

# **The Medium and Superior Level Professional Qualification of Topographers – The Romanian Experience**

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## **SUMMARY**

In the last two decades, the role of specialists in terrestrial measurements has increased exponentially, the possible explanations being the development of investment sector, the need of various beneficiaries to know tiny details concerning the territory up-dating information, the development of the segments whose activity requires knowing the area of operation, which claims the continuous presence of topography specialists in their operational structures. The components of the science of terrestrial measurements (survey or tracing topography, geodesy, cartography, land survey, photogrammetry, remote sensing, GIS), through their results, are covering from the informational point of view all the branches of the economical-social-administrative life. For this reason, the professional education of field specialists becomes a very important mission. This paper analyzes the Romanian experience in this area along the last 30 years.

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## **1. BRIEF HISTORY OF CIVIL GEODETIC EDUCATION IN ROMANIA**

The oldest technical education from Romania is the one of terrestrial measurements (cadastre). At the beginning of the 19<sup>th</sup> century Gheorghe Asachi has founded in 1813, within the Regnant School from Iasi, a class for preparing cadastre engineers, the first upper technical education institution with teaching in Romanian language. Then, in 1818, at Bucharest, the founder of the education in Romanian language in Wallachia, Gheorghe Lazar, establishes the Academical School for Philosophical Sciences at the "Sfantu Sava" Monastery, in a special group being trained here the first land surveyor engineers from Wallachia. After the unification of the principalities (1859), the University from Iasi is founded, where, from the beginning, there have been taught Topography, Theoretical Geodesy and Astronomy courses at the Faculty of Sciences.

Within the Polytechnic Institute of Bucharest (founded in 1921 by transforming the National School of Bridges and Roads), the courses of Topography and Geodesy (with a chapter of Photogrammetry) represented basic courses for the sections and faculties of constructions, mining and silviculture, also there existing a distinct specialty of Cadastre – within which some specialty courses were taught, which granted the right to obtain the diploma of cadastre engineer. Together with the reform in education from 1948, in Iasi there was opened the Institute of Terrestrial Measurements, which prepared specialists with higher education (geodesic engineers). In 1951, the institute is transferred to Galati as Faculty of Terrestrial Measurements. Since 1955, the Geodesy Faculty from Galati is transferred to Bucharest as Section of Geodesy at the Faculty of Roads and Bridges, 1991 representing the year when the Geodesy Section becomes again the Faculty of Geodesy within the Construction Institute from Bucharest (after 1994 – the Technical University of Constructions from Bucharest), with 5 years of study, until the academic year 2005-2006, when the length of studies is reduced to 4 years, in the context of the integration in the European Union.

## **2. THE INTERNATIONAL CONTEXT**

### **2.1 Training Geodesy Specialists in Various Countries**

Training quality specialists in the area of terrestrial measurements, at all levels of training, from qualified workers to doctors-engineers, requires the continuous documentation concerning similar activities carried on worldwide.

It is interesting the fact that having the same final purpose, training specialists that would be capable to operate within the mentioned sphere, different countries adopt different strategies, both organizational and pedagogical. It is difficult to find a common denominator of the

geodesic educational systems from various countries, of the years of study, certificates obtained, courses and number of hours allocated to each course. What is common to all educational plans is the groups of courses (General Topography, Engineering Topography, Geodesy, Cartography, Photogrammetry, Remote Sensing, Cadastre, GIS, Urbanism, Territory Classification and Organization), specifically and differently developed.

## **2.2 The Implications of the Statement from Bologna concerning the development of the European higher education until 2010**

The Ministers responsible for the higher education from 29 countries from Europe have signed the Statement from Bologna, on June 19<sup>th</sup>, 1999, agreeing upon some common objectives important for the coherent and harmonious development in the field of higher education until 2010. Romania has signed the Bologna Statement, thus committing itself to insert the objectives within the priorities of the Romanian higher education. Romania has created the legal frame needed to restructure the upper education on two levels, the implementation of the new structure being carried on beginning with the academic year 2005-2006.

