



INTERNATIONAL FORUM ON ENGINEERING CAPACITY

Beijing | 21-22 November 2018

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

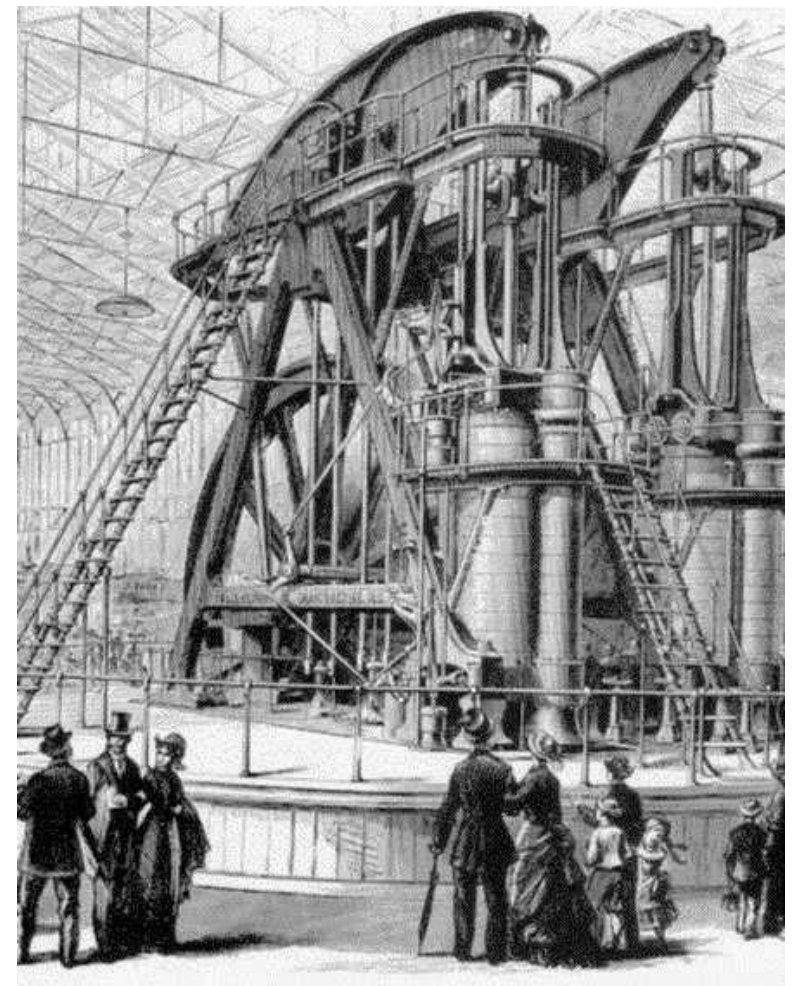
Engineer: the protagonist of innovation

- 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)



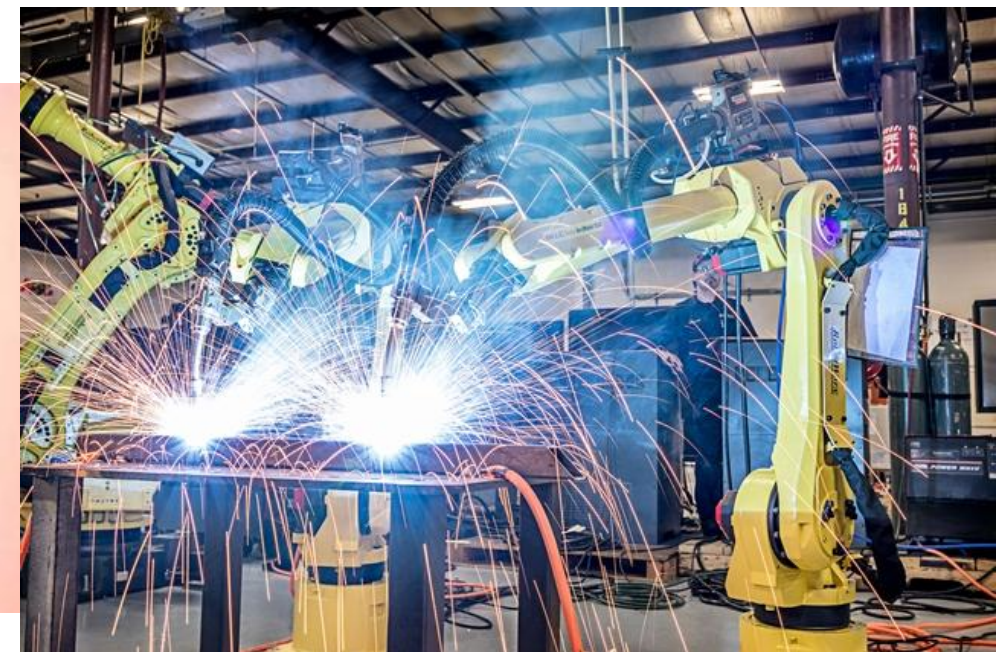
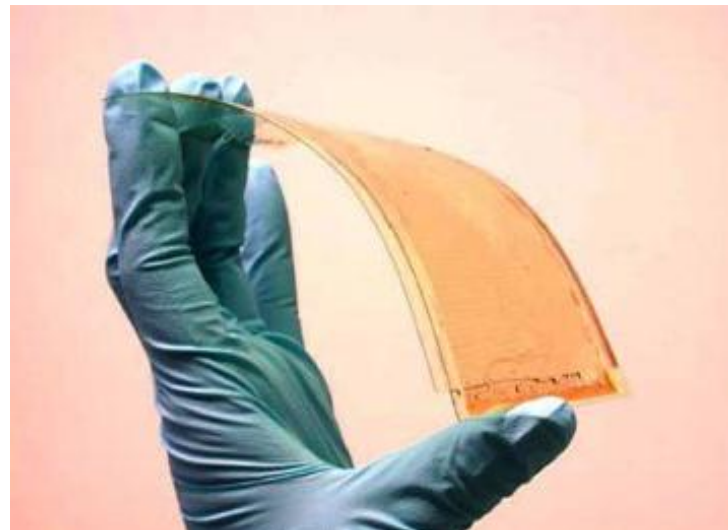
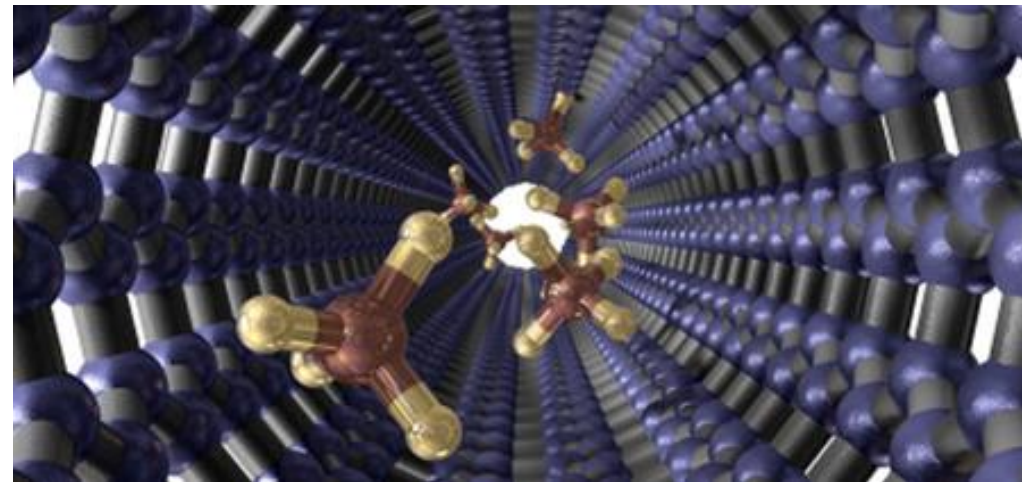
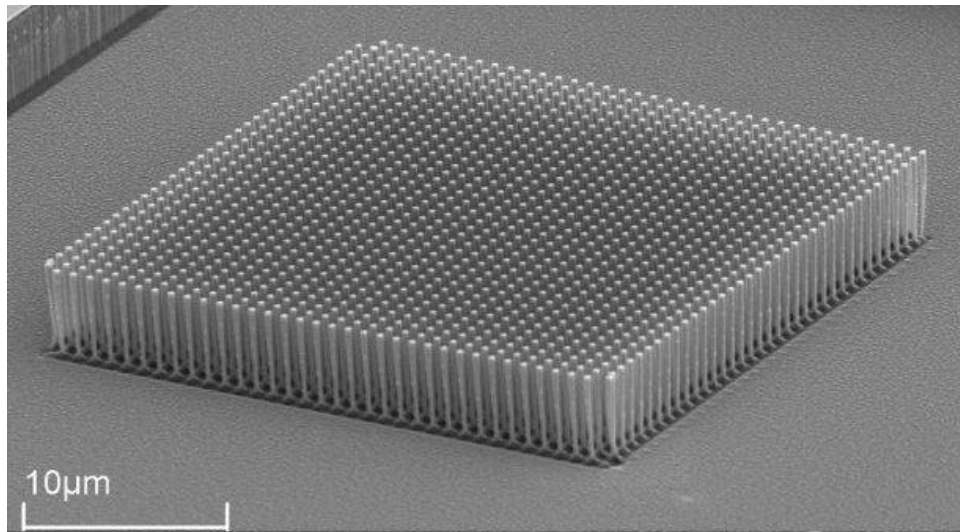
Engineer: the protagonist of innovation

