FOR TOMORROW?

A union of skills for a sovereign and prosperous Europe facing demographic and technological challenges

- Comparison, perspectives and needs of the current situation of engineers in Europe
- Solutions for the future of engineering education

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Introduction

In her introduction, **Alessia Lefébure**, dean of Institut Agro Rennes-Angers and Vice President of CDEFI’s Europe and International Commission, accentuated the importance of adapting engineering education to meet future challenges. Representing 204 French engineering schools that educate around 250,000 students, CDEFI plays a crucial role in maintaining the excellence and global influence of French engineering education. The speech underscored the need for a forward-looking approach, integrating interdisciplinary, adaptable, and sustainable methods to address climate action, digital transformation, and sustainability.

The Draghi Report presented to the European Commission emphasises Europe’s need for skills in digital technology, green innovation, and multidisciplinary collaboration. Engineers will be vital to Europe’s green and digital transitions, necessitating education reforms that include lifelong learning, environmental science, policy literacy, and leadership. Practical skills such as renewable energy design and sustainable urban planning must be embedded in engineering curricula.

The France 2030 initiative, through its Compétences et Métiers d’Avenir (CMA) programme, has supported 182 training projects with €2.5 billion in funding. This initiative aims to prepare the workforce for future challenges, underlining the need for engineers to co-design solutions with experts from various fields through interdisciplinary problem-solving.

The European Green Deal and Green Comp framework further stress the need for socially and environmentally conscious engineers. CDEFI advocates integrating sustainability into all levels of engineering education and supports initiatives like the Next European Framework Programme (FP10) and university alliances to prepare graduates to address Europe’s future challenges effectively.

This event, “Which and How Many Engineers for Tomorrow?”, highlights CDEFI’s dedication to addressing the current demographic and technological shifts. The 21st century demands evolution in engineering to tackle climate change, sustainable innovation, and digital transformation. The key questions revolve around institutional readiness, talent and resources, regulatory frameworks, immigration policies, and the potential roles of European universities and alliances in fostering necessary changes.

First introductory speech

Vanessa Debiais-Sainton, Head of Higher Education Unit at the Directorate-General for Education and Culture of the European Commission, opened her speech by recalling the urgent need to have more and better equipped engineers for a more competitive and resilient Europe. Attracting the right talents and developing the right skills are challenges pointed out in Ursula von der Leyen’s Political Guidelines 2024-2029, that also calls for the creation of a union of skills.

Debiais-Sainton quoted several publications recording this idea: Enrico Letta’s report on the future of the single market and its conception of a fifth freedom to enhance research, innovation and education; Mario Draghi’s report on the future of European competitiveness that indicate that labour shortages will be most pronounced in high skilled occupations. These reports underline the potential of the European degree to boost the development of high quality European joint degree programmes for all types of disciplines, including engineering.

To work towards the delivery of a European degree, **Debiais-Sainton** mentioned several initiatives that can be used as a base, such as the Erasmus JEDI project (Joint European Degree Label in Engineering),

The Marie Skłodowska-Curie Actions, Erasmus mundus, as well as the work of several European university alliances – EELISA and its ambition for a European engineer profile encompassing both scientific core competences and social, environmental, multicultural skills; Eut+ and its European Sustainability Science Lab; Ulysseus and its Joint Master’s Degree in Sustainable Energy, Transport, and Mobility for Smart Cities of the Future, etc.

In conclusion, **Debiais-Sainton** insisted on the importance for engineers to learn from other disciplines and cooperate with other professionals, such as lawyers, experts in marketing, ethics, in order to create new and less fragmented knowledge. Rethinking the profile of engineers is key to make Europe more competitive on the worldwide scene.

First round table – Engineers in Europe: the current situation, comparisons between different European countries, prospects and needs

This first round table was hosted by **Andreas Kaiser**, Head of research at JUNIA and Research Adviser at CDEFI, who introduced the discussion by asking the panellists about the current needs regarding skills in Europe.

