Presence and Perspectives of the Engineering Education at the Slovak University of Technology

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***Abstract**: The paper describes the present condition of the academic education within the broad spectrum of technical fields of study at the Slovak University of Technology in Bratislava (STU) which represents a flag ship of technical education in Slovakia. The described characteristics of engineering education within a three-level model reflect changes done in the context of university education harmonization and support of European higher education area creation. These are based on information and knowledge acquired from prominent universities abroad whilst in keeping at the same time our own traditions and that's why we represent a model that is typical for Slovak universities aimed at engineering education.*

Introduction

The recent decade in the life of our university was very dynamic and with the highest probability the changes we witnessed in that period of time are incomparable with any other phase of higher education development within Slovakia. The expressive dynamics of life at the universities were caused on one hand by all of the society changes which were brought along by the year 1989 in our country and by the creation of a new Higher Education Act (1990). The Act brought a lot of new positive things for universities. The spirit of democracy and self-management within the organization and also in the activities of the university along with freedom of scientific research and publication of its results, freedom of art creation, the right to teach and learn, the right to various philosophical opinions and religions as well as the right to their dissemination in order to represent the new and positive things beyond comparison with the past.

On the other hand the end of the past decade brought a significant activation of the external environment outside of Slovakia, giving rise to harmonization of the academic education in Europe (Lisbon Convention 1997, Sorbonne Declaration 1998, Bologna Declaration 1999). "The Conception of further development of the higher educational system in Slovakia for the 21st century" was adopted by the Slovak government in 2000.

1. Short History of STU

The end of the First World War brought along significant political activities in Europe which resulted in the formation of new states including the Czechoslovak Republic. Within that state system, a technical university in Slovakia was founded in 1937 and after significant changes relating practically to all school functionalities it was renamed to STU in 1991. The university development during its more than 70 years history can be divided into 3 phases. The 1st phase from its foundation is characteristic by study fields like civil engineering, mechanical engineering, electrical engineering, chemical- technological engineering but also branches which underlie independent universities like forestry and agricultural engineering, mining engineering and economic engineering.

The 2nd phase in the university development is determined by political changes in the years 1948 and 1989 which significantly influenced all spheres of society. By the foundation of a state in 1948 applying communist ideology came a reform to all universities to trying to unify the education process. The major task of universities centrally managed by the Ministry of Education was by course of law "to educate skilled and politically highly qualified experts devoted to the People's Democracy Republic and committed to the idea of socialism". The curriculum in all fields of study was "enriched" by the study of state ideology. A new education form was established – study of employed people the so called distance study that enabled especially for nomenclature cadres to get an academic education without having to stop working (Sikorová, 1997). The STU retained a high level of technical education in many areas of technology and science. The year 1989, the year of the most significant political changes in the second half of the 20th century in all of Europe started the 3rd phase in the STU development, during which more than 12 000 students studied here.

2. Significance and Mission of Academic Education in the Process of Society Changes

We live in a time when three substantial factors radically and continuously affect the way society functions: information society development, the impact of science and techniques on the development of new technologies and economic globalization. Information technologies provide important opportunities in production and education. In this manner they bring together production and education. Changes associated with information technologies result in significant economic and social consequences which affect the development of a society and its fundamental element – the human.

Development and dissemination of scientific and technological information accelerate. There appears a new model of knowledge creation and know-how that interconnects a high specialization and interdisciplinary creativity. We anticipate the creation of a worldwide labour market.

In this situation, the main statutory mission of universities in Slovakia is to develop a harmonious personality, knowledge, wisdom, goodness and creativity and to support education, science and cultural development. (Act No. 172/1990 Coll. on higher education institutions). They perform their tasks, especially as follows:

- Bringing up experts with the highest education and high moral principles.
- To develop and disseminate information and knowledge via research, development, artistic and other creative activities.
- To provide opportunities for a lifelong education.
- To bring up students in the spirit of democracy, humanism and toleration, leading them to creative, critical and independent reasoning, healthy self-assurance and national self-esteem.
- To develop international, especially European cooperation, support common projects with universities abroad and other foreign institutions.

Academic education is performed in higher education institutions through their employees and students. They are expected (Jurišica et al.,2001):

1. to have an ethical approach and scientific consistency,
2. to make use of autonomy and academic freedoms as system of rights and duties being aware of responsibilities towards the society,
3. to express independently their opinion of ethical, cultural and social issues,

4. to analyze emerging technological, economic and social trends,
5. to protect and propagate universal values of mankind,
6. to assist in the identification and solving of social issues.

