Higher Engineering Education Reform in the Universities in Serbia

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ABSTRACT: *This paper deals with Serbian higher education, especially in engineering, and with modern tendencies in globalization of European engineering education based on Bologna Declaration.*

The main goal of this work is to explain the existing system of engineering education in the Republic of Serbia: Scientific Universities with different Technical Faculties and Higher vocational technical schools. History of engineering education in the Republic of Serbia from the first Engineering Schools in 1846, then the Technical Faculty of Great School in 1863 and finally the University in 1905 will be presented as well as a comparative analysis with other relevant Universities (Technical) in Europe. Special focus will be done on the present state of affairs in the above-mentioned education with concrete measures for improvement of engineering education according to the actual European tendency.

At the same time necessity and a need for rapid, rational and efficient reforms and restructuring on Serbian higher education, especially in organizational, financial and educational domain, will be discussed.

1 INTRODUCTION

Modern engineering education in Europe is directly influenced by the Bologna Declaration which has defined the basic principles of higher education throughout Europe. It is unnecessary to emphasize the importance of efficient and rational education for the development and well-being of any society.

The university education in Serbia is unfortunately neither efficient nor rational. Average studies take too long, even twice longer than it is regulated, while the infrastructure and teaching standards are quite modest. Besides that, it is a system which still is not harmonized with the European educational system and represents a significant obstacle to faster integration of Serbia into the European cultural, scientific and economic tendency.

That is the reason why it is extremely important to take all necessary steps to establish a system of education, from high school to university education, which corresponds to European environment and respects the requests of common European educational system, for common – European labor market. That has been one of the main reasons for the state union of Serbia and Montenegro to join the Bologna Process, which will be formulated during the summit in Berlin in September 2003.

At this moment, there are two groups of tasks that are to be solved in the field of higher education in Serbia in the period up to the year 2010.

1. Restructuring of the higher education, including engineering, according to the model of developed European countries, and
2. Fitting into the European tendency of engineering education based on the principles of the Bologna Declaration.

The existing situation in engineering education in Serbia is analyzed in this paper and compared with the European practice in educating engineers in keeping with the Bologna model.

Taking into the consideration the need and necessity to join the contemporary European educational practice, which has been, growing in Serbia, concrete measures and activities that should be taken in the future are proposed in the conclusion of this paper in order to integrate into the consistent European field of higher education.

2 GENERAL INFORMATION ON THE REPUBLIC OF SERBIA AND ITS EDUCATION SYSTEM

As of 2003, the Republic of Serbia is a constitutive part of the state union of Serbia and Montenegro. It has an estimated population of 9.8 million and covers a land area of 88 361 km². GDP per capita is estimated at US$ 2 300. The total number of students at universities in Serbia (without Kosovo and Metohija) is 130,102 according to data from 2001. About 11,500 students graduate each year. There have been 35,000 students at technical faculties in Belgrade, Novi Sad, Kragujevac and Kosovska Mitrovica universities during the school year of 2001/02. The total number of university teachers (full time professors, associate professors and assistant professors) was 1,800 and 1,600 teaching assistant.

3 HISTORY OF ENGINEERING EDUCATION IN SERBIA

By establishing the "Engineering School" in Belgrade in 1846, started the education of engineers in Serbia. This school took only for three years but it had an important influence on forming a separate technical department at the "Lyceum" in 1853.

The key point in engineering education in Serbia occurred in 1863, when so called "Great School" was established so that it included three faculties, one of which was a 'technical' faculty for educating engineers.

When Belgrade University was established in 1905, the technical faculty with its three departments (civil engineering, architecture and mechanical engineering) was retained and such organizational scheme lasted until 1925 when the fourth department – chemical engineering - was set up at the technical faculty. It is important to emphasize that the organization of technical faculties, as well as the educational process itself (curricula, educational programs and teaching) was taken over from higher technical schools (technical universities) in the nearby European environment, mainly from Austria and Germany. This model, together with the related structure of teaching, has been preserved in most technical faculties in Serbia until this day.

