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## **GEOMATICS BACHELOR AND MASTERS PROGRAM IN BELGIUM**

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### **ABSTRACT**

A 4-year curriculum degree of "Licence in Geography option Land Surveying" was introduced in 1990 at two Belgian academic universities: both at the "Université de Liège" in the French speaking part of Belgium and at "Ghent University" in the Dutch speaking part of Belgium.

With the BAMA revolution in 2004, this degree has been converted into a 5-year curriculum finalised into an academic "Master in Geomatics and Surveying" (Ghent University) or a "Master in Geography, option Geomatics and Geometrology" (Université de Liège) and subsequent "Ph.D. in Geomatics and Surveying" (Ghent University).

The academic bachelor degree that gives direct access to the Master curriculum without additional compulsory courses is "Bachelor in Geography and Geomatics, Main subject: Surveying" (Ghent University), that can be obtained after 3 years of study. As suggested by the title, the geomatics/surveying degree is related to geographical sciences and located in the Faculty of Sciences.

On the opposite, University Colleges (also called Technical Universities) offer professional Bachelor degrees, while academic universities only offer academic Bachelor or Master degrees.

In October 2014, Ghent University will start an enhanced academic Bachelor program in Geomatics that allows direct access to the profession of chartered surveyor. The paper will discuss the education experiences, student number evolution and motivation for the enhancements of the Bachelor program.

## INTRODUCTION

In [1], the historical situation of surveying/geomatics education in Belgium is analysed and commented in detail. In summary, the complex situation in Belgium results in the fact that four quite different types of surveying education (Figure 1) are offered, all leading to acceptance as “Chartered Surveyor” by the official national “Institute of Surveyors”:

(1): The degree of "Professional Bachelor in Real Estate Option Surveying" obtained at 2 Dutch speaking University Colleges (also called "Technical Universities"): “University College Ghent” and “University College Artesis Antwerpen”) and 2 French speaking University Colleges (“Institut Reine Astrid Enseignement de Promotion Sociale IRAM” and “Institut d’Enseignement de Promotion Sociale de la Communauté Française IEPSCF”) after a 3-year curriculum (180 ECTS credits).

(2): The degree of "Academic Bachelor in Geography and Geomatics: option Surveying" obtained at 1 Academic University of the Dutch speaking community in Belgium (“Ghent University”) after a 3-year curriculum (180 ECTS credits).

(3): The degree of "Master of Science in Industrial Sciences: Land Surveying" obtained at 2 Academic Universities of the Dutch speaking community in Belgium (“Ghent University”, “KU Leuven” (with sub-departments KAHO-Sint-Lieven in Ghent and De Nayer in Mechelen) after a 4-year curriculum (240 ECTS credits), or after a 5-year curriculum (300 ECTS points) at 3 French speaking University Colleges (“Haute Ecole Léonard De Vinci ECAM Brussels”, “Haute Ecole de la Communauté Française et Hainaut - Institut Supérieur Industriel Mons ISI” and “Haute Ecole de la Province de Liège ISIL”).

(4): The degree of "Master in Geomatics and Surveying" obtained at 1 academic University of the Dutch speaking community in Belgium (“Ghent University”), or a degree of "Master in Geographical Sciences - Main Subject: Geomatics and Geometrology" at a French speaking University College (“Université de Liège”) after a 5-year curriculum (300 ECTS credits).