- 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

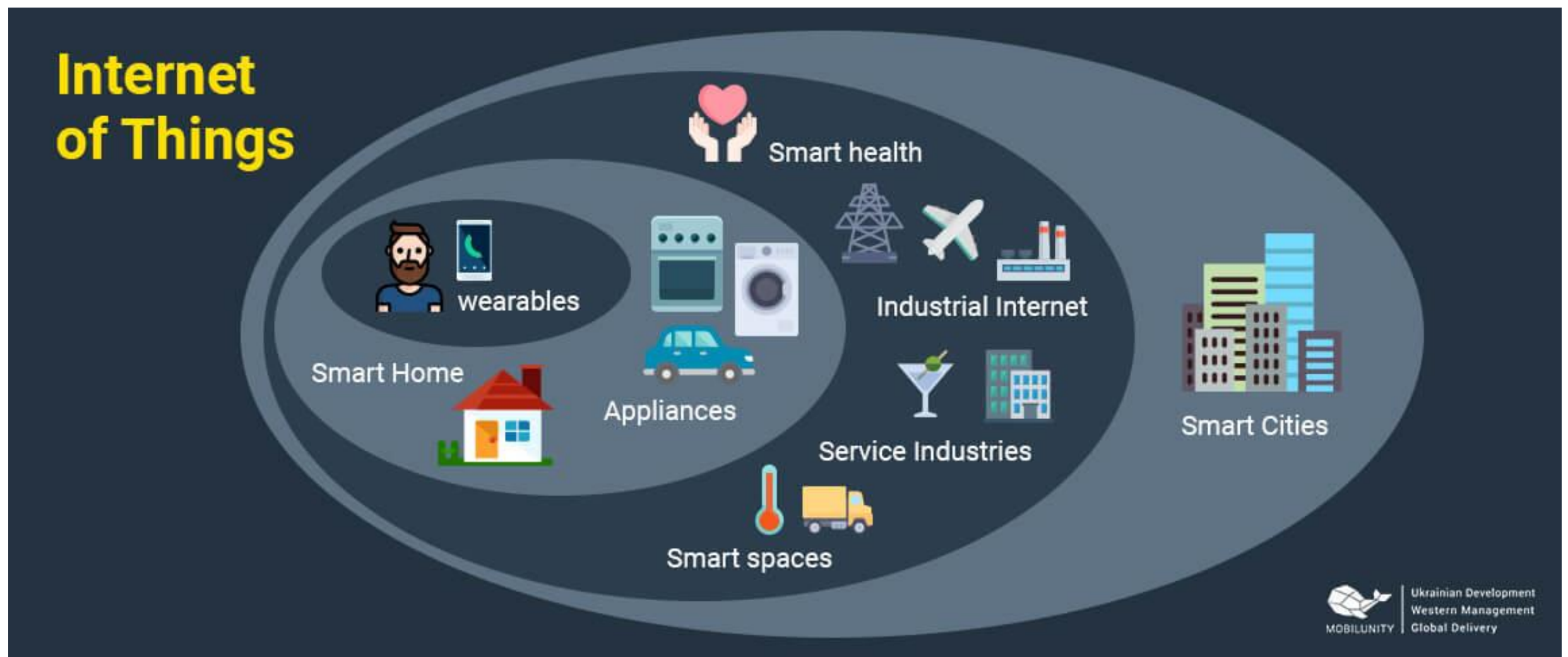
- Context and challenges: creating striking innovations
 - Green (-)