After World War II, the Government of the Peoples Republic of Serbia passed 1948 a regulation on separating the Technical Faculty from the university and changing it into the independent Higher Technical School in Belgrade (Technical university). It was a very important moment for the further development of technical studies and one of crucial points for joining the contemporary European course of educating engineers. This regulation shifted the existing departments of the technical faculty into independent faculties. Unfortunately this organizational structure was abandoned in 1954. That was the year when a decision was made on closing the Higher Technical School and returning the departments under the umbrella of Belgrade University. This act, as it turned out later, substantially aggravated the efficiency and rationality of studying. One begam to appoint teachers at technical faculties, as well as on all other faculties within Belgrade University, for all disciplines (subjects) that has been studied in them, so that irrational selecting of professors for the same subject has been done in most faculties. The prevailing climate was to have own teachers for all subjects taught at individual faculties, and it was even legally supported, and all that led to the sudden increase of the number of teachers who taught both major and alternative subjects. This practice ranged from general education programs to narrowly expert disciplines. Some specific faculties, as a rarity in the European engineering education practice, have been established as a partial response to the USSR university education.

The outcome of this forty-five year lasting 'original approach' is the situation we currently encounter: reticence of faculties that act as 'independent universities', a number of teachers with disastrously law pays, parallel departments of the same scientific and teaching disciplines in different faculties, and unreasonably educational system with substantial loss of university professors' authority.

On the other hand, spatial and personnel fragmentation of the university could not lead to the development of some important common contents. At the same time each individual faculty published its own textbooks, practically with the same teaching content within common core curriculum mastered at most faculties (Mathematics, Technical Physics, Technical Mechanics, Descriptive Geometry, Sociology etc.); this approach also spread to a number of engineering fields.

A comparative analysis of the number of faculties, teachers and associates at Belgrade University and some European universities points out the significant disproportion in the number of teachers and associates, and especially researchers; while the number of the former is much higher at Belgrade

University, the number of the latter, who represent the future of the university, is notably lower. If the constant brain drain to developed European countries, the USA, Canada and Australia, etc. continues, the problem with retaining the teaching and scientific young generation at the university will become worrying. This problem is to reach its peak in ten years time, and unless some urgent measures are taken for overhauling that, it can become a source of great problems and seriously jeopardize the reform of the university education in Serbia.

There is also a similar situation in other universities in Serbia: Nis, Novi Sad, Kragujevac and Kosovska Mitrovica, with personnel problems even more distinct.

Study programs to educate engineers at universities in Serbia take five years, i.e. ten semesters. Regular lecture studies go on for nine semesters while the tenth semester is intended for working out the diploma thesis. On the basis of the diploma thesis and its public presentation, an academic degree of graduated engineer (Dipl.ing.) is acquired.

Upon completing graduate studies it is possible to continue education with advanced training at the postgraduate studies lasting for two years. After all exams are being successfully passed, the completion of the Master of Science degree theses and its public presentation, the academic degree of master of technical science (M.Sc.Tech.) is acquired.

The highest degree in engineering acquired at the university is the Doctor of technical science (D.Sc.Tech.). This degree is acquired on the basis of working out a doctoral dissertation and its public presentation. The work on doctoral dissertation lasts for five years.

Figure 1 represents a comparative diagram of acquired academic degrees at universities in Serbia, Germany, the United Kingdom, and it also gives proposals resulting from the Bologna Declaration.

Besides the engineering university education, there are a certain number of higher vocational technical schools in Serbia where practical knowledge in various technical areas is gained. These schools take two years to complete and they are no guarantee for the direct access to a university. A very small number of students who graduate from higher vocational technical schools continue their studies at the university.