3. STU Nowadays

The development of an engineering education at the STU has been affected by political changes in 1989. In 1992 the government asked the Organization for Economical Cooperation and Development (OECD) to review globally the academic education here. Experts of OECD prepared a report defining 6 recommendations which are considered to be especially important for the development and regeneration of the Czech and Slovak educational systems (Final recommendations, 1992). The first of them is the recommendation of academic education diversification that meant a radical break with the existing system. Under diversification it was proposed to increase the percent of students admitted to study from ~ 15 % to 25 – 30 % thus building up an out-of-university sector from the higher educational system and to establish bachelor study as an independent type of study and not only the first phase of 4 to 6 years of academic study.

The above mentioned report, international contacts of university teachers and the legal personality of faculties were factors that incited faculties in 1993 – 1999 to radical structural and contentual education transformation at the STU. Since 1999 the STU faculties offer and provide academic education in a degree structure, i.e. bachelor, engineer (master) and PhD study.

STU holds long-time a very good position between universities in Slovakia what shows for example the accreditation process (see more in heading 3.2) finishing this year (2009). From 20 universities established in Slovakia (6 of them are technical universities) have in this accreditation only 6 universities confirmed the highest university status and STU belongs to them. In evaluation of Academic Ranking and Rating Agency (ARRA) within only technical universities received STU the best rank in last three years.

3.1. Study Characteristics and Organization at the STU

The offered education is aimed at technical, technological-material, technical-information, information, technical-economic, technical-artistic and artistic fields of study or disciplines.

As regards to the content aspect, study program curriculum is designed to enable the graduate:

- in bachelor study, to acquire theoretical and practical knowledge based on up-to-date science or art and to be able to use this knowledge in his career or ongoing university study;
- in engineer/master study, to acquire theoretical and practical knowledge based on up-to-date science or art and to gain abilities of the application of that knowledge in a career or PhD study;
- in PhD study, to acquire theoretical and practical knowledge based on up-to-date science and on ones own contribution as a result of scientific research and individual creative activities of the student in the field of science, technique or individual theoretical and creative activities.

In this manner education at all three levels is organically linked with scientific or artistic activities of teachers who by results of their creative activities practically and continuously innovate contents of special subjects and complete curriculum by updating new selective subjects for the professional profile of graduates of individual university study levels. Students are trained for development of the ability to acquire and classify the latest relevant information by means of advanced information-communication technologies. The development of language skills and specialized communication in foreign languages enables graduates to participate actively in international projects this being very important.

A summary of study possibilities at all three levels of university study (212 programs) is illustrated in the Figure 1 (Annual Report of STU, 2007). The Picture indicates the lowest numbers in bachelor study that confirms its mission – to gain a general education in the given area as possible. The acquisition of a deeper knowledge in a more specialized area is enabled by the 2nd and 3rd degree of university study which is often presented by the model of an "inverted pyramid".

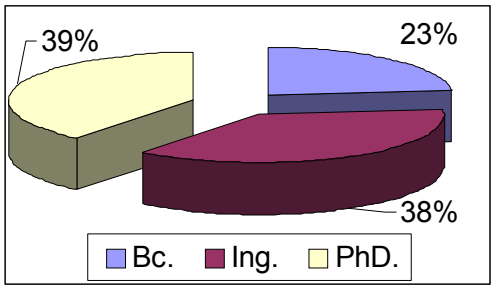

Figure 1: Study programs of STU

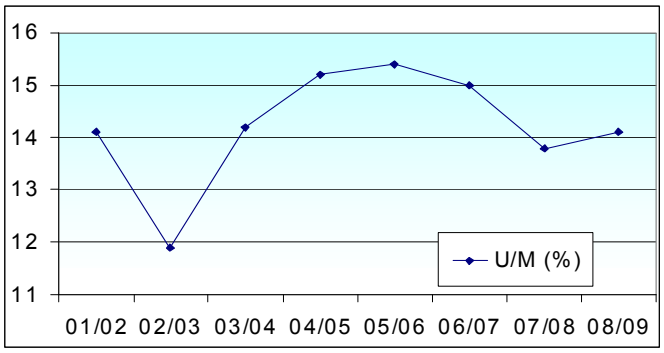

Figure 2: Proportion of applicants (U) and Secondary school-leavers (M) 2001 - 2009

All three levels of academic education apply the credit system study compatible with ECTS (Dalichow 1992) where students can determine their own pace of study within limits defined by study order of the university and create their own profile of study. Despite several years of experience with the credit system in faculties, it is not applied enough. E.g. practically it is not used for intra-university mobility.

Curriculum of individual study programs reflect are based on experience and desirable compatibility with significant technical universities abroad. They mirror the required proportionality of natural science subjects, theoretical-engineering (technical and technological) special subjects and humanities (Table 1).