Dirk Bochar, Secretary General of ENGINEERS EUROPE, mentioned that it remains a challenge to agree on a harmonized definition in Europe of what an engineer actually is. He felt that “engineer” referred to an education and that it only became a profession when a particular discipline would precede it, e.g. electrical engineer, mechanical engineer, chemical engineer, etc... In addition, in order to reach the goal of 1 million new engineers per year in Europe, **Bochar** indicated three urgent needs: attracting more people in engineering studies, having updated hands-on curricula and better meeting industry demands. In order to become more appealing to youngsters, the engineering profession required better “marketing”, i.e. more role models, success stories and a better image. He felt there is a need to amplify the profile of engineers and their value to society.

In echo, **Thomas Clochon**, Deputy Manager of Attractiveness at Syntec Ingénierie, stressed the importance for engineers to collaborate with non-engineers. In a recent production of their beliefs and concerns for the future of Engineering in France, Syntec addressed the need to work more ahead and with other actors on skills. The work consisted in gathering data on how many engineers there must be in companies and what skills they must have to meet with the ecological, industrial and digital challenges. Syntec concluded that in 5 years, 80 000 more engineers and technicians will be needed in France, meaning 10 to 20 000 more per year. To reach that goal, **Clochon** listed three levers: diversifying education paths, working on the intermediary step such as bachelors, and spreading the culture of science and technology among society.

Emily Barker, macroeconomist at the university of Southampton, addressed the common fear of seeing technology replacing our human activities. She emphasised many points against this idea, such as the human touch necessary in some occupation (care work for example), or intermediary skills that cannot be achieved by robots. Talking about the predicted demographic decline, she advocated for a restructuration of our training programme to make use of the population we have. For **Barker**, adaptation is key. It also applies for the EU as a union, that must be aware and acknowledge the differences between countries, especially in their ability to recruit STEM graduates. Indeed, East European STEM graduates often migrate in West European countries to find jobs they can’t find in their agricultural economy, making Western countries heavily rely on migration to keep their population growing. However, **Barker** remained positive about the future, arguing that the Covid crisis showed the ability of European countries to adapt by coordinating each other. This process must now be translated

into engineering education; the EU common market must be better organised so that we can make the best out of it.

Finally, **Arkadiusz Mężyk**, honorary president of CRASP, based his intervention on the example of the Silesian University of Technology in Poland, from which he is a former rector. The university faced several challenges regarding engineering education, including the lack of research centres and the lack of attractiveness of the curriculum for the candidates. Candidates needed to be convinced that they will be acquiring safety for their future with the engineering curriculum. In response, in 2016 the university started to implement changes in the quality of education, research and international collaboration, reorganising with the idea in mind to be more flexible, in curriculum as well as in teachings. They reduced the number of majors to make education paths more readable for candidates, and instead introduced more options to choose from afterwards (16 for the General Engineering major). Also, to address the need of contact with the practical, industrial aspect of engineering, the university opened a project centre and focused more on project-based learning. This reorganisation was a success in attracting more students. The only drawbacks they encounter today is the difficulty to find a common model through a European degree, even though the European university alliances are very popular in Poland. **Mężyk** advocated for a label or accreditation giving competences necessary regarding the EU policy.

Reacting to the interventions, **Andreas Kaiser** asked the panellists about the mobility of talents: is it key for Europe today? Is it one of the answers?

Dirk Bochar confirmed that cross border mobility is definitely an issue, especially in the context of an elderly growing European population. He stressed the need to adopt a more pragmatic approach intra- and extra- the European Higher Education Area (EHEA). Red tape and long bureaucratic procedures do not encourage people to move around in Europe. Since most countries are also lacking engineers, they do not like to see them go to another country either (brain drain). Overall, the European decision-making processes are also slow and tedious, based on complete consensus and take too long. Additionally for certain disciplines and particular countries the profession of engineer is over-regulated. Regarding mobility from outside the EHEA, **Bochar** believes this mobility will be essential for Europe’s competitiveness and this can be facilitated by bilateral agreements with countries from for instance Asia and Africa.

Thomas Clochon confirmed that there is a communication issue regarding the promotion of engineers in society today. According to him, engineers must altogether help to draw positive perspectives for tackling the future, which also means entering the political field. Their voice can be specifically relevant in the climate change area, because they are able to say what can and cannot be done and motivate young people to take actions.

