ENGINEERING EDUCATION AND PROFESSION IN EUROPE

Competences and mobility of Engineers

José M.P. Vieira

President
Outline

• Context: Engineer, the protagonist of innovation
• New paradigms for Engineering Education
• Engineering education quality in Europe
• Mobility of engineers in Europe level
• FEANI initiatives to facilitate mobility
• FEANI promoting engineers capability
Engineer: the protagonist of innovation

- Context and challenges: creating striking innovations
  - Manufacturing, textile industry (1750-1850)
Engineer: the protagonist of innovation

- Context and challenges: creating striking innovations
  - Steam, railway (1850-1900)
Engineer: the protagonist of innovation

- Context and challenges: creating striking innovations
  - Steel, electricity (1875-1925)
Engineer: the protagonist of innovation

- Context and challenges: creating striking innovations
  - Oil, car (1900-1950)
Engineer: the protagonist of innovation

• Context and challenges: creating striking innovations
  • Information, communication (1950 - )
Engineer: the protagonist of innovation

- Context and challenges: creating striking innovations
  - Microtechnology, nanotechnology, automation, medical engineering ( - )
Engineer: the protagonist of innovation

- Context and challenges: creating striking innovations
  - Green (-)

Source: Planet
Engineer: the protagonist of innovation

- Context and challenges: creating striking innovations
  - Internet of things (-)
Engineer: the protagonist of innovation

- Context and challenges

Source: National Academy of Engineering
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New paradigms for engineering education

- Waves of innovation
New paradigms for engineering education

- Challenges in engineering education (digitalisation)
New paradigms for engineering education

- Challenges in engineering education
  - What Big Data, IOT and globalisation mean for engineering education?
New paradigms for engineering education

- Challenges in engineering education (skills and competences)
New paradigms for engineering education

- Trends transforming education as we know it (European Commission)

<table>
<thead>
<tr>
<th>From here</th>
<th>To there</th>
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</thead>
<tbody>
<tr>
<td>Education frontloaded in early life</td>
<td>Learning throughout life</td>
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<tr>
<td>Blackboard, books and papers</td>
<td>Whiteboard, digital and virtual reality supports</td>
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<tr>
<td>Academic literacy</td>
<td>New forms of literacy, including digital</td>
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<tr>
<td>Lecture-based, theoretical, passive learning</td>
<td>Experiential, immersive learning, interactive, participatory courses and seminars, labs and simulation games across all disciplines</td>
</tr>
<tr>
<td>Teachers as lecturers</td>
<td>Teachers as learning coaches and mentors</td>
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<tr>
<td>Standardised, mass approach to learning</td>
<td>Customised, individualised learning</td>
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<tr>
<td>Discipline-based, focused on subjects and expertise</td>
<td>Competency-based, multidisciplinary, project-based and digitally-enabled learning</td>
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<td>Education mainly provided by a restricted set of state, religious or private actors</td>
<td>Diversification of education providers and of training partnerships</td>
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<tr>
<td>Recruitment based on degrees</td>
<td>Recruitment based on skills, talents and potential</td>
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</tbody>
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Engineering education quality in Europe

- The European Commission is committed to create a European Education Area by 2015, that should include:
  - Making mobility a reality for all: by building on the positive experiences of the Erasmus+ programme and the European Solidarity Corps
  - The mutual recognition of diplomas: by initiating a new 'Sorbonne process', building on the "Bologna process"
  - Promoting lifelong learning
  - Mainstreaming innovation and digital skills in education
  - Creating a network of European universities
  - Supporting teachers: by multiplying the number of teachers participating in the Erasmus+ programme and eTwinning network
Engineering education quality in Europe

- Need for mutual recognition of Engineering qualifications
  - Mobility/Globalization – transparency in comparability of academic titles (challenges of the Bologna process)
  - Difficulties on attribution of professional competencies due to more flexibility of construction of individual academic curricula
  - Rapidity, volatility and technological change is increasing
  - Labor market changes – temporary/project assignments prevail over long-term employment
  - Educational reforms by politics in some countries – learning-outcomes oriented standards and curricula, national qualifications frameworks (NQFs)
  - New /different forms of learning: CPD (Continuing Professional Development), MOOCS (Massive Open Online Courses), blended learning (combination of traditional training/digital online content), apprenticeships, etc.
Engineering education quality in Europe

