MODERNIZATION OF STUDY PROGRAMS – GOAL OF ROMANIAN GEODETIC EDUCATION

Petre Iuliu DRAGOMIR, Prof.PhD.eng. –Technical University of Civil Engineering Bucharest , petreiuliu.dragomir@gmal.com,
Dumitru ONOSE, Prof.PhD.eng. – Technical University of Civil Engineering Bucharest , balanta7@hotmail.com,
Aurel SĂRĂCIN, Assoc.Prof.PhD.eng.–Technical University of Civil Engineering Bucharest , saracinaurel@yahoo.com,
Gheorghe BADEA, Assoc.Prof.PhD.eng.–Technical University of Civil Engineering Bucharest, badeacadastru@gmail.com,
Caius DIDULESCU, Lect.PhD.eng.–Technical University of Civil Engineering Bucharest , caiusdidulescu@yahoo.com,
Ana Cornelia BADEA, Lect.PhD.eng.–Technical University of Civil Engineering Bucharest , badeacadastru@gmail.com,
Adrian SAVU, Lect.PhD.eng. –Technical University of Civil Engineering Bucharest , adisavu2002@yahoo.com,
Aurel NEGRILĂ, Assist.Lect.PhD.stud.eng.–Technical University of Civil Engineering Bucharest , negrilaa@yahoo.co.uk,
Tudorel CLINCI, Assist.Lect.PhD.stud.eng. –Technical University of Civil Engineering Bucharest , tudorelsilviu@yahoo.com

***Abstract**: Romanian geodetic education, as any other educational system in the world, can not develop as a closed system, unresponsive to specific developments in the European area of education and to general trends in the profession.*
Based on: comparative analysis of educational programs in EU faculties, curricula assessment of land measurement and cadastre specialization in four universities in Romania, skills necessary to be provided to the future graduates, using a model of quality assurance, proposals are made to modernize the geodetic engineering programs in Romania.

***Keywords:** geodesy, study programs, proposals to modernize*

1. Introduction

Bologna Declaration of June 1999, contains the steps required in terms of creating a common European higher education sector [EU Rectors' Conference of Confederation, 1999] and covers the following main points:

- introduction of an easily understandable and comparable degrees system;
- organizing the cycles of study in all countries, with a first degree qualification after three years of study;
- introduction of compatible credit transfer systems ;
- removing barriers to mobility for students and university teachers;
- creation of an European system of quality assurance with comparable methods and criteria;

- promoting the European dimension in curriculum design and education.

These steps have also been integrated by the Romanian higher education system.

Romanian geodetic higher education, like any education system in the world, could not develop as a closed system, unresponsive to specific developments in the European area of education and general trends in the profession.

Training concept of geodesists' vocational training should be based on common professional identity of experts community in land measurement. Geodesist profession has at international level a "common culture" and a common education. Professional issues that educational programs are designed to solve are basically the same, even if the solutions are different, responding to the national needs of society in each country.

To provide jobs and create a more competitive and sustainable economy, Europe needs a highly skilled workforce, able to face current and future challenges.

Number of graduates with license and / or master diploma varies widely in different countries and, to some extent, even between universities within the same country. It is therefore appropriate, on the increasing internationalization of labour markets and the gradual merging towards a global labour market, comparable levels of quality assurance activities to be developed in university geodetic education.

For this purpose it is necessary to provide compatibility of study programs content and as well of courses, so as detailed results of the educational process such as annexes to the study diploma to be able to be compared, which have a uniform internationally accepted content, corresponding to minimum education criteria, meeting national requirements in terms of training specialists able to give effective solutions for design, conduct and operation of works from the land measurements field with different destinations (engineering surveying, cadastre, urban planning, etc.).

To meet these goals, the Technical University of Civil Engineering Bucharest, in the framework of Human Resources Development Operational Programme 2007 - 2013, Priority Axis 1 "Education and training in support of economic growth and development of knowledge based society", major field of intervention: 1.2 "Quality in higher education", has launched and is ongoing the project "Online network for university collaboration to develop the capacity to provide superior competence in geodesy". Partners in this project are the Timisoara "Politehnica" University , Iasi "Gheorghe Asachi" Technical University and Alba Iulia "1 Decembrie 1918" University .

2. Evaluation of existing study programs, corresponding to the specialization "land measurement and cadastre"

An important step in the structuring of new programs of study consisted in achieving analyzes regarding study programs for specialization "land measurement and cadastre" implemented in the partner universities in order to create the possibility of identifying areas and methods to represent a common base for quality growth, based on aspects of quality implementation in partner universities, for the harmonization of study programs in compliance with the current standards and ensuring compatibility and comparability with international reference standards.