For her part, **Emily Barker** argued that both the education system and industry are too stagnant and need evolution. Industry has to express more openly what kind of engineers and skills is needed, and universities must adapt their curriculum accordingly so that they are more adapted to the market. She for instance suggested to develop joint degrees with companies, local and international, so that students can be guaranteed to find a job after graduation.

In addition, **Barker** pointed a massive problem regarding the lack of women in STEM, and advocated for put forward female role model to boost young girls’ confidence. Once again, the idea is to better communicate. She took the example of Elon Musk, who is not an engineer but is perceived like one because he knows how to sale himself.

Dirk Bochar felt that we are leaving the world of globalization and that Europe will need to ensure its own sovereignty e.g. in terms of energy supplies, defence, etc. The number of engineers required

tomorrow will not only be determined by politics (e.g. Green Deal), but by scientific developments (AI, etc.) and market competition (e.g. car industry). He felt it would be a commodity if more engineers would engage in national and European politics. In this context he mentioned that recent research revealed that from the 720 newly elected MEPs, merely 33 or 4,5% have an engineering educational background. From the 27 new Commissioners, none has an engineering education.

This idea is also developed by **Arkadiusz Mężyk**, for whom new professions will be designed by the new and disappearing needs of the market rather than by EU directives. In conclusion, Europe must be more flexible and listen to the market, the industry. We need to change the way we teach to make it adaptable to the fast pace of technological evolution.

Second introductory speech

José Carlos Quadrado, president of ENAEE, began by highlighting that his organisation, which started as a network, has now become a global entity promoting European values such as diversity, acceptance, and the pursuit of the common good worldwide. He emphasised that engineering studies should attract more underrepresented groups, as their inclusion is essential to addressing society's needs effectively. Diversity not only enriches innovation but also enhances the ability to tackle global challenges more efficiently.

To attract talent, **Quadrado** proposed modernising curricula and fostering partnerships between academia and enterprises. He also suggested considering the regulation of the engineering profession to maintain high education and practice standards. Advocacy for lifelong learning is crucial to keep engineering competitive in rapidly changing fields. Additionally, incorporating global challenges into the curriculum is important for students to understand their global impact and to achieve better goals.

Quadrado concluded by focusing on the need for global cooperation between institutions and the sharing of best practices, as exemplified by existing alliances.

Second Round Table: Training more engineers: what solutions and how to implement them?

For the second round table, **Christian Lerminiaux**, director of Chimie ParisTech, introduced the session and reminded the main topics discussed earlier such as diversity, regulations, mobility, and enhanced cooperation through initiatives like European universities.

Mattias Björnmalm, Secretary General of CESAER began by discussing regulations, stressing that while Europe is adept at managing risks, it falls short in embracing the positive aspects of risk, such as seizing opportunities and trying new things. This is particularly relevant for researchers and those at the cutting-edge of science and engineering. **Björnmalm** affirmed the importance of political support for fostering an environment where innovation can thrive. He referenced the Heitor group's report "Align, Act, Accelerate," which proposes the "Choose Europe" initiative aimed at making Europe a magnet for global talent in science and engineering, drawing inspiration from France's "Choose France" campaign. A pilot of this initiative is expected to launch next year.

Andreas Winkler, Secretary General of the European university alliance Unite!, using the example of his alliance, accentuating the urgent need for more engineers in computer science to tackle pressing societal challenges like digital transformation and climate change. He argued that these challenges are interconnected and require equally interconnected and complex responses. European universities, equipped to offer high-quality, interdisciplinary programmes, are perfectly positioned to address these needs. Unite! combines science, social sciences, and humanities to promote transdisciplinary approaches, which are essential for modern engineers who need not only technical skills but also soft

skills, democratic values, and an ethical mindset. **Winkler** cited the high-quality programmes, collaborative courses, and innovative pedagogies of Unite!, drawing attention to initiatives like the EU-Train project and the Unite Research School, which foster international mobility and research collaboration.

Greet Langie, Vice-President of SEFI and Professor at KU Leuven, discussed a literature review on the attractiveness of engineering programmes, accentuating the importance of lifelong learning and the integration of professional skills into curricula. She advocates for abandoning the term "soft skills" in favour of "professional skills" to better reflect their importance. **Langie** also addressed gender diversity in engineering, noting that societal stereotypes about engineers refrain women from pursuing engineering careers. She called for more research to understand these dynamics and for tailored interventions to increase female participation in engineering.