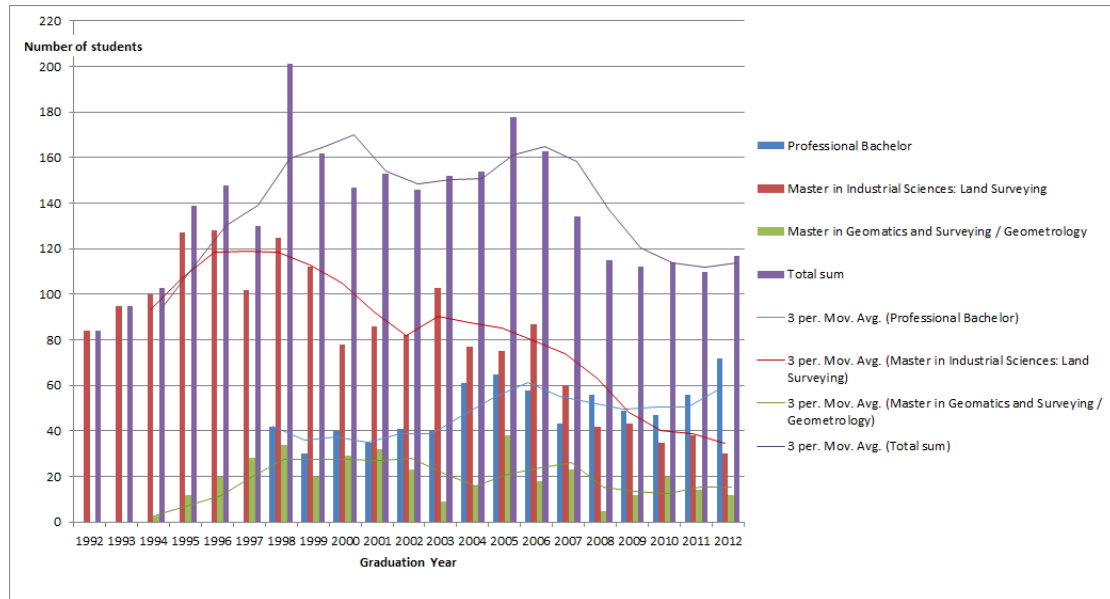


Figure 1: The number of graduates and trendline in “Surveying” education (1992-2012)[3]

A remarkable fact is that an education leading to “Chartered Surveyor” may take 3, 4 or 5 years of study, depending on the chosen institute and language. It can also be confusing that at the same Academic University (Ghent University), two different Master programs with a different 4 versus 5 year duration exist, both leading to the same “Chartered Surveyor” recognition. This is a new situation that started in October 2013, as a result of the integration of the “Master in Industrial Sciences” degree in the Academic Universities, up to September 2013 delivered by University Colleges. The quite important differences between both degrees, analysed in [1], are strongly related to the different localisation of both curricula, more specifically on the one hand in the Faculty of Engineering Sciences and Architecture, Department of Industrial Technology and Construction for the “Master of Science in Industrial Sciences: Land Surveying”, and on the other hand, in the Faculty of Sciences, Department of Geography for the “Master in Geomatics and Surveying”.

Concerning the PhD degrees, for the moment only a “PhD in Geomatics and Surveying” exists. It is unclear if, in the near future, a “PhD in Engineering Sciences: Surveying” will be created, so in this paper we focus only on the existing one.

According to the BAMA philosophy, special attention was paid to the interconnection of the different possible Bachelor/Master/PhD trajectories (Figure 2). “Pre-doctoral Programs” of typical 60-90 ECTS points allow the students to combine a range of Master programs with a “PhD in Geomatics and Surveying”.

