

The Leuven Lesson

Crossing Borders - Key statements from a leadership dialogue amongst deans, directors and department heads of engineering institutions following the **Valencia Vision**, the **London Agenda** and the **Munich Message**.





European Convention for Engineering Deans University Leadership Dialog 2020

Shaping Engineers For Responsible Impact

2-3 April 2020 - University Carlos III, Madrid, Spain

Save the date for the 12th SEFI Deans' Convention.

The objective of the ECED conventions is to bring together deans, presidents and directors from leading engineering institutions in Europe for in-depth discussion on contemporary challenges involved with engineering education. Over the past editions, the annual ECED conventions were attended by around 100 participants from all over Europe.

Charles III University of Madrid (Spanish: Universidad Carlos III de Madrid) (UC3M) is a public university in the Community of Madrid, Spain. UC3M is an institution with a distinctly international profile. It offers a broad range of master's and bachelor's degree programs in English and nearly 20% of the student body is made up of international students. It is the first university in Spain and the third in Europe in the number of its students participating in the Erasmus student exchange programs.



Context

Crossing borders is a phrase that can evoke different and multiple interpretations depending on our situation and background. On the one hand, it can create a sense of adventure and of individualism, a feeling of freedom and enthusiasm to shape our future without limits. However, while it certainly can promise access to new experiences, it can also make us think of trespassing safe and established limits that thus may lead us into non-friendly, disruptive and even hazardous. Even those for whom the idea of crossing borders is appealing, they too may feel that this would be better experienced through a movie, rather than the reality of being personally confronted with the side effects associated with having crossed established boundaries: lack of belonging to a well-organized discipline or group, or walking away from well-understood traditions and practices.

In Leuven, our discussions on *crossing borders* did not refer just to the individual but more widely to the identification of matters that limit thinking and creative processes in Engineering Education. This applies: **(i) to individuals**, that are driven by their interests, motivations and inertias; **(ii) to institutions**, including departments, universities and engineering associations, that have to rethink processes and structures; **(iii) to industry**, which has to seek a balance between competences delivered through higher education and systems of vocational training, and **(iv) to society** as a whole, that has to interpret these paradigms. For progress and sustainability, each has to examine their own comfort zone and continually question guiding principles.



Professors Lauwers, Sanchez, and Mueller opening ECED 2019

The picture of crossing borders within Engineering Education naturally leads to the intersection between academia and industry. Change processes are both required and possible against a background of digitization, globalization, new technologies, new options for didactics and knowledge transfer, and changing attitudes of society.

The good news: The executives who meet regularly at the European Convention for Engineering Deans are reflective, enthusiastic and adventurous. They know their business and meet with joy for intense exchanges. They want to trigger changes.

The bad news: The process of change in engineering education has tremendous complexity and must overcome various inertias, placing accepted traditions into question, forcing us to reflect on unconscious prejudices and stereotypes, to change communication patterns, to explain to non-engineers and society the essence of the individual engineering discipline.

In preparation for the European Convention for Engineering Deans in Leuven, the ambivalence and complexities of crossing borders were pre-identified and structured to focus on four categories. The different stakeholders were placed at the centre of the crossing borders challenge: students, PhD candidates, academic staff and business/ industry professionals. Furthermore, the focus was on the co-creation of future curricula. It was recognised that integrating and evaluating the different stakeholders' perspectives was a challenging task.

Contrary to asking questions, as we did at the 2016 Deans Convention in London, via our London Agenda, or making statements, as we did in the 2017 Munich Message, the Leuven Lessons try to identify and describe the key challenges that have to be faced. They provide good practice to help us to ensure a corresponding reflection within our institutions and hopefully the introduction of new measures. In short, they have been written to push a to do list for Higher Engineering Education Institutions.

Towards a meaningful student experience

Student criticism of engineering education can be harsh. “I quit my studies because I didn’t see any link to my future profession.” “Everything was too theoretical.” “Nobody needs partial differential equations later in his or her life.” The absoluteness of nobody reflects lack of wider contextual understanding, as analysis and equations may not be necessary for some practicing engineers within their professional roles, but essential for others who solve complex equations regularly using a range of methods and powerful software tools. Especially at an academic level within engineering sciences, this is an old discussion that regularly reappears, and one that can be dated back to the introduction of mathematics in engineering education in the 19th century and – in its essence – was evident in the differing knowledge and learning traditions of Plato and Aristotle in ancient Greece.