At basis of current study programs is the methodology developed by the Romanian Agency for Quality Assurance in Higher Education (ARACIS), designed to ensure optimal development conditions for the educational process and results in a series of standards and indicators, some of which referring to the duration of schooling and teaching volume for day classes:

- duration of studies - 8 semesters

- duration of a semester (min.) - 14 weeks,
- number of hours / week - 26-28.

Compliance with ARACIS standards was highlighted by the analysis of quality achievement in the partner universities and curriculum analysis.

Summary table for quality achievement in partner universities

Quality coefficients / performance indicators				
University	**Alba Iulia „1 Decembrie 1918" University**	**Bucharest Technical University of Civil Engineering**	**Iasi "Gheorghe Asachi"Technical University**	**Timisoara "Politehnica" University**
Ratio teaching positions no./ students no.	1/14	1/8		1/10
The number of full-time teachers	15	40		7
Share of core disciplines in the curriculum (in %)	20.3	20.2	17.6	18.6
Share of field disciplines in the curriculum (in %)	38.9	49.0	44.1	39.7
Share of specialized disciplines in the curriculum (in %)	32.8	23.1	31.4	37.0
Share of complementing disciplines in the curriculum (in %)	8.0	7.7	6.9	4.8

Comparative analysis of study programs of partner universities

This analysis was performed per each semester for all curriculum subjects. The analysis took into account the number of teaching hours, number of hours of practical applications and projects per year and number of transferable credits allocated to each type of disciplines: mandatory and facultative. Table shows an extract from the study.

Academic year: 2010-2011

Semester: 1 (Bucharest, Timişoara, Iaşi, Alba Iulia-extract)

No.	Course title	C	Applications			IS	Sum	CR	Form of examination (E, CO, V)
			S	A	P				
MANDATORY DISCIPLINES									
1.	**Higher mathematics I**	**2**	**2**	**-**	**-**	**2**	**6**	**4**	**E**
	Mathematical analysis	**2**	**2**	**-**	**-**	**2**	**6**	**4**	**E**
	Higher mathematics 1	**2**	**2**	**-**	**-**	**2**	**6**	**4**	**E**
	Mathematical analysis	**2**	**1**	**-**	**-**	**3**	**6**	**4**	**E**

2.	**Algebra**	**2**	**2**	**-**	**-**	**2**	**6**	**5**	**E**
	Algebra and Geometry	**2**	**2**	**-**	**-**	**2**	**6**	**4**	**E**
	Algebra	**2**	**2**	**-**	**-**	**2**	**6**	**5**	**E**
	Linear Algebra	**1**	**1**	**-**	**-**	**3**	**5**	**3**	**E**
3.	**Geometric representations of topographic surfaces**	**2**	**-**	**2**	**-**	**3**	**7**	**5**	**E**
	Descriptive Geometry	**2**	**-**	**1**	**-**	**1**	**4**	**3**	**CO**
	Geometric representations of topographic surfaces	**2**	**-**	**3**	**-**	**2**	**7**	**5**	**E**
	Descriptive Geometry	**2**	**-**	**2**	**-**	**3**	**7**	**4**	**E**

The conclusion was that the curriculum at each partner university meets the academic evaluation standards in the fundamental field Engineering Sciences, falling within the recommended general parameters.

Analysis of best practices in partner universities

Analysis of best practices within partner universities was another component of the studies aiming at identifying the main characteristics of the university programs in the field of Geodetic Engineering, identifying the competence and qualifications needs on the labour market in this field of study, developing quality standards for the content of the teaching-learning process and the framework program for university studies.

The analysis considered **good practice** as a superior method or innovative process involving a wide and reasonable accepted safe practices that result in improved performance of the higher education institution or program, usually recognized as "better" by other organizations. Good practice is not necessarily an example or an absolute method whose application ensures performance improvement of the higher education institution or program, but rather refers to identifying the best approach to a particular situation, since institutions are very different in terms of constituents and domain.

Approaches within each partner university have been studied regarding: developing educational programs, their approval, monitoring and reviewing, admissions in the faculty, student assessment, teachers evaluation, education for career and socio-human integration, scientific research, master and doctoral programs.

Manual of good practices resulting from this study was aimed at identifying the institutional processes and mechanisms for active adaptation of university education to labour market requirements and expectations by improving internal and external evaluation methodologies and of quality management tools for study programs offered by universities.

