



SOCIÉTÉ EUROPÉENNE POUR LA FORMATION DES INGÉNIEURS
EUROPEAN SOCIETY FOR ENGINEERING EDUCATION
EUROPÄISCHE GESELLSCHAFT FÜR INGENIEURAUSBILDUNG

SEFI: 40 years of driving engineering education to meet future challenges

2013-2014 - Towards 2020



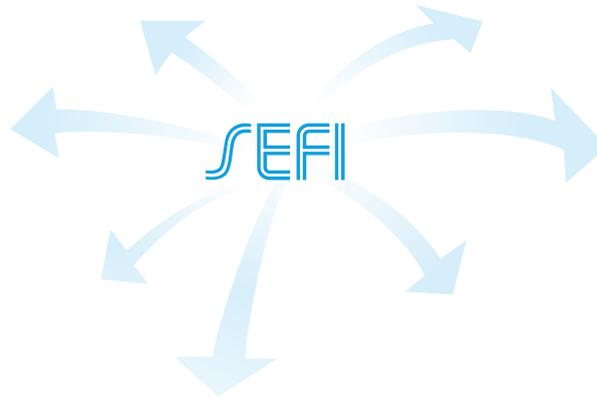
**SEFI is the largest network of engineering education institutions
and engineering stakeholders in Europe**

"The passion for engineering education"

Published by SEFI aisbl, Brussels, Summer 2014

SEFI Annual Report

SEFI Annual Report 2013-2014



Founded in 1973 as an international non-profit organisation SEFI is the largest network of Higher Engineering Education players in Europe.

SEFI brings together around 400 members among which 147 Higher Engineering Education Institutions, 207 Individual Members, 35 Associate Members and 7 Industrial Members (corporate partners and members). SEFI Head Office is based in Brussels but it is assisted in its work by a network of national correspondents all over Europe.

Our members are located in more than 48 countries worldwide: Argentina, Australia, Austria, Belgium, Canada, China (PRC), Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ghana, Greece, Hungary, Ireland, Italy, Japan, Kazakhstan, Kuwait, Kyrgyzstan, Latvia, Lebanon, Lithuania, Macedonia (FYROM), Malaysia, Mexico, the Netherlands, Nigeria, Norway, Poland, Portugal, Romania, Russia, Slovak Republic, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Turkey, United Kingdom, Uzbekistan, United States of America...

SEFI is the first example of an association in Europe, directly linking the institutions of higher engineering education, hence independent of national and community filters in establishing its policy, as an international forum for discussing problems and identifying solutions relating to engineering education.

We thank our members for their continuous support and we look forward in cooperating with them over the coming years!



The list of our members is available online on www.sefi.be. Individual members are listed in the "members only" section of the website

SEFI thanks its corporate partners for their support



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SEFI Annual Report 2013-2014



As the economic crisis begins to ease and a number of countries begin to see growth, many will look to engineering to help accelerate this recovery.

Engineering educators need to both share ideas of effective practice in preparing future engineers but also to anticipate future challenges. The annual SEFI conference, provides an excellent opportunity for educators, students, policy makers and industry to meet, debate and consider future directions.

As a major research and education university, the University of Birmingham is delighted to be hosting the SEFI 2014 conference in collaboration with SEFI member institutions in the UK.

Join us to learn, share and influence in September 2014.

Professor Kamel Hawwash, President of SEFI

15th - 19th September 2014

University of Birmingham, UK

Educating Engineers for Global Competitiveness



Keynote Speakers

Professor Dr PE Seeram Ramakrishna, National University of Singapore

Dr Keith Willey, University of Technology, Sydney

Susan Scurlock, Chief Executive and Founder, Primary Engineer

Dr Cynthia Atman, University of Washington College of Engineering

Professor Alice Roberts, University of Birmingham

www.sefi2014.com

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Message from the President

This has been an extremely important year for SEFI. We had an excellent conference in Leuven and plans were well underway for the 2014 Conference in Birmingham. The new Administrative Council included some new faces that brought tremendous energy to SEFI. The Bureau was refreshed and we set out to re-orientate SEFI for the future. The first few months saw the development of an orientation paper and a focus on topics that SEFI would commit to leading on.

SEFI, as Europe's most important network of stakeholders involved in engineering education places it in a unique position to both strengthen cooperation between them and to respond to the challenges engineering education faces from time to time. SEFI is also able to bring colleagues together to identify and develop projects for possible funding from the variety of EU sources that are available. We did this in early January and SEFI was involved in three bids under the ERASMUS+ calls.

Governments in Europe are realising the importance of engineers and engineering education in helping with the recovery from the most severe crisis faced for decades. Engineers have to be even more mobile than they have been in the past as they chase work opportunities and it is therefore imperative that their knowledge and skills are transferrable. Employers continue to challenge the skills of graduates but I find that when pressed to articulate what they believe they lack, there is no clear answer.

I firmly believe that as an engineering education community, we need to be more confident about our achievements. We are a community that is full of ideas and innovations and are seeking to evidence the success of our practice using sound academic research methodologies. This will be confirmed again through the Birmingham SEFI Conference. And this area of our work is important as we continue to speak up for engineering education both as individuals and as SEFI.

We held our first SEFI Debate under the Greek Presidency of the European Union in April on the theme of "Engineering Education Facing the Challenges of the Crisis in Europe". We had an excellent

discussion at which we welcomed Mrs Vassiliou, European Commissioner for Education, Culture, Multilingualism and Youth. The Debate both raised SEFI's profile with the decision makers in Brussels and provided an opportunity for our members to influence the debate on skills and the way in which the Bologna process should develop. I announced the establishment of a task force on engineering skills and the academic input into possible changes to Bologna will be discussed through the European Engineering Deans Council workshop to be held during the SEFI conference in Birmingham and beyond.

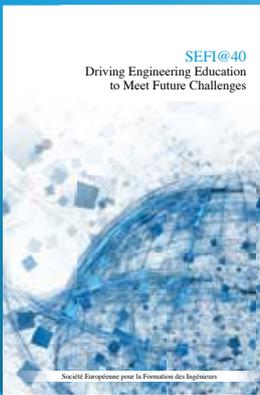
And finally, one of the issues that struck me during my first year as President was the wealth of examples of effective practice for improving engineering education. However, I believe that, as a community, we need to find more effective ways for making these easily accessible and user friendly to those that wish to implement them.

Thank you for supporting SEFI and I look forward to working with you in future.



Professor Kamel Hawwash
 University of Birmingham
 President of SEFI

Some highlights



“Engineering Education Fast Forward 1973 > 2013 >>” SEFI 2013 Annual Conference and 40th Anniversary

330 delegates from 33 countries met in Belgium during four days to discuss and share views and experiences. This Conference marked also the 40th anniversary of SEFI, for which 50 special invited guests, former SEFI Presidents, Leonardo da Vinci Medalists, Fellows, came from all over the world. The conference was brilliantly organised by the KU Leuven. A more detailed report of the Conference is available on www.sefi.be



KU LEUVEN



This book, published thanks to the support of Dassault Systèmes, presents an overview of SEFI's achievements since its creation in 1973, reflections on special engineering education subjects as well as contributions on special topics towards the future.



SEFI Award for the best PhD Thesis in Engineering Education

Dr. Pia Lappalainen receiving the award from SEFI Past President Wim Van Petegem (KU Leuven) for her PhD thesis on «Socially Competent Leadership-predictors, impacts and skilling in engineering».



SEFI Leonardo Da Vinci Medallist 2013

Dr. Frank De Winne (left on the photo) is Head of the European Astronaut Centre in Cologne, he owns a Masters degree in telecommunications and civil engineering from the Royal Military Academy of Belgium and received doctorates Honoris Causa from the University of Hasselt, the University of Antwerp, Gent University, the University of Liège and the University of Mons. Frank De Winne is also the first European Space Agency astronaut to command a space mission, and is dedicated towards the education of science and technology to children and young adults.



SEFI AWARDS

The 2013 SEFI Fellowships were awarded this year to Prof. Mervyn Jones (Imperial College, London), Prof. Aris Avdelas, (Aristotle University of Thessaloniki) in recognition for their long lasting and active involvement engineering education in general and in SEFI in particular.



