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# Five Decades at Technical Universities

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Curriculum development and the assurance of the quality of education is the main mission of Programme Committee of any Faculty at Kaunas University of Technology (KUT) in Kaunas, Lithuania. Globalisation and cooperation in the economy, rapid technical development and a liberalisation of the market is the challenge for Lithuanian technical universities and colleges to follow international trends and tendencies in engineering education generally, and in electronics in particular. In this article, the author deals with the activities and achievements of the academic staff of the Faculty of Telecommunications and Electronics at Kaunas University of Technology. Future plans and milestones are also presented and considered.

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## INTRODUCTION

Almost half a century ago, the author was enrolled at a university as a first year student. There were a few reasons to choose a technical university. At first engineering, especially electronics, was an attractive area for study and future employment in industry, research or at educational institutions. Secondly, in a totalitarian system, engineering was considered as an occupation that was not tied directly to politics.

An academic career for a bright and able university graduate was a challenge, because engineering education was on the rise, technical institutions were growing and the demand for young teachers was high. Teachers were encouraged to undertake research and earn a degree at a university. The other incentive for a degree was a much higher salary and the possibility of obtaining a good academic or administrative position.

In the former Soviet Union, the higher education system was unified for all republics. Central government institutions were responsible for the development and approval of curricula and syllabi. Institutions of higher education were only allowed to make minor changes that were considered necessary for the needs of local industry and communities. Therefore, academic staff were responsible mainly for teaching and personal development.

Things had changed after the restoration of the independent state of Lithuania in 1990. In accordance with the Science and Education Law of Lithuania, two-level degree programmes were introduced. Also, a

western-style flexible module/credit system has been implemented that emphasises the unity of study and research, a broad fundamental education, liberal study programmes and independent work. This was a challenge for universities because the former rigid curriculum could not meet the new approach towards education. In order to develop new or modernise existing curricula and syllabi, universities created Programme Committees. Obviously, there was a lack of experience; as such, international academic cooperation with foreign universities was highly beneficial.

A specially valuable initiative was the decision by the UNESCO International Centre for Engineering Education (UICEE) to organise *Baltic Region Seminars on Engineering Education* with participants from countries inside and outside of the Baltic Region. Since 1990, the Director of the UICEE, Prof. Zenon J. Pudlowski, has played a remarkable role by involving universities from Eastern Europe in the activities of the Centre and by creating favourable conditions for these activities.

## ACTIVITIES IN ENGINEERING EDUCATION

The main mission of the Programme Committees of the Kaunas University of Technology (KUT), Kaunas, Lithuania, was continual curriculum development and the assurance of quality of education. From the very beginning, the author was deeply involved in the

activities of the Programme Committee of the Faculty of Telecommunications and Electronics. Although his experience was focused on electronics engineering education, it was not confined by this specific area.

Serious steps in Information and Communications Technology (ICT) education system were taken by a Career Space consortium [1]. This consortium developed Curriculum Development Guidelines, *New ICT Curricula for the 21<sup>st</sup> Century: Designing Tomorrow's Education*, with the hope that the successful implementation of these guidelines would be beneficial to industry, academia and students. This challenge concerning industry and society was a problem for the global engineering education community in general, and for Kaunas University of Technology (KUT) in particular.

The formal modernisation of engineering education at the KUT started a decade ago. At that time, not all the problems were perceived and taken into consideration. Some problems were identified only later, mainly because of cooperation with partners from western universities and from participation in international programmes.

Let us consider the reasons. The first reason is the lack of competition among technical universities to attract graduates from secondary schools to the university. There are usually many more applicants than a university can enrol, for the time being. Secondly, graduates of the KUT, at least in information, electrical and electronics engineering, have no problems with employment. However, this does not mean that their education is excellent. The demand for graduates with engineering education has not decreased and employers have no alternatives.