General trends in the profession

New technologies that have emerged in the last decade also require new concepts in geodetic engineering study programs. These new technologies can be summarized in five categories:

1. Today's trends converge fully automated measurement systems, which reduce the geodesic's role to a simple operator whose qualification can be provided by reading a well written manual.

2. New measurement technologies are no longer simple improvement of old techniques, they are rather based on completely different principles. Traditional experience is becoming increasingly questioned. Examples are: GNSS technologies, computer-aided mapping and geo-information systems.

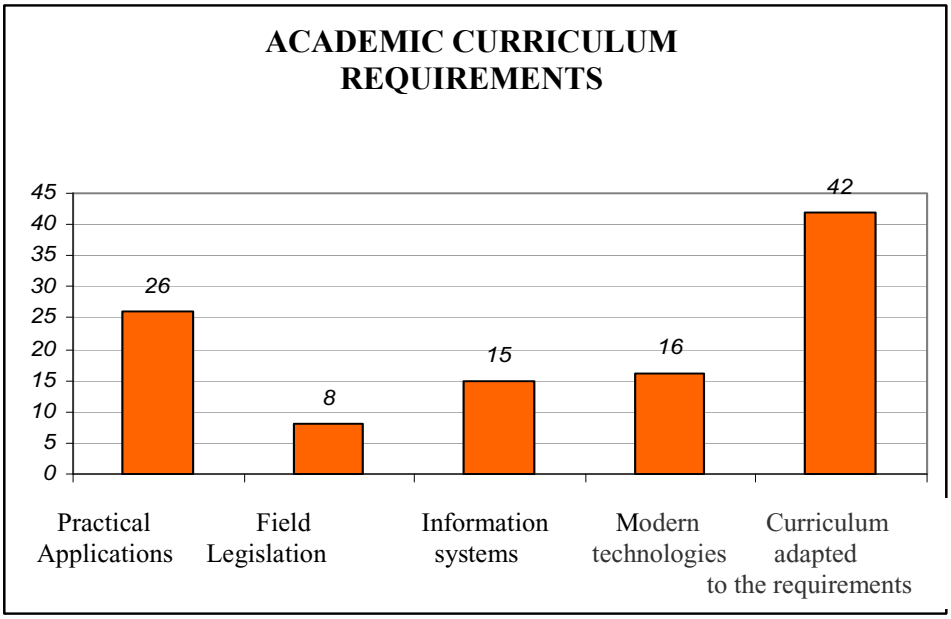
3. Data capture traditionally separated tasks, processing, presentation and analysis become complementary components of a single system of measurement and calculation.

4. Methods of land use management and planning were developed from technical and administrative procedures to processes that include social and environmental problems, in order to ensure sustainable development.
5. New fields of study are the management, marketing, quality control according to new trends in the profession.

General views on current study programs

For analyzing the situation of the profession in Romania and in order to obtain the general opinion about the current programs of study of geodetic engineering, a questionnaire was been created and distributed to representatives of the business environment from land survey domain. The questionnaire was designed so as to provide for geodetic engineering domain from Romania, an overview of competencies, skills and knowledge that graduates must possess upon completion of university studies, for easy integration to the first job.

Requirements expressed by business environment in the field reached important aspects of curriculum for land measurement and cadastre specialization, shown in the chart below.



Comparative analysis of curriculum of EU field faculties with those from the partner universities

The analysis aimed at establishing reference points and creating the necessary tools, methodologies for evaluating existing standard in geodetic engineering in Romania, including ensuring compatibility and comparability with international reference standards. Curricula of faculties of field universities in EU countries - England, Austria, Bulgaria, Czech Republic, Denmark, Germany, Greece, Lithuania, Portugal, Slovenia, Spain, Hungary, and Canada have been analysed.

Recommendations to ensure compatibility and comparability with international standards

Based on the analysis conducted in partner universities within the e-learning project, there were a number of useful recommendations on improving the academic curriculum of land measurements:

• Ensuring for the first and second years of a common training (common trunk) and differentiation on specialties in the last part of the study;

• Structure for the first and second years must be designed so as to enable changing the final specialization;
• Ensuring packages with optional compulsory disciplines ensuring transversal competences;
• Education should be based on more individual study and lifelong learning;
• There should be flexibility in the choice of internship, namely ensuring smooth conduct of professional practice**;**
• Adaptation of educational process to labour market requirements by increasing the time allocated to applied activities;
• A smaller number of required disciplines;
• A larger number of optional disciplines;
• More conditioning for specialized disciplines, which result in greater involvement of students;
• Preparation of curriculum so as to ensure continuity for master and doctorate cycles.
• Provide the framework for continuous improvement of teachers from the study program.
Analysis of the occupation degree of students showed that: the number of courses per semester is higher by about 3 to 4 disciplines, and the total number of hours / semester is higher (28-30 hours / week as compared to 24 hours per week) - even with a year of study in addition to universities from the West.
The study of the organizational structure of the faculties in many of the mentioned universities, as well as recommendations for harmonization with international quality standards led to the necessity of reviewing / rethinking specializations related to engineering geodetic field, through the Romanian market request perspective , defining the skills needed for each specialization and development of new curricula.