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

The screenshot shows the homepage of the National Academy of Engineering's website, titled "Greatest Engineering Achievements of the 20th Century". The page features a large "20" in the background. A navigation menu at the top right includes "About", "Timeline", and "The Book". A "Welcome!" section asks how many of the 20th century's greatest engineering achievements are used today, listing examples like cars, computers, and telephones. A list of 20 achievements is provided, split into two columns. The "LinkEngineering" logo is at the bottom left, and a grid of 16 small images representing various engineering achievements is at the bottom right.

Greatest Engineering Achievements OF THE 20TH CENTURY

◆ About ◆ Timeline ◆ The Book

Welcome!
How many of the 20th century's greatest engineering achievements will you use today? A car? Computer? Telephone? Explore our list of the top 20 achievements and learn how engineering shaped a century and changed the world.

1. Electrification
2. Automobile
3. Airplane
4. Water Supply and Distribution
5. Electronics
6. Radio and Television
7. Agricultural Mechanization
8. Computers
9. Telephone
10. Air Conditioning and Refrigeration
11. Highways
12. Spacecraft
13. Internet
14. Imaging
15. Household Appliances
16. Health Technologies
17. Petroleum and Petrochemical Technologies
18. Laser and Fiber Optics
19. Nuclear Technologies
20. High-performance Materials

LinkEngineering

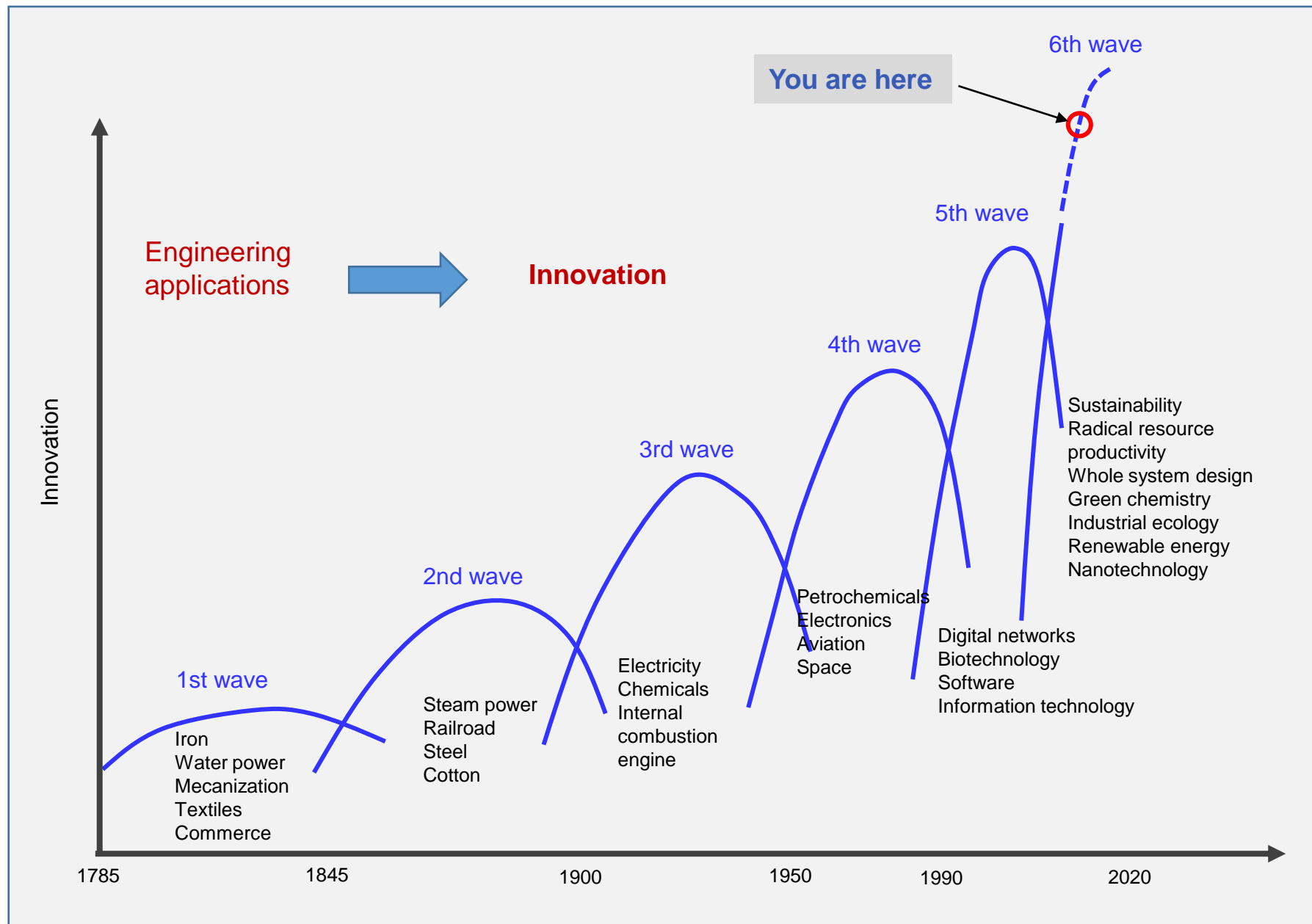
Greatest Achievements

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New paradigms for engineering education

- Waves of innovation



New paradigms for engineering education

- Challenges in engineering education (digitalisation)