The global electronic industry is growing at up to 10-15% per year, and will probably continue in a few years. In Lithuania, the demand for graduates is still on the rise in such growing areas of electronic applications as telecommunications, broadcasting, television, biomedical electronics, instrumentation, computer engineering, repair and maintenance services. Globalisation of the economy and the liberalisation of the market is the challenge for local universities to follow international tendencies in engineering education generally, and in electronics in particular.

Formally, there are no serious obstacles to follow this way because the educational system is very much like that adopted in western universities. The study programmes are flexible. Students are free to choose subjects, to move from faculty to faculty, and even to study some subjects at other institutions.

An analysis of educational situation undertaken a decade ago at KUT revealed several deficiencies, as follows:

- There was too much emphasis placed on teaching rather than on learning;
- Practical training did not reflect the fast changing needs of society and the labour market;
- There was limited access to information for both students and some academics because the level of English language proficiency was low;
- There was a lack of modern teaching laboratories and instrumentation because of scarce funds from the government;
- Study programmes needed to be modernised.

In order to solve some of these problems, the TEMPUS PHARE Joint European Project, *Restructuring of Electronics Studies in Lithuania*, was carried out from 1997-2001. Participating institutions of the project included the following:

- Kaunas University of Technology, Kaunas, Lithuania;
- Vilnius Gediminas Technical University, Vilnius, Lithuania;
- Technical University of Denmark (DTU), Copenhagen, Denmark;
- City University (CU), London, England, UK;
- University of Karlsruhe (UniK), Karlsruhe, Germany.

Activities of the project were coordinated by the author. These participating institutions had excellent experience: the Technical University of Denmark in engineering educational development, City University in the implementation of policies on quality assurance and quality enhancement in engineering education, and the University of Karlsruhe in the internationalisation of engineering education. These aspects were of great interest to their Lithuanian counterparts.

The main objectives of the project were to:

- Perform an essential review and analysis of the curricula at the Bachelor and Master degree levels, and formulate the requirements for new curricula, plus the contents of courses and teaching laboratories;
- Develop new and/or modernise existing courses and establish teaching laboratories in modern information technologies, metrology and instrumentation, plus the computer-aided design of electronic circuits;
- Retrain teachers from the KUT and VGTU at the DTU, CU and UniK;
- Reduce any communication barriers that may exist between the universities involved;

- Promote the learning of English as the main tool within engineering education and research;
- Implement the European Credit Transfer System (ECTS) and those curricula changes unavoidable for the SOCRATES/ERASMUS programme.

The accomplishment of these objectives was based on enthusiasm and the accumulated experience of Lithuanian academics, close cooperation with partner universities from abroad, professional and technical assistance from local universities and, above all, on financial support from the European Union (EU). Positive outcomes of the TEMPUS project created a favourable situation for international cooperation in engineering education.

In the course of 2000-2005, the author was involved in the activities of the Thematic Networks *Thematic Harmonisation in Electrical and Information Engineering in Europe* (THEIERE) and THEIERE-DISS within the framework of the SOCRATES Programme.

The objectives of these thematic networks were as follows:

- *Preparation of a survey concerning the available curricula in electrical and information engineering throughout the whole of Europe;*
- *A reflection on the best practices of high engineering education in the specific field of electrical and information engineering in a European perspective;*
- *The development of pieces of curricula and pedagogical tools available through the Internet as pre-requisites to help students for mobility exchange programmes;*
- *To enable a curricula comparison that will facilitate the transfer of knowledge between higher education institutions [2].*

The set of pedagogical tools developed in the project was utilised for creating a virtual library for online/distance learning. The outcomes of the project assisted in harmonising the curricula in electrical and information engineering and, in that way, facilitated the exchange of students within the framework of the SOCRATES/ERASMUS programme throughout Europe.

In curriculum development, the needs of local employers have to be taken into consideration as well. Every spring, the Student Association of the Faculty of Telecommunications and Electronics organises Career Days with the participation of representatives from industry. Such an event is a good opportunity to

discuss industry needs and learn the opinions of employers about graduates' education and abilities, because these representatives are primarily engineers who work as managers or supervisors of projects.

