

CONTEMPORARY PROBLEMS OF ENGINEERING EDUCATION IN EUROPE: HOW TO FOLLOW GLOBALIZATION

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Abstract

The paper discusses actual situation in engineering education in Europe and suggests some measures to resolve contemporary problems in the education area. The new education policy of universities is formulated. Some principles of cooperation between industry and science are suggested, which are of an urgent and important need for the European education system. Focuses on human (anthropocentric) approach in engineering is described as the key to the development of the European engineering education. Massive Open Online Courses are considered as new, but very important players in engineering education market. The question of engineering education attractiveness in Europe is formulated as becoming decisive.

Keywords: *Cooperation, Competitiveness, Industry Needs, Global Knowledge, MOOCs.*

1. Introduction

Globalization has led to huge changes in the industry around the world. It activates itself as changes in industrial processes, as well as changes in the requirements of the labor force. Qualifying employees must change quickly and flexibly to ensure their continuing professional development. Today, the evolution of engineering practices should lead to improvement not only in technical devices, but also in entire system of engineering education, which should be closer to the real needs of users.

In this situation, it must be noted that engineering education in Europe lags behind the progress in science and technology and unable to fully meet the growing needs of the economic market. Development of effective principles of cooperation of industry and science is an urgent and important need for the European education system for training engineers. The most important point is to establish a well-functioning and productive environment of engineering. Especially important is training of specialists in microelectronics, biotechnology, low-cost production, process improvement management, recycling and use of waste as well as in transport and logistics

To make a correct engineering industry needs prediction of the international aspect of higher technological education is extremely difficult. Rapid changes in the area today make more and more difficult to foresee engineering education tomorrow, based on past experience of universities.

Technologic development and dissemination of new materials have happened so quickly, that for the first time in our history we have to admit many outdated rules and infrastructure needed to serve society today. Here the effect of globalization has caused tremendous changes in the industry all over the world

When defining a new education policy, we must understand the changes in the traditional university model, previously focused on the teacher (teacher-oriented), and now passing to a new educational culture focused on student (learning-oriented). Today, a key aspect of engineering education is becoming the new so-called "networking" culture.

Here's how it is formulated by the policy makers at Aalto University (Finland) [4]:

- Focus on the selected direction in world-class research.

- Focus on long-term issues and important areas of research.
- Aim thinking on creativity, inspiration and enrichment of the academic community.
- Integrate research, education and social interaction in various disciplines to produce synergy.
- Strive for deep and sustainable social, cultural and economic impact.

Let us remind one of the main goals of the Bologna process implemented in the framework of the development of European higher education. This objective is stated as follows: “As we look ahead, we recognize that, in a changing world, there will be a continuing need to adapt our higher education systems, to ensure that the European Higher Education remains competitive and can respond effectively to the challenges of globalizations”. [4]

2. Key to the development of engineering education

Key to the development of engineering education is to establish a framework for lifelong learning (life-long-learning) worldwide. In a globalized business engineers need to improve their ability to communicate both in writing and verbally, and must be able to work as a team to address and resolve issues. Approach that focuses on human (anthropocentric) includes a special selection of technologies in the design of the technical system and its evolution, oriented to the needs of operators.

Role of human priority includes following requirements: control device operator and its responsibility, achievement and implementation of professional and social competence, teamwork, and precise execution of the task specification. Important parts in the anthropocentric system are safety, health and environmental protection.

It must be assumed that in the near future devices will evolve toward cyborgs, which characterizes the presence of integrated "man - machine" interfaces. This will ensure a more efficient use of human potential and the joint set of technical facilities, having more flexibility, determination, self-healing, self-regulation and others.

Today, the evolution of engineering practices should lead to improvement not only of technical devices, but also of the entire system of engineering education, which should be closer to the real needs of users and objects.

Today the engineer must be able to cope with a wide range of problems from different areas. Some competencies, such as teamwork, communication skills, ability to work in an international team with students from various disciplines, nationalities and levels of knowledge and skills are of particular importance for successful employment in engineering positions. For this reason, many engineering departments implement their programs in problem-based learning in the form of projects. In such interdisciplinary projects the skills needed to work in international teams are developed.