SEFI awarded a special Honorary Membership to Mrs. Chiara Maffioli for her lasting support to her deceased husband, Prof. Francesco Maffioli, Former SEFI President, SEFI Treasurer.

The “**SEFI F. Maffioli Prize**” was also announced and will be given for the first time in Birmingham in 2014. The award is given to individual students or student organisations in recognition of their dedication to SEFI and/or engineering education in Europe and in the world, an to reflect Prof. Maffioli’s passion for the cooperation with the students, ensuring that they have a voice in the development of engineering education.

“40 Years of Leadership and Recognition”

During the Annual Conference the “40 Years of Leadership and Recognition” event brought together those who contributed to the history of the organisation. The event was held in the Arenberg Castle, KU Leuven.



General Assembly 2013

The General Assembly 2013 was held in Leuven on 20 September. On this occasion, **Prof. Antonia Moropoulou**, Vice-Rector of the National Technical University of Athens, was elected as SEFI Vice-President 2013-2016.

9 colleagues were also elected for a mandate in the Administrative Council: Profs. **Jerzy Rutkowski** (Silesian University of Technology), **Ladislav Musilek** (Czech University of Technology in Prague), **Esat Alpay** (University of Surrey), **Pieter de Vries** (TU Delft), **Hannu Matti Jarvinen** (Tampere University of Technology), **Joao Rocha** (President of the Instituto Superior de Engenharia do Porto), **Carlo Noé** (Università Carlo Cattaneo), **Tuncay Dogeroglu** (Dean of Anadolu University) and **Mr. Yiannis Pavlou** (National Instruments).



Prof. Antonia Moropoulou

The General Assembly was also the occasion of a very interesting brainstorming session about SEFI, its activities and orientations for the future. The results of the discussions lead to the preparation of the **SEFI Orientation Paper 2014-2020**, presenting the objectives and working topics of our Society towards 2020. The Paper will be on www.sefi.be after its approval by the General Assembly 2014.

SEFI in 2013-2014 Some highlights

Inaugural SEFI Debate “Engineering Education Facing the Challenges of the crisis in Europe”

The event was organised on April 7th with the support of the Hellenic Presidency of the European Union (EU) and hosted by the Permanent Representation of Greece to the EU. This event brought together 35 representatives from other organisations involved in engineering and engineering education, from academia, from industry, from the European Commission and other policy makers... for lively discussions and an interactive debate.

The record of Commissioner Vassiliou’s speech is available on www.sefi.be



The event featured a panel of high rank leaders of Ecole Nationale des Ponts et Chaussées (F), Delft University of Technology (NL), Belgium Building Research Institute (BBRI)/ European Construction Technology Platform/ Eurekabuild (B) and Solvay S.A. (B) namely Dr. A. de la Bourdonnaye, Dean R. Fastenau, Mr. J. Vyncke and Dr. Ms C. Malcorps

We were honored by the presence of EU Commissioner for Education, Culture, Youth and Multilingualism Mrs. Androula Vassiliou, here depicted with SEFI President Kamel Hawwash and Vice-President Antonia Moropoulou.



«It is clear that we need in Europe more and better skilled engineers to answer the societal challenges and to keep Europe as a good place to study and do research. This is important for SEFI and its institutional members. In any event, we need to do more and better, so use the EU programmes like Erasmus+ to help built this new educational landscape. I encourage SEFI to work with us in this context». (Commissioner Androula Vassiliou)

Creation of a SEFI Task Force on Engineering Skills

The Debate highlighted the pressing need for a deeper understanding of the challenges facing engineering education in Europe in relation to engineering skills and the question of whether engineering graduates have the skills that both they and industry require for competitive Europe is regularly raised. Therefore, a new Task Force will be established as from the Autumn 2014 to work on this topic, notably in cooperation with our sister organisation ASEE.

6th European Convention for Deans in Engineering

The event was organised by SEFI, jointly with CESEAR and the University of Lund – LTH, in Lund, Sweden on 2-3 April 2014. 80 engineering deans attended the convention and discussed on “Engineering for a connected World” from three different perspectives: Research, Institutions and Education.



SEFI in Europe and in the World

SEFI participated in or organised the following events¹

Participation only
Participation with (plenary) presentations

September 2013

- "The Different Engineering Doctorates in Europe", SEFI EEDC- 4ING Workshop, Leuven
- ENAEE Annual Conference, Leuven
- IACEE Board meeting, Leuven
- IGIP International Conference on Engineering Pedagogy, Kazan
- World Engineering Education Forum 2016, Cartagena

October 2013

- International Conference of the Portuguese Society for Engineering Education, Porto
- CESAER Seminar on Entrepreneurship, Aachen
- GEDC Annual Conference, Chicago
- International Presidents' Meeting of European Engineering Chambers & Organizations, Athens
- QUEECA Project and Management Meetings, Tashkent
- BEST Conference, Brno
- International Conference on ITBHET, Antalya
- SEFI Bureau meeting, Brussels

December 2013

- ENAEE Extraordinary GA, Brussels
- Measuring the Success of University-Business Cooperation in Education, Brussels
- SEFI AC meeting, Brussels
- Online Educa, Berlin

January 2014

- SEFI meeting for possible project partnerships in "ERASMUS +", Brussels

February 2014

- EPICES project meeting in SUPMECA, Paris
- SEFI Bureau meeting, Brussels

March 2014

- EPICES project meeting - Brussels
- MANUSKILLS project meeting - Brussels

April 2014

- ECED 2014, Lund
- SEFI EU Debate "Engineering Education Facing the Challenges of the crisis in Europe", Brussels
- Engineering Professors' Council Congress, Glasgow
- 6th International Conference on Computer Supported Education, Madrid
- EUA Annual Conference in Brussels, Brussels



May 2014

- Workshop and Symposium in the context of the launch of the AAU UNESCO Centre on Problem Based Learning in Engineering Science and Sustainability, Aalborg
- PTEE 2014 (WG Physics), Aveiro
- CESEAR HR Conference, Delft

June 2014

- CoR Conference, EU, Brussels
- Valencia Global Conference, Valencia
- Eurotech seminar, Copenhagen
- Cartagena Network Conference, Wroclaw
- 2014 IACEE Annual Conference, Palo Alto
- ASEE International Forum and 2014 ASEE Annual Conference, Indianapolis
- Mathematics WG Workshop, Dublin

July 2014

- Manuskills Forum, Milan
- BEST Summer Workshop, Cluj-Napoca
- IIDEA Workshop, Tsinghua

¹ We hereby apologise for any possible omission

Cooperation and projects

Cooperation



IIDEA (International Institute for the Development of Engineering Academics)

SEFI contributed to the organisation of the 3rd IIDEA Workshop in Tsinghua, July 4-5, 2014 on "Cross-sector collaborations in EE: Masters student Learning and Faculty Development. IIDEA is a joint initiative of IFEES and SEFI, whose leadership recognized the need to create a central place where engineering education institutions could come to search for capacity building opportunities.



ASEE (Americal Society for Engineering Education)

President Kamel Hawwash and Council member and EEDC President Mike Murphy (DIT) were our official representatives at the ASEE Annual conference in Indianapolis this year. On this occasion, SEFI organised a plenary session during the ASEE International Forum preceding the conference. Our speakers were Profs. Hawwash and Murphy, as well as former SEFI Vice President JC Quadrado (ISEL) and EE Research Chair, R. Clark (Aston University).



GEDC (Global Engineering Deans Council)

F Côme attended the Annual Conference of the Global Engineering Deans Council, Chicago in October 2013. A joint SEFI/EEDC and GEDC workshop in WEEF (World Engineering Education Forum) 2015 is also in preparation (Florence, 20-24 September 2015).



IFEES (International Federation of Engineering Education Societies)

Françoise Côme has been elected in the IFEES Executive Committee meeting and appointed IFEES Vice President for Europe. Close cooperation between our both organisations is maintained in the context of the WEEF 2014 and 2015 and of IIDEA.