4 THE BOLOGNA PROCESS AND GLOBALIZATION OF ENGINEERING EDUCATION

Needs to reform the engineering education are caused on one hand by the demand of the common European labor market, and on the other hand by the increase of competitive ability in relation to engineers from other regions. It is important to emphasize certain trends that started to appear in almost all European countries, and which, of course, have not evaded Serbia:

- the noticeable decrease of the number of students at engineering faculties;
- lower interest for studying engineering by high school students, their understanding that these studies are substantially harder compared to some other lucrative occupations (like management, economy, law, etc.);
- comprehension that the job of an engineer is not comfortable and that it is done in an inadequate surroundings; as well as
- impact of the reduction of the population of 18 to 19 years of age in regard to birth-rate problems that has been present starting from 1970s (in the 20th century).

The basic principles of the university education reform at the European level are established by the Bologna Declaration in 1999. Mobility, transparency, compatibility and comparability of diplomas represent the base for further work and forming the common European educational system.

In the following period until 2010, a consistent concept of higher education is to be established on the European continent based on so called 'ECTS' system (i.e. European Credit Transfer System) and absolute mobility of students, teachers researchers and administrative personnel within the frameworks of European universities! This will enable all graduate students a free access to European labor market with automatic recognition of their diplomas regardless to the country and university where it is acquired.

The stated concept anticipates so called three-cycle study system – "undergraduate (BSc (3-4 yrs 180-240 ECTS) / graduate (MSc (1-2 yrs 60-120 ECTS) / postgraduate (PhD (3yrs 180 ECTS))" with the simultaneous insurance of demanded quality of studies and accreditations to higher educational institutions at the European level.

The basic idea is that students, after completing an entire university teaching cycle, receive adequate diplomas (BSc, MSc, PhD) and that they are empowered to perform certain jobs for which interest and need on the labor market exist.

The past course of reforms that have been going on quickly in the European continent show that there is a significant consent in defining goals and it is formulated by the European Association for Engineering Education (Societe Europan pour la Formation des Ingenieurs). The views of this Association, also accepted by engineers in the Republic of Serbia, can be generally expressed as following:

- consent with establishing common European system – European dimension of comparative engineering education,
- consent with common European system of transferable credits during studies (ECTS), as well as with promoting ideas on mobility of students, teachers and researchers within European universities,
- consent with the Bologna Declaration signatories' recommendation on securing the quality of education and accreditation to educational institutions at the university level,
- taking into consideration the existing quality of engineering education in Europe,
- selecting on integrated 5-year engineering study program correspond to the idea of a common European Education area, and definition of a curricula oriented towards engineering practice that guarantees to graduate students' faster integration into European labor market.

New curricula and teaching programs are already present in some European technical universities and the teaching in accordance with them is being done starting from the school year 2001/2002, i.e. 2002/2003.

In view of the current activities in the university education in Europe, this moment is remarkable, it could be said historical, for implementing an overall reform in university education in Serbia. The basic goal of this reform, along with applying the principles of the Bologna Declaration, is also to make the essential changes in university education in accordance with the realistic capabilities and needs of Serbia.

The experiences of some European countries (Germany, Austria, Switzerland, Holland) with a similar engineering education system, in the current implementation of reforms based upon the Bologna Declaration is of special importance and use for Serbia. These experiences will be precious for the reform steps which are to be taken within the area of engineering education and will contribute to more efficient integration of Serbia into European courses of educating engineers.

At this moment, some extensive activities are being undertaken in Serbia to form legal frameworks that will enable the realization of the Bologna process. Professors, students and government representatives in Serbia are involved in these activities with an aim to create a law on higher education, which is absolutely compatible with modern European laws in this area.

It is expected that the first curricula and teaching programs according to this model of studies start to be implemented during the school year of 2004/2005.

Figure 2 shows a suggested European model of engineering education for scientific (BSc, MSc and PhD) and applied studies (BEng).

Figure 3 shows the suggested European structure of university engineering studies curriculum for undergraduate (BSc) and graduate (MSc) cycles.