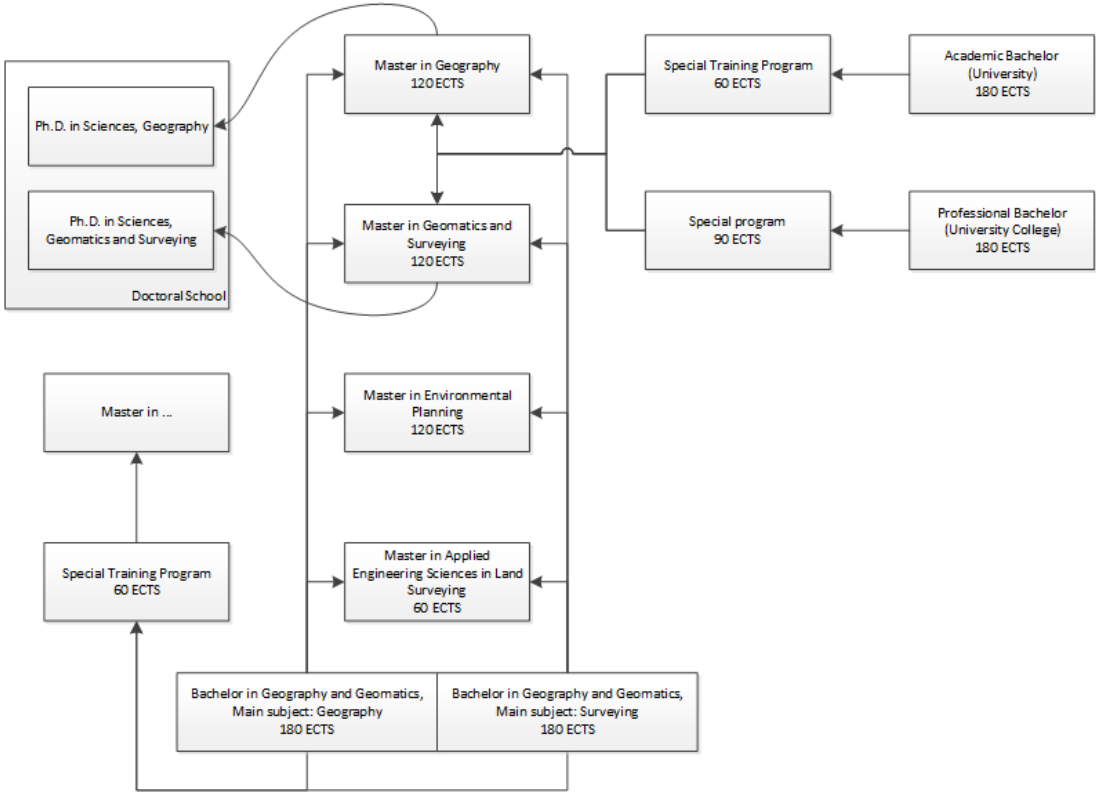


Figure 2. - Interconnection of the different types of Surveying/Geomatics education (referring to Ghent University)

## STUDY SUBJECTS "MASTER IN GEOMATICS AND SURVEYING"

The old 4-year curriculum "/Licence in Geography - Option: Surveying" was transformed in October 2004 into a "Bachelor in Geography and Geomatics" followed by a "Master in Geography" or a "Master in Geomatics and Surveying".

The vision that lies at the origin of this program is het FIG definition [2] of a surveyor (23 May 2004) (FIG = International Federation of Surveyors):

*A surveyor is a professional person with the academic qualifications and technical expertise to conduct one, or more, of the following activities:*

- *to determine, measure and represent land, three-dimensional objects, point-fields and trajectories;*
- *to assemble and interpret land and geographically related information,*
- *to use that information for the planning and efficient administration of the land, the sea and any structures thereon; and,*
- *to conduct research into the above practices and to develop them.*

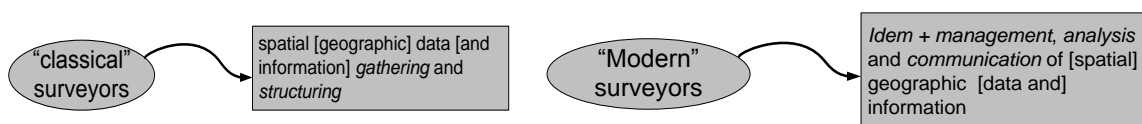


Figure 3 "Classical" surveyor versus "Modern" surveyor

The 3 pillars of this definition (data acquisition, information management, real estate (construction, law, value estimations,...) were used as basis for the new Geomatics program at Ghent University [5]. It is based on the view that a "Modern Surveyor" has to focus, not only on data acquisition, but also on the analysis, management and communication of spatial and geographic data and information, with other words, the "Modern surveyor" focuses on "Geomatics" (Figure 3). Geomatics (Figure 4), as defined by the Canadian Institute of Geomatics, *is a field of activities which, using a systematic approach, integrates all the means used to acquire and manage spatial data required as part of scientific, administrative, legal and technical operations involved in the process of the production and management of spatial information.*

As generally accepted by EEGECS (= European Education in Geodetic Engineering, Cartography and Surveying), Geomatics is closely related to the fields of remote sensing, geodesy, computer sciences, photogrammetry, cartography, law, spatial planning, construction... This is reflected in the "Bachelor in Geography and Geomatics" program of Ghent University (Figure 5), consisting of 2 Main Subjects (or options) that can be chosen by the student: either "Main Subject: Geography" or "Main Subject: Geomatics/Surveying". The latter is to be preferred if the student wants to continue with the "Master in Geomatics and Surveying". The first year, there is no difference between both programs while in the second and third year at least half of the courses is different (Figure 5), a difference translated into typical geomatics and surveying related subjects as Topometry, Photogrammetry, Cartography and Law,...