## **3. THE NATIONAL CONTEXT, NOMENCLATURE, ORGANIZERS**

### **3.1 Applying the European Credit Transfer System into Romania**

In order to create the premises of developing higher education centered on the student, together with the reorganization of the academic studies on three successive levels – license, master, doctorate, and in order to promote the transferability of study credits between the faculties of the same higher education institution, between Romanian institutions of higher educations, and between them and universities from other countries, the Minister of Education and Research has issued an order by which the European Credit Transfer System – ECTS is generally applied both in *recording the professional results of the students* from all levels of education, and in *operating the transfer of professional results obtained by students* as result of attending and taking the exams of the courses included in the educational plans of other universities from our country or other countries, or from other faculties of the same university.

This measure is applied both to the license level, and to the master studies, beginning with the academic year 2005-2006.

### **3.2 The Organizers of Academic Studies in the Field of Geodesy**

After the foundation of the Faculty of Geodesy from Bucharest, in 1955, as we have seen, the academic training of field specialists was carried on as follows:

- 1955-1990 The Faculty of Geodesy from Bucharest, the Institute of Constructions from Bucharest, Geodesic Engineers and Sub-engineers, with an academic training of 5 and 3 years, respectively, the Mining Faculty, The Institute of Mining from Petrosani, Mining Topography Engineers and Sub-engineers, with an academic training of 5 and 3 years

- 1990-2005 to the above mentioned, there are added faculties of constructions, environment engineering, silviculture and sciences, which form geodesic specialist engineers and/or college engineers at Timisoara, Iasi, Galati, Oradea, Alba Iulia, Baia Mare, Brasov, faculties of Geography, which train college cartography engineers at Timisoara, Iasi, Bucharest, Cluj, Agronomic Institutes at Bucharest, Cluj, Timisoara, Iasi, Craiova, which form cadastre college engineers.



**Fig 1.** The map of Romania, most of county capitals are academic centers

#### **4. THE CONTENT OF EDUCATIONAL PLANS OF THE FIELD ACADEMIC SPECIALTIES, UNTIL THIS ACADEMIC YEAR**

By the regulations of the education ministry, the percent of the physical classes in the subjects belonging to the groups of courses that assured the training of the future specialists, through short-term or long-term studies, was:

- *fundamental courses at least 18%*, the main courses being: Mathematical Analysis, Algebra, Differential Geometry, Superior Mathematics, Descriptive Geometry and Technical Drawing, Computer Use, Physics, Chemistry, Drawing
- *technical field courses at least 30%*, the main courses being: General Topography, Geodesy, Engineering Topography, Cadastre, Photogrammetry, Remote Sensing
- *speciality courses at least 30%*, the main courses being: Constructions – Traffic routes, Cartography, G.I.S, Management, Organizing cadastre works, Specialty Cadastre, Astronomy
- *optional courses at least 10%*, Systematizing, Urbanism, Urban Management, Satellite Geodesy, Monitoring the time behavior of buildings and terrains, Accounting, Legislation

- The percentage of physical hours at *complementary courses at most 8%*, Foreign Languages, Physical Education, Social Sciences
- The percentage of the course hours with respect to other hours (seminaries, tutorials, projects, practice, diploma thesis) at least 70%.

## **5. CURRENT REGULATIONS CONCERNING THE TRAINING OF SPECIALISTS IN THE FIELDS OF GEODESY**

### **5.1 Training Technicians**

Training technicians is carried on through after high school studies, as the Nomenclature concerning the training of specialists through after high school classes specifies for the area of constructions, the professional specialty of construction topographer, and for the area of mining topography, the professional specialty of mining topographer. The training is carried on in construction high schools in most of the counties and in mining high schools in the mining regions of Baia Mare, Petrosani. The length of studies is of two years, in general with taxes. The characteristic of education is that high school graduates without baccalaureate diploma can apply, too.