Former SEFI President Dr. Anette Kolmos received the 2013 IFEES Global Award for Excellence in Engineering Education. The Award recognizes individuals who have made outstanding and original contributions to engineering education through exemplary teaching, research, and/or leadership innovations.



CESAER (Conference of European Schools for Advanced Engineering Education Research)

Cooperation with CESAER has been enhanced last year with the organisation of the 6th ECED. SEFI representatives have also participated in CESEAR organised events such as the CESAER in Aachen and in Delft.



IGIP (International Society for Engineering Education)

Françoise Côme was invited in Kazan for the 42nd IGIP International Conference on Engineering Pedagogy in September where she was invited for a plenary presentation and on this occasion received the IGIP "Adolf Melezinek Meritorious Service to EE" Award.



BEST (Board of European Students for Technology)

Students are important stakeholders in Engineering Education, and BEST is like a natural partner for SEFI at many occasions, in projects, in conferences, in publications, etc. SEFI AC members participated to BEST workshops (Romania, July 2014) and in the 2013 BEST president's Meeting. Meetings are scheduled for the autumn of 2014 (in Birmingham and in November in Brussels) to "seal" the future cooperation with BEST.



EEDC (European Engineering Deans Council)

The European Engineering Deans Council was created under the auspices of the Former Eugene project. The organization is managed by SEFI HQ in Brussels. Activities have been undertaken such as the 4ING-EEDC-SEFI workshop which brought together 62 deans in Leuven, on 16 September 2013 and will continue in 2014 with another workshop in Birmingham on engineering graduates skills.

Activities of EEDC aisbl are complementary to those of SEFI in the framework of the Deans Conventions.



ENAAE (European Network for the Accreditation of Engineering Education)

The ENAAE 2013 Conference was held in conjunction with SEFI 2013 in Leuven. Also, last March, Françoise Côme ended her mandate as ENAAE Vice President in March 2014, but remains member of the ENAAE Administrative Council until the end of 2015. SEFI and ENAAE closely cooperate in the context of the QUEECA project (see on following page).

Projects

Current projects

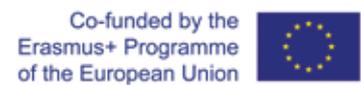


ECDEAST: Engineering curricula design aligned with EQF & EURACE standards is a TEMPUS project that ended in the fall 2013, *see invited contribution of Prof. Heitmann page 11.*



QUEECA - Quality of Engineering Education in Central Asia: this is a TEMPUS three-year project aiming to set up and start implementing a system of quality assurance (QA) of engineering education in Central Asia (CA) countries, Uzbekistan, Kazakhstan, Kirgizstan and Tajikistan. The project is coordinated by the University of Florence.

Applications under ERASMUS +



EERE – Engineering Education for a Resilient Europe is a new project submitted for funding to the European Commission (April 2014) under ERASMUS + (Knowledge Alliance). If successful, the project will be coordinated by the University of Florence with as partners SEFI, University of Birmingham, University of Braunschweig, Universidad Politecnica de Valencia, KU Leuven, ISEP and regional authorities and local companies.



EPICES – European Platform for Innovation and Collaboration between Engineer Students is a new project submitted under ERASMUS + (Strategic partnership). The project is coordinated by the Supméca, Paris. With as partners SEFI, Aalto University, Riga University of Technology, Politecnico di Torino, Universidad Politecnica de Valencia, University di Napoli Federico II.

KU LEUVEN

ReadySTEMgo – Early identification of STEM readiness and targeted academic interventions is a new successful project submitted under ERASMUS + starting in October 2014. The project is coordinated by the K.U. Leuven with as partners SEFI, University of Birmingham, Hamburg University of Technology, University of Zilina, Politecnico di Torino, Budapest University of Technology and Economics and Aalto University.

(*) - At the time of the publication of this report, both EPICES and ReadySTEMgo, submitted to ERASMUS National Agencies last April, have been accepted by the European Commission.

Working Groups*

Gender and Diversity in Engineering Education

The working group raised its membership from several European countries, but also from Australia and US, coordinators from other SEFI WG are involved as well. That allows strategical discussions and special measures in an international context and as well in a SEFI orientation.

SEFI WGGD was member of the Advisory Board of the EU project teaching-learning.EU. Diversity aspects had a strong emphasis in this field. Results (german only): <http://www.teaching-learning.eu>.

SEFI WGGD is in touch with the project genSET – Women in Science (<http://www.genderinscience.org>), with the European Centre for Women and Technology (ECWT), a network of female engineers, working together with National Science Foundation (NSF) and US universities. Results are available on: www.womenandtechnology.eu.

Ethics in Engineering Education

In September 2013 an extended discussion forum on Engineering Ethics was held during the SEFI Annual Conference in Leuven. The session focussed on future developments and initiatives that may improve engagement with Engineering Ethics (and the WG) by SEFI members and university teachers in general. There was consensus that “toolkits” and resources for teaching ethics would be useful, as well as a collation of practices for incorporate ethics topics into the classroom. A specific suggestion was the production of a short pamphlet listing classroom and other activities for ethics engagement with relevant examples (and follow-up references) where possible. This work is on-going, and a PDF pamphlet is expected to be produced in the coming academic year.

In April 2014, an invited presentation was given at the annual meeting of Heads of Civil Engineering Departments (UK). The session was titled: “Teaching of ethics in Engineering courses – approaches used in practice” and was well-received. Subsequent enquiries have been made as to the possible set-up of Engineering Ethics workshops in industry contexts.

Sustainability in Engineering Education

Following a first cooperation, the working group chairperson participated for the second time as a speaker in the BEST workshop that took place in July 2013 in Madrid and concerned education to sustainability.

During the SEFI Leuven Conference in September 2013 both an open meeting of the WG and a session on the topic took place.

An enquiry on the theme “Did you put in place multicultural pluridisciplinary projects for education to sustainable engineering” had been previously realized and its results were to be presented during the open working group.

An interest has been formulated by some educators to find some example on the website of SEFI of already existing curricula in the field of Sustainability. In the future a cooperation with the WG Curriculum Development could be able to offer some models from inside and outside Europe (the way to teach SD is far from being unique!) for inspiration examples or good practice to the members of SEFI.

Continuing Engineering Education and Lifelong Learning

There has been a noticeable increase of papers in the CEE field during the SEFI 2013 annual conference which brought more CEE attendants to the conference. On this occasion a workshop has been organised with SEFI Conference key note speaker Sue Bray from U.S with the theme: *Preparing engineers for the challenges of global work teams*. There were over 20 participants engaged in an active discussion over the theme. Several members of the working group have also been very active whole year long to prepare the programme of 14th World Conference on CEE in Stanford at the end of June (25-27.6.2014) and as well as meetings and workshops around this event. If in last decade the activity at International level on CEE has moved overseas to U.S one can note that SEFI’s presence in [IACEE](http://www.acee.org) has increased in the last year, especially with the election of Kirsti Miettinen as vice-president succeeding to our Past President Wim Van Petegem.

Educational Technologies

During the 2013 Conference in Leuven an Open Workshop on ‘Online Learning and the Future of Engineering Education’ was organised. This workshop comprised a short introduction, a discussion based on the key words participants supplied and a collaborative activity to list future activities (and focus) of the work group. To support the communication and exchange between the group members, it was decided to make use of dedicated online tools (Yammer, Twitter...). A joint workshop with the working group on Curriculum Development was also held in Leuven.

The WG contributed to the organization and the reporting of the inaugural SEFI debate which took place in Brussels in April 2014. An initiative was started to involve SEFI partners in the initiative of the Centre for Education and Learning (organized by the universities of Leiden, Delft and Erasmus) to submit a proposal for the Erasmus+ programme on the topic ‘Staff Development’.

* The list of the SEFI WGs Chairs is available on page 27

Another initiative was started to specifically organize a SEFI partners consortium for the submission of a proposal in the framework of the 2020 programme concerning online learning. The current partners will use the conference in Birmingham to work out the details for the plan and establish a firm group of participants.

Next to several other contacts there was an exchange with the WG on Gender and Diversity about the possibilities to use the MOOC data gathered at the Delft University of Technology for research. Increasingly research can profit from open resources and this activity could be an example of shared interest and exchange of expertise.