Recommendations that emerged from the studies serve as important milestones for improvement educational plans and programs.

3. Proposals for modernization of study programs

The quality assurance model

Quality assurance model, designed in accordance with the general framework developed by the European Association for International Education (EAIE), aims to provide a framework outlining the key characteristics which are considered to have a significant impact on the development of quality programs for geodetic engineering field.

The diagram in Fig.1 presents the factors that define quality, according to the mentioned model. It aims to combine the goals and objectives of an educational program with the analytical curriculum, students evaluation form and expected knowledge, aptitudes and attitudes acquired by students at the end of the study.

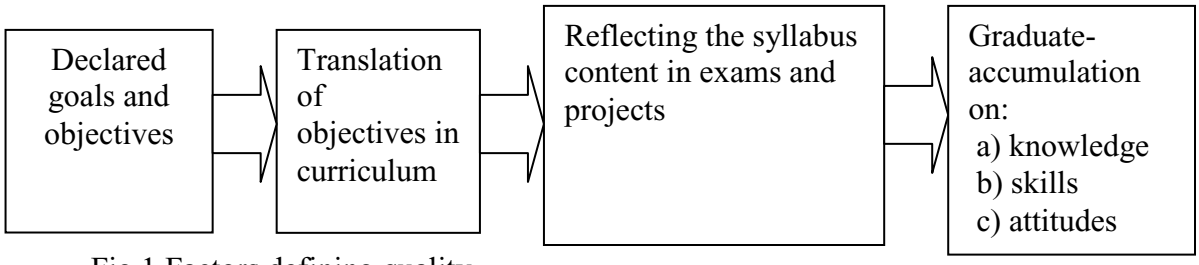


Fig.1 Factors defining quality

In the compatibilization of ongoing study programs with international reference standards , creating an appropriate learning environment for students should also be considered.

Aspects of the learning environment can focus on six specific activities while for obtaining educational programs in accordance with international reference standards, the

universities must have the characteristics of a high quality education. In defining characteristics of high quality learning the use of the model based on seven principles is recommended. Focusing issues related to learning environment and characteristics of high-quality education as a matrix allows the user to define the weight given to each facet and a single frame of action, taking into account both stakeholders: institutional climate and program characteristics.

			Six aspects of the total learning environment					
			1	2	3	4	5	6
			Designing curriculum content and organization	Teaching learning evaluation	Support, guidance of student	Student progress and achievement	Learning resources	Quality development
Seven characteristics of High Quality Education	A	Knowledge discovery						
	B	Long-term retention						
	C	Creating new knowledge						
	D	The connections between old and new knowledge						
	E	applications						
	F	The ability to communicate knowledge						
	G	The desire to know more						

Figure 2 Interaction of quality education characteristics and various aspects of the total learning environment.

Since correct identification of the high quality learning characteristics through the issues that represent the learning environment can be quite complex, the model can also be used as a test grid which can provide benchmarks for performance evaluation.

Curriculum framework of land measurements and cadastre specialization

From the analysis of general and specific skills of the concerned specialization (land measurements and cadastre), from the comparative study between the curriculum of partner universities from the e-learning project, as well as from the comparison with the curriculum from faculties of universities in European Union the framework of the harmonized curriculum was proposed .

Given the requirements of the labour market in Romania in the field of land measurements and cadastre, as well as the results of evaluation of existing study programs corresponding to the specialization "land measurement and cadastre", through the consultation of relevant international standards, two programs of study for the specializations: Geodesy and Geomatics and Cadastre and Property Management have been proposed to be developed.

Proposal for study plans

In the proposed study plans it was considered that semesters 1-4 form the common trunk of the two specializations in order to offer students the opportunity to knowingly choose one of two specializations.