5 CONCLUSION

The engineering education reform in Serbia must be based on clearly defined concepts and strategies adopted at the state level and adequate to the real needs and society potential. The concrete activities that should be carried out in the future period refer to:

- rational organization of universities (classical university and/or technical university) depending on the number of students, number of faculties and available resources (funding, teaching staff, associates, infrastructure and teaching standards etc.),
- evaluation of the existing curricula and programs and establishing initiating grounds for introducing ECT(A)S, setting up a modular way of teaching based on one-semester subjects,
- introducing a larger number of elective subjects,
- creating conditions for mobility, first at the level of the state union of Serbia and Montenegro, and then within the Balkans and finally within Europe, and

- providing conditions for permanent engineering education, so called lifelong learning.

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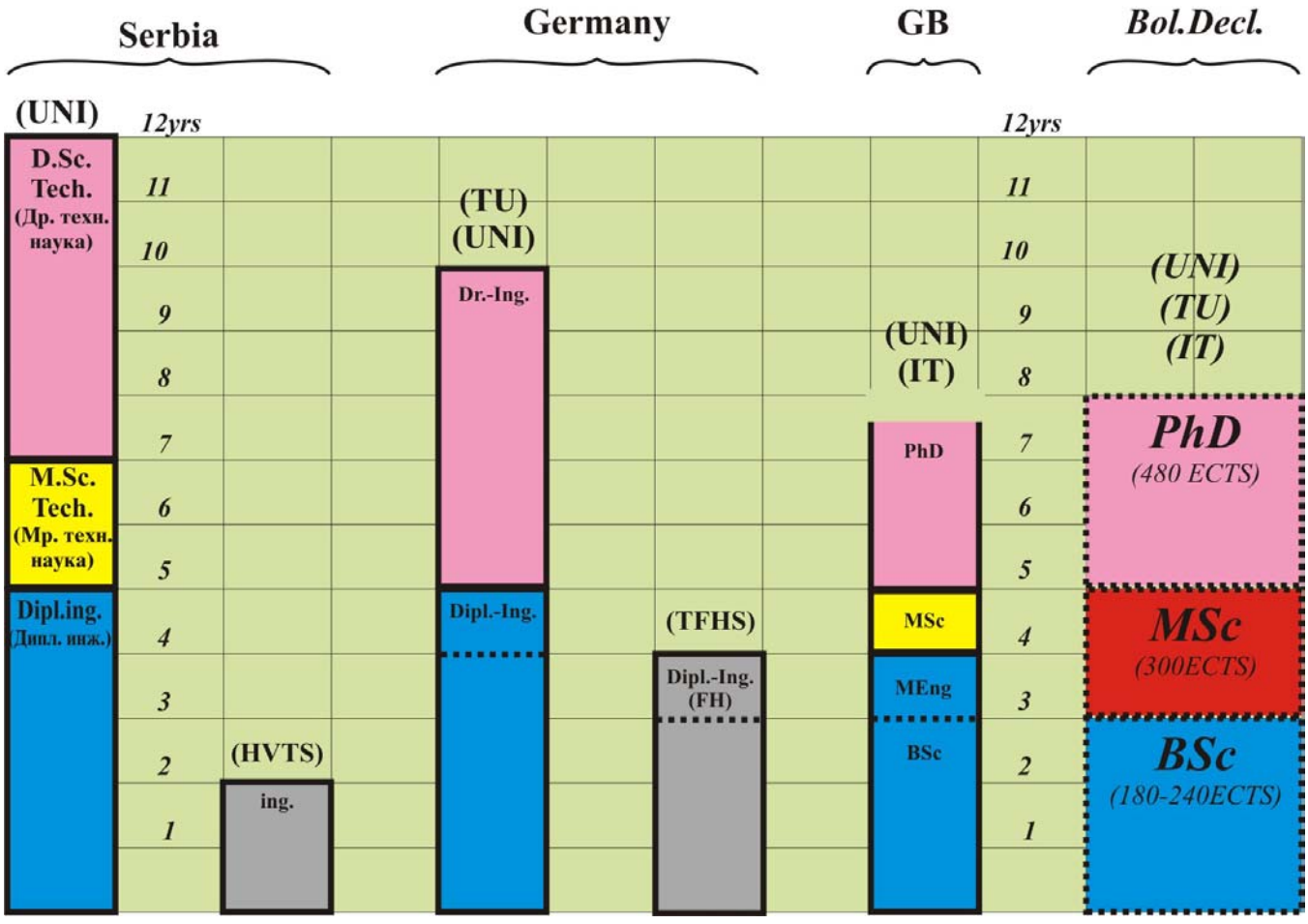