At one meeting, these representatives were asked to arrange the presented knowledge and abilities of graduates in a list with decreasing importance. The average results are presented in Table 1. The higher position in the list was considered as more important for a graduate. Any deviation of answers from the mean was expressed by the standard deviation.

Table 1: Knowledge and abilities of graduates.

Rank	Competence	$\sigma$
1.	Professional competence	2.03
2.	<i>Ability to solve problems and develop plans</i>	2.13
3.	<i>Ability to gain and apply new knowledge</i>	2.04
4.	<i>Fluency in English</i>	2.83
5.	Professional skills	2.95
6.	Computational literacy	2.61
7.	<i>Ability to work in team</i>	2.17
8.	<i>Communication skills</i>	1.57
9.	Basic sciences	3.37
10.	Economics and management	1.78
11.	Ethical standards and legal responsibilities	0.92
12.	Humanities and perception of arts	1.67
13.	Protection of the environment	0.66

It is obvious that some of these elements of the list reflect the very curriculum, while the rest represent peculiarities of curriculum realisation (these are printed in italics).

What was the main finding from this? Obviously, it was a positive evaluation of the abilities to solve problems and develop plans, gain and apply new knowledge, and fluency in English. Even abilities to work in teams and communication skills were of higher status than basic sciences, economics and management, ethical standards and legal responsibilities. This was not a surprise, since similar tendencies have been indicated by other authors [3]. Thus, educating a student for a successful professional career is not so much dependent upon the curriculum or study programme, but more upon the realisation of it, including the development of independence, critical thinking and personal responsibility.

The key issue in any education is its quality. This depends not only upon the professional skills of academic staff, accessibility to modern information technologies and up-to-date equipment in laboratories, but also upon the student's attitude with regard to the studies itself.

In order to learn students' opinions, questionnaires were distributed to undergraduate students from the third and fourth years of study in four different classes of the electronics and telecommunications specialties. The questionnaires were completed in the classroom, with the aim to obtain every individual student's response. In conclusion, about 60 students took part in the survey, with each one of them reasonably attending classes.

In the students' opinions, the basic motivation for studies is the need for knowledge. The majority agreed that, at first, education provides specific knowledge. Secondly, it opens the mind or provides general knowledge. Some students, basically in the third year of study, were dissatisfied with the first and second year study subjects as being too theoretical. They felt that the subjects lacked practical design work, as well as the practical skills that they considered important for the engineering profession.

Although the majority of respondents were generally satisfied with the quality of studies, some preferred a more flexible study style. It was no wonder that clever students were in favour of independent study under the supervision of a professor instead of compulsory classroom activities.

Students sitting in a university class today are different from those students who had occupied the same seats 15 or more years ago. Classrooms are now filled with a generation of students who were raised on television, video games and the Internet. Evidently, their attitude towards education in general, and to a traditional university in particular, is different. As a consequence, some students' ethical or moral standards are still *terra incognita*.

There is a prevailing opinion in society that higher education may better establish one's professional career, thus the majority of students have plans to continue their education for a Master's degree. However, such aspirations are well-grounded only if a student's academic performance is reasonable.

How should one cope with the problem? Apparently, a unique solution cannot be found. Enrolment in universities and colleges is growing in Lithuania. Almost 80% of graduates of secondary schools are admitted annually to Lithuanian higher education institutions, including technical universities, faculties and colleges. This means that higher education is accessible to almost everyone – irrespective of his/her abilities, knowledge background and ambitions. Undoubtedly, the professional skills of academic staff are also very important.

According to Richard M. Felder,

*College teaching may be the only skilled profession for which no preparation or training is provided or required. You get a Ph.D., join a faculty, they show you your office, and then tell you "By the way, you're teaching 205 next semester. See you later" [4].*

Unfortunately, this is also often the case in Lithuania. Therefore, a teacher's professional development is of great concern for an appropriate department, since the department is responsible for the quality of education. Thus, educational problems and techniques are often discussed at departmental meetings and seminars.