3. A Global Dimension and New Players in Engineering Educations

Today we have new players in Engineering Educations – Massive Open Online Courses (MOOCs). The best example – MIT Circuits and Electronic course, with more than 150, 000 registered students. Current experience shows - MOOCs work if they offer excellent, well-considered content, access to some of the top minds on the subject, a high quality peer group and a well-designed platform.

Class Central search system gives more than forty MOOCs in Software Engineering, supplied by Stanford University, University of California, Berkeley, École Polytechnique Fédérale de Lausanne, Peking University, University of New Mexico, University of Toronto etc. There is no doubt that engineering education system will be dramatically changed in the nearest future by efforts of these massive MOOCs offering in the global education market.

But just to understand the need for change in higher and, in particular, higher engineering education is quite insufficient. We must understand that these changes specifically affect educational institutions training engineers.

Let us formulate these challenges of globalization based on the results of the project TREE [7]:

1. How ever booming labor market and the increasing number of stakeholders.
2. Stiff competition in the field of education between public and private sectors.
3. Adapting to radical changes in the system of higher education, research and implementation of training programs in general (in particular in the sector of engineering and technology)
4. Creating strong internationally recognized systems of quality assessment.
5. Improving the attractiveness and competitiveness in the world of European higher education.

Questions of engineering education in Europe have been researched by a number of scientists, including an international team headquartered at the University of Florence (Italy). They have carried out a number of projects in this area and some interesting results. For several years, the Institute of Transport and Communications is involved in one of these projects – EUGENE. [5] The purpose of this project was to increase the impact of European engineering education on competitiveness, innovation and socio-economic growth in both the European and global context. Some results of the project are still interesting to discuss.

In this case it is necessary to mention the Official Journal of SEFI, the Société Européenne pour la Formation des Ingénieurs (the European Society for Engineering Education) – European Journal of Engineering Education, whose aims are to develop information about engineering education, improve communication and exchange between professors, researchers and students and promote cooperation between various institutions involved in engineering education. [12] The Journal examines economic, cultural and social factors which influence the education of engineers in different societies and provides a forum where teachers and researchers from engineering schools, institutions and industry can share accounts of good practice and discuss methodology. Technological changes constantly create new demands on both engineers and educational system they came from. The Journal contributes to development and improvement of engineering education necessary to meet those demands.

However, many student engineers have little opportunity to work with others outside the silo of their department specialty. While there are some good examples of integration between disciplines and departments, The University of Sheffield Faculty of Engineering recognized that there had been potential for more collaboration to introduce experience of cross- faculty multi-disciplinary working into the curriculum. That resumed in working group of staff members from each of the nine engineering departments looking at opportunities for developing a vehicle to facilitate wider integration and exposure of students to inter- and multi-disciplinary projects. The recent 3-year project "A Global Dimension for Engineering Education" aimed to encourage embedding of global knowledge and awareness into the curriculum as well as had studied the challenges of sustainable development and importance of integrating technical knowledge within the wider context of social, environmental and economic development.

Another way to further development of engineering education is the implementation of joint program in several universities with appropriate diploma (JD - Joint Diploma). In this case, the accredited program in parts or in total can be mastered by students at several universities in different countries. JD can stimulate new ways of students' thinking and create new opportunities for multicultural education, open up new intellectual horizons, in order to create better employment prospects and broad professional perspective.

University teachers can find own opportunities in JD programs in international development of their professional competence by establishing links with colleagues abroad and acquiring new contacts and research topics. These programs can expand the understanding of the application of innovative teaching and learning methods.

4. Attractiveness of Engineering Education

We would like to dwell on the question the attractiveness of engineering education in Europe. If we look at the statistics over the last decade, it's clearly less number of students receiving education in engineering, compared to students studying in the field of social sciences. For example , the percentage of students receiving education in engineering and education in the social sciences in the universities of Latvia for the last decade is amended as follows : 2004 - 9 % and 54.7 % , 2006 - 10.3% and 54.3 % , 2008 - 11.1% and 54.0% , 2010 - 13.4% and 46.8% , 2011 - 14.2% and 44.0%, 2013 – 15.3% and 40%.