Mathematics and Engineering Education

The major activity of the working group was the organisation of the 17th SEFI Mathematics Working Group Seminar that took place in Dublin, Ireland, on June 23 - 25. About 70 participants from 12 European countries came together for three days to discuss important issues related to the mathematical education of engineers. The seminar was jointly hosted by the Dublin Institute of Technology (DIT), the Institute of Technology Tallaght (ITT) and the Institute of Technology Blanchardstown (ITB). The programme consisted of three keynote lectures by Thomas Schramm (Hamburg HafenCity University), Tim Joyce (Office of Public Works, Ireland) and Chris Sangwin (University of Loughborough), 20 paper presentations and about 10 poster presentations and software demonstrations. In addition, there were two larger discussion sessions on "What are the important topics in the mathematical education of engineers?" and "How can technology improve teaching and learning?". The next seminar is planned for 2016 in Gothenburg, Sweden. In the meantime, a special workshop is intended to take place in Orléans during the 2015 SEFI Annual Conference.

Engineering Education Research

At the Leuven conference, the SEFI EER Working Group held both an open meeting and a workshop that was facilitated by Maura Borrego from the USA and focused on the work being undertaken in the US to develop a taxonomy for the EER Research field. The SEFI conference was an opportunity for the research team to engage with a different constituency of colleagues to ensure a range of voices were inputting into the work. The open meeting was really the start of a dialogue with the wider community. Many interesting ideas were presented and a clear plan of action for the EER WG will be discussed in Birmingham. This plan will translate into explicit actions around issues like networking, visibility, communication and developing the quality of EER in Europe. Within regions, EER events have taken place. In the UK the 2nd EER Symposium was held at Northumbria University, the NNEER group met in May and many colleagues were present at Aalborg for the launch of the UNESCO Centre. The WG Chair was present at the ASEE Conference in Indianapolis in June, visiting Purdue University, presenting and

generally networking in the EER section of the exhibition space where all of the key US EER players were present. A Special Issue of EJEE due in 2015 will explore the state of EER in Europe. Horizon 2020 will also offer to the EER WG opportunities of a productive dialogue.

Curriculum Development

On the occasion of SEFI 2013 Conference, the group together with the Educational Technologies WG run a joint Workshop on the topic "Curriculum Development for Open Education", structured in two parts. In the first of them, a presentation of Urbano Domínguez on the Curriculum Development was followed by another by Linda Mebus on the experiences at the TU Delft with the implementation of several online masters. The second part was devoted to a discussion in groups on the two issues, and the presentation of the findings from the groups. Main topics discussed on curriculum development were ensuring employability of students, Assessment in the CD process, and what should be removed from the curriculum. Among the topics considered on online education design, were interaction (student - teacher / student - student), interpersonal communication, teacher training and online education.

During this year, the members of the group maintained their interest in active learning and teacher training, with a special reference to methods and attitudes in teaching and learning. Looking backwards to the activities in the last few years, curriculum content appears not to have been a topic of major interest. In line with Europe 2020 initiative flagships, the Group plans a deeper involvement in matters like mobility and new skills for new jobs.

Physics and Engineering Education

The Working Group increased its membership this year, bringing together SEFI members from 12 different countries in Europe.

This year major event was the eight Conference on 'Physics Teaching in Engineering Education (PTEE)' that was held in Aveiro (Portugal) from 22-24 May 2014. The event focussed on "ready to use ideas" which can be implemented in physics courses for engineers. Examples are the use of an electronic dice to activate students during lectures, video analysis of mechanical problems to contextualize the theory, concept maps to help structuring the content of a course, etc. More information can be found on <http://ptee2014.web.ua.pt/>.

The Working Group Chairperson Greet Langie has also submitted successfully a new ERASMUS + Strategic Partnership "ReadyStemGo" of which she is now the coordinator and SEFI an active partner. Congratulations!

More details about our working groups is regularly published in our newsletters and on www.sefi.be

Publications



European Journal of Engineering Education - EJEE

EJEE serves a worldwide audience with about as many submissions from Europe as from other parts of the world geographical distribution of submissions and accepted papers

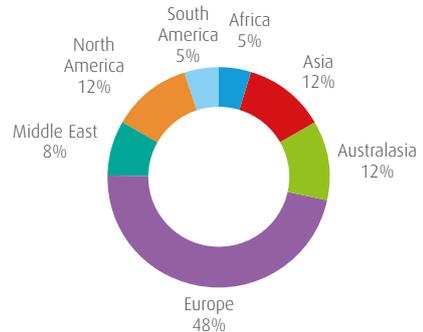
The number of downloads of EJEE increased to 34.723 in 2013.

The estimated impact factor of EJEE for 2013 is: 0.223. The average over the past five years is 0.177, with a high of 0,212 in 2008 (EJEE Publishers report 2013).

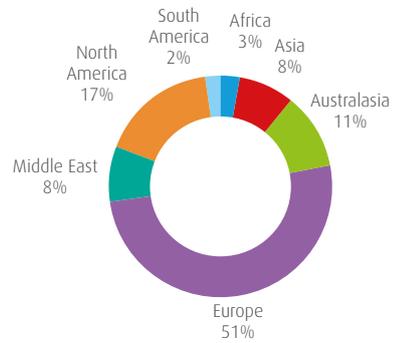
As can be seen from the geographical distribution of downloads EJEE serves a worldwide audience.

The EJEE editorial committee is constituted of 39 members, including 9 non-Europeans under the leadership of the Editor in Chief, Prof. Erik De Graaff (Aalborg University).

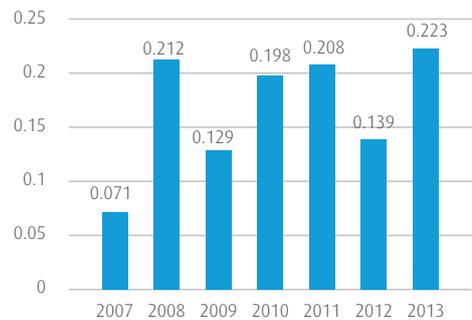
Geographical Distribution of Original Submissions



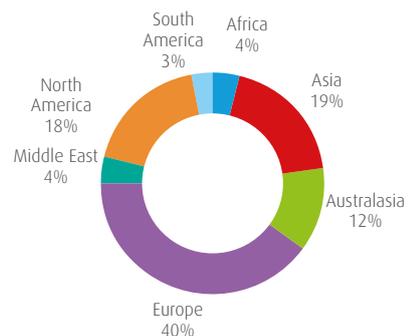
Geographical Distribution of accepted papers



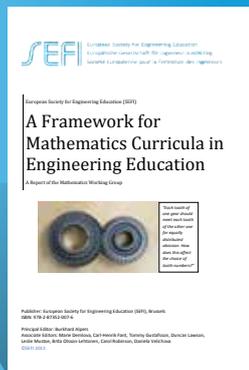
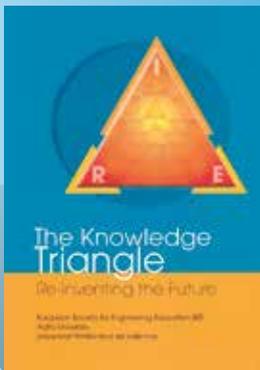
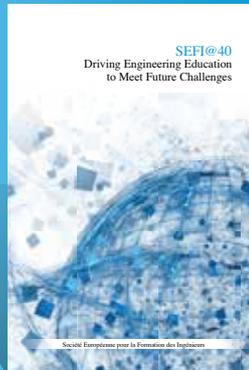
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Special contributions



The power of being connected

Xavier Fouger - Dassault Systemes, Senior Director Global Academia Programs, SEFI Vice President

Among all profound changes which reshape our lives at planetary scales, the deepest transformations which happened or are to occur in a foreseeable future originate in connections across people, across things and across people and things.