FIGURE 1 - Academic degrees at universities in Serbia, Germany, United Kingdom, and proposals from the Bologna Declaration

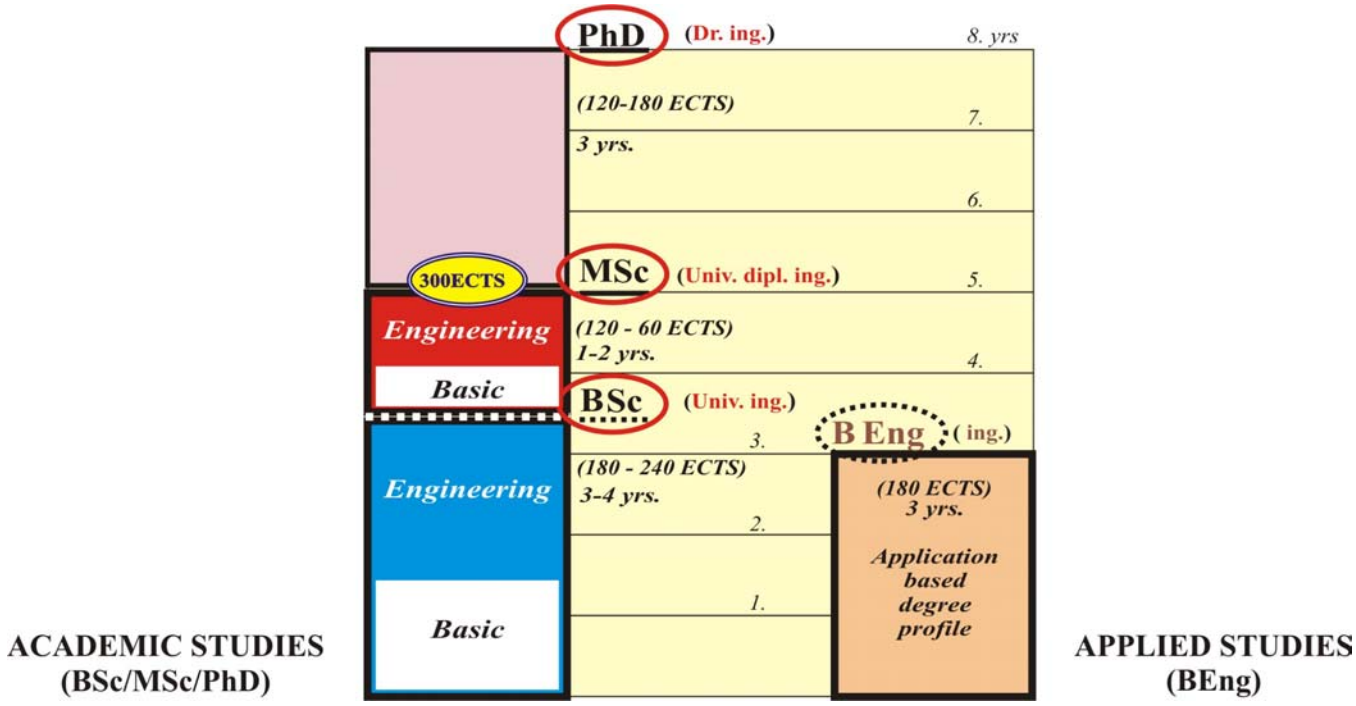

FIGURE 2 - Global model of engineering education for academic (BSc, MSc and PhD) and applied studies (BEng).