Panel discussion moderated by Prof Tinne de Laet

Without crossing our own borders, as engineering educators we dismiss these criticisms as being a rationalization for intellectual laziness and incompetence, euphemistical justification, lack of self-awareness, or the narrow expectations of students for the profession – reflected perhaps through the lens of craftsman versus engineer. Of course, these criticisms could also represent truth, given the numbers of engineering roles, and indeed professions, in which complex methods and analysis are not required. The general response to these criticisms has been to try to introduce real world problems and industry/business experience (BE) into the engineering curriculum.

However, if we set aside the tensions that exist within the traditions of engineering education that take either a theoretical approach or a practical approach, the discussion can be centred on common ground. The discussion must focus on the intrinsic value of a business experience within the engineering curriculum. Accepting the drive to “make engineering education real” and to get students to “build a bridge or an engine” together with the more challenging task of getting students to master difficult theory, then real-world problems and industry/business experiences (BE) might be taken as an intrinsic value and a solution for motivation problems. However, the charm of practical problems must not mask the necessity of a well thought-out practical and structural configuration of a meaningful Business Experience. A meaningful BE (i) should not just replace on-the-job training that will take place later anyway; (ii) should not just be implemented as a motivating contrast to dry and difficult theory, and thus (iii) BE must be embedded in the systematic development of essential and identified competencies together with a study program enriched with effective coaching and valuable feedback.

Challenges to a Meaningful Business Experience for Students:

The challenge is for each engineering education institution to answer the key question of what “meaningful” means for them in the context of BE. This will require addressing:

- Defining and describing their purpose/goal for BE.
- Setting out their approaches for the co-creation and delivery of BE.
- This means exploring how to do it, the kind educational tracks that will be used, how to scale it, and how to deliver it at scale.
- How to deal with quality assurance and quality management considering the various actors involved, possibly with divergent interests.

Approaches to implementing a Meaningful Business Experience for Students:

The Leuven Lessons describes four steps to implement a meaningful BE for students.

- Define the BE as part of a coherent competence profile for defined cohorts of students (such as undergraduate students), making both the benefits and the expected commitments visible:
 - » For the industry partner, address the commitment required for BE as part of the company’s mission; highlight the benefits to the industry partner, for example:
 - demonstrating corporate social responsibility (CSR),
 - obtaining access to a talent pipeline,
 - providing inspiration for an ever-changing ‘young’ generation or with new entrants to engineering education,
 - creating attractive experiential learning spaces such as co-teaching, hackathons, peer assisted processes, etc.

- » For the university, address the role of BE within the Engineering Education curriculum as part of the university's mission, highlighting its benefits, for example:
 - assurance of coherent set of graduate competences aligned to the university's educational philosophy,
 - staying connected to engineering practice and getting inspiration and motivation from those connections,
 - providing a base for start-ups,
 - solving societal problem (big challenges).
- Define and cross-check the competences for which BE efficiently complements the university education. BE provides insights into challenges of real engineering roles that require:
 - » a solid mastery of theoretical foundations, the importance of which should not be masked by attractive – probably easy going – practical issues,
 - » collaboration and mutual respect between different disciplines,
 - » understanding the importance of integrating inter- and transdisciplinary approaches,
 - » an experience of multiple solution spaces,
 - » the necessity for conceptual thinking,
 - » strengthening the awareness for necessary reflections and discussions, for example regarding key elements of processes when treating real life problems.
- Establish formats to raise awareness of the above issues among the students; given the variety of future professional profiles:
 - » Discuss and reflect the interests of students in order to further shape BE profiles,
 - » catch internships and industry involvement to students based on interests,
 - » guide and support the students during their transition to professional life.
- Develop appropriate guiding documents for both university supervisors and industry representatives:
 - » Elaborate clear criteria for BE in order to avoid a pure limitation to training-on-the-job formats,
 - » create awareness that learning objectives also have to play an adequate role in internships,
 - » provide a transparent platform to address and assess the learning objectives.

The Academic PhD: lost in limbo or a perfect start to a career in industry?

Sometimes our PhD students, who we generally see as self-motivated, can appear lost. “Why should I make a PhD?” “I was told that industry doesn't need PhDs, they don't need ivory towers but hands-on work.” In the 21st century, what is the role of a PhD qualification? Is it the necessary qualification for entry into an academic career? Is it proof of a specific qualification, in order to be capable of handling difficult issues independently, or to be allowed to manage one's own projects? Do PhD programs develop leaders for academia or develop executives for industry, or both?