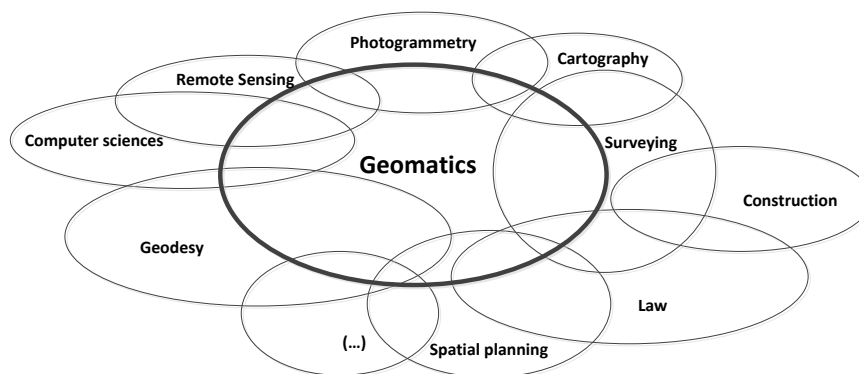


Figure 4: Interacting disciplines of Geomatics

An outcome to the professional market after the "Bachelor Geography and Geomatics – Main Subject Geomatics/Surveying" is possible, although almost all students continue their studies with a "Master" study, mostly the "Master in Geomatics".

Bachelor Geography and Geomatics		Bachelor Geography and Geomatics - 2nd year		Bachelor Geography and Geomatics- 3rd year			
Mathematics I	5	General Courses		General Courses			
Mathematics II	5	Introduction to Landscape Science	5	Philosophy		5	
Physics I	5	Geographic Information System (GIS)	5	Spatial Analysis: Methods and Techniques		6	
Physics II	5	Remote Sensing	5	Cartography		5	
Introduction to geology	5	Statistics	5	Bachelor Dissertation			
Introduction to physical geography	5	Geodesy	5	Courses related to GEOGRAPHY		Courses related to GEOMATICS	
Chemistry	5	Courses related to GEOGRAPHY		Elective courses		10	Elective courses
Introduction to geomatics	5	Sociology	4	Introduction to Soil Science	4	Integrated Exercises Geomatics	4
Programming	5	Introduction to Petrology	3	Introduction to Ecology	4	Photogrammetry	5
Introduction to Surveying Engineering I	5	Geomorphology	5	Study of the Quaternary	5	Topometry II	5
Introduction to social and economic geography	5	Introduction to Mineralogy	3	Landscape Science	6	Legal Aspects of Real Estate	5
Economics	5	Biospere: Botany	5	Population and Urban Geography	5	Administrative law	5
		Transport Geography	5			Real law	5
		Introduction to Climatology and Meteorology	5				
		Introduction to historical geography	5				

Figure 5: Bachelor program "Geography and Geomatics" at Ghent University (Belgium)

Especially for Ghent University, the 3-year Academic Bachelor has been modified in 2014 in order to counter the competition of the “Professional Bachelor”. More law and real-estate related topics are included.

Direct access to the "Master in Geomatics and Surveying" is possible with this renewed program for the "Bachelor in Geography and Geomatics - Main subject: Geomatics/Surveying". Other students, with for example a "Professional Bachelor" or an "Academic Bachelor" can enter the Master after a "Special Program" of 60 up to 90 ECTS points. The "Special Program" is tailor-made as a function of the Bachelor program the student followed.

Master Geomatics and Surveying		
General Courses		
GI-Applications		7
Land Registration		5
3D Acquisition and Visualisation		5
Practical Training I		7
Geographical Information Management		5
Judicial instructions concerning Environmental Planning and Urban Development		5
Geographical Information Platforms		5
Quality of Measurements		5
Map Projections and Coördinate Systems		5
Hydrographic Surveying		6
Elective course		5
Master's Dissertation		30
Minors		
Minor Research (30 credits, to choose from:)	Minor Education	Minor Economics and Business Administration
Historical Cartography		
Practical Training 2		
GIScience & Technology		
Constructive and Designing Infrastructure		
Communication Networks		
Information Management		
Multimedia Techniques		
Image Processing		
Geomatics Project		
Current Topics Geo-ICT		
Integral Water Management and Policy		
Agricultural and Rural Policy		
Nature Management and Restoration Ecology		
Project Geo-ICT		

Figure 6: Master program "Geomatics and Surveying" at Ghent University (Belgium)

The Master program consists of 120 ECTS points or 2 years of study. It consists of 3 important parts (Figure 6):

- A compulsory program of 60 ECTS points with 10 courses, including 7 ECTS points for "Practical training", mainly executed in private companies during 6 weeks;
- The Master thesis of 30 ECTS is started in the first year of the Master. The thesis is a monograph with oral presentation and defence at the end of the second Master year;
- A "Minor" program consisting of 30 ECTS points, with 3 possible options:
  - (1) a "research" minor with a choice out of 14 possible courses;
  - (2) an "education" minor, as a preparation for a later *aggregation diploma* (= licence to teach in secondary schools and some types of higher education schools);
  - (3) an "economics and business administration" minor with a number of courses focussed on business and economics.