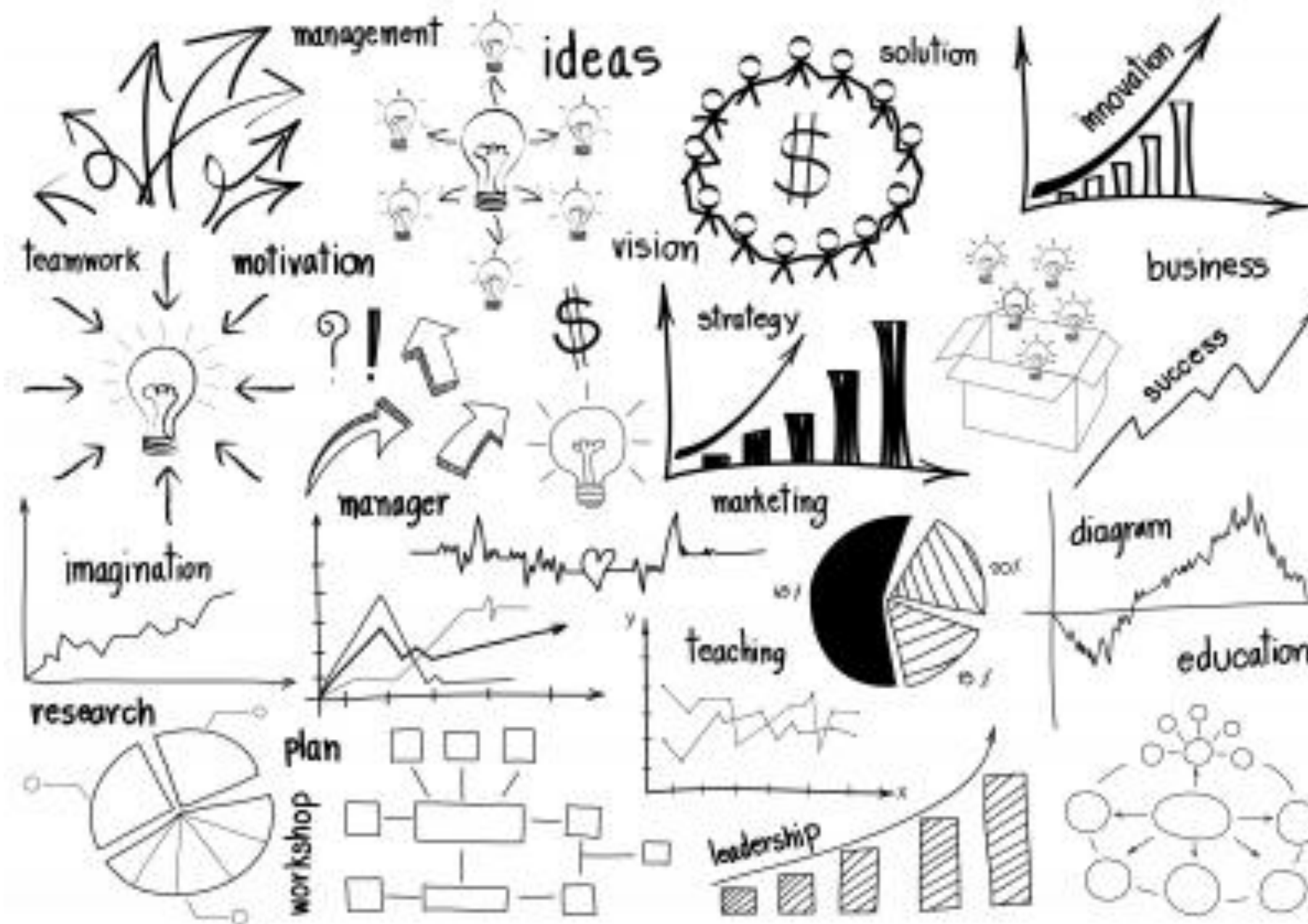
New paradigms for engineering education

- 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)



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

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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)



- The European Network for Accreditation of Engineering Education (2006-ENAE) with the EUR-ACE Accord (2014):