### **5.2 Training Engineers**

In what concerns the organization of license academic studies, besides adopting the stipulations of the Statement from Bologna concerning the organization of academic studies, by which one of the measures was to reduce the length of technical studies from 5 to 4 years, another measure applied beginning with this year was to allocate the number of students for the license, master and doctoral level, for the state scholarship positions, centralized for each university, and not on areas or specialties.

### **5.3 Organizing and Carrying on Master Academic Studies**

One of the decisions of the domain ministry rules the basic principles concerning the organization and carrying on of master academic studies, according to the procedures of the Law concerning the organization of academic studies. The main stipulations are:

- The levels of license, master and doctoral academic studies are set out by distinct application and graduation procedures.
- The master academic studies represent the second level of academic studies and assure detailed learning in the area of license studies or in a close area, developing scientific research knowledge, and represents a mandatory preparing basis for doctoral studies.

#### **5.4 Organizing and Carrying on Doctoral Academic Studies Beginning with the 2005/2006 Academic Year**

In what concerns the reorganization of doctoral studies, the Minister of Education and Research issues an order whose main stipulations are:

- The higher education institutions that were granted the quality of an institution that can organize doctoral studies, through an order of the Minister of Education and Research, until the date of coming into activity of the order, have to reorganize this activity, beginning with the academic year 2005/2006, such that doctoral studies become a distinct level of academic studies.
- According to the stipulations of the same decision, the doctoral studies have two types: scientific doctorate and professional doctorate. The specialists from the areas of fundamental arts and physical culture and sports can obtain either professional doctorate or scientific doctorate.
- Each Institution that Organizes Doctoral Academic Studies drafts the Organizing and carrying on Regulation of the doctoral academic studies. Through the stipulations of this regulation I.O.S.U.D. details:
  - The institutional, legal and contractual frame;
  - The norms of ethical and professional behavior;
  - The financial aspects concerning the organization of doctoral studies, according to the active legislation.
- A distinct component of the organization and carrying on regulation of doctoral academic studies must refer to the mechanisms for assuring the *high quality* of advanced study programs and of scientific research programs.

#### **6. CASE STUDY: TRAINING GEODESIC SPECIALISTS WITHIN THE NORTH UNIVERSITY OF BAIJA MARE, MARAMURES COUNTY**

The region of Maramures has strengthened in the last 30 years its position of leader of Transylvanian geodesy, both because of the prestigious activity of specialists from the region and because of organizing some scientific events in the domain.

The lack of higher education institutions in the field of mining topography or geodesy in Maramures or nearby, in time determined an acute deficiency of specialists. In this context, within the North University of Baia Mare, within the area of Geodesy, there was established a cadastre specialty, beginning with the academic year 2003-2004, a three years college. Beginning with this academic year, because of the reorganization of the Romanian higher education, the four-year structure was adopted.

##### **6.1 Organizing the Cadastre Academic College Within the North University of Baia Mare**

According to the stipulations of the National Council of Academic Assessment and Certification, through national standards concerning the percentage of courses, there have

been established the percent that each group of courses must represent in the educational plan, and therefore, for the college from Baia Mare we have:

- Fundamental courses, 19,8%,
- Technical field courses, 34,10%,
- Specialty courses, 42,20%,
- Optional courses, 10,40%,
- Complementary courses, 4,62%,
- The percentage of course hours with respect to other hours (seminaries, tutorials, projects, practice, diploma thesis) 74,70%.

This form of academic training is being removed, the North University of Baia Mare having graduation series in 2006 and 2007, in Baia Mare, and in 2007 in the subsidiary from Bistrita, respectively.