There also is a slight change in this ratio in favor of increasing the percentage of students receiving education in engineering, as a result of consistent government policy aimed at developing the real economy, and raise prestige of engineering graduates within labor market of Latvia. This is achieved in particular by creating of more budget places in universities for engineering training programs. However, this alone is not enough.

Image of engineering work in public opinion should be changed. This can be achieved through newspapers, television and other media. Special effect can be expected from conferences and exhibitions organized by outstanding technologically oriented business groups and associations aimed at the interests of the youth audience.

Such a strategy can be implemented, for example, on TV shows with physical experiments to solve non-trivial task, like German ARD television program does using German technology group Thyssen-Krupp. German Association of Physics DPG using Ruhr University Bochum promotes prestige of engineering degree with help of video movies, photos and descriptions on DVD, which can be regarded as an example of good practice.

Additional opportunity to increase the number of engineering professionals is to attract students of engineering programs. The number of male students significantly outnumbers women in engineering programs across Europe. In Latvia, the number of women in engineering programs in 2004 was only 21%, with an overall percentage of women enrolled in higher education is 63%. In 2013, with the total percentage of women students equal to 58% (64% in 2011) of all students, they were in engineering programs only 21% (22% in 2011). [11]

IEEE Women in Engineering (WIE) is the largest international professional organization dedicated to promoting women engineers and scientists and inspiring girls around the world in order to follow their academic interests to a career in engineering. IEEE provides services and programs to faculty, students, and volunteers. One of many missions of the IEEE Educational Activities Board University Resources Committee (URC) is to address issues related to faculty curriculum and development. Expanding commercial and social needs create unprecedented demand for engineering professionals that are technically proficient, and who can apply their expertise in a wide range of organizational, cultural, legal, and functional environments. IEEE works to serve by developing “classroom ready” cross-disciplinary, team-based course materials and projects for use by university-level instructors. [10]

The goal of the Real World Engineering Project (RWEP) program is to provide university educators in the IEEE fields of interest, who teach first year students world-wide with a library of free projects [8]:

- that are high quality;
- hands-on;
- team-based; and
- have a social impact.

RWEP projects allow students to discover the importance of various engineering and computer related fields of study in solving contemporary problems, and elicit excitement about creative problem solving.

Pennsylvania State University Women Engineering Program serves a community of approximately 1700 women graduate and undergraduate students and faculty in the College of Engineering. WEP focuses on development retention, recruitment, and overall climate enhancement activities. [9]

It should be noted that the attractiveness of engineering education also affects educational qualification of the academic staff. In a number of universities in Europe for all invited teaching professionals from the industry mandatory courses on pedagogy, sometimes with the mandatory certification, are implemented. International Organization for Engineering Education (IGIP) offers a special program of 20 ECTS credits for improving teaching and didactic training of teachers of engineering schools. Similar programs for teachers of engineering schools offer the University of Latvia and the European Humanities University in Vilnius (in the form of distance education). These programs include the theory and practice of pedagogy, psychological and sociological aspects of higher education, multimedia and e- learning technology, intercultural communication, and ethical aspects of engineering.

5. Conclusion

There are three historical models universities in Europe. Namely, the model of research at Humboldt University, the Anglo-Saxon model with a strong emphasis on developing of the student's personality and the Franco -Spanish rigidly centralized model. All universities including so called universities of applied science today are actually faced with changing economic conditions and social demands, are under this pressure and must be changed and adapted. Education management for people with technical mindset that work at engineering universities becomes decisive.

If politicians can not make a scientific career of technical researcher sufficiently attractive for the best young minds, it certainly works to the detriment of society - at a time when technological advances are the foundation for the core values - such as economic growth, environmental protection, health, as well as strengthening national security.

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