- 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



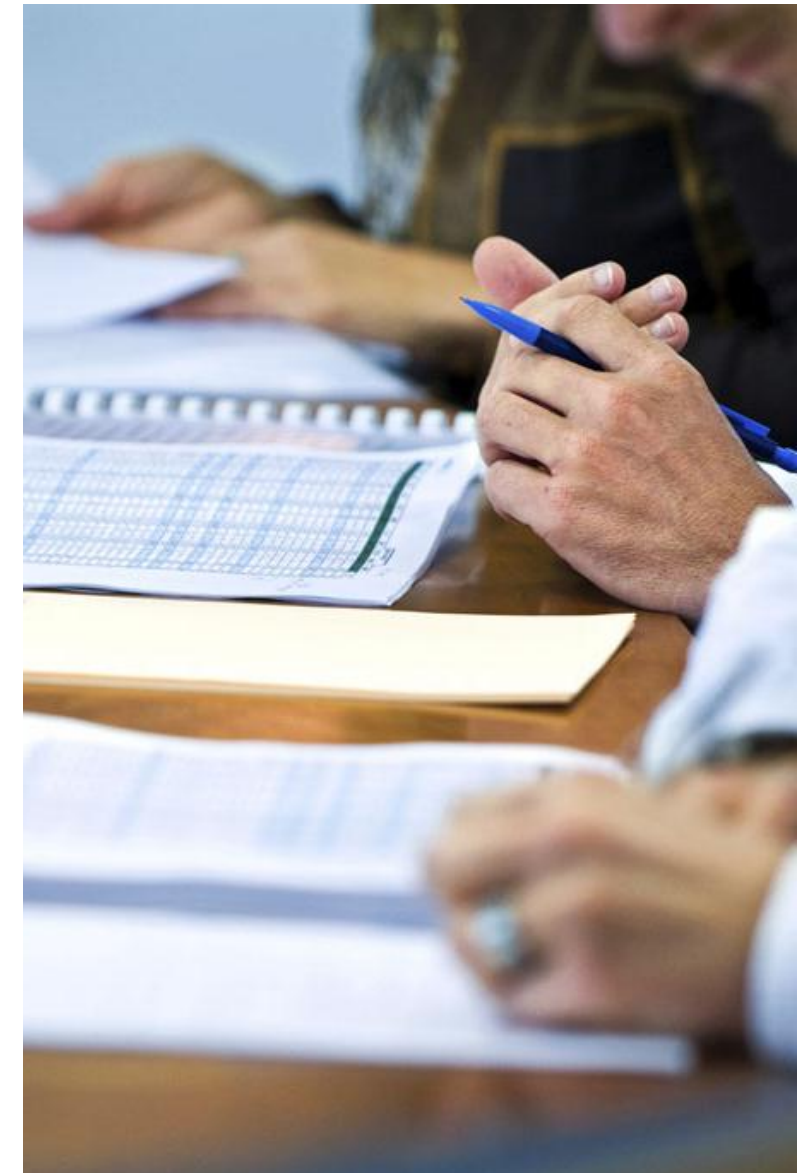
Engineering education quality in Europe

- FEANI European Engineering Education Database

Country	Institutions	Programmes	Country	Institutions	Programmes
Austria	16	453	Luxembourg	1	5
Belgium	33	329	Malta	1	26
Bulgaria	6	57	Norway	24	244
Croatia	4	12	Poland	29	262
Czech Republic	9	54	Portugal	45	619
Denmark	16	294	Romania	15	93
Estonia	3	15	Russia	7	287
Finland	47	355	Serbia	16	61
France	170	656	Slovakia	5	36
Germany	155	2592	Slovenia	2	132
Greece	6	33	Spain	125	574
Hungary	16	115	Sweden	18	127
Iceland	2	24	Switzerland	27	316
Ireland	20	577	The Netherlands	36	393
Italy	34	263	United Kingdom	112	5515

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

Outline

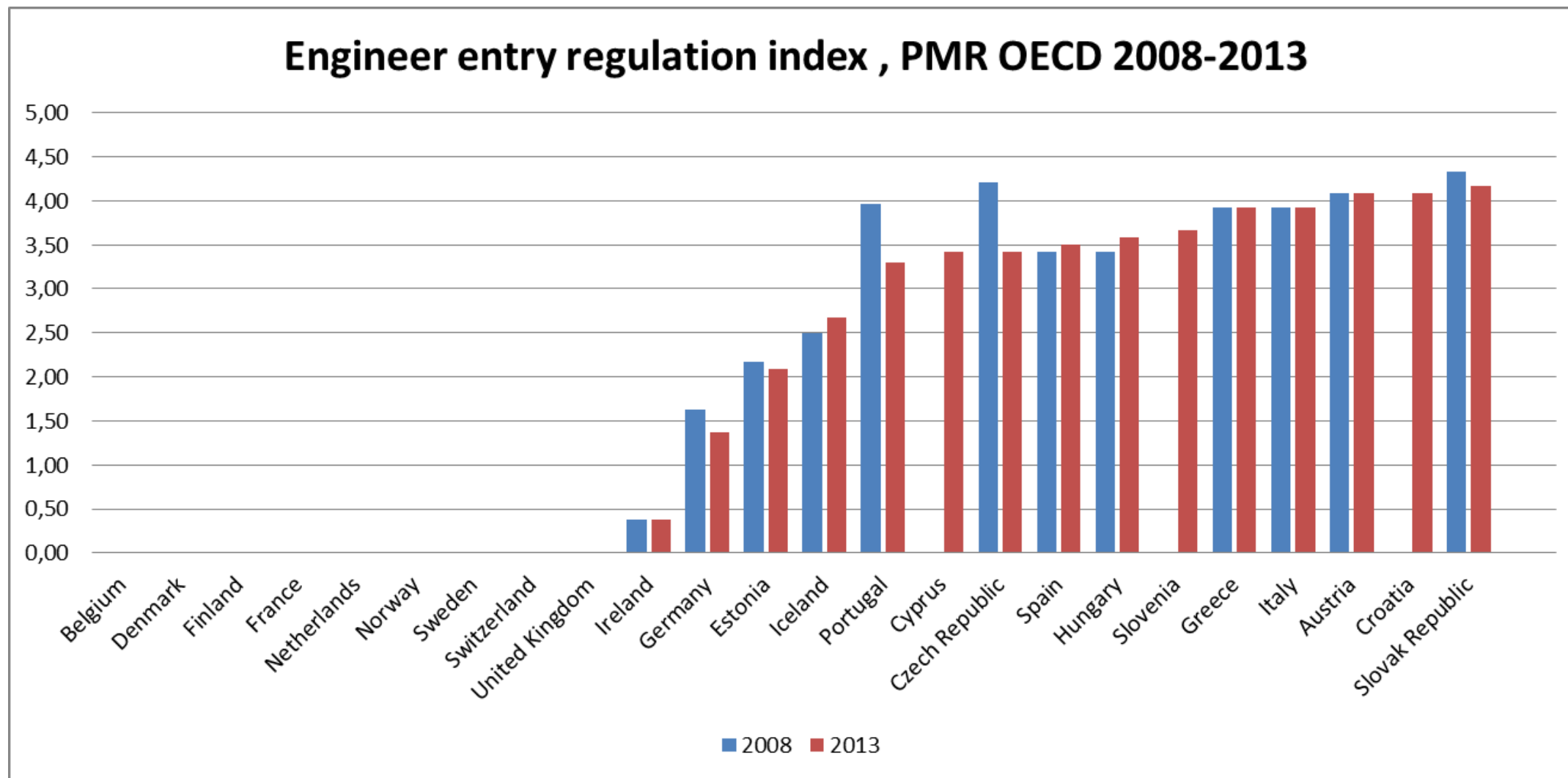
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- FEANI initiatives to facilitate mobility
- FEANI promoting engineers capability

Mobility of engineers in Europe level

- Political context
 - European Qualifications Framework (Directive 2005/36/EC)
 - "Shaping a renewed strategy for completing the internal market for goods and services. This includes reviewing the application and scope for further extending the principle 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

- Revised Directive 2005/36/EC (Directive 2013/55/EU)
 - 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