- Global accreditation systems
  - International Engineering Alliance:
    - The Washington Accord (1989 - Engineers)
    - The Sydney Accord (2001 - Engineering Technologists)
    - The Dublin Accord (2002 - Engineering Technicians)
    - EUR-ACE label for the Bachelor degree
    - EUR-ACE label for the Master degree
Engineering education quality in Europe

- EUR-ACE

  - 13 Accreditation Agencies authorized to award the EUR-ACE label to engineering programs
  - 17 Full Members and 5 Associate Members
  - FEANI is a Full Member of ENAEE and ensures its Secretariat
  - EUR-ACE accredited programs are eligible for the EEED
Engineering education quality in Europe

- FEANI European Engineering Education Database
  - The reference for quality European Engineering Education
  - An independent database
  - A database listing the institutions of engineering HE in European countries represented within FEANI and their engineering programs recognized as fulfilling the FEANI quality requirements for good engineering education
  - EUR – ACE programmes are inserted in the EEED
  - List of more than 1,000 HE institutes with more than 10,000 engineering programs accredited by EEED
  - Programs in the EEED are the education requirements for the EUR ING professional title
## Engineering education quality in Europe

- **FEANI European Engineering Education Database**

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<thead>
<tr>
<th>Country</th>
<th>Institutions</th>
<th>Programmes</th>
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<tbody>
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<td>United Kingdom</td>
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</table>
Engineering education quality in Europe

- The FEANI European Monitoring Committee
  - 15 members plus Chair, proposed by FEANI National Members and appointed by FEANI for 3 years
  - Work in an independent capacity, in line with its Terms of Reference (ToR)
  - Consists of Engineers, with expertise in the European professional formation systems, including both the engineering education and the professional experience
  - Membership of the EMC reflects the spectrum of engineering employment and the variety of geographical regions, cultural background and engineering formation systems in FEANI
Engineering education quality in Europe

- Learning outcomes of engineering programmes listed in the FEANI EEED
  - Knowledge and Understanding
    - A thorough knowledge of the principles of engineering, based on mathematics and a combination of scientific subjects appropriate to their discipline
  - Engineering Analysis
    - An ability to apply appropriate theoretical and practical methods to the analysis and solution of engineering problems
  - Engineering Design
    - Knowledge of the use of existing and emerging technologies relevant to their field of specialization.
    - Knowledge of standards and regulations appropriate to their field of specialization
  - Investigations
    - An awareness of continuous technical change and the cultivation of an attitude to seek innovation and creativity within the engineering profession
Engineering education quality in Europe

- Learning outcomes of engineering programmes listed in the FEANI EEED
  - Engineering Practice
    - A general knowledge of good engineering practice, in their field of engineering and the properties, behaviour, fabrication and use of materials, components and software
  - Transferable Skills
    - An understanding of the engineering profession and an obligation to serve society, the profession and environment, through commitment to apply the appropriate code of professional conduct
    - An ability in engineering economics, quality assurance, maintainability and use of technical information and statistics
    - An ability to work with others on multidisciplinary projects
    - An ability to provide leadership embracing managerial, technical, financial and human considerations
    - Communication skills and an obligation to maintain competence by continuous professional development (CPD)
    - Fluency in European languages sufficient to facilitate communication when working throughout Europe
  - All six criteria are then detailed separately for Bachelor and Master levels
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Mobility of engineers in Europe level

- Political context
  - "Shaping a renewed strategy for completing the internal market for goods and services. This includes reviewing the application and scope for further extending the principal of mutual recognition in the single market and designing new policy measures to address remaining obstacles to a fully functioning single market for goods and services" (EU Commission)
  - The current mutual evaluation exercise (art. 59 of the professional qualifications directive)
    - Highlighted the complexity of the situation in the Member States as regards engineers, and civil engineers in particular
    - Profession of engineer captures many different professions and titles with an extensive range of activities
Mobility of engineers in Europe level

- Engineers regulated very differently among EU Member States
Mobility of engineers in Europe level