Experiencing global engineering at University

As innovation is increasingly becoming a global process, educators struggle to provide engineering students with an authentic experience of working together with peers dispersed across the planet in producing an engineering result. A shining example of overcoming this difficulty is provided yearly, from September to January by a SEFI member, ENIM, through a project called "global factory" which became this year "Digital Farm". A group of undergraduate students in universities located in various countries in Argentina, Brazil, Colombia, Peru, Morocco, the United Arab Emirates, France, Germany and China. Students use latest collaborative 3D design and simulation techniques combined with social networking practices to design a fully featured factory or, this year, a technical solution to a farming problem.

When asked about motivational and challenging aspects of the project, the most challenging dimension was to work across time zones while the most rewarding in terms of motivation was the intercultural interactions. In a paper at next IEEE "Frontier in Education" mentoring educators will report about the unique learning outcomes of the project both in terms of procedural methodologies and human skills students acquired in this employment driven exercise. SEFI members can gain a lot in sharing how such breakthrough learning innovation are realized by peers and should take the advantage of being a network to explore the benefits of collaborative students activities that mimic across institutions realistic industry practices.

Connecting SEFI members

While students need to be given opportunities to explore the power of collaborative engineering, our own activities within SEFI can greatly benefit from interacting across ourselves.

I had the chance to defend an educational research proposal of a French SEFI member in front of an international jury which was composed of an Italian physicist, educational scientists from Belgium and UK, a Swiss economist and an Austrian lawyer. They were all eminent academics and had in common to speak French and to be candid about systems engineering, which was the subject of the proposal. It is indeed a challenging task to assemble panels of international specialists in a given discipline speaking a given language.



Students at EAFIT in Medellin were modifying the engine to be assembled in the virtual factory while sharing accurate technical options with peers in 6 other countries.

SEFI is a remarkable network of experts in various domains and countries. I think that the society is best positioned to elevate the recognition of this expertise at cross European level. Why could SEFI not maintain a database of member's expertise and spoken languages and provide agencies, governments and accreditation boards with the most complete panel of multi-lingual experts to staff auditing committees and juries?

This is a task I would like to move forward that would show the power of being connected.



Why is materials education important?

“The capabilities of materials and the way they are used has built our modern world,” explains Prof Mike Ashby, Emeritus Professor at Cambridge University Engineering Department and Granta cofounder. “But it is also true that materials are linked to many of our modern problems, such as resource consumption, energy use, & air pollution. A better understanding of materials and innovation in their use must be part of solving these problems.”

Materials education, then, is vital not only to develop groundbreaking products, but also for its impact on challenges such as tackling climate change or improving human health. Materials matter in so many areas that we need not only to educate the next generation of materials scientists, but also to engage the interests of engineers, designers, and scientists. Materials is an ideal ‘hub topic’ for educators seeking to help students work across disciplines, and for the Systems Approach to teaching that many universities are now adopting.

At Granta, our aim has been to promote and to enable the teaching of materials across curricula, spanning the sciences, engineering, and design. Today, we support the teaching of materials at over 1000 universities and colleges through a rich array of teaching resources, advice, and ideas. Granta’s CES EduPack™ provides a comprehensive database of materials and process information, coupled with powerful materials software tools to view and apply this information, and supported by teaching resources providing ideas, graphics, exercises, and projects.

Visit www.grantadesign.com/education to find out more

Materials Education Symposia

Granta also facilitates collaboration amongst a worldwide network of materials educators: in recent years we have been very pleased to also coordinate many Materials Education Symposia with support from leading engineering organizations such as SEFI. These events bring together hundreds of educators involved in teaching materials-related topics to undergraduates. They’ve demonstrated that there is an active international community with a very strong interest in adopting the interdisciplinary teaching of materials. The Symposia help to support and develop this community.

Read the report from the Spring 2014 events: www.materials-education.com/2014/report.htm
Visit www.materialseducation.com to find out more about upcoming Symposia:

- [1st Asian Materials Education Symposium](#)
National University of Singapore, Dec 11-12, 2014
- [7th International Materials Education Symposium](#)
University of Cambridge, UK, April 9-10, 2015
- [6th North American Materials Education Symposium](#)
Ohio State University, March 26-27, 2015



Photographs from the 2014 Materials Education Symposia, supported by: ASM International (the Materials Information Society); Cambridge University (Department of Engineering and Department of Materials Science & Metallurgy); European Society for Engineering Education (SEFI); Federation of European Materials Societies (FEMS); Granta Design, Cambridge; Materials Division, American Society for Engineering Education (ASEE); National University of Singapore; and University of Illinois at Urbana-Champaign.

USER STORY

Marquette University Integrates Model-Based Design into Undergraduate Mechanical Engineering Curriculum



Diagram, created by Kevin Craig, representing the engineering disciplines within mechatronics and their applications.

The Challenge

Teach engineering students to solve real-world, multidisciplinary problems with the tools and system design approach used by practicing engineers

The Solution

Integrate Model-Based Design with MATLAB and Simulink into all four years of the undergraduate mechanical engineering curriculum

The Results

- Engineering communication skills acquired
- Graduates prepared to apply Model-Based Design in their careers
- Students motivated with real-world challenges

Mechanical engineering students at Marquette University apply Model-Based Design throughout their undergraduate studies. The curriculum, which emphasizes Model-Based Design and human-centered design in multidisciplinary systems engineering, is part of a department-wide effort to foster learning by having the students solve real-world engineering problems.

“When students learn Model-Based Design, they see how engineers really work in organizations that recognize the value of modeling and simulation,” says Dr. Kevin Craig, Robert C. Greenheck Chair in Engineering Design and professor of mechanical engineering at Marquette. “They also learn to speak the universal language of engineering, which is modeling.”

The Challenge

Marquette mechanical engineering faculty recognized a compelling need to modify the curriculum. “Many college students today are too focused on their next grade or their GPA,” Craig explains. “We wanted our students to take ownership of the challenge before them, be motivated to learn, and integrate all they learned.”

From their experience in industry, Craig and his colleagues recognized a need for engineers who use modeling as the basis for design. “Companies taking a design-build-test approach can save lab time and development costs by simulating models,” says Craig. “We want our students to learn the advantages of modeling for system design, because that is the approach they will use when they graduate and work with other engineers.”

The Solution

Marquette integrated Model-Based Design with MATLAB® and Simulink® into multidisciplinary engineering system design courses in all four undergraduate years.

First-year students take *Engineering Discovery 1*, in which they model, simulate, and analyze basic electrical, mechanical, fluid, thermal, and electromechanical systems using MATLAB and Simulink, and then validate their models with hardware experiments.

In *Engineering Discovery 2*, students apply the same modeling and simulation approach, as well as computer programming in MATLAB, to energy-related products, systems, and processes.

In the second year, the focus shifts to discipline-specific courses. Mechanical engineering students in *Electromechanical Engineering Systems* use MATLAB and Simulink to model simple electrical systems made up of resistors and capacitors. Via simulation they explore the effects of under-sampling on aliasing. They then compare simulation results with measurements taken on actual circuits in the lab.

In the same course, students study basic controller design and model a proportional-integral controller for an RC circuit. Using Simulink Coder™ they generate code from their model and run it on an Arduino® microcontroller, comparing the results on the lab oscilloscope with the simulation results.

In the third-year course *Multidisciplinary Engineering Systems*, the students use



"I tell my students the same thing I tell engineers who have been practicing for 30 years: Model-Based Design is the key to solving the problems we face. MATLAB and Simulink are the tools, and modeling is the language of modern engineering practice." —DR. KEVIN CRAIG, MARQUETTE UNIVERSITY

Model-Based Design to develop classical controls for thermal, electromechanical, and fluid power systems. They design the controllers using root locus and frequency response techniques with Control System Toolbox™. They are introduced to SimElectronics®, SimHydraulics®, and SimMechanics™ for modeling physical systems, and are encouraged to use these products on their own.

In the *Mechatronics* course, fourth-year students design and build a two-wheeled self-balancing transporter. They use MATLAB and Simulink to model the mechanical structure, motors, sensors, and control electronics. With System Identification Toolbox™ they estimate friction and other system parameters.

The linear quadratic regulator control for balancing the transporter is developed in MATLAB, and the proportional-integral-derivative control for steering and forward-backward motion is developed using Simulink Control Design™. Students automatically generate control, sensing, and RF communication code from their Simulink model for deployment on an Arduino microcontroller.