The majority of engineering teachers have never had a formal course in education. Instead, they learned something about teaching from their professors. This is valuable, but not enough. This is why the University seeks to improve this situation. There is a special compulsory educational programme in pedagogy for young instructors and the possibility for further professional development for every teacher once every five years.

The Programme Committee encourages the professional development of academic staff as well. A teacher, in order to be successful in his/her occupation and, maybe, attractive to students, must be persistent and inventive, has to be prepared to use different approaches, various methods and techniques, including active learning.

As a matter of fact, active learning techniques do not make the teacher's job easier, but instead enhance the role of the teacher in the classroom. Therefore, the professional competence of the teacher is of great importance for the effectiveness of engineering education.

There is an ambiguous situation at a university. The main occupation of an academic staff member is teaching, but any promotion to a higher position is based on his/her research activities! Unfortunately, most research shows that there is almost no correlation between effective teaching and effective research. Research is very important for professional development, but personal perfection in teaching should be taken into consideration as well.

## ACHIEVEMENTS

The Career-Space Curriculum Guidelines and Generic Skills profiles were incorporated into bachelor degree courses at the Faculty of Telecommunications and Electronics. The Modernised curriculum provided graduates in electronics and telecommunication

engineering with the knowledge and professional skills at the level of European Union standards.

Established relations with partner universities and experience obtained from involvement with the TEMPUS Project was applied for the development of a system of permanent improvement for electronics engineering education in Lithuania. This also stimulated international cooperation in engineering education.

In response to the needs of students, the Programme Committee introduced a foundation course under the title *Material Science and Engineering*, with the laboratory project in the area of study for first year students. At the Faculty of Telecommunications and Electronics, Master's degree study programmes were developed and introduced with the active participation of the author.

International cooperation is very important for the professional development of academic staff. In order to stimulate this activity, a supporting group from the European Association for Education in Electrical and Information Engineering (EAEEIE) was established at the Faculty of Telecommunications and Electronics. The group consists of eight academic staff members, including two Council Members of the Association.

## Selected Publications

Selected publications accomplished:

- Krivickas, R., Perspectives of engineering education in electronics. *Global Journal of Engineering Education*, 1, 3, 309-311 (1997).
- Krivickas, R.V., The quality of master degree programmes. *Proc. Global Congress on Engineering Education.*, Kraków, Poland, 211-212 (1998).
- Krivickas, R.V., Quality assurance in engineering education. *Proc. 2<sup>nd</sup> Baltic Region Seminar on Engineering Education*, Riga, Latvia, 19-20 (1998).
- Krivickas, R.V., Quality of engineering education: student opinion. *Proc. 3<sup>rd</sup> Baltic Region Seminar on Engineering Education*, Göteborg, Sweden, 177-179 (1999).
- Krivickas, R.V., Problems of engineering education. *Proc. 2<sup>nd</sup> Global Congress on Engineering Education*, Wismar, Germany, 383-385 (2000).
- Krivickas, R.V., Bachelor's knowledge and skills: the employer's opinion. *Proc. 4<sup>th</sup> Baltic Region Seminar on Engineering Education*, Copenhagen, Denmark, 75-76 (2000).
- Krivickas, R.V., Online engineering education. *Proc. 5<sup>th</sup> Baltic Region Seminar on Engineering Education*, Gdynia, Poland, 173-174 (2001).
- Krivickas, R.V., Quality engineering education and student performance. *Proc. 3<sup>rd</sup> Global Congress on Engineering Education*, Glasgow, Scotland, UK, 152-154 (2002).
- Krivickas, R.V., The modernisation of studies in electronics. *Proc. 6<sup>th</sup> Baltic Region Seminar on Engineering Education*, Wismar/Warnemünde, Germany, 39-41 (2002).
- Krivickas, R.V. and Krivickas, J., The new college system of engineering education in Lithuania. *Proc. 7<sup>th</sup> Baltic Region Seminar on Engineering Education*, St Petersburg, Russia, 115-116 (2003).
- Thiriet, J-M., et al, Towards the Harmonisation of Electrical and Information Engineering Education in Europe. Lisboa-Nancy: EAEEIE, 123-127 (2003).
- Krivickas, R.V., Active learning at Kaunas University of Technology. *Proc. 8<sup>th</sup> Baltic Region Seminar on Engineering Education*, Kaunas, Lithuania, 85-87 (2004).
- Krivickas, R.V., Quality developments in engineering education. *Proc. 9<sup>th</sup> Baltic Region Seminar on Engineering Education*, Gdynia, Poland, 203-206 (2005).
- Krivickas, R.V., Active learning at Kaunas University of Technology. *Global Journal of Engineering Education*, 9, 1, 43-47 (2005).
- Krivickas, R. and Joëys, A., *Basic Circuit Theory*. Vilnius: Mokslas (1980) (in Lithuanian).
- Krivickas, R., *Digital Signal Processing*. Vilnius: Mokslas (1984) (in Lithuanian).