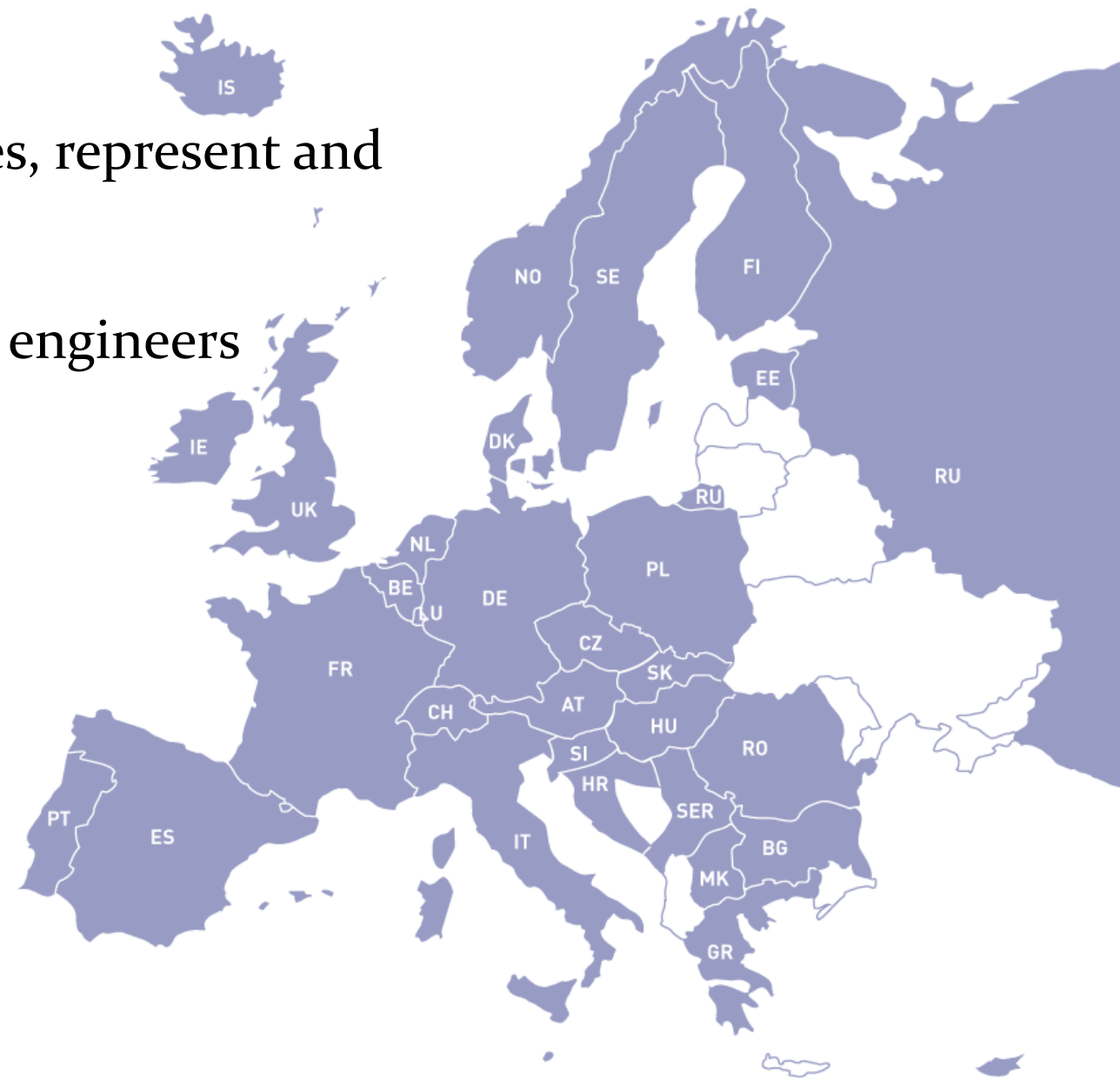
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FEANI initiatives to facilitate mobility

- 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

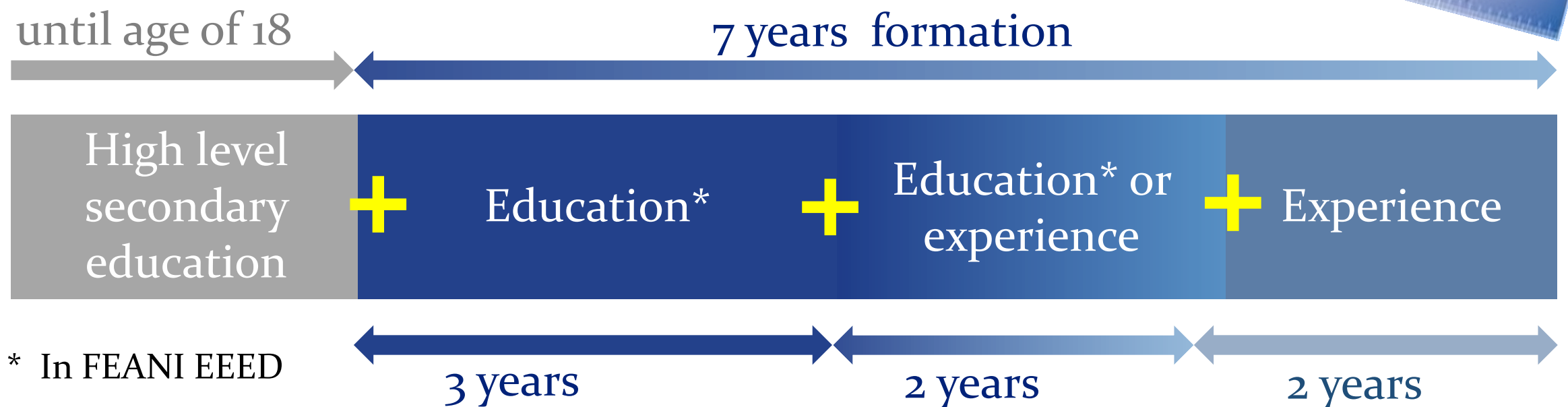
FEANI initiatives to facilitate mobility

- 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

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

engineering card
BERUFS AUSWEIS FÜR INGENIEURE

01. Mustermann
02. Max
03. 30.07.1978, Musterstadt
04a. 01.12.2009 04b. 30.11.2019
05. VDI 06. 007

07. *M. Mustermann*

08. A1A2 B1 C1

www.engineering-card.de

Studium Academic studies		Datum Date
A1	Bachelor/Diplom [FH]	30.07.2003
A2	Master/Diplom [TU/TH]	27.11.2005
A3	Dr.-Ing.	
Berufserfahrung Professional Experience		
B1	Unternehmen Free Economy	X
B2	öffentl. Dienst Civil Service	
B3	selbstständig Self-employed	
Weiterbildung Further Education		Anzahl Number
C1	Seminar mit Teilnahmebescheinigung Tutorial with Certificate of Attendance	1
C2	Seminar mit Abschlussprüfung Tutorial with Final Exam	
C3	Fortbildung mit Zeugnis Advanced Education with Certificate	