Fourth-year students also use Model-Based Design for capstone design projects, which often involve partnering with local companies.

The Results

Engineering communication skills acquired.

"MATLAB and Simulink are the gold standard in modeling and simulation," says Craig. "When our students learn Model-Based Design, they also learn to communicate effectively with other engineers even if they don't share a common spoken language."

Graduates prepared to apply Model-Based Design in their careers.

"Many companies I work with are trying to change their culture and adopt Model-Based Design," says Craig. "Our graduates are ready to step in and be the catalyst for change in those companies, because they have used Model-Based Design for four years."

Students motivated with real-world challenges.

"As educators, we have to appeal to our students with real problems that motivate them," says Craig. "When students combine the use of MATLAB and Simulink with hardware to solve practical challenges, their desire to learn is maximized. Anything short of that is inadequate."

Industry

- Education

Application Areas

- Embedded systems
- Control systems
- Mechatronics

Capabilities

- Data analysis
- Mathematical modeling
- Algorithm development
- System design and simulation
- Physical modeling
- Embedded code generation

Products Used

- MATLAB
- Simulink
- Control System Toolbox
- SimElectronics
- SimHydraulics
- SimMechanics
- Simulink Coder
- Simulink Control Design
- System Identification Toolbox

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Engineering Professor Uses **MapleSim** to Introduce More **Exploratory Methods of Teaching**

Dr. James Andrew Smith, Electrical and Biomedical engineering professor at Ryerson University, Toronto, is very excited about experimental changes he made to his teaching approach in class. He introduced tools and methods that help students

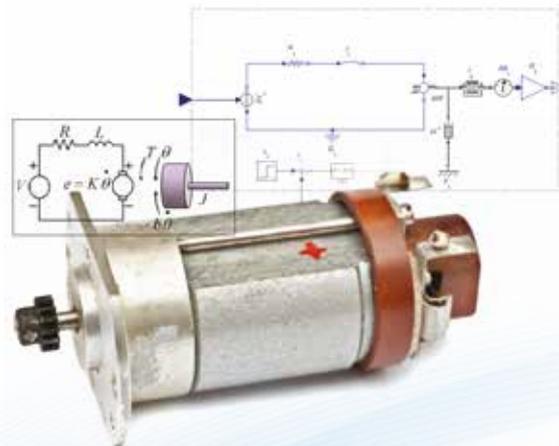


generate knowledge through interaction, explore the subject better and create a more in-depth understanding of the subject. He calls this an “inductive approach” to learning rather than the traditional “deductive approach”. He considers MapleSim – the system level modeling and simulation tool from Maplesoft – as a key inductive learning tool, very different from deductive learning tools.

Dr. Smith introduced MapleSim in the third year Electrical Engineering program, in classes focussing on an introduction to robotics and microsystems. One goal of these classes is to familiarize students with tools for analysis, simulation, visualization and design. He used the system-level modeling tool MapleSim to see how an inductive approach to learning can improve student comprehension. “An inductive approach allows students to explore a system, and derive equations from the behaviors they observe in the system,” explained Dr. Smith. “Contrast this with the deductive approach, which is the traditional way of teaching, that involves giving students a set of equations and letting them deduce what it means and what kind of behavior it demonstrates. The inductive approach enables knowledge generation through interaction and pushes the students to explore further.”

According to Dr. Smith, traditional tools have their place, but they don’t let the students see under the hood, which is an impediment to learning. “What makes MapleSim different from others is that students can ask MapleSim for underlying equations and interact with it in different scenarios. This openness is very unlike other tools in the market. With MapleSim, students can easily connect the analytic models in textbooks to the numeric solutions that result from the simulation. It also has a very intuitive user interface which makes it easy for students to explore the software and arrive at new conclusions.”

As an illustration, Dr. Smith provides a simple topic dealt with in the third year engineering program. A very fundamental concept all students deal with in the electrical engineering class is the subject of operational amplifiers. It is important for students to tie in how an operational amplifier modulates a signal or how it amplifies/attenuates a signal, and any simulation package used has to be able to facilitate a very clear understanding of this concept. Traditionally, the instructor



would refer to a standard text book like "The Art of Electronics" and give students the golden rules of operational amplifiers and tell them how current goes into certain ports and not other ports and why voltages should be of a particular value. The students are then asked to solve the circuits by hand. "There is a lot of potential for error here," said Dr. Smith. "It is a lot to ask of the students especially if they haven't had any experience with electronics, and it is difficult for them to figure it out in a short amount of time."



Alternatively, Dr. Smith's inductive approach gives them MapleSim. He gets the students to start by drawing the schematic, and then simulate with MapleSim. He then makes

them extract the underlying equations in MapleSim, explore it using different scenarios, and analyze the equations to derive conclusions. "The best part of this for students is that they can match it with what they are seeing in their textbooks," said Dr. Smith. "The simulation process they go through is the same as they see in the text book. It reinforces what they read and provides a nice link between what they do on the computer and what they see in the textbook."

In addition, Dr. Smith takes the use of MapleSim further by extending basic examples in the textbook to show students more useful real life illustrations. This expands the scope for students and they are encouraged to think beyond the limited span of a particular problem. Because of MapleSim's system-level approach to multi-domain systems, students often extend a problem in electrical engineering to what they learn in their mechanical engineering class or instrumentation class. "To me this is the real power of MapleSim," added Dr. Smith. "Because of its possibilities in multi-domain modeling, it beats other software tools that are similar. It provides students with a familiar environment to work with, and helps them relate problems and examples in different fields to get a comprehensive view."

Dr. Smith is convinced that MapleSim is a critical tool in an engineering instructor's toolkit because it facilitates inductive learning, which, he believes, is the paradigm of the future.



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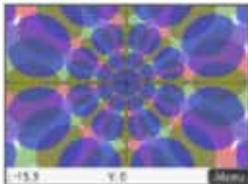
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- Statistics

The Engineering Universities & EU Programme Period 2014-2020

I participated as the moderator in the Conference organized by the European Commission and European University Association on 20th June 2014. Three prestige speakers partook in my Panel: Walter Deffaa, Director-General for Regional Policy, Robert-Jan Smits, Director-General for Research, and Jan Trzuszczyski, Director-General for Education.

The discussions inspired me to rethink the changing role of universities in our society. Therefore I decided to take the space here and link some of the ideas the conference sparked in my thinking to my experiences at Aalto University and to some recent opinions by the EU Committee of the Regions CoR, in which I have acted as a Rapporteur.

Regional Innovation Ecosystems

When setting the target for Europe to become a global leader in tackling the grand societal challenges, as stated in Horizon 2020, the research, development and innovation activities need to acquire a strong regional dimension based on a deep understanding of innovation ecosystems.

The Smart City concept has been one of the EU focus areas in driving sustainable growth and improving quality of life. The enablers include investments in modern ICT infrastructure and e-services, as well as in human and social capital. The drivers of change include, above all, regional renewal capital and the effectiveness of innovation ecosystems – targeted especially at modernizing the Triple Helix collaboration culture and increasing regional responsiveness through citizen participation.

This challenges universities to adopt EU policy elements that suit



(Markku Makkula at the Committee of the Regions)

EUROPEAN UNION



Committee of the Regions

their operating culture and goals. As a result of globalization and digitalization, also universities should put more effort to assuming their special identities – the Smart Specialisation culture adopted by the EU influences their unique goals and operating cultures. The university institution in each nation and also in Europe as a whole forms an entity that enables different roles as well as scientific and practical emphases for the different universities. In an era of digitalization, the critical mass no longer has to locate in one physical space – what matters is the mental network together with its strong human collaboration.

Universities can have a strong influence in every city and in every region. Professionals in working life need to take concrete action to apply new knowledge to renewing both the public- and private-sector structures and processes towards innovativeness and efficiency. The CoR stated in the Horizon 2020 opinion: “The laboratories for innovation are no longer traditional university facilities, but regional innovation ecosystems operating as test-beds for rapid prototyping of many types of user-driven innovations: new products, services, processes, structures and systems, which need to be of transformative and scalable nature.”