Specific role within the UICEE global network:

- Participant at all (1<sup>st</sup> – 9<sup>th</sup>) *Baltic Region Seminars on Engineering Education*;
- Participant at the 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> *Global Congresses on Engineering Education*.

Specific linkages within and outside the UICEE global network:

- UICEE individual member.
- UICEE Silver Badge of Honour award for distinguished contributions to engineering education, outstanding achievements in the globalisation of engineering education through the activities of the Centre, and, in particular, for remarkable service to the UICEE, awarded in 1997.

- The 2004 UICEE Gold (Third Place) Award for a Distinguished Contribution in delivering an outstanding paper to the 8<sup>th</sup> *Baltic Region Seminar on Engineering Education*, held in Kaunas, Lithuania, between 2 and 4 September 2004.
- Lithuanian State Prize Laureate for the textbook *Basic Circuit Theory* (in Lithuanian, co-author A. Joèys) in 1985.
- Best Lecturer's Diploma, Kaunas Polytechnic Institute (since 1990 - Kaunas University of Technology), 1990.
- Member of the Council of the European Association for Education in Electrical and Information Engineering (EAEEIE).
- Individual member of the European Society for Engineering Education (SEFI).

Participation in Thematic Networks (Programme SOCRATES-ERASMUS):

- *Thematic Harmonisation in Electrical and Information Engineering in Europe* – Projects THEIERE and THEIERE-DISS (2000-2005) [2].
- *Reference Point for Electrical and Information Engineering in Europe* – Project EIE-Surveyor (2005-2008) [5].

Specific and outstanding involvement in conferences on engineering education include the following:

- Organising Committee Chairman of the Conference *Problems of Engineering Education*, Kaunas University of Technology, 2003, which incorporated participants from technical universities and colleges of Lithuania;
- Local Organising Committee Chairman of 8<sup>th</sup> *Baltic Region Seminar on Engineering Education* in Kaunas, Lithuania, 2-4 September 2004.

## FUTURE PLANS AND MILESTONES

The popularity of the engineering profession is not on a rise, although the prosperity of society depends upon the advancement of technology. The majority of able graduates from secondary schools prefer to study management, public administration, law or humanities, yet industry badly needs good engineers. There is a very serious problem concerning how to attract and motivate students to study engineering, and how to make engineering education more efficient.

Traditionally, engineering is still a realm of men in Lithuania. As such, it is important to increase the

recruitment of females and to create a favourable academic and social environment for women in technical universities and colleges.