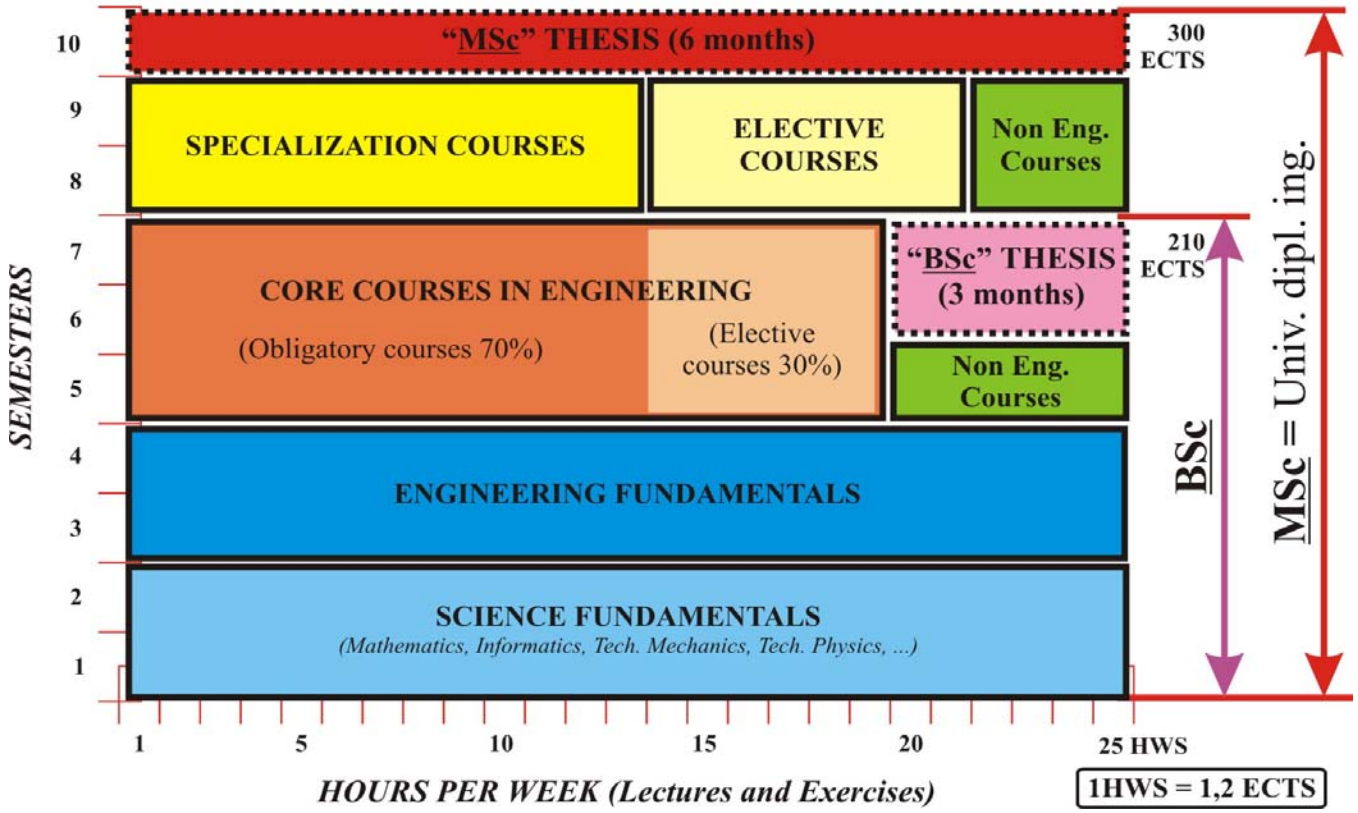

FIGURE 3 - Global structure of university engineering studies curriculum for undergraduate (BSc) and graduate (MSc) degrees