## **6.2 The Educational Plan of the Specialty of Terrestrial Measurements and Cadastre, the Field of Geodesy, at the North University of Baia Mare**

Restructuring the educational plans, beginning with the academic year 2005-2006 was performed according to the new national standards regarding the percentage of courses. But it was wished that the 12% attributed to the organizing institution to give particularity to the training, according to the local characteristics and specific. Therefore, the percents of the groups of courses were established as follows:

- At least 17% physical hours at fundamental courses, according to standards (Mathematical Analysis, Linear Algebra, Analytical and Differential Geometry, Superior Mathematics, Numerical Methods, Physics, Descriptive Geometry, Technical Drawing, Computer Programming, Infographics, Geography, Programming Languages), studied only in the first four semesters, with a percentage of 18,14%, in the case of the faculty from Baia Mare,
- At least 38% physical hours at field engineering courses (General Course of Constructions, Traffic Routes, Mathematical Geodesy, Physical Geodesy, Astronomy, General Topography, Engineering Topography, Cadastre, Photogrammetry, GIS Basics, GIS, Geodetic and Topographic Instruments, Mathematical Cartography), studied in the semesters 2-6, 40,6%, in the case of the faculty from Baia Mare,
- At least 25% physical hours at specialty engineering courses (Analytical Photogrammetry, Carto-editing, Specialty Cadastre, Cadastral Legislation, Digital Cadastre, Cadastral Reliability, Monitoring the Behavior of Terrains and Buildings, Tracing Investment Works in Cinematic Regime, Organizing Geodetic Works, Management, Urban Management, Sub-terrestrial Measurements, Urbanism, Spatial Geodesy, Remote Sensing, Global Positioning Systems GPS, four optional courses, Organizing the Territory, Geodesic Measurements through waves, Geodesic Networks Design and Optimization), studied only in semesters 7 and 8, 25,66% in the case of the faculty from Baia Mare, from which 2,5% must be allocated to the diploma thesis, 2,78% in the case of the faculty from Baia Mare,

- 12% physical hours at courses according to the options of universities (Geomorphology, Fundamentals of Cartographic Representations, Fundamentals of Geodesy and Topography, Geometric Basics of Photogrammetry, Fundamentals of Engineering Measurements, Work Safety in Topo-geodesic Works, Accounting and three optional courses, studied in semesters 1-8, 12,52 % in the case of the faculty from Baia Mare,
- At most 8% physical hours at complementary courses (Communication Theory, Foreign Language (E, F, G, R), Physical Education), 2,78% in the case of the faculty from Baia Mare,
- The percentage of the course hours with respect to the other hours (seminaries, tutorials, projects, practice, diploma thesis) at least 80%, 107,40% in the case of the faculty from Baia Mare.
- The academic year contains two semesters of 14 weeks each, two exam sessions of 4 weeks each, two weeks of practice,
- The number of hours on a week is 24-28, in the case study there was chosen the option of 24 hours/week,
- The number of exams in a semester 3-5, the number of colloquia 2-4, the number of projects 1-3, in general 5-6 projects,
- The graduation exam is sustained after finishing the 8<sup>th</sup> semester and a period of drafting.
- The current equipment: laboratories of topography, photogrammetry, informatics, informatics in geodesy-GIS, physics, geomorphology-geology; geodesic, topographic, photogrammetric, GPS equipment; specialized software; a well-equipped technical library,
- The faculty consisting in professors and lectors, all doctors in sciences or having their doctoral thesis close to finalization. It should be mentioned that Baia Mare is the second center in Romania, from the point of view of the number of doctors in Geodesy, important consideration in the decision to found the section.

Also, a GIS section is intended to be founded, many courses being common with those from the specialties mentioned before.

## 7. CONCLUSIONS

The Romanian geodesic education has an age of almost 200 years, being the oldest technical education in our country. It has gone through more phases presented in this paper, it has trained specialists that operate successfully in the entire world. Now, it respects worldwide standards. Thus, in order to accomplish the objectives determined for 2010, measures were taken to analyze the progress obtained in the Bologna Process, thus providing useful information concerning the evolution of the process, offering the possibility to take the necessary steps for accomplishing the objectives.

The geodesic education from Maramures was reorganized within this context, following the normal path for adopting European standards in the entire Romanian education.

The perspectives of this type of education ,in the context of Romania's integration in NATO and EU, are benefic with respect to the permanent increase of constructions, which claims a



large number of specialists in geodesy. The new specialization is a solid alternative of the old mining specializations which are nowadays in decline.

## REFERENCES

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