Where do we see this new development? The new institutes, most of which have only been set up in the past few years, are flexible entities with a collaborative approach. Examples abound: Incubators and Accelerators, Living Labs, Entrepreneurial Hubs, Development Labs, Social Innovation Labs, Fab Labs, Societal Innovation Learning Camps and Future Centers. They usually operate as associated entities of universities, municipalities and businesses. They typically combine new, open, mental, physical and virtual operating practices – enabled by new funding practices and broad stakeholder networks and entrepreneurial mentality. In all this, universities are most often the forerunners and even drivers of societal change.

Industrial Renaissance

A strong industrial base is of prime importance to European competitiveness and to steady growth. The longest crisis ever experienced by the EU has underlined the importance of real economy and strong industry. Industrial activity is a component of the ever wider and more complex value chains and networks, in which large companies and SMEs from different sectors and countries interconnect with each other.

The traditional product chain concept with its fixed phases and production factors is receding because the real picture is of complex and often globally networked ecosystems. Technologies play a key role as enablers of new, sustainable approaches.

The targeted development cannot be achieved without a strong knowledge base provided by universities of technology. Universities, however, have to renew their offering: on the one hand they need to deepen their scientific expertise and validity, and on the other hand, they are to facilitate the applicability of the latest knowledge to practice. Naturally, the interests and responsibilities of universities differ.

The measures of the Member States and local authorities should not be limited to narrowly local industrial sectors, but they should rather promote cross-sectoral and interregional cooperation and innovation. Multidisciplinarity and crossing cultural borders are of growing importance as success factors promoting growth and new jobs. Industrial value-adding chains ranging, for instance, from raw material procurement all the way to business services and logistics, as well as links with research institutes, universities and other education centres, must be properly integrated into industrial policy activity in the regions and at the EU level. Horizon 2020 and the new EU funding practices can promote this development and especially increase cooperation between industries and top-level research.

Universities & Smart Specialisation

Universities help national, regional and local governments in policy shaping and in implementing these policies. As part of their societal role, universities form a knowledge base for regional strategies as well a service base for regions and different industrial clusters. One of the main goals of the EU Smart Specialisation policy and regional RIS3 processes is to turn the outcomes of hundreds or even thousands of small projects revolving around the same topics in different parts of Europe into societal impact with the help of well-documented concepts and tools. These instruments would help build a European action mainstream and support by adopting new solutions in different locations and regions.

The three-pillar structure of Horizon 2020 creates opportunities to achieve the Europe 2020 Strategy targets. In terms of evaluation and funding criteria, the emphasis is on global excellence; all activities draw on scientific expertise. The role of universities is crucial. However, positive answers with targeted actions need to be sought for the key questions: Are the political decision-makers at EU, national, as well as regional and local levels committed to the necessary investments in intellectual capital and in new concepts of knowledge co-creation? Are European universities ready and able for the needed reforms?

Case Energizing Urban Ecosystems

A good example of this trend is Energizing Urban Ecosystems EUE, a Finnish 4-year research program for 2012-2015, with 20 million € funding from industry and public bodies, including Tekes, The City of Espoo, and Aalto University. The theories and practical implementation of this research program are focused on the Espoo Innovation Garden, i.e. the Otaniemi-Keilaniemi-Tapiola area around the Aalto University campus.

In this innovation-enabling environment, the EUE program demonstrates how to effectively implement the key enabling success factors of the Europe 2020 strategy, and how an updated Triple Helix model supported by the Knowledge Triangle approach can enhance collaboration between the city, universities, research institutes and diverse enterprises throughout a regional innovation ecosystem. The EUE program has moved forward in a number of ways, including its scientific research on regional information modelling integrated with virtual reality applications. The next phase is emphasizing the actions to operate as a regional "Open Innovation Digital Challenge Platform". For the next years, the EU policy should be centered much more strongly than in the past on encouraging bottom-up activities. This means especially focusing on societal impact through experimentation and rapid prototyping and integrating this with scientific and entrepreneurial discovery. And naturally, the best outcomes should be disseminated and scaled for deployment all throughout Europe.

Conclusions

During the programme period 2014-2020, much has changed and, hopefully, much more will change compared to the previous 7-year period.

The universities play a crucial role in achieving the targets set for the new EU funding procedures and in applying the new administrative rules in practice.

The following policy guidelines enable the new governance mentality:

- 1. Focusing more on impacts, especially societal impacts;**
- 2. Drawing more innovation from research results;**
- 3. Adopting regional innovation strategies based on smart specialisation;**
- 4. Going beyond mere support for clusters, towards regional innovation ecosystems;**
- 5. Stressing the importance of multi-disciplinarity;**
- 6. Promoting user-driven developments;**
- 7. Developing a bottom-up entrepreneurial mindset;**

- 8. Using cohesion funds to promote innovation and capacity building;
- 9. Pursuing synergies both within Horizon 2020 and between it and the cohesion funds;
- 10. Promoting multi-finance solutions to the funding puzzle.

Universities must be determined in developing their academic culture, as well as operational processes and structures, if aiming to meet the challenges related to their societal role. Instead of the

traditional methods based on sectorization and silos, universities need to create a culture of networks and co-creation that penetrates the entire university and also its local, national and international stakeholders.

Markku Markkula

SEFI Fellow

Member of the EU Committee of the Regions CoR

Advisor to the Aalto University Presidents

CLOSING THE INNOVATION DIVIDE

Rapporteur Markku Markkula

THE COMMITTEE OF THE REGIONS points out that:

- As many phenomena of the digital society have already demonstrated, significant transformation takes place from the bottom up, and a pervasive mindset of "entrepreneurial discovery" is critical.
- Innovation communities operate as ecosystems through systemic value networking in a world without borders.
- Regions need new arenas as hotspots for innovation co-creation. These could be described as "innovation gardens" and "challenge platforms", which together form prototype workspaces for inventing the future.
- The CoR endorses new investments in open innovation and crowdsourcing. These are the key concepts associated with the smart city and citizen participation.
- The concept of "connected smart cities" needs to be further developed and extended throughout Europe.
- The CoR encourages the Commission to set up "entrepreneurial discovery" programmes to work at different levels and discover what is most effective for local needs and European scaling.
- A circular economy for knowledge: the results of European Commission and national research and innovation funders' programmes and projects must be reused.
- The best pioneers for developing and running Europe-wide projects should be financed through Horizon 2020 and cohesion funding – the aim being also to test effective methodologies and tools in real life collaboration and cross-border learning.

Curriculum Design with Reference to EQF and Accreditation Standards: Outcomes of TEMPUS ECDEAST

From 2010 to November 2013 SEFI has been partner in the ECDEAST project and contributed by various experts to the development, implementation and evaluation of three master programmes at three Russian Research Universities: TPU – Tomsk Polytechnic University, BMSTU – Bauman Moscow State Technical University, SPbSPU – Saint-Petersburg State Polytechnical University. Other partners in the project have been the European Network for Accreditation of Engineering Education (ENAAEE) and three more HEIs: Kaunas University of Technology, the Lucian Blaga University at Sibiu and, as the grant holder and coordinator, the University of Applied Sciences Wismar.

The main objective of the project, financed by the EU TEMPUS programme, was the design and implementation of new master engineering curricula for Russian Universities based on the experience of the European partners and the EUR-ACE requirements for graduate competences. Since Russia decided to join the Bologna Process and adopted a four plus two year study structure for first and second cycle degrees it is an urgent topic for the Russian Ministry of Education and Science together with leading Russian Universities to develop master programmes in engineering and various areas of specialisation in accordance with the 3rd generation of Russian Federal Education Standards (FES) and European Quality Standards as represented by

SEFI in 2013-2014 Special contributions

the European Qualification Framework and the ENAEE administered accreditation standards of the EUR-ACE Bachelor and EUR-ACE Master Labels. After completion of the project and the first graduations the Russian partner Universities are expected to apply for the EUR-ACE Master Label with the newly implemented programmes.