Joep Bresser, head of the EU office of the EU STEM Coalition, described efforts to enhance STEM education across Europe through collaboration between government, business, and education sectors. He affirmed the need for long-term, systemic policies to promote STEM education, sharing the success story of the Dutch STEM platform launched in 2000. **Bresser** stressed that sustained investment and a multi-year approach are crucial for success: the number of STEM graduates in the Netherlands started to drop as soon as the fundings for the platform were lowered.

Several key issues and proposals were raised by participants and the audience regarding the challenges and opportunities in STEM education and engineering careers:

Carle Bonafous-Murat from France Universités underscored the importance of involving young girls in STEM education, referencing the book *Marie Curie habite dans le Morbihan*. The book links the low level of innovation to the underrepresentation of women in STEM and calls for strategic approaches to find role models to inspire young girls.

Joep Bresser pointed up the positive correlation between a country's innovation levels and the number of girls in STEM fields. He highlighted the importance of role models, who can visit classrooms to provide positive reinforcement, and advocated for creating an inclusive culture involving various community actors like science centres, libraries and even sports clubs who can also help with the inclusive culture in the young age.

Mattias Björnmalm agrees with the added value of role models but noted that additional expectations should not systematically be placed on top of the regular work that professionals from underrepresented groups already face. Instead, institutions should support potential role models from underrepresented groups by ensuring that such efforts can be integrated into their regular work hours.

A participant from the audience suggested having engineers explain their jobs to pupils and students, possibly through a film or documentary, to better illustrate the daily life of engineers.

Greet Langie asserted that universities have the responsibility to equip students with employability skills from the outset. **Andreas Winkler** pointed out the uneven job market in Europe and underlined the need for a European-wide education and job market, accentuating the importance of openness among employers to international graduates. **Bresser** provided an example from Benelux and the Baltics, where a treaty among the six countries was signed to automatically recognise all diplomas, creating a unified market space.

Iason Dougenis from the European Commission inquired about when and how the trend of a lack of engineers in Europe began. **Björnmalm** responded that, despite relatively reasonable employment rates across the EU, organisations face difficulties in finding highly skilled individuals. This is not a new issue,

as it has been reported for many years. It highlights the importance of nurturing strong connections between different sectors, including academia and industry.

Winkler presented data from Germany, noting a 10% decrease in students in STEM subjects over seven years and a 23% decrease in engineering and computer science.

Lerminiaux emphasised the need to make the job market more fluid and to increase mobility within and outside Europe. He warned against losing too many skilled graduates and suggested continued education as a short-term solution. He also pointed out the importance of adapting curricula to attract more students, considering gender perspectives, and ensuring engineers are visible in schools.

Isabella Zin Tomasino from Grenoble INP- UGA discussed the need to open STEM and engineering education to unconventional profiles and adapt recruitment methods accordingly.

A final comment from the audience noted the recent decline in communication abilities and how technology impacts our humanity.

Synthesis of the seminar

Alessia Lefébure concluded the seminar by summing up the key challenges that were highlighted by the panellists during the day regarding engineering education:

- Greater diversity and representation: we cannot say engineers are crucial when they remain underrepresented in politics;
- Historical lesson: engineering schools were created in time of crisis, and we are today again in one of those moments;
- Definition: today we lack a common definition of what an engineer is, making mobility a challenge, and there is a strong need to go back to the curriculum;
- Attractiveness and early education: there is a need for more flexibility in paths to the engineering degree, from primary school to higher education;
- Global talent mobility: Europe must develop more tools to attract international talents in order to compete with the US and China;
- Risk innovation: risk must be seen as positive and risk-taking should be fostered.

Alessia Lefébure's final thought is as follows: important feminine engineer figures, such as Ada Lovelace, were both scientists and open to human sciences. They show us the path to combine creativity, imagination and humanity and to integrate it into the engineering world. She wishes that this event will be a meaningful step toward shaping a generation of engineers who don't just solve problems but build solutions that are innovative, inclusive, and sustainable.

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