



## Comparative analysis of engineering study programs at two universities in Italy and Serbia

Milica Stojković<sup>1</sup> and Elisabetta Ghirardelli<sup>2</sup>

<sup>1</sup> Faculty of Technical Sciences, University of Kragujevac, Serbia

<sup>2</sup> Student of University of Brescia, Brescia, Italy

e-mail [milica.stojkovic@ftn.kg.ac.rs](mailto:milica.stojkovic@ftn.kg.ac.rs), [e.ghirardelli@studenti.unibs.it](mailto:e.ghirardelli@studenti.unibs.it)

**Abstract:** *Engineering is the discipline and profession that has as its objective the application of knowledge and results of the mathematical, physical and natural sciences to the resolution of problems regarding the satisfaction of human needs. In the context of internationalization of higher education, the main goal of this paper is to compare opportunities for engineering education in educational systems of two European countries, Italy and Serbia. For that purpose the structure of university study programs in the field of engineering education at University of Brescia and University of Kragujevac was analyzed.*

**Keywords:** *engineering education, university study programs, comparative analysis...*

### 1. INTRODUCTION

Engineering arises as the technical field related to the use of scientific knowledge for the development of systems and solutions that meet the needs of society. In this sense, applying the technical standards, it provides methodologies, projects and specifications for the design, implementation and management of a physical asset, of a product or of a more or less complex, and more in general service for the development and control of an industrial process through appropriate system. [1]

Nowadays engineering covers a lot of different disciplines ranging from industrial, mechanical, chemical, energetic, textile, civil and environmental, information engineering, electrical and informatical, clinical to marine, nuclear and aerospace engineering. From these disciplines are derived a lot of different specializations, so that there are around 50 different fields belonging to engineering education.

Higher education is becoming more and more international for several reasons related to commercial advantage, knowledge and language acquisition, enhancing the curriculum with international content, and many others.

### 2. HIGHER EDUCATION IN ITALY AND SERBIA

Italy has played an important role in European higher education: it is one of the four countries that first engaged to create the so-called "European Area of Higher Education" (Sorbonne Declaration, May 1998), thus starting that type of higher education reform which, known as "Bologna Process" (Bologna Declaration, June 1999) is being implemented all over Europe.

According to the report from 2012 made by MIUR (Ministry of Education, University and Research), in collaboration with CIMEA Foundation Rui and CINECA [2], Italian higher education is structured in a binary system, consisting of two main articulations: the university sector and the non-university sector. At present, the university sector is made up of 89 university institutions which are classified in 58 State universities, 17 non-State universities but legally recognized by the State, 2 universities for foreigners and 6 higher schools specialized in postgraduate university studies and 6 online learning universities. The non-university sector includes 4 education typologies with their institutions: higher schools of design (polytechnics for the arts, academies of fine arts, higher institutes for applied arts, music conservatories and recognized music institutes, higher institutes for musical and choreographic studies, national academies), higher education in language mediation (higher schools for language mediators), higher integrated education (programs of higher technical education & training) and a few specific fields (e.g. archiving, diplomatic, restoration, military studies, etc.) which, along with their respective institutions, fall under the supervision of ministries other than that of Education. According to a statistical survey made by the Office of Statistics of MIUR updated to November 2015 [3], in the Italian universities there are around 1 600 000 students.

According to report from 2012 made by EACEA (European Commission Education, Audiovisual and Culture Executive Agency) and National Tempus Office in Serbia [4], the three-cycle structure of higher education based on the Bologna principles was formally implemented in the academic year 2006/2007. The Law on Higher Education (LHE, 2005 and amendments in 2008, 2010 and 2012) provides a legal basis for full implementation of the Bologna Declaration and the Lisbon Convention.

There are three types of higher education institutions in Serbia: universities (*univerzitet*), colleges of applied sciences (*visoka škola strukovnih studija*) and colleges of academic studies (*visoka škola akademskih studija*). Serbia has altogether 8 public and 9 private universities, 47 state-funded colleges of applied studies and 17 private colleges of applied studies. The number of colleges of academic studies is 8 in total: 3 are state funded and 5 are private. According to the data for academic year 2011/2012, there were approximately 200 000 students in higher education.

A comparative overview of important features of higher education system in Italy and Serbia is presented in Table 1.