  - Facilitate mobility for professionals under the general system (engineers belong to general system)
  - Two new avenues for “automatic” recognition:
    - Common training frameworks (Art.49a): harmonisation of training on the basis of a common set of knowledge, skills and competences
    - Common training tests (Art.49b): no harmonisation of training but a common training test (“aptitude test”)
  - No compensation measures

*Common training framework (CTF) is a common set of minimum knowledge, skills and competences necessary for the pursuit of a specific profession*
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FEANI initiatives to facilitate mobility

- Introduction to FEANI – the European Federation of National Engineering Associations
  - Through its 34 European member countries, represent and strengthen European Engineers by
    - Striving for a single voice of European engineers
    - Improving their career development
    - Affirming their professional identity
FEANI initiatives to facilitate mobility

- The FEANI Policy Paper on ‘Educational Policy’ (10/2010) highlighted the importance of Science and Technology in primary and secondary education:
  - Present science and technology in a modern, practical and attractive manner in primary and secondary education
  - Communicate engineering in a positive and inspiring way
  - Increase public understanding of the influence of technology
  - Pay special attention to attracting girls/women into engineering
  - Invest in the quality of engineering education
  - Increase the funding of education and research in technology
  - Education is the way to innovation
  - Change is a challenge
  - Nurture positive attitude towards lifelong learning (LLL) during education
  - Enhancing sustainable development with technology
FEANI initiatives to facilitate mobility

- The FEANI perspective for Engineering Education
  - Quality Assurance and Values (Codes) - good quality education for all
  - Need for VET – Vocational Education and Training in addition to academic education
  - Learning outcomes & competences: constantly verify quality and pertinence of descriptors for the respective profession
  - Identification of skills necessary in flexible/technological environment – avoiding skill mismatch (employability)
  - Inclusion of Soft Skills in the systems: team working, management, languages, involvement, etc. (- but keep up quality of core skills for specialties)
  - Cohabitation academic education – work placement during HE
  - Integration of LLL (global and aging society) – definition/accreditation of CPD
  - Benefits from technology/digitalization
FEANI initiatives to facilitate mobility

- EUR ING – professional title for engineers. FEANI Guideline extract:
  - Competence describes what someone can do
  - Engineering education and professional experience combine to a required level of engineering formation
  - Competences are not necessarily aligned with formal education
  - Competence may be the result of several individual paths of non-formal or informal learning processes. For measuring/assessment, it is necessary to demonstrate the learning outcome
  - Competence does not describe the learning process of the individual but it assumes that learning has taken place
  - The initial education of engineers typically takes place in formal education in universities, universities of applied sciences and technical colleges. This may take the form of first-cycle, second cycle or integrated programmes which have either an applications-oriented or conceptual/theoretically-oriented profile
FEANI initiatives to facilitate mobility

- EUR ING
  - Framework for the award of the EUR ING professional title to Engineers - applicants must be members of a FEANI member association

- Objectives of the EUR ING:
  - To facilitate mobility
  - To establish mutual recognition

until age of 18

7 years formation

High level secondary education + Education* + Education* or experience + Experience

* In FEANI EEED

3 years

2 years

2 years
FEANI initiatives to facilitate mobility

- EUR ING

- Available for all engineering card holders who fulfil the FEANI criteria for professional experience and CPD

- Special cases limited to cases known from chartered engineers (UK) and HTL engineers (Austria)

- Title is valid for 5 years and can be renewed

Engineering Education
- Only engineering graduates are eligible

Professional Experience
- min. 2 years for BA
- min. 4 years for MA

Continuing Professional Development
- min. 30 h/year
FEANI initiatives to facilitate mobility

- ENGINEERING CARD
  - Professional card for engineers
  - Document/Register validating professional qualifications
FEANI initiatives to facilitate mobility

- ENGINEERING CARD
  - Available for all graduates that have successfully concluded one of the study programs included in the FEANI Database (EEED)
  - Full documentation of the engineering competences of card holder
  - Valid for life
FEANI initiatives to facilitate mobility

- **EUR-ING (2017-2018):**
  - 245 engineers were awarded the EUR ING title in 2017, 156 in 2018 at the end of September 2018.
  - Overall, 33,685 EUR ING titles in total have been issued.
  - Applicants can chose either the e-application form or the former hardcopy application.