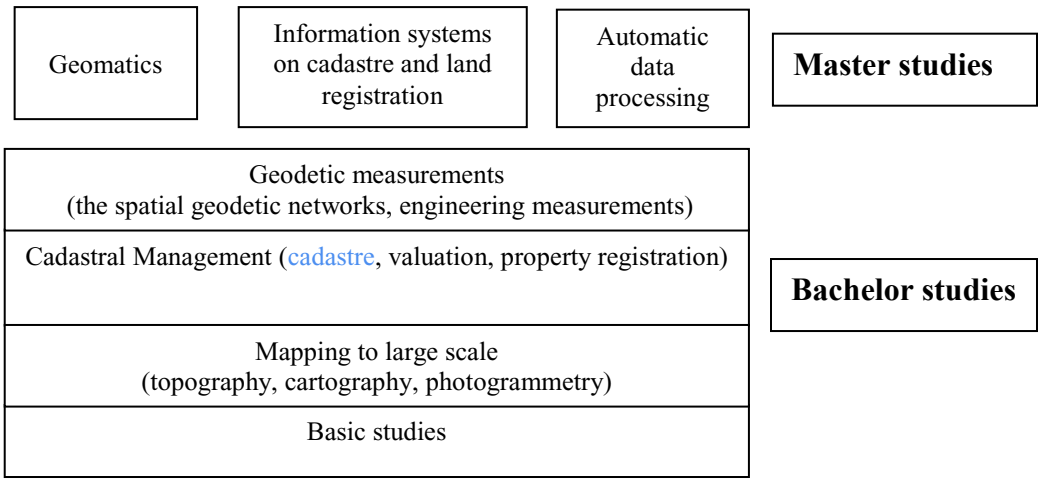


Fig. 3. The curriculum framework of the land measurements and cadastre specialization

In semesters 5 to 8 a differentiation between the two specializations shall be made, taking into consideration the recommendations resulting from the study of European field standards.

It was envisaged that in the curriculum for university studies for years 3 and 4 to be carried out the transfer of knowledge in a professional and methodical approach of notions related to the specialization profile chose by the student.

Therefore for Cadastre and Property Management specialization it was sought that the curriculum integrates new courses on the principles of law and economics, as well as land management and real estate valuation.

Regarding the specialization Geodesy and Geomatics in the proposed curriculum it was aimed to development the Geomatics component.

Specifically, it is proposed to take into account the achievement of the following skills:

Competences for geodesy and geomatics specialization

- Design and development of support networks for surveying, cadastral measurement and other engineering measurements.
- Making specific measurements required for development of : topographical, situation, execution and cadastre plans.
- Application in the field of civil and industrial construction projects, communication ways, hydraulic structures, bridges, land improvement projects .
- Determination and analysis of construction and land movements and deformations.
- Creation of spatial data infrastructures and GIS development.
- Establishment of the spatial geodetic networks.
- Modelling based on geodetic and gravimetric data.
- Processing of Photogrammetry and remote sensing data for mapping large areas of land.

Competences for cadastre and property management specialization

- Creation and development of support networks for surveying, cadastral measurement and other engineering measurements.
- Making specific measurements required for development of plans: topographical, situation, execution and cadastre plans.

- Measurement of the technical - utilities networks.
- Application on the field of civil and industrial construction projects, communication ways, hydraulic structures, bridges, land improvement constructions.
- Measurements to determine the movements and deformations for the constructions and land.
- Evaluation of real estate properties.
- Realization of 3D photogrammetric products for urban and rural development and environmental monitoring.
- Realization of information systems for cadastre and for specialized fields.
- Property Management System.

A principle taken into consideration in the realization of this proposed structure was decongestion of current study plans of partner universities. Therefore the channelling of top problems to the master programs is proposed.

When students continue to study on the one of those three Master's programs - Figure 3 - "Framework curriculum specialization land and cadastre measurements", concentration of on theories and on solving complex problems is much more significant.

4. References

1. *Enemark, S. , Plimmer, F. (2002). Mutual recognition of Professional Qualifications, FIG, Copenhagen, Denmark, 2002.*
2. *European Association for International Education, (1995). The European Union's. Pilot Projects for Evaluation Quality in Higher Education, EAIE, Amsterdam.*
3. *HEFCE, (1995). Assessor's Handbook, Quality Assessment Division, HEFCE, April-September 1995.*
4. *HEQC, (1995). Managing for Quality, Stories and Strategies, HEQC, London.*
5. *Kells, H.R. (1995). Building a National Evaluation System for Higher Education: Lessons from Diverse Settings, Higher Education in Europe, Vol. XX, Nos 1-2, 1995, CEPES, Bucharest.*
6. *POSDRU 86/1.2/S/63140 “ Online network for university collaboration to develop the capacity to provide superior competence in geodesy "-activities A.5, A.6.3, A.7, A.8, A.11*
7. *Standards of the Romanian Agency for Quality Assurance in Higher Education*