Table 1: An overview of important features of higher education system in Italy and Serbia

	Italy	Serbia
Types of tertiary education programs	The three-cycle structure (Bachelor, Master and PhD)	The three-cycle structure (Bachelor, Master and PhD)
Types of tertiary education institutions	<ul style="list-style-type: none"> <li>- Universities (58 public, 17 private, 2 for foreigners, 6 postgraduate university and 6 online learning university)</li> <li>- Higher schools of design</li> <li>- Higher education in language mediation</li> <li>- Higher integrated education</li> <li>- Other specific fields</li> </ul>	<ul style="list-style-type: none"> <li>- Universities (8 public and 9 private)</li> <li>- Colleges of applied sciences (47 public and 17 private)</li> <li>- Colleges of academic studies (3 public and 5 private)</li> </ul>

In Serbia Faculties usually have the status of a legal body, but they cannot exist independently as they need to be a constituent part of a university. Universities are the only teaching and research higher education institutions in the country that provide all three cycles of higher education as well as some forms of lifelong learning. In Italy the universities are organized in departments. A department is an organizational structure within the Italian university, which promotes and coordinates research activities and related teaching of one or more areas of research that are of uniform purpose and method. The Gelmini's reform in 2010 (Law 30 December 2010, n. 240) abolished the university faculties and the related organs, replaced and merged the competence of the university department [5]. The departments enjoy administrative and financial autonomy within the limits prescribed by the regulations of the universities.

### 3. ENGINEERING EDUCATION AT UNIVERSITY OF BRESCIA, ITALY, AND UNIVERSITY OF KRAGUJEVAC, SERBIA

In this paper comparative analysis was conducted at level of two medium size public Universities in both Italy and Serbia. University of Brescia and University of Kragujevac are very similar regarding the size of these universities, referring to the number of students, employees and departments/faculties (comparative data of main features of both Universities are presented in Table 2). As it was argued in the previous section, faculty level in higher education in Serbia equals department level in Italy.

**Table 2.** Comparison of main features of University of Brescia [6] and University of Kragujevac [7][8].

	University of Brescia	University of Kragujevac
Number of employees	1 078	1 133
Number of students	approx. 14 600	approx. 19 000
Number of faculties / departments	8 departments:	12 faculties:
	Economics and Management Law Molecular and Translational Medicine Surgery, Radiology, and Public Health	Economics Law Medical Sciences
	Mechanical and Industrial Engineering Information Engineering Architectural Engineering and Mathematics Civil Engineering	Mechanical and Civil Engineering Engineering Science Technical Sciences
	Clinical and Experimental Sciences	Agronomy Education Teachers Training Faculty Philology and Art Hotel Management and Tourism

University of Brescia consists of 8 departments related to 4 big teaching areas: economy, law, engineering and medicine. All the departments are located in the city of Brescia [9]. University of Kragujevac consists of 12 accredited faculties which are located in 6 cities of central Serbia: Kragujevac, Čačak, Jagodina, Kraljevo, Užice and Vrnjačka Banja [10].

According to the data for academic year 2014/2015, at a national level, University of Brescia covers the 22<sup>nd</sup> position among the 58 Italian public universities, considering a lot of factors like attractiveness, sustainability, international mobility, satisfaction, teaching and research. According to Webometrics Ranking of World Universities, University of Kragujevac is 4<sup>th</sup> ranked public University in Serbia [11], among total of 8 public universities.

Engineering in University of Brescia covers three main branches, related to the name of the departments: information engineering, mechanical and industrial engineering, civil, environmental and architectural engineering [12]. Engineering in University of Kragujevac covers the following main branches: mechanical engineering, IT engineering, electrical engineering, civil engineering and management engineering. At both of universities these broad areas of engineering are thought through variety of courses. The frequencies of university courses these fields of engineering across all levels of studies at both Universities are given in Table 3.

Table 3: The structure of university study programs in engineering at all levels of studies at University of Brescia and University of Kragujevac

	University of Brescia			University of Kragujevac		
	Bachelor	Master	PhD	Bachelor	Master	PhD
Information Engineering	1	2	4	2	2	2
Mechanical and Industrial engineering	2	3	4	6	5	2
Electrical engineering	1	1	1	1	1	1
Engineering management	1	1	/	1	1	/
Civil, Environmental and Architectural Engineering	3	4	4	1	/	/

At University of Brescia the Information Engineering’s main competences range in the fields of automation, electromagnetic fields, electronics, physics of fundamental Interaction, information technology, electric and electronic measurements, condensed matter physics and telecommunications. Teaching and research activities for Mechanical and Industrial Engineering are chemistry for technologies, nuclear physics, technical physics, industrial and mechanical plants, economic and managerial, fluid machines and systems for converting energy, metallurgy, mechanical and thermal measures, science and technology of materials, sociology of economic and work processes. Study programs for Civil, Environmental and Architectural Engineering are focused on architecture, restoration of historical and modern buildings, building technology, structural analysis and design, seismic engineering, seismology, structural mechanics, geotechnical engineering, transportation, waste management, fluid mechanics, hydraulic structures and hydrology. Bachelor’s level undergraduate study consists of 180 ECTS, Master’s level of 120 ECTS and Doctoral studies of 180 ECTS.