## PHD SYSTEM

A master degree is the main condition to apply for a PhD degree. For applicants with a foreign master degree, there will be an individual evaluation with regard to their academic competences and background to be able to carry out scientific research. If these competences do not satisfy, a pre-doctoral training programme may be a requirement for admission. A pre-doctoral training is a one or two year full-time study programme for which successful students acquire a certificate at the end. The courses to follow complement the student's specialisation and attend to stimulate his social

integration and his knowledge of Dutch or English. Such a study programme gives the student a full student status, based on which non-EU students can get a residence permit. If the entrance requirements are met, the next step is to find an interesting subject or research area, a promoter for the doctoral research, and, in most cases, funding.

In the new doctoral structure introduced at the end of 2007, all PhD research is centralized in "Doctoral Schools". A Doctoral School is an interdisciplinary body offering a clear-cut framework for all matters relating to doctoral studies. Ghent University has five Doctoral Schools, which encompass different Faculties. The "PhD in Geomatics and Surveying" resides in the Doctoral School of Natural Sciences. The mission of the Doctoral Schools is to provide support to doctoral students during their doctoral research, to foster a culture of quality in (doctoral) research and to promote the international and social stature and prestige of the doctorate (for more details cfr. [4]). Examples of actual PhD subjects that were recently defended or close to finishing are:

- Modelling the world in 3D, aspects of the acquisition, processing, management and analysis of spatial 3D data;
- Tunnel ovalisation monitoring: 3D data acquisition with laser scanning and point cloud processing;
- The influence of the trilateral relationship between observer, landmark and environment on the identification of indoor landmarks;
- Infrastructural approach of road safety and speed control: traffic calming methods;
- Use of a GIS for the research of multi-dimensional conceptual temporal spaces;
- Archaeological heritage in the North Sea - Development of an efficient assessment methodology and approach towards a sustainable management policy and legal framework in Belgium;
- Calculation of casualty risks during and after disasters: definition of a methodology which incorporates variable spatio-temporal elements;
- Development of an algorithm for the automatic placement of labels on a map.

## EXPECTED EVOLUTIONS

Three main evolutions can be discerned in Belgium in the educational surveying field:

- 1) The competition between the different institutions leading to recognised "Chartered Surveyor" diplomas is becoming fiercer, especially because the duration varies between 3 and 5 years depending on the path followed (3-year Professional Bachelor, 3-year Academic Bachelor, 4- and 5-year Master studies).
- 2) As the number of students in the Academic "Master in Geomatics and Surveying" is decreasing at Ghent University, the inclusion of more hydrography/bathymetry related topics and courses is planned. A IHO certified "Postgraduate Hydrography cat. B" program, together with the Antwerp Maritime Academy started in September 2012 and a "Hydrography cat. A" program is planned for 2016.
- 3) There is an increasing demand towards more project work and practical training [6]. The paradigm is that financial support by European and national funding is decreasing due to the economic crisis and that the publication pressure on academic staff has become so high that time-consuming practical training projects are suffering. To tackle this issue is one of the challenges for the near future.



## CONCLUSION

In this paper, the actual very complex situation of education in Belgium in the domain of geomatics and surveying was analyzed, as well on Bachelor, Master as PhD level, introducing "Doctoral Schools" as the central points of PhD research. Since October 2013 the integration, in the Flemish part of Belgium, of the Master education programs of the former "University Colleges/Technical Universities" within academic universities, leading to 2 different Surveying oriented Master diplomas (4- and 5-year curricula) within the same academic university (Ghent University) is a fact. Brand new for October 2014 is a renewed program "Bachelor in Geography and Geomatics: main subject geomatics/surveying" that contains more practical surveying courses in order to deliver diplomas that are recognised by the official national "Institute of Surveyors" and give direct access to this profession, while at the same time offering the perfect preparation for the students that want to continue their studies and refine their specialization during the subsequent "Master in Geomatics and Surveying".

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