- **ENGINEERING CARD (2017-2018):**
  - 175 Cards were issued in 2017 (DE, CZ, HR, PL, PT, RS).
  - 67 Cards were issued in 2018 until June 2018.
FEANI initiatives to facilitate mobility

- Proposal for an integrated concept

<table>
<thead>
<tr>
<th>European Engineering Education Database</th>
<th>EngineerING Card</th>
<th>EUR ING Title</th>
</tr>
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<tbody>
<tr>
<td>Programmes fulfilling the FEANI requirements</td>
<td>Engineers graduated in a programme listed in the FEANI Index</td>
<td>Engineers graduated in a programme listed in the FEANI Index and fulfilling the FEANI requirements for professional experience and CPD</td>
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FEANI promoting engineers capability

• The Engineers Europe Advisory Group concept
FEANI promoting engineers capability

- Establishment of the Engineers Europe Advisory Group

- 11 September 2018: Inauguration of the Engineers Europe Advisory Group (EEAG): An informal network embracing all relevant stakeholder groups (academia, students, young professionals, industry and employer federations, professional organizations)

- A Letter of Intent was signed by 11 organizations (12 incl. FEANI)

- 88 meeting participants
FEANI promoting engineers capability

 Establishment of the Engineers Europe Advisory Group

Bridging the gap
An innovative new alliance is set to strengthen the voice of Europe's engineers while deepening engagement with policymakers, industry and academia.

FEANI is an innovative new alliance that aims to strengthen the voice of Europe's engineers while deepening engagement with policymakers, industry and academia. This was the key message at the recent Engineers Europe Advisory Group (EEAG) launch event in Brussels.

Jose Vieira, President of FEANI, Europe's largest federation of engineers, explained that the motivation behind the Advisory Group was to allow the engineering community to have a wider impact on society. The primary objective was to provide a unified voice for engineers on a European level. However, to do so effectively, "the input of other stakeholders will be essential." This is why we have invested considerable time and effort in preparing the setup of the Group.

Key priorities for the group include greater cooperation with employer organisations, enhancing the status of engineers and ensuring sufficient engineers to meet future demand, and to actively explore the implications of digitisation for engineering.

During a panel discussion on the future of work, industrial competitiveness and the challenges of an ageing workforce, European Commission DG for Education, Youth, Sport and Culture, Theres Christophidou explained that "the ever-increasing use of technology demands ever stronger digital skills." Theres, she believed, were the new literacy and were essential in maintaining European competitiveness. Although the demand for STEM (Science, Technology, Engineering and Mathematics) skills was immense, not enough people were choosing to study them. "Digital talent is essential - we need to ensure the quality and nature of education is delivering what we need." 

Exalting the logic behind EEAG, Dick Boddaert, FEANI Secretary General, expressed his hope that the initiative would address those issues currently facing the engineering profession. It was FEANI’s mission, explained Boddaert, to build bridges between stakeholders in academia and industry. Various agency donor groups sign the Advisory Group’s ‘Letter of Intent’ to explore and, with an important signal of Europe’s common interest to achieve these common objectives.

Working together, the Advisory Group will develop a work programme to address the challenges posed by digitalisation, including how best to promote the study of STEM subjects, bridging the digital divide and ensuring the appropriate education provisions. It would also consider the inevitable ethical implications of digitalisation.

Boddaert offered the metaphor of EEAG as a vehicle capable of bridging those existing gaps. It was an analogy to a sustainable vehicle.
FEANI promoting engineers capability

- EEAG: Academic and Professional Organizations
FEANI promoting engineers capability

- EEAG: Industry and Employer Associations
FEANI promoting engineers capability

- The challenge for Engineering profession certification systems
  - Keywords: Trust in Quality Assurance

QUALITY ASSURANCE OF:
- Engineering education
- Professional competences
- CPD and Lifelong learning
FEANI promoting engineers capability

- The FEANI perspective (UN SDG)

A successful sustainable development agenda requires partnerships between governments, the private sector and civil society. These inclusive partnerships built upon principles and values, a shared vision, and shared goals that place people and the planet at the centre, are needed at the global, regional, national and local level.
THANK YOU

Beijing 21 November 2018

José M P VIEIRA
PRESIDENT