At University of Kragujevac [13] Bachelor's level undergraduate studies with 240 ECTS are the most frequent in Electrical and Computer Engineering, Mechanical engineering, IT engineering, Industrial and management engineering, Military-industrial engineering and Urban engineering. Bachelor's studies with 180 ECTS are found only in Mechanical engineering (with variety of modules).

At Master's studies courses with 60 ECTS are the most frequent: Electrical and Computer Engineering, Mechanical engineering, IT engineering, Industrial and management engineering, Engineering management, Industrial engineering - Business information systems and Military-industrial engineering. Courses with 120 ECTS are also available at Master's level in Mechanical engineering (with variety of modules such as: Production engineering, Mechanical structures and mechanization, Motor vehicles and IC engines, Energy and process engineering, Applied mechanics and automatic control, Industrial engineering, Informatics in engineering and Road traffic engineering, Computer aided machine design, Production engineering, Automatic Control, robotics and fluid techniques, Power engineering and environment protection)

Doctoral studies of 180 ECTS are found only in Mechanical engineering, Electrical and Computer Engineering and IT engineering.

#### 4. CONCLUSION

Academic offer in engineering education at University of Brescia, Italy, and University of Kragujevac, Serbia, was analyzed in this paper. Both universities represent medium size and quite solid medium-high quality universities in the national context of each country.

Overall it can be concluded that at both universities, regardless of the level of the studies, mechanical and industrial engineering courses are the most frequent ones, followed by IT engineering courses. The main difference was determined in the field of civil, environmental and architectural engineering: University of Brescia has more diverse offer in courses in civil, environmental and architectural engineering at all levels of studies. On the other hand, mechanical engineering courses are more developed in University of Kragujevac bachelor's and master's programs.

It can also be concluded that there are opposite trends from bachelor to PhD studies when it comes to total number of academic courses in engineering: at University of Brescia number of academic courses in engineering is increasing from bachelor to PhD programs (from 8 courses in the Bachelor degree to 11 courses for the Master and up to 13 courses for PhD study programs). However, at University of Kragujevac the trend is opposite: the number of academic courses in engineering is decreasing from bachelor to PhD programs (from 11 Bachelor's courses to 9 Master's course and up to 5 PhD courses).

All these similar features and few differences between the two university and, in an overview, between Italy and Serbia, allow the internationalization of higher education, that is becoming always more important for students and academic staff.

#### REFERENCES

- [1] CEEE. *Definition of Engineering/Engineering Technology*, Western Michigan University: Center for Excellence in Engineering Education, retrieved May 2016 from <http://wmich.edu/engineer/ceee/miller/082903/Lecture%20Notes.pdf>
- [2] MIUR, CIMEA of Fondazione Rui and CINECA (2012). Study in Italy. CINECA for MIUR, <http://www.study-in-italy.it/>

- 
- [3] MIUR, Office of Statistics. Survey on Education University <http://statistica.miur.it/scripts/IU/vIU1.asp>
  - [4] EACEA (2012). *Higher education system in Serbia*. Tempus Office Serbia, [http://eacea.ec.europa.eu/tempus/participating\\_countries/overview/Serbia.pdf](http://eacea.ec.europa.eu/tempus/participating_countries/overview/Serbia.pdf)
  - [5] Norme in materia di organizzazione delle università, di personale accademico e reclutamento, nonché delega al Governo per incentivare la qualità e l'efficienza del sistema universitario, *Gazzetta Ufficiale* retrieved from <http://www.camera.it/parlam/leggi/102401>
  - [6] [http://www.unibs.it/sites/default/files/ricerca/allegati/libretto%20uni%2003-09\\_0\\_0.pdf](http://www.unibs.it/sites/default/files/ricerca/allegati/libretto%20uni%2003-09_0_0.pdf)
  - [7] [http://www.kg.ac.rs/Docs/izvestaj\\_o\\_radu\\_2012-2015.pdf](http://www.kg.ac.rs/Docs/izvestaj_o_radu_2012-2015.pdf)
  - [8] [http://www.kg.ac.rs/Docs/Informator\\_o\\_radu\\_Univerziteta\\_u\\_Kragujevcu.pdf](http://www.kg.ac.rs/Docs/Informator_o_radu_Univerziteta_u_Kragujevcu.pdf)
  - [9] Università degli Studi di Brescia <http://www.unibs.it/mission>
  - [10] University of Kragujevac <http://www.kg.ac.rs/eng/about.php>
  - [11] Ranking Web of Universities – Serbia <http://www.webometrics.info/en/Europe/Serbia>
  - [12] Università degli Studi di Brescia – Departments <http://en.unibs.it/departments>
  - [13] University of Kragujevac – Members <http://www.kg.ac.rs/eng/members.php>