Natural science	Theoretical-engineering	Special	Humanities
25 - 30 %	20 - 40 %	20 -50 %	5 - 15 %

Table 1: Structure of subjects in study programs

Lectures	Seminars	Laboratory exercises
40 - 50 %	15 - 30 %	25 - 40 %

Table 2: Methods of the education process

When we divide the process into lectures, seminars (seminar workshops, special workshops) and laboratory exercise (lab and design exercise, special lab exercise, art studio creation, seminars and annual works) the situation at the university as an average percents for the whole study is illustrated in the table 2 (Internal report of STU 2001).

The surveys confirm that it is important for the university to observe factors influencing students´ satisfaction. The students prefer the possibility to choose learning content and also to influence the organization of the educational process and at the same time independent thinking and acting. However, students positively evaluate good university reputation and a possibility to obtain recognition for above standard reached results.

3.2. Education Quality Management and Control at the STU

One of the principles of creating European higher education within the area listed in (Bologna Declaration, 1999) is a challenge to support European cooperation in education quality assurance. After 1989 at the state level a statutory duty (Act No. 172/1990, Act No. 131/2002) was placed to submit study programs of all three education levels provided by the university to accreditation. For judgement of university predisposition to implement proposed study programs the government of the Slovak Republic established an institution – the Accreditation Commission (AC) as its advisory body. The AC reviews especially:

- Requests of universities to implement study programs,
- Requests of non-university institutions to take part in implementation of PhD study programs,
- Proposals for granting state approval for a legal entity to operate as a private university,
- Proposals for any change in the system of fields of study.

Every six years the AC accredits all public universities according to a relatively complicated criteria system and makes a motion to the government for integration of universities, higher education institutions of a non-university nature and professional universities into categories. It is necessary to note that universities can implement only accredited study programs.

This system represents education quality management and control from the state level.

In an effort to come closer to the educational level of significant technical universities abroad, the STU conducted foreign audits of its institutional evaluation. The first one, conducted by IESC – International Executive Service Corps in 1997 was aimed at efficiency of the university organisation and management (IECS, 1997). The second one in 1998, conducted by the Association of European Universities was aimed at complex examination of educational, scientific and administrative-managerial competence of the university (CRE, 1998). The third audit in 2007 was conducted by request of the government by the European University Association (EUA) within the audit of all public universities in Slovakia (EUA 2007). The SWOT analyses of these audits including recommendations are motives for the STU on how to regulate their own activities to fulfil the mission.

The STU continuously monitors and regulates the quality of complex education activity. The applied model of the education quality management system includes the following processes:

- Evaluation of study programs by internal and external experts and successive approval of modifications,
- Proposal of new study programs and their harmonization with programs abroad.

Implementation of such a system required to define organizational structure, responsibilities of individual university bodies and managers and their powers. The university adopted a four-level quality management structure as follows: university => faculty => field of study => education subject.

The STU graduates have the lowest unemployment rate among Slovak universities aimed at engineering education. The interest in study at the STU is not corresponding with the diminishing number of secondary school-leavers caused by demographic development in Slovakia (Figure 2).

4. Conclusions

Education development at the STU in the recent two decades was expressively affected by two factors. Political changes in the years 1989 – 1990 that transformed practically all areas of social life in the communist countries of Central Europe enabled to change the life of universities on the principle of research freedom, free dissemination of knowledge and the possibility to present one's own academic opinions and ideas. In token of that we want to mention the fact that the next Assembly Congress SEFI (European Society for Engineering Education) and IGIP (International Society for Engineering Education) in 2010 will be organized by the STU.

Another change that affected the structure of the academic education process was motivated by harmonisation of academic education (Sorbonne Declaration 1998) and by the creation of the European higher education area (Bologna Declaration 1999). These changes have been applied at all Slovak universities providing engineering education.

It is obvious that this dynamic development also brought along certain negative aspects:

- Permanent under sizing of subsidizing funds of the state budget resulting especially in continuously deteriorating conditions of material and technical provision of the education process.
- Insufficient appreciation of graduates at many study programs provided by the university in the social practice.
- High loss of students especially in the first year of bachelor study which reflects insufficient preparation for higher technical education at secondary schools.
- The extensity of education methods especially e-learning is not applied enough in the education process.
- Low number of foreign mobilities, incommensurate to university traditions and education quality.

On the other side strong points of the present system are as follows:

- Education offered by the STU covers practically the whole spectrum of technical education
- Research activities of university employees form a base of knowledge serving the purpose of updating curricula contents.
- The pedagogues´ structure at the university
- Permanent professional contact and cooperation with practice in areas of applied research brings along impulses for innovation of study programs.
- Achievements of students in state-wide and international contests and acquisition of appreciations by various institutions of practice can be seen as another quality parameter.

These positives create a basis for further positive university development leading to adequate preparation of students for entering the home and foreign labour market and their successful career.

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