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

Engineering
Education

Professional
Experience

Continuing
Professional
Development

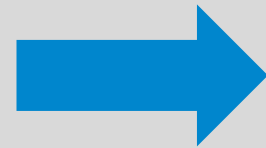
FEANI initiatives to facilitate mobility

- 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

European Engineering Education Database



EngineerING Card



EUR ING Title

Programmes fulfilling the FEANI requirements

Engineers graduated in a programme listed in the FEANI Index

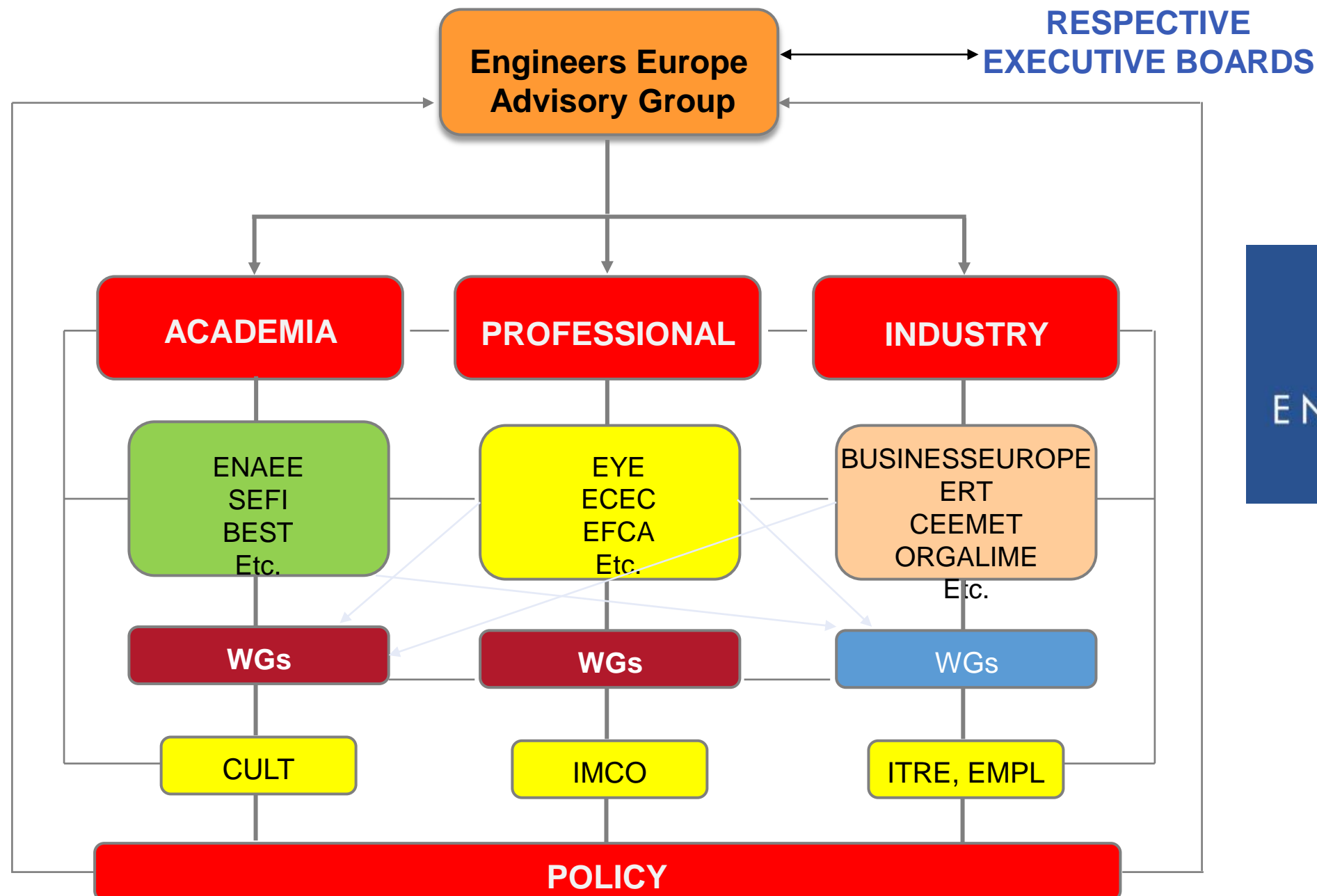
Engineers graduated in a programme listed in the FEANI Index and fulfilling the FEANI requirements for professional experience and CPD

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- **FEANI promoting engineers capability**

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

ENGINEERS EUROPE ADVISORY GROUP

Sponsored event by 



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. **Colin Mackay** reports.

An innovative new alliance is set to strengthen the voice of Europe's engineers while better engaging with policymakers, industry and academia. This was the key message at the recent Engineers Europe Advisory Group (EEAG) launch event in Brussels.

Jóse 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 digitalisation 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, Themis Christophidou explained that "the ever-increasing use of technology demands ever-stronger digital skills". These, 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 assess whether the quality and nature of education is delivering what we need".

Explaining the logic behind EEAG, Dirk Bochar, FEANI Secretary General, expressed his hopes that the initiative would address those issues currently facing the engineering profession. It was FEANI's mission, explained Bochar, to build bridges between stakeholders in academia and industry. Having so many diverse groups sign the Advisory Group's 'Letter of Intent' he explained, sent an important signal of Europe's commitment to achieving 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 skills gap and ensuring the appropriate education providers. It would also consider the inevitable ethical implications of digitalisation.