Europe-wide the answers differ and are rather vague. At a European level, there is insufficient information about the impact of a PhD on the professional career and the role of PhD graduates within companies. There is a lack of clear statistics and thus a structured discussion about the different motivations for a PhD is difficult. There is also insufficient information on the topic of the extent to which successful PhD research has an impact on future success. Is it a ticket to high level functions in industry – as it seems to be the case in some countries? Do we run a risk to devalue the Masters' education in order to upgrade the PhD?

Therefore, a common understanding of the value of an engineering PhD should be elaborated and shared with business and industry. It can then be reflected in PhD programs and in doctoral schools.

Challenges to the Academic PhD:

- Answering the questions regarding the purpose of a PhD:
 - » Additional training for high potentials with open consecutive career paths or
 - » preparation for an academic career?
- Creation of a suitable quality management with a focus on scientific standards
- Creation of adequate formats in the PhD programs and doctoral schools

Approaches for the Academic PhD:

- Various formats: PhDs in collaboration with business as well as PhDs in basic research, always based on scientific standards
- Exchange of definitions of the purpose and essence of an Engineering PhD
- Definition of – career specific – competence profiles of PhD graduates
- Exchange of good practice in Europe based on statistics and surveys that have to be carried out.

Mobility of

- Faculty staff , exploring the world outside of the Alma Mater
- Business professionals, climbing the

Bi-directional mobility of faculty and business professionals presents challenges. “What should we do with those academics coming from the ivory tower with no idea about what—who–when in our daily project work?” “These practitioners with their routine work, apply results without knowing where they came from, that is risky and does not fit into a scientific environment”.

It would appear to be self-evident that it would be beneficial to improve the consciousness of academia regarding the real world problems of industry concerning the scientific background of their daily work. How can contact between university academics and industry be improved? Also for sustainable engineering competence profiles, this strong interaction between academia and industry is crucial.



Prof Todd Davey talking about the European initiatives on University-Business Cooperation

Vibrant interaction between industry and academics could be a windfall for both in that it opens new perspectives on individual career paths for both academics and business professionals. In simplest terms, industry could have academics working with them, and professors with current industry experience could enrich universities. To make this a reality, do we need more flexible career paths from industry into academia and vice versa?

Both systems appear to be quite incompatible given, at first glance, disjoint success criteria and metrics as well as reward systems. In order to activate hidden potential by crossing borders we should not be naive and we have to be aware of visible and hidden obstacles in order to be able to improve the permeability between the two worlds for sustainable cross-fertilization between industry and academia. If successful, industry can obtain easier access to the knowledge and innovation of a university. University research and the development of competence profiles within Engineering Education will also be inspired by successful industry interaction. The breeding ground for science at a university in combination with the product-, production- and result orientation of industry can create innovations and can foster spin-offs and accelerators for young professionals.

An analysis of the challenges shows that (i) potential synergies are hampered by systemic differences and incompatibilities, (ii) there are often no clear institutional exchange formats between academic staff and industry, and (iii) prejudices from both sides still prevail.

Challenges to Mobility of Staff:

- Objectification of the differences, ambivalences and characteristics (reflecting prejudices and observations) in order to find a way to transform differences into benefits, and to purposefully use the individual strengths; the mutual awareness of the differences and strengths can be split in 3 categories:
 - a. Processes of value creation:
 - i. Academics are typically (too) specialized, while business professionals (industrials) are typically (too) little science oriented.
 - ii. Academics work in longer time scales; business processes move at a faster pace.
 - iii. Academics enjoy their independence and autonomy; industrials are naturally externally determined by their projects.
 - iv. Academics have easier access to knowledge and skills of other parts of university.
 - b. Personal attitude:
 - i. Different attitudes of both groups towards Intellectual Property and secrecy.
 - ii. Academics are supposed to be more risk averse than industrials.
 - iii. Crossing borders is linked with re-elaborating status and reputation of both.
 - c. Societal and systemic boundary conditions:
 - i. Academics are often state employees with little performance-oriented dynamics in salaries; while industrials generally accept more risk and are generally better paid.
 - ii. Uncompromising and merciless career system within academia at the universities does not allow interruptions.