The objective of industrial placement is to provide students with the opportunity to gain practical experience in an area that relates to their academic studies, and to develop further their professional technical and interpersonal skills. The situation where industrial placement was previously not compulsory and was left entirely to a student's decision has changed. In 2004, it was included in the curriculum with a duration of at least two months. The Programme Committee is analysing the effectiveness of this novelty, but only some preliminary results are available. These findings are still ambiguous, but to some extent, are better than what was expected.

## REFERENCES

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4. Felder, R.M., Resources in Science and Engineering Education (2005), <http://www.ncsu.edu/felder-public/RMF.html>
5. EAEEIE, Thematic Network EIE-Surveyor, Reference Point for Electrical and Information Engineering in Europe (2005), <http://www.eie-surveyor.org/>

## BIOGRAPHY



Romanas Vladas Krivickas is a professor of electronics and the Head of the Department of Signal Processing at Kaunas University of Technology, Kaunas, Lithuania. He graduated in radio-electronics from Kaunas Polytechnic Institute in 1961 and received his doctorate from Vilnius University in

1967. As a postgraduate fellow, he was at Tokyo University and the Polytechnic University in New York, USA. After graduation, he dedicated himself to an

academic career. His research interests are in circuit theory, signals and systems, as well as digital signal processing. He is the author of two textbooks. Currently, he is in charge of curriculum development at the Faculty of Telecommunications and Electronics at Kaunas University of Technology.

On the international front, he is a Council Member

of the European Association for Education in Electrical and Information Engineering (EAEIE).

He is also an active member of the UNESCO International Centre for Engineering Education (UICEE). In 1997, he was awarded with the UICEE Silver Badge of Honour for his distinguished contribution to engineering education.

## ***9<sup>th</sup> Baltic Region Seminar on Engineering Education: Seminar Proceedings***

edited by Zenon J. Pudlowski, Romuald Cwilewicz & Józef Lisowski

The very successful *9<sup>th</sup> Baltic Region Seminar on Engineering Education*, conducted at Gdynia Maritime University (GMU), Gdynia, Poland, between 17 and 20 June 2005, was held in conjunction with the GMU's 85<sup>th</sup> Anniversary and, indeed, the 85<sup>th</sup> anniversary of maritime education in Poland. Contributions from ten countries are represented in the 50 papers, which include an informative Opening Address about the GMU by its Rector, three Keynote Addresses and various Lead Papers. These papers present a diverse scope of important issues that currently affect on engineering and technology education at the national, regional and international levels. The strong participation from academics at the GMU displays the University's enthusiasm to advancing engineering education for the benefit of students, staff, industry and society.

The paramount objective of this Seminar was to bring together educators from the Baltic region to continue dialogue about common problems in engineering and technology education under the umbrella of the UICEE. To consider and debate the impact of globalisation on engineering and technology education within the context of the recent economic changes in the Baltic region, and in the context of the strong revival of the sea economy, were also important objectives of this Seminar. Moreover, the other important objectives were to discuss the need for innovation in engineering and technology education, and to establish new links and foster existing contacts, collaboration and friendships already generated in the region through the leadership of the UICEE.

The papers incorporated in these Proceedings reflect on the international debate regarding the processes and structure of current engineering education. They are grouped under the following broad topics:

- Opening and keynote addresses
- New technologies and developments in maritime engineering education
- Case studies
- Simulation, multimedia and the Internet in engineering education
- Innovation and alternatives in engineering education
- Specific engineering education programmes
- New trends and approaches to engineering education
- Quality issues and improvements in engineering education

It should be noted that all of the papers published in this volume were subject to a formal peer review process, as is the case with all UICEE publications. It is envisaged that these Proceedings will contribute to the international debate in engineering education and will become a source of information and reference on research and development in engineering education.

To purchase a copy of the Seminar Proceedings, a cheque for \$A70 (+ \$A10 for postage within Australia, and \$A20 for overseas postage) should be made payable to Monash University - UICEE, and sent to: Administrative Officer, UICEE, Faculty of Engineering, Monash University, Clayton, Victoria 3800, Australia. Please note that sales within Australia incur 10% GST.

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