Bochar offered the metaphor of EEAG as a vehicle capable of bridging these existing gaps. It was analogous to a sustainable vehicle

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-  **FEANI – European Federation of National Engineering Associations**
Prof. Dr. José VIEIRA
President
-  **ASD – AeroSpace and Defence Industries Association of Europe**
Mr. Jan PIE
Secretary General
-  **BEST – Board of European Students of Technology**
Ms. Antonia NANAU
President
-  **CECIMO – European Association of the Machine Tool Industries**
Mr. Filip GEERTS represented by Mr. Vincenzo RENDA
Director General
-  **CEMBUREAU – The European Cement Association**
Mr. Koen COPPENHOLLE
Chief Executive
-  **EFCA – European Federation of Engineering Consultancy Associations**
Mr. Kevin RUDDEN represented by Mr. Jan VAN DER PUTTEN
President
-  **ENAE – European Network for Accreditation of Engineering Education**
Prof. Bernard REMAUD
President
-  **EU STEM COALITION**
Mrs. Beatrice BOOTS
Executive Director
-  **EYE – European Young Engineers**
Mr. Chris WATERS
Secretary General
-  **KU LEUVEN - KATHOLIEKE UNIVERSITEIT LEUVEN**
Prof. Dr. Ir. Bert LAUWERS
Decaan, Faculteit Industriële Ingenieurswetenschappen
-  **SEFI – European Society for Engineering Education**
Prof. Mike MURPHY
President
-  **TECHNISCHE HOCHSCHULE GEORG AGRICOLA - Staatlich anerkannte Hochschule der DMT-Gesellschaft für Lehre und Bildung (DMT-LB)**
Prof. Dr. Jürgen KRETSCHMANN



FEANI promoting engineers capability

- EEAG: Academic and Professional Organizations



conference of european schools
for advanced engineering educa
and research



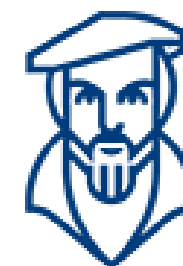
European Council
of
Civil Engineers



European Network for Accreditation of
Engineering Education



European Council
of Engineers Chambers



Technische
Hochschule
Georg Agricola

FEANI promoting engineers capability

- EEAG: Industry and Employer Associations

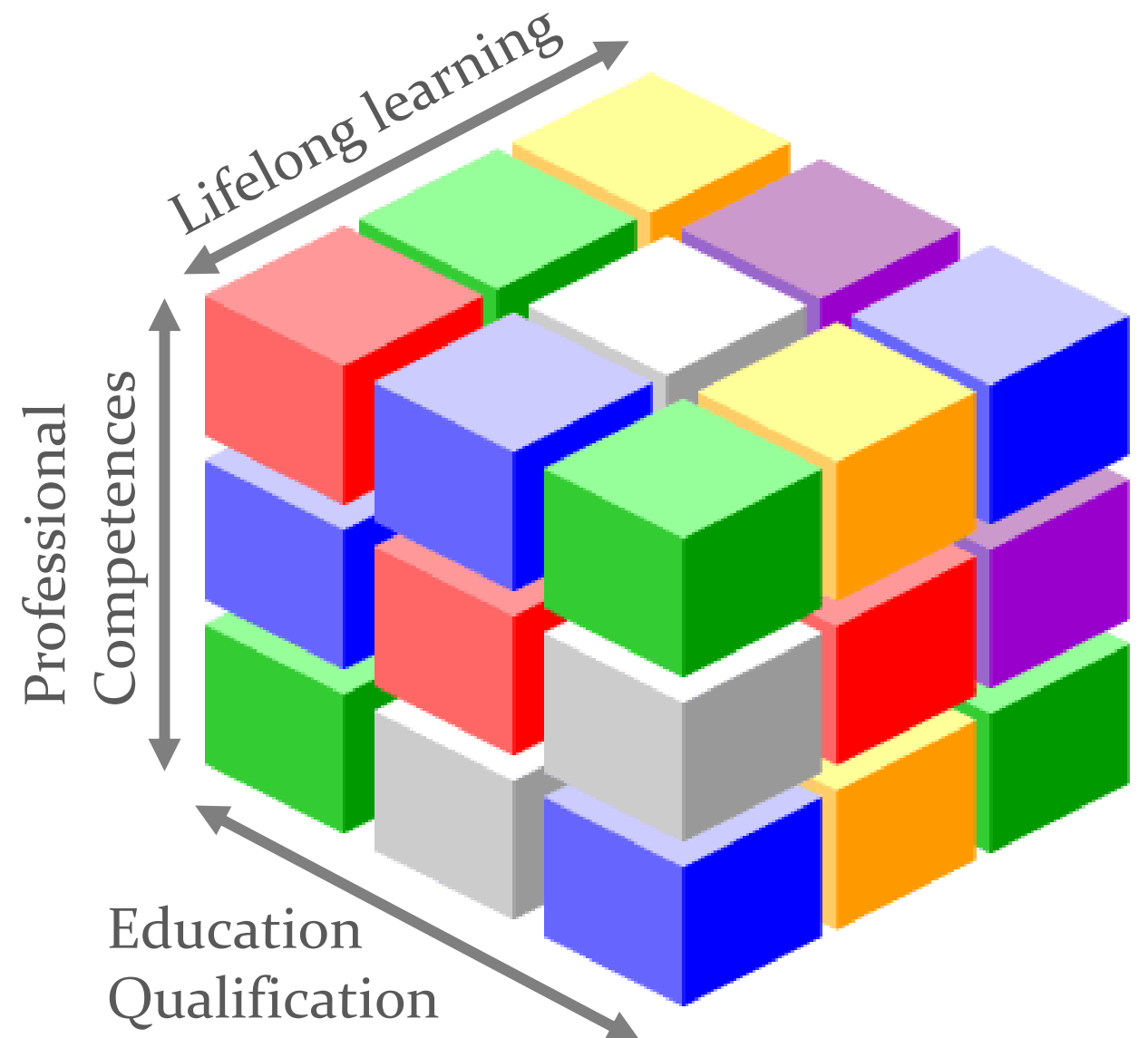


FEANI promoting engineers capability

- 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.

17 PARTNERSHIPS
FOR THE GOALS



The background of the slide is a photograph of an ornate ceiling, likely from a historical building. The ceiling features a grid of decorative panels in shades of blue and gold. In the center, there are two circular recessed lights. The overall lighting is warm and highlights the intricate details of the ceiling's architecture.

THANK YOU

Beijing 21 November 2018

José M P VIEIRA
PRESIDENT