Approaches to Mobility of Staff:

- Create awareness of the three objective categories above, and the possible points of action that can be taken at different levels (individual, institution, system).
- Open constructive discussion, without being negative on the differences, on the challenges in category a) “Processes of value creation”; discuss openly how potential differences at the level of specialization, time scales, independence and access can be brought to synergies for innovation.
- Adjust or add evaluation criteria to assess performance during the period of exchange and incorporate performance into the reward system.
- Elaborate exchange programs defined by the HR department at universities and in industry (e.g. 3 to 6 years full/part time) with a commitment to take people back and to consider the performance.
- Develop assessment procedures to identify people who are able to participate, reflecting the known challenges (especially of category b).
- Find ways to increase flexibility in salaries.
- Integrate processes into the BE.
- Foster spin-offs or accelerators.

Symbiosis between universities and industry stakeholders in shaping engineering curricula

While it might be a generalization, it is probably true to say that engineering academics are slow to change. “The professions of civil or mechanical engineering have an enormous tradition which has to be maintained!” “The setup of engineering profiles has to respect a sustainable core of the discipline which was the key for success since the 19th century!” Such types of, admittedly exaggerated, attitudes might be the reason why it took decades until newer disciplines like Computer Science or Technology oriented Social Sciences penetrated into the core curricula of “classical” engineering disciplines. Add to this that it might take us decades to examine what digitalization might mean for education, long after its impacts will have been felt. Can we afford this? What are the true obstacles? Does the accreditation process allow us to alter educational profiles and to reshape them by combining disciplines?

Given the limited duration of engineering study programs, new content is always choreographed with removing other elements and altering curricula. Typically, this is easier to do in the case of new study programs in which there may be no stakeholders who watch attentively to what the university department is doing. However, traditional professions also require new competences. Thus the challenge is to deal with obstacles that arise and to incentivize those who are willing and take the initiative to discuss and implement necessary changes.

Challenges to Shaping Engineering Curricula:

- Academics and engineering departments have to learn to abandon content in favor of new content and to overcome inertia and reluctance to do this.
- Accreditation bodies and engineering associations have to recognize and accept necessary changes.
- Foster new formats for integrating new disciplines and encourage a shift to other active pedagogies and teaching styles, such as Project Based Learning.
- Provide an environment for a consistent discussion and focus on competence profiles (i.e., outputs) rather than on teaching content (i.e., inputs).
- Recognise that program reforms are slow processes.



Prof Laurent Champaney presenting ENSAM Paris

Approaches to Shaping Engineering Curricula:

- Co-Creation should focus on the definition of necessary future competence profiles. In order not to be influenced too much by the status quo and to support freedom of thought, this should be done in mixed stakeholder groups and independent from existing offers.
- The detailed design of study programs has to be done at universities responding to the previously defined competence profiles. The design thus translates competence profiles into teaching approaches, content and targeted knowledge, skills and aptitudes in individual modules in order to make the curriculum flexible for students, staff and business.
- Appropriately structured interdisciplinary student projects are an adequate means to develop transversal competences. This could also include activities such as participation in student competitions.

Leuven Lesson

Conclusion

The Leuven Lessons has resulted from the 2019 European Convention for Engineering Deans. Its theme was crossing borders, these borders principally being the membrane between the university and industry. Crossing borders was used as a mechanism to examine issues associated with developing meaningful student business experiences; examining the purpose of the engineering academic PhD, and the advantages and difficulties with mobility of academic staff into industry, and industry staff into academia. It also briefly examined issues associated with evolution and co-creation of the engineering curriculum. On each of these topics guidelines are provided as an aide to the department and the university to successfully explore these complex matters.



Prof Mike Murphy, SEFI President, sums up the ECED 2019

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SEFI is the largest network of higher engineering education institutions (HEIs) and engineering stakeholders in Europe. As an international NGO created in 1973, SEFI contributes to the development and improvement of Higher Engineering Education (HEE) in Europe, promotes information about HEE and improves communication between teachers, researchers and students, reinforces the university-business cooperation and encourages the European dimension in higher engineering education. SEFI is an international Forum composed of HEIs, academic staff and teachers, students, related associations and companies in 41 countries.

Our activities: Annual Conferences, Ad hoc seminars/workshops organised by our working groups, councils and ad hoc committees, organisation of the European Conventions for Engineering Deans, Scientific publications (including the European Journal of Engineering Education), European cooperation projects, position papers, cooperation with other major European associations and international bodies such as the European Commission, the UNESCO, the Council of Europe or the OECD. SEFI also participated in the creation of several organisations such as ENAEE, IFEES, EuroPace, IACEE and IIDEA.

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