Russia by the Federal Standards still sticks to quite detailed prescriptions by the Ministry of Education and Science for even branch specific and specialised programmes, but with the third generation of FES shifted to an outcomes and competence based approach. This facilitates comparisons with European Qualifications Frameworks and accreditation standards. It turned out that apart from differences in focus and terminology there is a high degree of compatibility in content and level of the required outcomes at first and second cycle degree level. In addition, the National Research Universities and thus the 3 involved Russian partners have been granted greater autonomy and freedom in developing their own programmes allowing to adapt to EUR-ACE or other standards. As a consequence, it requires a new and comprehensive approach to curriculum design, implementation, assessment and quality management which the faculty and programme developers need to learn and apply. Like in other Universities in many Bologna Process signatory countries the shift to learning outcomes caused a tremendous challenge for programme providers.

With a significant contribution of SEFI the ECDEAST project therefore developed Guidelines for Curriculum Design taking into account current educational concepts of “constructive alignment” as well as other examples of comprehensive curriculum design as represented in former SEFI publications and also the approaches of the CDIO - Network, the TUNING project and accreditation agencies like ABET. Besides referring to EUR-ACE and EQF standards also the ECTS User Guide turned out to be a valuable source for the guidelines.

The Guidelines functioned as a basis for a training programme of involved faculty and staff and the subsequent development of the programmes, new modules, teaching material and assessment approaches. In addition, a faculty exchange programme addressing the involved teaching staff was established between the three Russian and the three other partner Universities. It included also a visit of the European Commission and the Katholieke Universiteit Leuven, organized by SEFI General Secretary Françoise Côme and Communication Officer, Jacques Schibler, and participation and presentations of Russian faculty members about the ECDEAST project at SEFI Annual conferences. In autumn 2012 the new programmes enrolled the first students, in spring 2014 an external evaluation by peer review teams organized by ENAEE and with support of SEFI experts took place. A final Conference at Bauman Moscow State Technical University in June 2014 provided the opportunity to disseminate the concepts and results of the ECDEAST

project and to confront and compare them with similar master curriculum development activities in other projects based e.g. on TUNING and CDIO approaches. Finally a booklet on “Engineering Curriculum Design Aligned with Accreditation Standards” was published documenting various concepts of curriculum design and required standards in more detail and providing examples of the programmes and modules now implemented as one result of the ECDEAST project.

The various outcomes and papers have been continuously documented and published by the project web site provided by the Tomsk Polytechnic University (TPU), organized and up-dated by Evgeniya Kulyukina and Oleg Boev. The web site is still accessible, many documents including the guidelines and the booklet can be downloaded under the items “activities” and “publications”:
<http://ecdeast.tpu.ru>.

The publication “Engineering Curriculum Design Aligned with Accreditation Standards”, edited by Oleg Boev, Norbert Gruenwald and Guenter Heitmann, Wismar 2013, can also be downloaded in either an English or a Russian version from:
<http://www.robert-schmidt-institut.de/downloads.php>



Prof. Guenter Heitmann
(Formerly TU Berlin, ASIIN)
SEFI Expert in the ECDEAST
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Honorary Member



New Developments on Accreditation of Engineering Programmes in Europe and Central Asia

SEFI members are well aware of the EUR-ACE® system for the “European Accreditation of Engineering Programmes”, of which SEFI was a leading actor since the very beginning. At present, accreditation of higher education (HE) programmes as entry route to the engineering profession is widespread throughout the world, but historically Europe has been in the forefront, although different words have been and are used: indeed, the word “accreditation” was not used in European specialized literature and documents until the late 1990s, when it came from American usage. But even if different words were and are used, Europe has pioneered engineering accreditation, as proved by the examples of France, where the “habilitation” is the main task of the “Commission des Titres d’Ingénieur” (CTI), established by law in 1934 with representatives of academia, employers and social stakeholders, and of United Kingdom, where a similar role has been played since the 19th Century by the Professional Institutions of the different engineering branches (disciplines): hence, in the UK accreditation was (and is) distinguished by branch; in 1981 the overarching Engineering Council (EngC, originally EC-UK) was established to coordinate and ensure quality and consistency among the Institutions. Recognition of professional qualifications within the European Union and consequent mobility of professionals is guaranteed since 1989 by “Directives” (= European laws), while the “Bologna process” has established the 47-countries “European Higher Education Area” (EHEA), ensuring transparency, compatibility and quality of academic degrees. However, neither the “Directives” nor the “Bologna Process” are concerned with “accreditation” as defined above: therefore, up to a few years ago there was not any European accreditation system of engineering education accepted on the continental scale.

To fill up this lack was (and is) the main purpose of the EUR-ACE adventure, that began within three European “Thematic Networks” on engineering education, namely H3E “Higher Engineering Education for Europe” (1996/99), E4 “Enhancing Engineering Education in Europe” (2000/04) and TREE “Teaching and Research in Engineering in Europe” (2004/07), that were followed by a series of projects (with SEFI as partner in all these projects) specifically devoted to the European accreditation of engineering programmes:

- EUR-ACE “European Accredited Engineer”
- EUR-ACE IMPLEMENTATION
- PRO-EAST
- EUR-ACE SPREAD

These projects gave rise to the ENAEE (European Network for Accreditation of Engineering Education), that owns the EUR-ACE® trademark and authorizes national Agencies to award to qualified educational programmes the “EUR-ACE®

BACHELOR” and “EUR-ACE® MASTER” labels, recognized by the European Commission as a “quality labels”. The first EUR-ACE® labels were awarded in 2007, and are now more than 2000, with a great increase in the most recent years (particularly noticeable in UK). The six Agencies that were originally authorized are now 13: the latest authorizations have been given in 2013 to KAUT (the Polish Accreditation Committee for Technical HE Institutions) and in 2014 to OAQ (Swiss Center of Accreditation and Quality Assurance in HE), FINHEEC (Finnish HE Evaluation Council, now merged into the “Finnish Education Evaluation Centre” - FINEEC) and ANECA-IIE (the Spanish National Accreditation Agency ANECA, in conjunction with IIE – Instituto de la Ingeniería de España, the main Spanish Engineers’ Professional Organization). Taking into account of the agreement of the French

“Commission des Titres d’Ingénieur” (CTI) to accredit in Belgium, the countries in which the EUR-ACE® system is systematically applied are at present 14: Belgium, Finland, France, Germany, Ireland, Italy, Poland, Portugal, Romania, Russia, Spain, Switzerland, Turkey, UK.

A formal “Mutual Recognition Agreement” among all EUR-ACE®-authorized Agencies will be officially signed in a public event in Brussels next November.

Another very important development of EUR-ACE® will come from the **QUEECA project (2012-2015)**, supported by the TEMPUS EC programme, that is aimed at extending the EUR-ACE® system in four Central Asia countries (Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan), by setting up and implementing a system for Quality Assurance and accreditation of Engineering Education, in which the accredited programmes must satisfy the same conditions required for the award of the EUR-ACE® label. This will be achieved by the creation and training of National Engineering Education Societies in the four concerned countries, that at the conclusion of the project will ask ENAEE to be EUR-ACE®-authorized. SEFI is also partner of the QUEECA project.



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SEFI is the largest network of higher engineering education institutions (HEIs) and educators in Europe. It is an international non profit organisation created in 1973 to contribute to the development and improvement of HEE in Europe, to reinforce the position of the engineering professionals in society, to promote information about HEE and improve communication between teachers, researchers and students, to reinforce the university-business cooperation and to encourage the European dimension in higher engineering education. Through its membership composed of HEIs, academic staff, students, related associations and companies, SEFI connects over 1 million students and 158000 academic staff members in 48 countries. To reach its goals, SEFI implements diverse activities such as Annual Conferences, Ad hoc seminars/workshops organised by its thematic working groups and task forces, organises the European Engineering Deans Conventions, publishes a series of Scientific publications (European Journal of Engineering Education) and Position Papers, is involved in European projects, cooperates with other major European and international associations and international bodies (European Commission, UNESCO, Council of Europe, OECD). SEFI also participated in the creation of ENAEE, IFEEES, EuroPace, IACEE and of the Institute for the development of Engineering Academics, IIDEA, and of the European Engineering Deans Council, EEDC.



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